

HCLA-01L



Harding Lawson Associates

November 3, 1995

32531 004

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95-DRF-0977

Dear Mr. Olson:

After reviewing the comments from Rocketdyne, Harding Lawson Associates is submitting this revision to the *Geophysical and Hydrologic Testing Surveys* report, originally submitted on September 27, 1995.

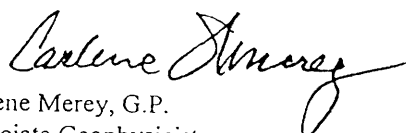
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1. The text of the report (cover page through page 18) should be replaced.
2. The plates (1 through 5) should be replaced.
3. Appendix E (Acoustic Televierer Data) should be replaced.
4. The Distribution page should be replaced.

We regret any inconvenience caused by these replacements. Please feel free to call me at (415) 884-3276 if you have any questions or need any additional information.

Sincerely,

HARDING LAWSON ASSOCIATES


Carlene Merrey, G.P.
Associate Geophysicist

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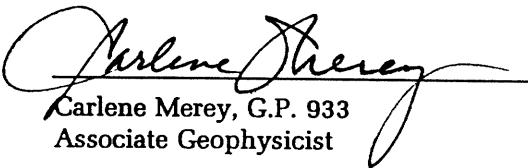
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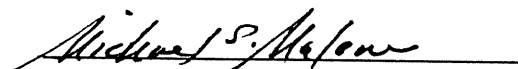
**Geophysical and Hydrologic Testing Surveys
Rocketdyne/Santa Susana Field Laboratory
Ventura County, California**

Prepared for

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DISTRIBUTION

EXECUTIVE SUMMARY

Geophysical and hydrologic testing along with geologic reconnaissance mapping conducted at Rocketdyne's SSFL facility have assessed stratigraphic features and fracturing within the Chatsworth Formation near Well RD-7. RD-7 is an open borehole with steel conductor casing down to 25 feet and a total depth of 295 feet below ground surface (bgs). The orientation of bedding averages approximately N45°E dipping 35° and two major fracture sets trend northeast dipping southeast, and north-northwest dipping northeast. Geophysical borehole logging conducted in RD-7 identified massive units of predominantly sandstone with interbedded shale and mudstone, along with several zones of fractures and borehole enlargements associated with fine-grained beds. Surface geophysics mapped the depth to bedrock along two lines near Well RD-7, averaging approximately 15 feet. Overburden velocities were averaged 1,300 to 1,600 ft/sec and bedrock velocities were 5,900 to 6,200 ft/sec.

The bedrock aquifer has a low hydraulic conductivity, approximately 0.003 ft/day, and packed-off intervals in well RD-7 had hydraulic conductivities ranging from approximately 0.029 to 0.73 ft/day. Hydraulic conductivities were found to decrease with increasing depth. Chemical analysis detected trichloroethene in groundwater at similar concentrations in four discrete intervals sampled and tested in the borehole. The inorganic chemistry data, major cations and anions, indicate that the pond near RD-7 has distinct inorganic chemistry from the groundwater sampled from Well RD-7.

1.0 INTRODUCTION

This report presents the results of the geophysical and hydrologic testing surveys conducted by Harding Lawson Associates (HLA) for Rockwell International Corporation, Rocketdyne Division (Rocketdyne) at Rocketdyne's Santa Susana Field Laboratory (SSFL), Canoga Park, California. The surveys were conducted and managed by Carlene Merey and Phil Boudreau, HLA geophysicists, and Mike Malone, Tom Lindros, Brian Hawes and Will Cablk, HLA geologists, from August 16 through 21, 1995. HLA's services were authorized under Rocketdyne's Support Services Agreement No. R54PJK95034319.

This report was prepared for the sole use of Rockwell International Corporation, the only intended beneficiary of our work. No other party should rely on the information presented herein without the prior written consent of HLA.

2.0 PURPOSE AND SCOPE

The purpose of the surveys was to learn more about the nature and extent of fracturing within the bedrock around RD-7 (Plate 1) using surface and borehole geophysical methods and aquifer testing of RD-7. The scope of work included:

- Geologic field reconnaissance mapping in the immediate area of RD-7, including strike and dip of bedrock outcrops, orientation and nature of fracturing, and aerial photograph identification of lineaments
- Removal of pumps and piping at RD-50 and RD-7; the pump and associated piping was replaced at RD-50 after video logging
- Borehole geophysical logging of RD-7 including video, acoustic televiewer, caliper, temperature, resistivity, spontaneous potential, natural gamma and heat pulse flowmeter; video logging was also conducted in Well RD-50.
- Surface seismic refraction surveying around RD-7 to test the efficacy of the technique
- Aquifer testing by total well recovery and packer testing to determine the hydraulic conductivity of intervals identified through the borehole data
- Chemical analysis of groundwater samples taken from the above intervals
- Inorganic analysis of pond water
- Preparation of this report.

3.0 FIELD PROCEDURES

This section describes HLA's geologic mapping, well pump removal/reinstallation, geophysical logging, seismic refraction and hydraulic testing procedures for the Rocketdyne site. Geophysical methods are described in detail in Appendix A.

3.1 Geologic Mapping

The vicinity of Well RD-7 was mapped at a scale of 1 to 50 feet. Stereo-paired photographs were viewed to facilitate the mapping. Geologic mapping was performed to provide an understanding of the stratigraphy and bedrock structure sufficient to provide a basis for interpreting the downhole data from boring RD-7. The results of mapping are presented on Plate 1.

3.2 Pump Removal/Reinstallation

Prior to geophysical logging activities, the pumps in Wells RD-7 and RD-50 were removed; the pump for RD-50 was subsequently reinstalled.

3.2.1 Well RD-7

On August 5, 1995, HLA removed the existing 3/4-horsepower Grundfos 5 S 1022 electric submersible pump, 1-inch-diameter steel discharge pipe, and 1-inch-diameter Westflex continuous polyethylene sounder access tube from Well RD-7. All materials were placed on pallets adjacent to the wellhead and covered with plastic. Appendix B illustrates the pump and sounder tube construction encountered. The pump intake was encountered at 274.38 feet below the top of casing (BTOC), or 273.34 feet below ground surface; the sounder tube extended to approximately 250 feet BTOC and was open at the bottom. Pipe thread compound was observed on all threaded discharge pipe connections and electrical tape was used to tie the electrical cable to the discharge pipe above each connection. No damage or excessive wear of the pump, motor, discharge pipe, electrical cable, or sounder tube was noted. Following removal, the pump and motor were bench tested and surveyed with electrical test equipment. The pump, motor, and electrical cable were within acceptable limits for

normal operation. As requested in Rocketdyne's Invitation to Quote dated May 17, 1995, the pump materials were not reinstalled after completion of the geophysical logging, packer testing, sampling, and recovery testing.

3.2.2 Well RD-50

HLA also removed the existing 1/3-horsepower Grundfos 5503-9 electric submersible pump, 1-inch-diameter steel discharge pipe, and 2-inch-diameter Schedule 40 PVC sounder access tube from Well RD-50 on August 5, 1995. Well RD-50 is approximately 1,500 feet southwest of Well RD-7. The wellhead plate was rusted shut and had to be removed with a welding torch. All materials were placed on pallets adjacent to the wellhead and covered with plastic. Appendix B illustrates the pump and sounder tube construction encountered. The pump intake was encountered at 169.94 feet BTOC or 168.62 feet below ground surface, and the sounder tube extended to approximately 160.5 feet BTOC. The sounder tube interval from 140.5 to 160.5 feet BTOC consisted of 0.010-inch slotted PVC open at the bottom. Pipe thread compound was observed on all threaded discharge pipe connections. No damage or excessive wear of the pump, motor, discharge pipe, electrical cable, or sounder tube was noted, however the wellhead landing plate was damaged during removal. The pump and motor were bench tested and surveyed with electrical test equipment prior to reinstallation and found to be within acceptable limits for normal pump operation. Following completion of video logging in the well, the pump was reinstalled on August 22, 1995. All materials were steam cleaned at the well site immediately prior to reinstallation, teflon thread tape was used to seal each pipe joint, and plastic wire ties were used to strap the electric cable to the discharge line. Water was recovered at the surface during a functional check of the pump performed after reinstallation.

3.3 Geophysical Well Logging

The geophysical logs performed for this survey included black and white video, acoustic televiewer (ATV) and heat pulse flowmeter (HPF), temperature, natural gamma, spontaneous potential (SP), point resistance (PR), 16-inch and 64-inch normal resistivity, and 3-arm caliper. The complete suite of logs was run in Well RD-7; a video log was run in Well RD-50.

The video log was run first in Well RD-7 to locate rock discontinuities and ensure that the well was open and clear for subsequent logging. The ATV log was run second, followed by the HPF. After the well was allowed to sit for a day so current flow could equilibrate, the remaining logs were completed. In general, the starting depth measuring point for the log was set and the sonde then lowered to the bottom of the hole. However, video and temperature logs are recorded on down runs. Data are recorded while the sonde is being lowered, and the maximum range of the data is noted. The plotting scale is adjusted to get maximum deflection on the analog chart record during the uphole run of the sonde. Logs are presented on Plate 2.

3.4 Seismic Refraction Survey

Two seismic refraction spreads were conducted near Well RD-7 to provide data correlations with the geophysical logs. Geophones were spaced at 10-foot intervals along each line, resulting in spread lengths of 230 feet. The spreads were located in areas of low relief with little or no brush and are shown on Plate 3. Travel-time data were collected for shot points at $x = 0.25, 0, 25, 115, 205, 230,$ and 255 feet in an attempt to use the generalized reciprocal method (GRM) to

interpret the data. However, the hammer and plate produced insufficient energy to overcome relatively high background noise and alternative properties of the fill, eliminating our ability to obtain complete coverage of the deepest refractor observed in the data set. Therefore, effective interpretation of these data utilizing the GRM was not possible and a more conventional seismic refraction inversion program was employed.

The general procedure for recording seismic refraction data was to set up a seismic spread with the 24 geophones spaced 10 feet apart, plant the geophones, and then record data for a given shotpoint. Data from several hammer blows at each shotpoint were stacked to improve the signal to noise ratio. After all the shot points had been taken, the relative elevations of each geophone location was recorded using a hand level and stadia rod. For shotpoints at the end of each spread, the geophone nearest to the shot was moved inward 5 feet to ensure that the travel path of the seismic wave was the same for the reversed shot.

3.5 Packer Testing

Following review of the video log and borehole geophysical data by HLA and Rocketdyne staff, four test intervals were selected for packer testing and sampling. Test intervals were selected to characterize significant water-bearing fracture zones and intervals of little to no fracturing. The packer test intervals are shown in relation to identified bedrock discontinuities and geophysical logs on Plate 2. A typical packer assembly schematic is presented in Appendix C. The following intervals were selected:

Interval Numbers	Upper Packer (feet, bgs)	Lower Packer (feet, bgs)
1.	100	132
2.	static water level (62)	148
3.	212	250
4.	253	total depth (295)

3.5.1 Step Rate Pumping

Following packer inflation, pumping was initiated at a rate sufficient to recover water at the surface. The volume of water required to fill the discharge pipe was calculated and recorded on the field data sheet. A check valve installed on the discharge pipe prevented backflow into the test interval. Water discharged at the surface was routed through a flow meter manifold, and discharged into polyethylene storage tanks provided by Rocketdyne. Immediately following discharge of water through the flow manifold, the pump rate was adjusted to an appropriate low flow rate (approximately 0.1 to 0.25 gallon per minute). Because the initial pumping rate used to fill discharge pipe was higher than the step test pumping rates, and the water level in the well was not yet in equilibrium with the formation, the water level continued to rise during the first step. A constant pumping rate was maintained until a stable rate of water-level change (increasing, decreasing, or stabilized level) was achieved. The initial flow was established at a rate such that the water level within the test interval would increase (i.e., flow into the test interval exceeds the pumping rate). Transducer readings above and below the test interval were examined to evaluate if the packers were seated correctly. Leaking packers were detected by observation of significant water-level or pressure responses outside the test interval. When a leaking packer was detected, the test was terminated, the packers were repositioned in the borehole, and testing resumed with the packer inflation procedure described above. Times, flow rates, volume removed from the test interval, and water quality parameters (temperature, pH, electrical conductivity and turbidity) were recorded at regular intervals or significant changes throughout the packer test. As a quality control measure, transducer readings and water-level measurements were also recorded using an electric well sounder to provide backup data in the event of electronic data loss, and a calibration check of the 10 psig transducer above the test interval. All field instruments were calibrated daily or prior to each use relative to standard solutions provided by the manufacturer.

Following stabilization of the initial pumping rate, the pumping rate was incrementally increased to identify (1) the rate at which the

flow into the well is equal to the pumping rate at a specific drawdown level (i.e., the rate at which the water-level in the test interval is maintained at a constant level) and (2) various rates for which the flow into the well is less than the pumping rate at various drawdown levels (i.e., the water-level is dropping within the test interval). Each pumping rate was maintained until a stabilized rate of water-level change was recorded. Water quality parameters were measured at regular intervals throughout the purging of each test interval. The second objective of pumping rate increases was to purge a sufficient volume of water to allow for representative sampling of formation water from the isolated test interval. The target volume of 10 test interval volumes was not obtainable due to the extremely low flow rates and the length of the intervals tested; however, a minimum of 1.5 test interval volumes was required to meet the minimum project and data quality objectives.

3.5.2 Sample Collection

After water quality had stabilized, samples were collected from a disposable 1/4-inch-diameter polyethylene sampling tube. The pump discharge was split to the sampling tube immediately above the upper packer. The pumping rate was reduced to approximately 100 milliliters per minute and the flow diverted to the sampling tube by closing the valve on the 1 1/4-inch discharge line at the surface. A check valve on the 1 1/4-inch discharge line prevents backflow into the test interval or sampling tube. A minimum of two sampling tube volumes was purged at 100 milliliters per minute prior to sample collection. Samples were collected from a sampling valve at the surface. The sampling tube was replaced prior to each test interval. The appropriate laboratory-supplied sample bottles were carefully filled from the sampling port to minimize potential sample aeration. Samples collected for analysis for selected cations and anions were filtered using a disposable 0.45-micron filter prior being transferred to the laboratory-supplied sample bottle. The sample bottles were sealed, labelled, and immediately placed into a cooled ice chest for transport to the state-certified analytical laboratory. As a quality control (QC) measure, one laboratory-supplied trip blank sample per day was stored in the cooled ice chest and

handled in the same manner as the well samples. Samples were recorded on a standard HLA chain of custody form to document sample identification and handling (Appendix D). Observations during packer testing and groundwater sampling were recorded on an HLA well development record.

Water samples were also collected from the pond adjacent to Well RD-7. A clean sampling container was used to collect a water sample from approximately 5 to 10 feet below the water surface as far away from the shoreline as possible (approximately 10 to 15 feet). The water sample was transferred into the laboratory-supplied bottles in the same manner as the well samples, sealed, labelled, and placed into the cooled ice chest.

3.5.3 Sample Analysis

Samples were transported to Quanterra Environmental Services, Santa Ana, California on the day they were collected. Well and pond samples were analyzed for major cations (sodium, potassium, calcium, and magnesium), major anions (chloride, sulfate, nitrate), alkalinity as carbonate and bicarbonate, pH, total dissolved solids (TDS), and specific conductance using EPA Test Methods 6010, 300.0, 310.1, 150.1, 160.1 and 170.1 respectively. The well samples were also analyzed for volatile organic compounds (VOCs) using EPA Test Method 8240. Nitrate and pH analyses were performed within 48 and 24 hours of collection respectively, to meet method holding time requirements; all other analyses were requested on a standard 10-working-day turnaround basis.

3.6 Aquifer Testing - Recovery Data

Aquifer testing was performed to identify approximate aquifer characteristics of Well RD-7. An aquifer recovery test was performed August 21 through 22, 1995 on the whole borehole. The test was performed by pumping the well at a relatively high rate for a short duration, and monitoring the water level recovery. Drawdown and recovery data were collected at 1-minute intervals using a 100 psig pressure transducer and Hermit data logger. Water levels were allowed to recover to the

normal (pre-test) static level prior to the start of pumping. Pumping was performed at a constant rate of 68 gallons per minute. Recovery data were recorded until the water level recovered to within 90 percent of the pre-test level. The data were evaluated as slug test data because the volume of water was removed nearly instantaneously compared to the recovery duration and there are no drainage effects from a gravel pack associated with a standard cased well design.

3.7 Decontamination Procedures

All downhole equipment was steam cleaned prior to use. Transducers, cables, and other dedicated monitoring equipment were washed in a residue-free detergent (Liquinox) and rinsed in tap water and deionized water prior to use. Disposable polyethylene sample and packer inflation tubing was replaced before testing and sampling each interval.

3.8 Waste Disposal

All water produced from this investigation was retained in clean, polyethylene storage tanks provided by Rocketdyne. Labels provided by Rocketdyne describing the well number, date of accumulation, and appropriate facility information were affixed to each tank. The tanks are located adjacent to Well RD-7. HLA has forwarded the sampling results to Rocketdyne, which is responsible for waste handling and treatment.

4.0 DATA REDUCTION

4.1 Seismic Refraction

Preliminary data reduction was performed in the field to assess data quality and site characteristics. For each shot-point, P-wave arrival times were obtained from the seismograph output. Using these data, a time-distance graph was prepared by plotting arrival times in milliseconds (ms) against surface distance in feet (ft) from the shotpoint to the corresponding geophone location.

These time-distance graphs were checked for the correlation of reciprocal times as a verification of data quality. Arrival times that align into a single straight line segment are considered to be the result of the energy traveling along the top of a single seismic layer. Acoustic velocities were determined by calculating the slope of the straight line segments interpreted on the time-distance graphs and were evaluated with respect to average seismic velocities of known materials.

Final analysis of these data was performed using the refraction modeling software SIPT2, from Rimrock Software. This program calculates an average velocity for each layer and depths to the refracting surface. This program includes an automated first-break picking routine to generate time-distance pairs for later interpretation. These computer-determined travel times may be overridden by the operator to account for improper picks due to excessive noise or low signal strength. The input to the interpretation program includes the horizontal and vertical position of all shot points and geophones, the first arrival times for each geophone, and the layer designations for each arrival time as determined from the time-distance graph. The seismic data reduction uses velocity calculation and ray-tracing procedures to calculate a seismic model that fits the observed data. The computer program output consists of the computed average velocity and the depth of each seismic layer beneath every shotpoint and geophone.

The reduction of seismic refraction data produces a layered velocity model that best fits the arrival time data. Generally, the model incorporates

three assumptions. First, the subsurface consists of relatively flat lying (less than 20 degrees from horizontal) and continuous velocity layers within the geophone spread. Second, the thickness of each layer is sufficient to allow adequate resolution of successively deeper seismic layers. Third, the P-wave velocity increases with depth. The seismic refraction cannot provide detailed information about local variations in material velocity and rock condition. Rather, the velocity models represent average velocity for each layer; there may be localized areas within each spread where the seismic velocity is greater or less than the value presented.

4.2 Packer and Recovery Tests

Pressure head data collected from transducers installed above, below, and within the packer test intervals were reduced by plotting head against time on arithmetic graphs. Data from transducers installed either above or below the packer test interval were inspected only to confirm that the packers were preventing hydraulic communication as intended, and were not used to derive aquifer parameter data.

Raw data from the transducer within the packer test interval were corrected to mean sea level elevation in feet, and plotted against time in minutes. Each test comprised several pumping rates that were maintained for non-uniform periods of time; approaching steady state was not a criteria for increasing the pumping rate during any of the packer tests. For this reason, only those pumping rates (steps) that produced distinct and quantifiable drawdowns were used to assess aquifer parameters.

Specific capacity was calculated by dividing the pumping rate (in gallons per minute, referenced to zero) by the measured drawdown (in feet, also referenced to zero) for each step that showed appreciable drawdown. The amount of drawdown used in this calculation was taken from the time-drawdown graphs just before the pumping rate was increased, and may not represent a steady-state drawdown. This process yielded a series of specific capacities for each

packer test interval, that were then averaged for each interval. Since water levels did not equilibrate in the time allotted, the specific capacities are likely overestimated along with the calculated transmissivities and hydraulic conductivities.

Aquifer transmissivity may be approximated by multiplying the measured specific capacity by 1,500 (for an unconfined aquifer) or 2,000 (for a confined aquifer) (*Groundwater and Wells*, Fletcher G. Driscoll, Johnson Filtration Systems, Inc., 2nd ed., 1986. 1089 pp). Transmissivity may then be divided by the packer test interval thickness (in feet) to obtain an approximate value of hydraulic conductivity (in feet per day). It is assumed that flow into the packer test interval is horizontal, and that the packer test interval thickness then equals the saturated thickness of the formation being tested.

Aquifer test data analysis was limited to two sets of recovery data because steady state conditions could not be approached, and the well was purged dry within several minutes of pumping at 12 and 68 gpm. Because of the short pumping time required to dewater the well, rising water levels were analyzed as rising head slug tests using the Bouwer-Rice slug test analysis, although the tests are referred to in this text as recovery tests. This analysis yields hydraulic conductivity results in feet per day.

Note that these estimates of aquifer transmissivity and hydraulic conductivity are based on theoretical groundwater flow equations derived for homogeneous, isotropic porous media. Fractured rock aquifers generally do not conform to these assumptions, however, the estimated hydraulic properties can be used to evaluate the relative permeabilities of the well intervals.

5.0 RESULTS

5.1 General Site Conditions

The ground surface near Well RD-7 is composed of a series of alternating southwest-northeast trending narrow sandstone ledges (ridges) and intervening swales. Fill has been placed throughout the swales and moderately dense vegetation is present.

A relatively narrow, steep-sided north-flowing drainage crosses north-northeasterly through the site west of RD-7. This swale is visible as a photo lineament on the air photos and is labeled PL-1 on Plate 1. The drainage ravine has abundant oak trees, brush and poison oak.

5.2 Geology

5.2.1 Description of Units

The Cretaceous-age Chatsworth Formation (map symbol Kc) underlies the site. This unit is composed of numerous fining-upward beds grading from thin intervals of siltstone, mudstone and/or shale at the top of beds to coarse sand and/or pea-sized gravel at the base of beds. Beds are typically 3 to 10 feet thick and appear to be the result of submarine fan deposition. Soft sediment deformation is occasionally visible at bedding contacts where fine-grained sediment has been deformed as load structures intruded into the overlying coarse material. Fine-grained rip-up clasts are occasionally visible in the basal portion of coarse-grained beds. The thickest fine-grained bed observed during the field reconnaissance was a 3- to 5-foot-thick mudstone and shale exposed on the north side of the pond excavation.

The sandstone is moderately cemented and moderately strong to strong. Localized areas of friable material are present occasionally along some fractures and frequently along fine-grained sand beds. Field observations suggest primary porosity of the sandstone is low (<5 percent) with higher porosity possibly associated with the more friable zones. Friable zones produce conspicuous cavities in outcrop that are frequently inhabited by bird nests and bee hives.

Well RD-7 is located near the northern edge of Burro Flats, a relatively flat area that resulted from Pleistocene-age alluvial erosion and deposition. Burro Flats was subsequently tectonically uplifted to its current elevation in the Simi Hills. The same alluvial processes that shaped Burro Flats at least partially shaped the area around RD-7. Up to 18 feet of alluvium (Qal) overlies bedrock at Well RS-16 approximately 70 feet northeast of RD-7 (Plate 1). The thickness of the alluvium likely varies laterally over an undulating bedrock erosion surface produced by former channels and/or scour depressions eroded into the bedrock surface.

Soil and rock fragments derived from weathering and slope processes have accumulated as colluvium (Qc) in the swale areas between the bedrock ridges.

Fill (af) and debris have been placed in the more accessible areas adjacent to Well RD-7. Asphalt, concrete, and rebar are exposed in the fill. Approximately 8 feet of fill were encountered in RD-7.

5.2.2 Structure

Bedding strikes northeasterly and dips moderately toward the northwest. Two fracture sets are visible in outcrop. One set is oriented approximately perpendicular to bedding and striking approximately northeast and dipping southeast. A second set strikes north-northwest and dips toward the northeast. Beds and fractures measured during the field mapping are shown on Plate 1. These features were plotted as poles on a lower hemisphere stereonet also shown on Plate 1.

Fracturing combined with bedding generally breaks the otherwise massive sandstone into blocks 10 to 15 feet on a side. Field observations indicate some fractures are capable of conducting significant volumes of groundwater because they are open and unfilled and the presence of staining and cavities along fractures and beds indicates groundwater is transported through

these near-surface discontinuities.

The photo lineament west of Well RD-7 (PL-1 on Plate 1) does not appear to significantly displace the major sandstone ledges that intersect it, consequently this zone is interpreted to be a zone of fracturing rather than faulting. Fracturing of the relatively hard sandstone would be expected to increase secondary porosity and hydraulic conductivity resulting in the fracture zone (photo lineament) possessing relatively high groundwater storativity and transmissivity. If this is the case, the photo lineament may represent a separate hydrogeologic unit.

5.2.3 Hydrostratigraphic Units

Geologic conditions near RD-7 indicate that least three hydrostratigraphic units are present: the poorly consolidated fill and alluvium overlying bedrock, the fractured and bedded bedrock of the Chatsworth Formation, and the possible fracture zone associated with photo lineament PL-1.

Groundwater in the alluvium and fill is unconfined and perched and likely the result of infiltration of surface water and precipitation. The relatively thin nature of these soil materials suggested saturated conditions may only be present seasonally. Groundwater may accumulate and persist in areas of deeper alluvium, particularly where alluvium is deposited in depressions scoured into bedrock.

Groundwater in bedrock is associated with discontinuities including fractures and beds that have created secondary porosity and permeability. Primary porosity and permeability in the sandstone appear to be low. Field observations suggest the intersection of fractures may have the highest capacity for conducting groundwater. Consequently the intersection lines formed by the principal fracture sets and bedding may define the principal groundwater flow paths. The presence of fine-grained sediment at the top of the beds suggests bedding may have a significant influence on flow direction.

Groundwater levels observed in RD-7 represent the combined potentiometric heads of the entire bedrock interval penetrated by the well. It is uncertain whether groundwater is confined or unconfined at this well. It is possible that both

conditions exist.

The photo lineament may represent a zone of increased fracturing, in which case this zone may have relatively high storativity and transmissivity. This zone may be connected hydraulically to the less fractured wall rock represented by bedrock encountered in RD-7. Recharge for this zone may include infiltrating surface water and precipitation and possibly some groundwater from the less fractured rock beyond the boundaries of the fracture zone.

5.3 Geophysical Well Logging in Well RD-7

Caliper, natural gamma, temperature, 16-inch and 64-inch normal resistivity, point resistance, spontaneous potential (SP), and heat pulse flowmeter log data are presented on Plate 2. Corrected and, in some cases, smoothed digital data for each sensor are shown on Plate 2 as a function of depth. In addition to these standard geophysical logs, a high-resolution sonic imaging tool was used to obtain acoustic televiewer (ATV) data. The application of ATV logging is relative new to hydrogeologic investigations and has been shown to provide valuable fracture and bedding information in open-hole rock boreholes. Discontinuities interpreted from the ATV log are also presented on Plate 2. The electric logs (i.e., resistivity, point resistance, and SP), temperature, and ATV logs were run only in the fluid-filled portions of the well where the probe's electrodes and detectors were below the static water level. All depth data are recorded from the top of the metal casing.

5.3.1 Caliper Log

The 3-arm caliper tool records the average diameter of the borehole as it is lifted up the borehole. Caliper data are important for evaluating lithology and for recognizing artificial natural gamma and electric log (resistivity and SP) responses. The caliper log for the upper approximately 25 feet of Well RD-7 shows that the inside diameter of the steel conductor casing is approximately 10 1/8 inches. Below approximately 25 feet, the average diameter of the borehole is 8 5/8 inches to the bottom of the hole at a depth of approximately 295 feet.

Localized variations in the borehole diameter are typically associated with structural features in the rock. At depths of 118 and 125 feet, the caliper shows sharp excursions indicating that the average diameter of the borehole enlarges by nearly 1 inch. Typically, localized excursions are indicative of openings in the rock wall associated with small separations in the rock beds and/or open fractures. Bedding planes and/or fracture sets are also indicated by minor enlargements of typically less than 1/2 inch that occur at depths of 34, 72, 112, 149, 187, 203, 213, 249, 274, 278, and 284 feet. The depths of the numerous sharp excursions (enlargements) in Well RD-7 can be evaluated together with other log data to help identify the major beds intercepted by the borehole. Secondary porosity such as fracturing and even possibly solution openings would also produce localized enlargements in the diameter of the borehole; however, these data alone cannot provide direct information as to the type of feature responsible for the enlargement nor the significance of the feature with respect to fluid flow.

Depth intervals exhibiting a slightly irregular borehole diameter (e.g., the intervals from 137 to 141 feet and 251 to 263 feet) may represent a zone of thin bedding where the action of the drill bit created an uneven borehole wall. Depth intervals where the caliper shows a uniform diameter suggest a relatively thick and massive bed. The thickest interval indicative of massive rock is between approximately 153 and 186 feet. The next thickest interval suggestive of massive rock is indicated from 38 to 58 feet.

5.3.2 Natural Gamma Log

Natural gamma logs are primarily used to identify changes in lithology near the borehole. At the Santa Susana site, the most significant naturally occurring gamma-emitting radioisotopes are potassium-40 and the daughter products of the uranium and thorium decay series that are present in small amounts in the sedimentary rocks. Higher concentrations of gamma-emitting isotopes would be expected in mudstone and shale. The gamma log provides a record of the total natural gamma radiation detected within a given energy range as the sensor is lowered or raised through the borehole. The gamma detector measures the number of gamma photons

(in counts per second [CPS]) reaching the gamma probe. Thus, in addition to changes in lithology, the presence of casing, enlargements in the borehole diameter, and cement/grout will influence the recorded CPS.

The gamma logs show low gamma CPS for the 0 to 25 feet depth range due to attenuation from the steel conductor pipe and the enlarged borehole diameter. Corrections for borehole size and casing could not be made because the casing wall thickness and the size of the annulus between the casing and borehole wall is not known. Below 25 feet, the gamma CPS ranges from approximately 125 to 200 CPS. Generally, areas of predominantly quartzite sandstone would be indicated by lower CPS values, from approximately 125 to 145 CPS. Higher CPS values would indicate zones of more arkosic sandstones, mudstones, and/or shales.

The gamma log shows four intervals where the CPS generally exceed 145. These intervals are highlighted on the log trace. The first depth interval is from approximately 27 to 37 feet, although the upper limit is unknown because of the presence of the conductor casing. The second high CPS interval occurs from approximately 67 to 74 feet. The first two intervals correspond with localized enlargements shown by the caliper, indicating that the higher natural gamma CPS are probably associated with fine-grained materials such as a mudstone or shale bedding.

The third interval extends from approximately 112 to 150 feet and shows the highest gamma CPS recorded in Well RD-7. This zone can be divided into two high gamma CPS zones separated by an approximately 8-foot-thick low gamma CPS zone. The upper zone from approximately 112 to 129 feet shows the highest gamma CPS and corresponds directly with a zone of frequent borehole enlargements (caliper data). The lower zone extends from approximately 137 to 150 feet. Both zones of high gamma CPS correspond with irregular caliper response and are indicative of a rather broad interval containing relatively thin bedding and localized open fractures and/or bedding planes.

5.3.3 Temperature

The temperature of the fluid in the borehole was recorded as the probe was lowered down the borehole. The log shows a smooth trace with a general increase in fluid temperature with depth. At the time of the run, the temperature of the upper half of the fluid-filled portion of the well was fairly constant, measuring approximately 19.5 degrees Celsius. Below approximately 150 feet, the temperature steadily increased to a maximum of approximately 20.2° C. A gradual increase in temperature with depth is consistent with the typical effects of the earth's geothermal gradient.

Rapid temperature changes that could be associated with active fluid exchange between the borehole column and the surrounding rock (i.e., zones of in-flow and out-flow) are not apparent on the temperature log. Vertical flow, either up or down, caused when a well is completed in multiple aquifers having different hydraulic heads can sometimes be detected if the flow rates are high. The lack of rapid temperature changes in Well RD-7 water along the column suggests low flow conditions and/or some degree of hydraulic equilibrium near the borehole. These observations also suggest that a substantial volume of water is probably not entering or leaving the borehole from a localized interval (crossflow) or, if there is an inflow or outflow of water, that the crossflow fluid has nearly the same temperature as the water in the borehole column.

5.3.4 Electric Logs

Electric logs, including 16- and 64-inch normal resistivity, point resistance (PR), and spontaneous potential (SP) provide measurements of the electrical and electro-potential properties of earth materials. These data, when evaluated with other geophysical log data, can provide qualitative information on porosity, permeability, fluid flow, and lithologic changes.

The most prominent feature shown by the four electric logs is centered at a depth of approximately 120 feet and is indicated by anomalous log responses within the depth interval from approximately 100 to 130 feet. A second, deeper but less prominent, feature is

indicated by the point resistance and normal resistivity logs centered at approximately 250 feet.

The upper anomalous electric log (PR and resistivity) response is characterized by a low resistivity zone centered at approximately 115 feet. Low resistivity zones in rock materials are normally associated with a higher porosity and/or a change in pore-water conductivity. Higher porosity may be the result of fracturing, weathering, bedding, or faulting. The negative SP response from 110 to 130 feet indicates a possible inflow of water within this interval. This electric log anomaly corresponds with localized borehole enlargements shown by the caliper data at depths of 118 and 125 feet and high CPS natural gamma data in the 112- to 129-foot depth range. Together, these data suggest that Well RD-7 intercepts a higher permeable zone(s) in the depth interval between approximately 115 and 130 feet.

The deeper electric log anomaly is characterized by a localized low resistivity and resistance response measured by the resistivity and PR, respectively. The electric log anomaly is centered at 250 feet and appears over a relatively narrow 3-foot interval that correlates directly with a borehole enlargement measured by the caliper and a localized natural gamma high CPS at the same depth. These data suggest a localized high porosity zone that may be associated with more permeable conditions.

5.3.5 Heat Pulse Flowmeter

Heat pulse flowmeter data were recorded at six locations in Well RD-7 to measure the ambient flow either up or down, of fluid in the borehole. The measure depths were selected to bracket a suspected high permeability zone indicated by the other borehole data. The flowmeter data show ultra-low flows of 0.01 to 0.02 (gpm). Three measurements indicate upflow, and the other three measured downflow. Intervals of inflow and outflow of fluid can be inferred by inspecting the change in the magnitude of the flow and/or direction between two measurement points. For example, a point of inflow is indicated between 100 and 120 feet because the flow above the interval is up and the flow below the interval is down. Similarly, a point or zone

of outflow is indicated in the interval from 225 to 283 feet. It should be recognized that the flows measured by the heat pulse flowmeter survey in Well RD-7 are very low and are at the low end of the instrument's measurement range. Therefore, the values presented on Plate 2 have been rounded to the nearest 0.01 gpm.

5.3.6 Acoustic Televiwer

Acoustic televiwer data were useful in locating discontinuities along the borehole. The interpreted locations of discontinuities in RD-7 are presented on Plate 2. Because the technique collects data from the entire circumference of the borehole and with a known orientation, the "strike and dip" of these features can be determined. The orientation of these discontinuities have been plotted on a stereonet which is presented in Appendix E along with a table listing these discontinuities.

5.3.7 Video Logging

Black and white video logging was useful in corroborating zones of fracturing and bedding as well as assuring a clear borehole for subsequent logging. The quality of the video log was fair due to equipment malfunctions, the relatively large diameter borehole and some turbidity.

5.4 Seismic Refraction Survey

HLA's review of the seismic refraction data acquired along the two lines at this site (Plate 3) show a relatively thick section of low velocity materials indicative of poorly consolidated material such as soil or fill materials overlying

moderately consolidated materials (Plates 4 and 5). A review of the time-distance graphs indicate a significant amount of scatter between adjacent arrival times, which may indicate heterogeneous materials in the near surface layer. Where the localized variations of the arrival times assigned to the deepest layer occur on line segments from multiple shot points, the variations may indicate variations in refractor topography. Further analysis of these time-distance graphs indicates velocities of 1,300 to 1,600 feet per second (fps) for Layer 1 and 5,900 to 6,200 fps for Layer 2. Modeling of these data indicates an irregular topography for Layer 2 with the thickness of Layer 1 ranging from 9 to 20 feet. Layer 2 is interpreted to represent the top of bedrock. Nearby RD-7 indicates depth to bedrock as 8 feet. Projecting the slope of the surrounding outcrops down to the seismic lines, the depth to bedrock correlates well with the seismic interpretation of approximately 15 feet.

5.5 Packer Test

The results of the drawdown packer tests indicate decreasing hydraulic conductivity with depth, as presented in the table below. Raw data generated from the packer tests are presented on arithmetic graphs on Figures 2 through 5, from which all hydraulic parameters were calculated. Hydraulic conductivities were calculated from measured values of specific capacity for each packer test interval.

Handwritten notes:
 The results of the drawdown packer tests indicate decreasing hydraulic conductivity with depth, as presented in the table below. Raw data generated from the packer tests are presented on arithmetic graphs on Figures 2 through 5, from which all hydraulic parameters were calculated. Hydraulic conductivities were calculated from measured values of specific capacity for each packer test interval.

Packer Interval Data

Interval	Specific Capacity (gpm/ft)	Saturated Thickness (ft)	Confined Transmissivity (ft ² /day)	Confined Hydraulic Conductivity (ft/day)	Unconfined Transmissivity (ft ² /day)	Unconfined Hydraulic Conductivity (ft/day)
100 to 132	0.088	32	23.5	0.73	17.6	0.55
Static Water Level (60) to 148	0.167	88	44.6	0.51	33.4	0.38
212 to 250	0.006	38	1.54	0.040	1.15	0.030
253 to TD (300)	0.005	47	1.39	0.029	1.04	0.022

Given the uncertain aquifer character of the water-bearing bedrock unit, two sets of transmissivities and hydraulic conductivities have been calculated from the measured specific capacity in each packer test interval for comparison purposes. Unconfined conditions may dominate in areas where shallow fractures and bedding planes are in communication with the vadose zone. However, the majority of fractures in the water-bearing bedrock unit appear to be hydraulically tight and the bedrock is expected to possess very low values of storativity, which is indicative of confining conditions. No storativity data are available to determine the unconfined or confined nature of the water-bearing units; it is assumed here that the majority of the water-bearing bedrock unit behaves under confining conditions.

The decrease of hydraulic conductivity with depth, regardless of the confining nature, agrees with the

assumption that the aperture of fractures and bedding planes generally decrease with depth, with the most water being produced from the upper 150 feet of the well. As shown in the table above, the hydraulic conductivities calculated for the lower portion of Well RD-7 approach the values calculated using recovery test data.

5.6 Aquifer Testing - Recovery Data

Recovery test data from the 68 gpm pumping rate are presented in Figure 1. Results indicate that hydraulic conductivity is 0.003 feet/day for the entire length of the borehole. These values fall within the expected range of hydraulic conductivities for a tight sandstone (see below).

Approximate Hydraulic Conductivities for Selected Materials (converted to feet/day from Freeze and Cherry, 1979)

	High	Low
Unfractured Metamorphic/Igneous Rocks	< 2.8E-4	< 2.8E-7
Sandstone	2.8	2.8E-4
Clean Sand	2.8E3	2.8

5.7 Analytical Results - Organic Chemistry

Results of the organic analysis indicate a similar level of TCE was detected in each of the four packed off intervals. The concentrations ranged from 39 to 67 micrograms per liter ($\mu\text{g/l}$). The

results are presented in the following table. No other VOCs were detected without qualification; cis-1,2-dichloroethene was detected below the reporting limit or as an estimated concentration (qualified as "J") ranging from 1.6 to 3.5 $\mu\text{g/l}$. Complete laboratory data are presented in Appendix F.

**Organics Analyses
Results in µg/l**

Analytes	Sample Numbers			
	RD-7-100 (100 to 132 feet)	RD-7-150 (60 to 150 feet)	RD-7-249 (212 to 250 feet)	RD-7-296.5 (253 to 296.5 feet)
TCE	67	39	47	41
Cis-1,2-dichloroethene	3.5J	1.6J	2.7J	1.8J

**5.8 Analytical Results -
Inorganic Chemistry**

Results of the inorganic analysis also indicate that the four packed off intervals have very

similar chemical signatures. The results are presented in the following table. Laboratory data are presented in Appendix F.

Inorganic Analysis

Analytes	Units	Sample Numbers				
		PD-1	RD-7-100	RD-7-150	RD-7-249	RD-7-296.5
		9.10	7.20	7.30	7.20	7.30
Specific Conductivity	umhos/cm	340.00	869.00	848.00	841.00	834.00
TDS	mg/L	198.00	586.00	540.00	546.00	536.00
Carb	mg/L	16.60	0.10	0.10	0.10	0.10
Bicarb	mg/L	105.00	265.00	269.00	272.00	269.00
Chloride	mg/L	17.40	39.50	45.80	42.60	42.00
Nitrate	mg/L	0.18	4.50	4.90	4.60	4.60
Sulfate	mg/L	22.40	90.70	73.50	82.40	83.30
Calcium	mg/L	14.60	98.80	106.00	99.60	103.00
Magnesium	mg/L	7.00	14.50	13.90	14.30	14.80
Potassium	mg/L	0.10	0.10	0.10	0.10	0.10
Sodium	mg/L	41.60	35.70	38.30	36.80	38.30

Data for the water sample from the nearby pond were compared with groundwater data for the four well intervals. The pH of the pond is surprisingly high at 9.1; the average pH of the well water is 7.25. Other inorganic constituents are also distinctly different from the pond water. On the basis of this limited information, the following data interpretations can be made:

- The pond water and the well water are not in chemical equilibrium. If they are in hydraulic connection, the time span to

achieve equilibrium is so great that they are functionally unconnected.

- The chemical parameters of the pond water suggest that water other than rainwater is contributing to the pond.

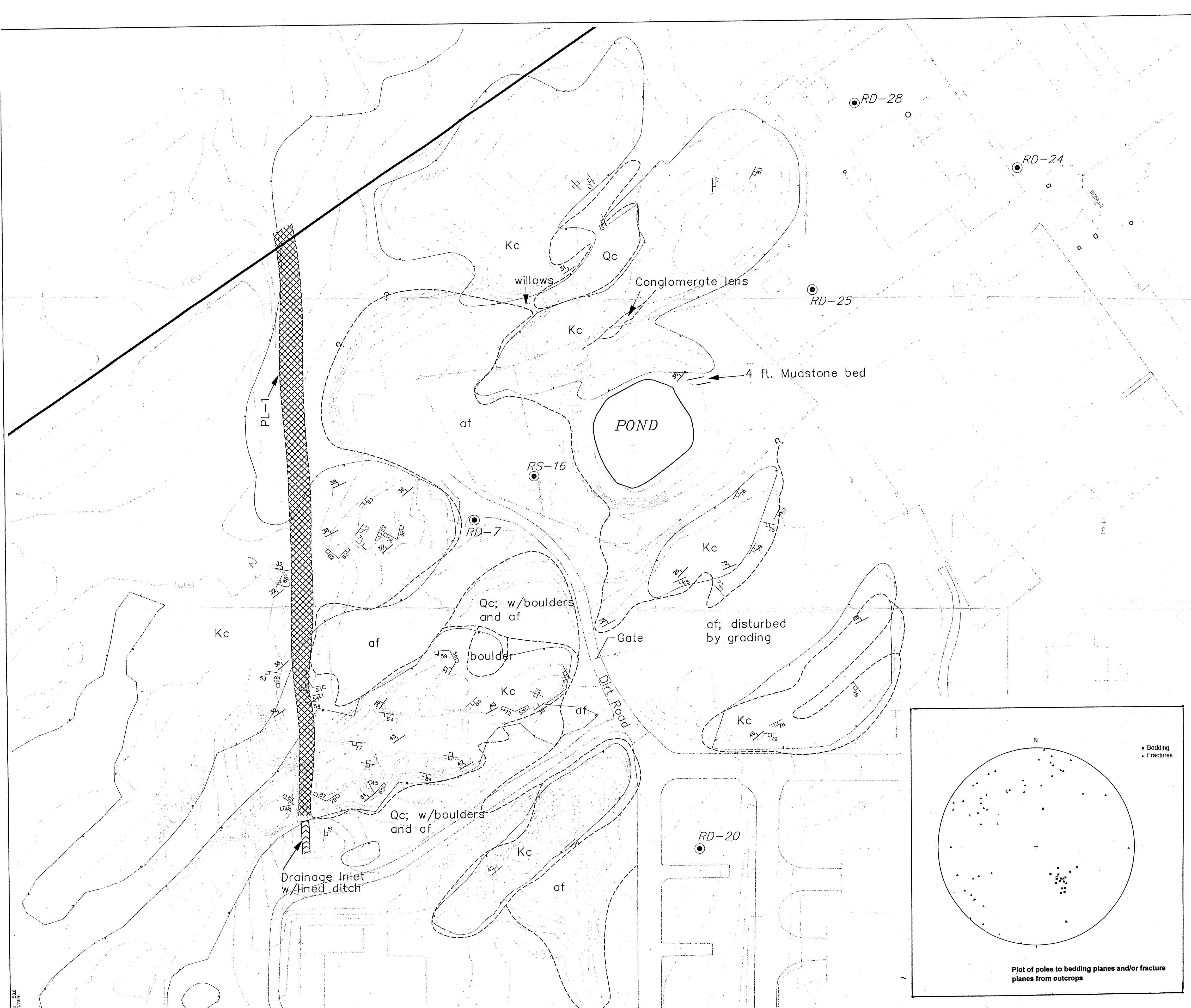
- Both the well and the pond are slightly to moderately oversaturated with calcite, which diminishes the possibility that the pond water would dissolve calcite cement from the sandstone rock as it infiltrated and passed through it.

So what

6.0 CONCLUSIONS

Results of the geophysical and hydrologic testing indicate that useful characterization data can be obtained through the combined efforts of several techniques. Significant progress toward a conceptual understanding of the hydrogeology near Well RD-7 was achieved. The conclusions of the surveys include:

- Downhole geophysical logs in combination provided information about the distribution and frequency of bedrock discontinuities, the approximate location of fine-grained beds, and a basis for evaluating a possible association between groundwater flow and rock discontinuities in a borehole.
- Hydraulic testing confirmed generally decreasing hydraulic conductivity with increasing depth.
- Geologic mapping provided a basis for interpreting downhole geophysical data at RD-7 and provided a framework for developing a conceptual flow path model.
- Geology suggests at least three hydrostratigraphic units: (1) fill/alluvium, (2) fractures with the Chatsworth Formation and (3) a possible fracture zone associated with photo lineament PL-1.
- The degree of hydraulic interconnection is still uncertain between the three hydrostratigraphic units. Additional aquifer tests would help evaluate such interconnections and flow pathways.
- Seismic refraction surveying provided useful information for assessing the configuration of the fill/alluvial aquifer. However, it shows a limited capacity to evaluate the deeper bedrock aquifer.



EXPLANATION

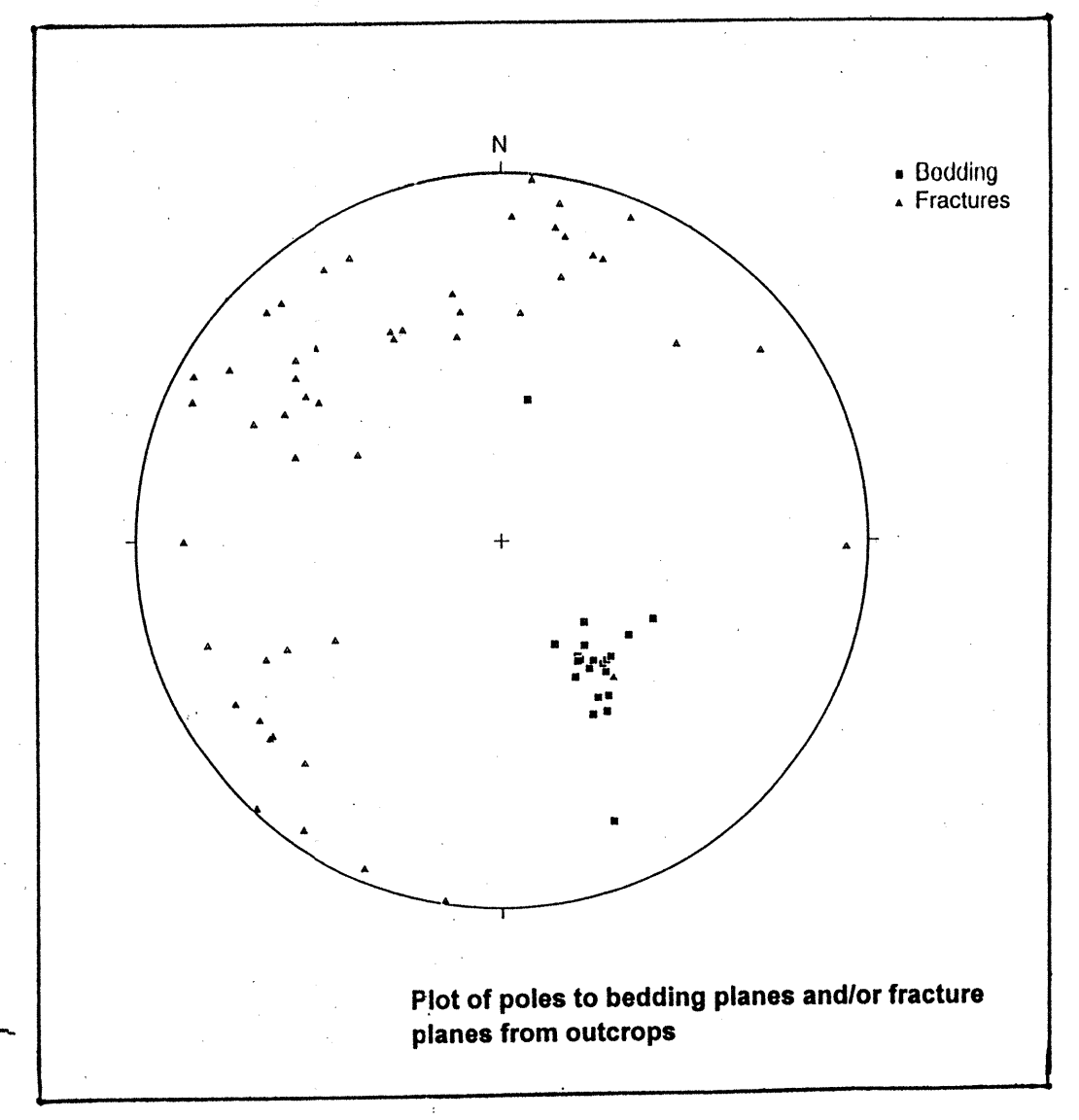
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Contour Interval 20 feet
- Rock Outcrop
(provided by Rocketdyne/SSFL)
- Building Footprint
- Metal Fence
- Area Boundary
- RD-7* Monitoring Well Location

GEOLOGIC UNITS

- SOILS DEPOSITS**
- af* Man-made Fills; commonly includes asphalt, concrete and shot rock (boulders); appears to be loosely placed.
 - Qc* Ravine and Slope Deposits; may include older alluvium commonly disturbed by previous grading activity, frequently covered by fill
- ROCK UNITS**
- Kc* Chatsworth Formation; marine sandstone including minor interbeds of shale, mudstone, and lenticular conglomeritic sandstone

GEOLOGIC SYMBOLS

- Contact, dashed where approximately located, queried where uncertain
 - Photo Lineament (PL-1); suspected fracture zone
 - Strike and Dip of Beds
 - Strike and Dip of Fractures
- 50 0 50 100
SCALE IN FEET



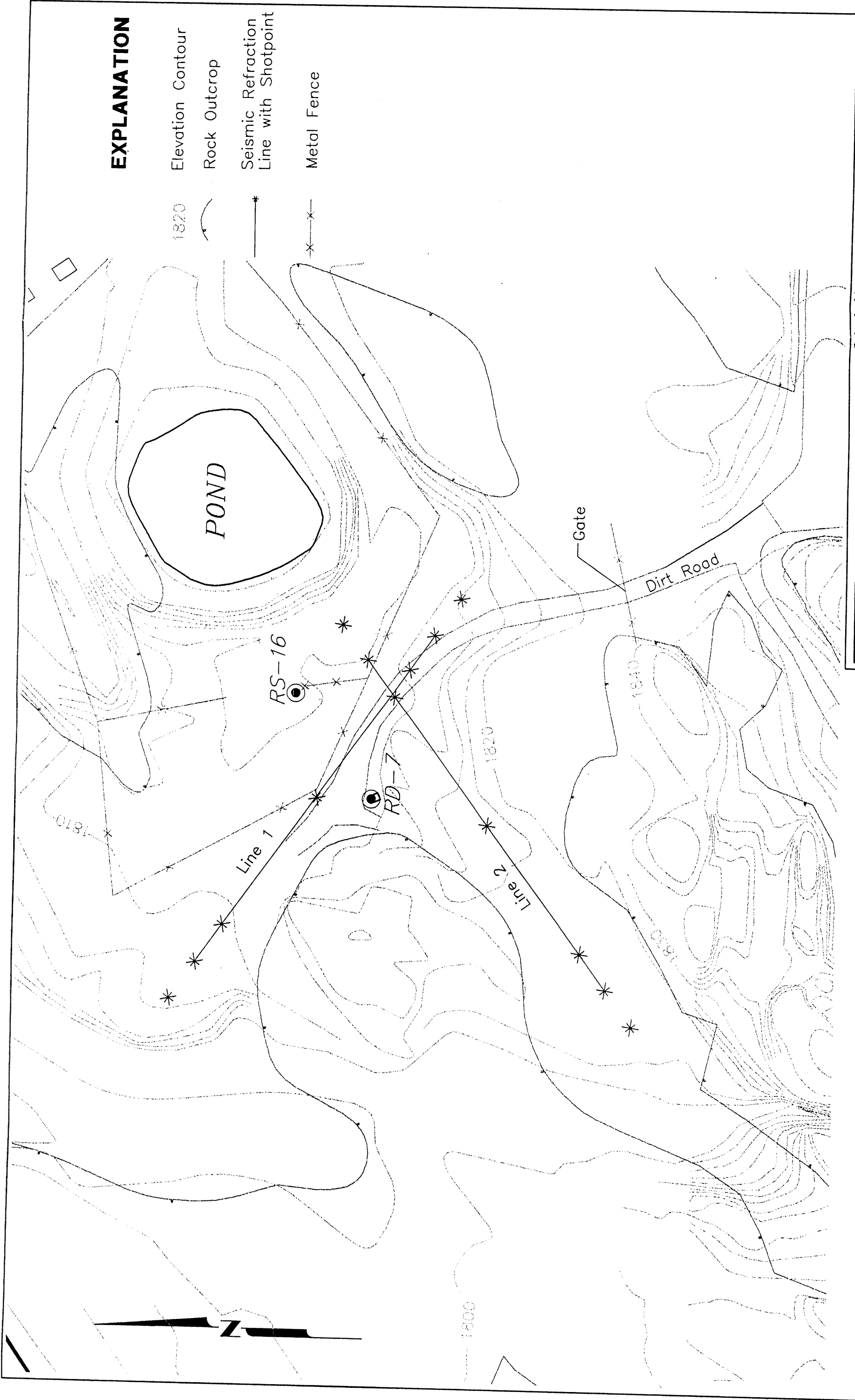
NO.	DATE	REVISIONS	BY	CHK	DATE

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 CHECKED: APPROVED: *[Signature]*
 DATE: DATE: 11/2/95

Harding Lawson Associates
 Engineering and Environmental Services
 105 Digital Drive, Novato, California 94949
 Phone (415) 883-0112

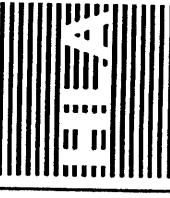
Geologic Features Map
 Geophysical and Hydrologic Testing Surveys
 Rocketdyne/SSFL
 Ventura County, California

PLATE: 1
 SHEET: 1 of 1
 REVISION NUMBER: 1
 DATE: 11/95



EXPLANATION

- Elevation Contour
- Rock Outcrop
- Seismic Refraction Line with Shotpoint
- Metal Fence

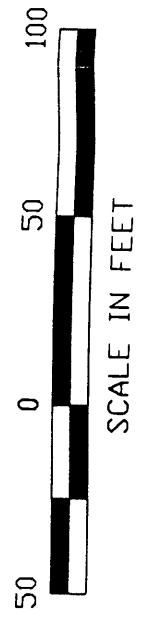


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Seismic Line Locations
 Geophysical and Hydrologic Testing Surveys
 Rocketdyne/SSFL
 Ventura County, California

PLATE

3



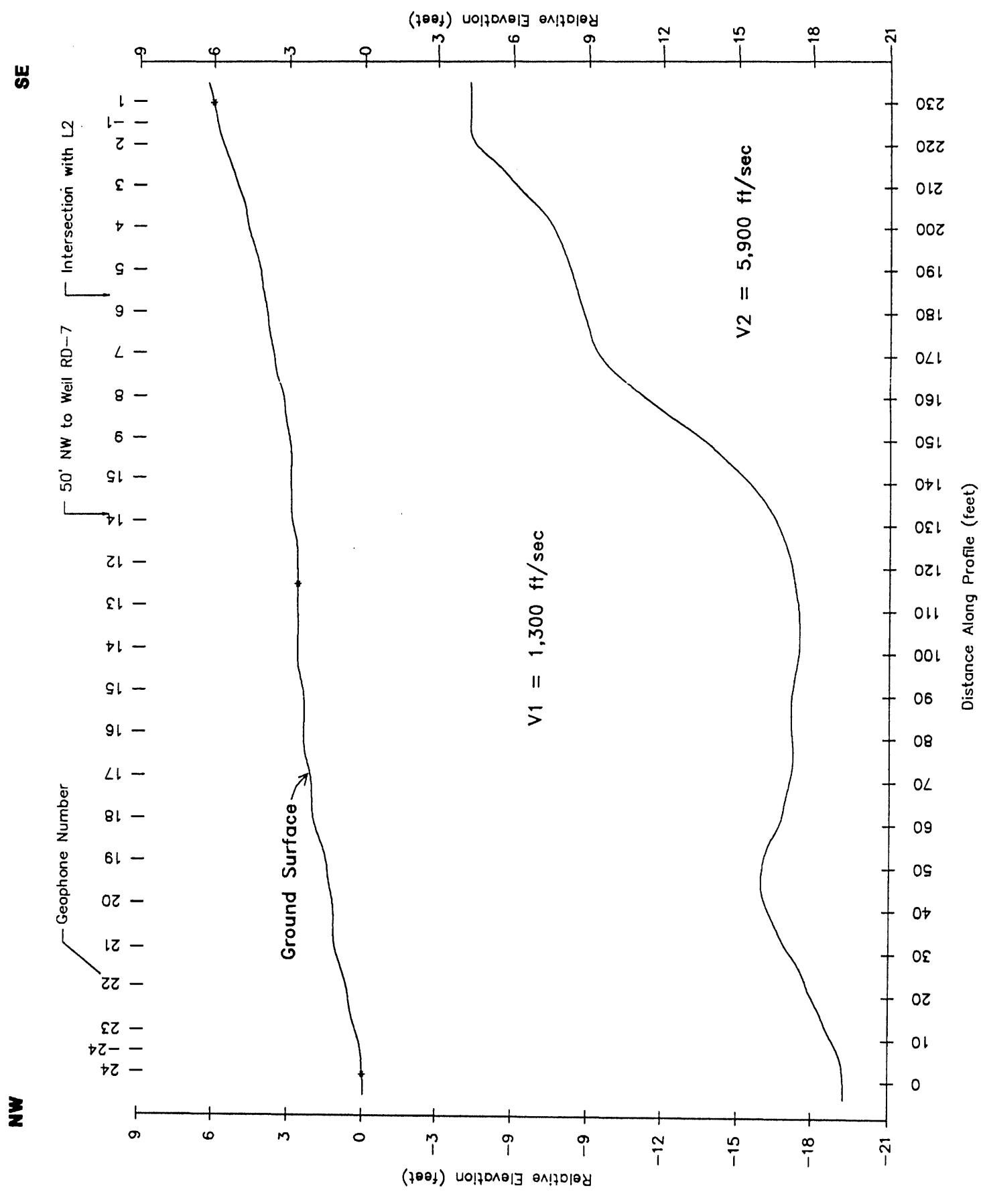
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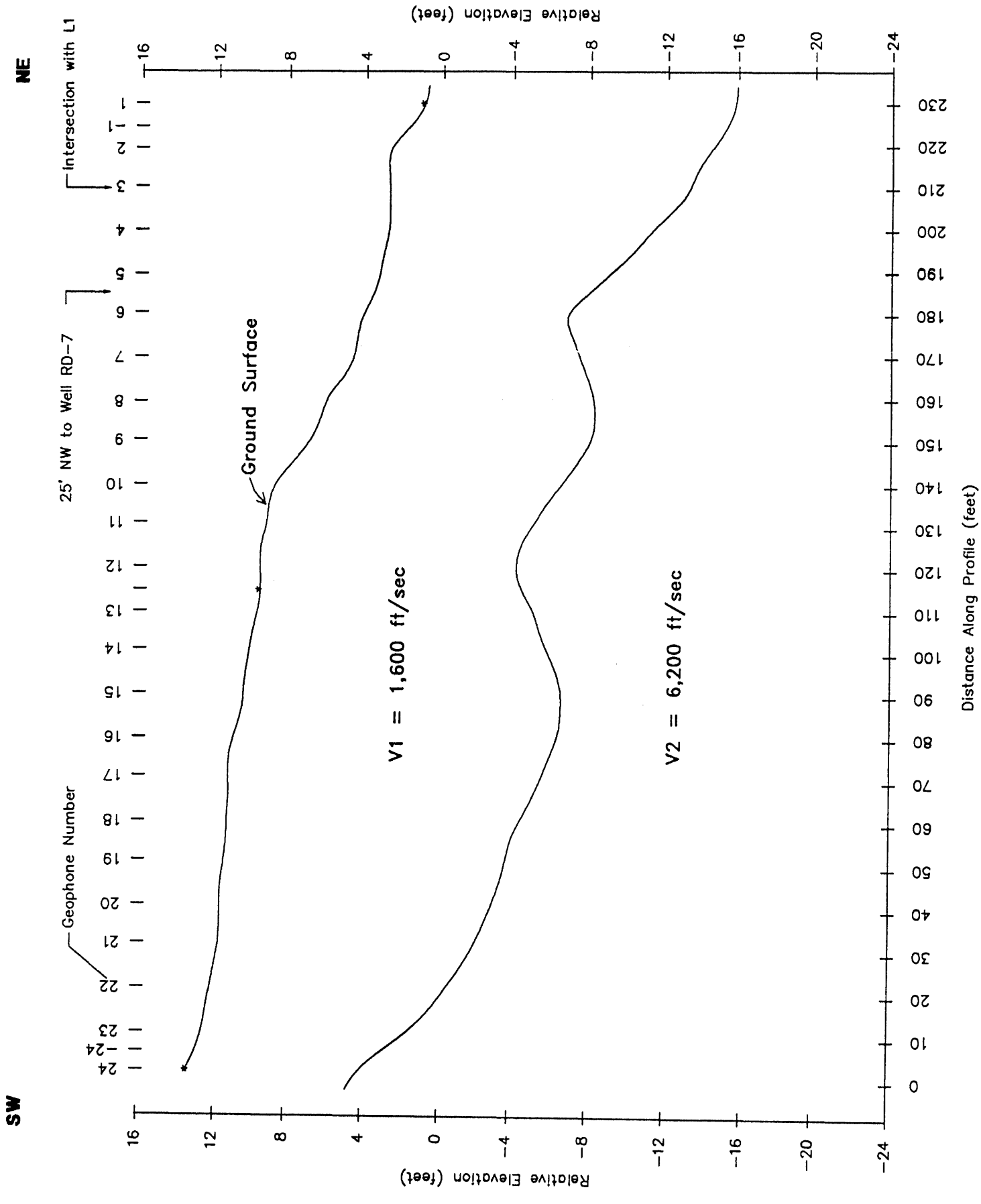
* Shotpoint Location

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Environmental Services

Seismic Refraction Line 1
Interpreted Depth Section
Geophysical and Hydrologic Testing Surveys
Rocketdyne/SSFL
Ventura County, California

APPROVED *[Signature]*

DRAWN BWH
JOB NUMBER 32531 004
DATE 9/95
REVISED DATE 11/95



EXPLANATION
 * Shotpoint Location

PLATE **5**
 REVISION DATE 11/95

DATE 9/95

APPROVED *[Signature]*

JOB NUMBER 32531 004
 DRAWN BWH

Harding Lawson Associates
 Engineering and Environmental Services

Seismic Refraction Line 2
Interpreted Depth Section
 Geophysical and Hydrologic Testing Surveys
 Rocketdyne/SSFL
 Ventura County, California

APPENDIX A
METHODOLOGY

APPENDIX A

METHODOLOGY

A.1 Geophysical Logging Methods

Geophysical logging was conducted using seven sondes: black and white video; acoustic televiewer (ATV); heat-pulse flowmeter (HPF); temperature; natural gamma, spontaneous potential, and single point resistance; normal resistivity; and three-arm caliper. The complete suite of logs were run in well RD-7, however only the video log was run in well RD-50. With the exception of the video, ATV, and HPF, all results were recorded in both digital and analog formats. The ATV and HPF results were recorded in digital format only due to the high sampling rates. Video results were recorded on video tape for additional review. The following sections describe each logging method.

A.1.1 Video Logging

The video survey was performed using a Laval Underground Survey borehole inspection system. The system consists of a power control unit including a color video monitor, a cable and winch assembly with a 1/4-inch coaxial armored cable, a 1 5/8-inch black and white down looking camera with a centrally located light below the camera lens, and a VHS format video cassette recorder (VCR). The data from this system includes a visual image of the borehole condition with the corresponding depth indicated on the screen. This image can be recorded on video tape for review at a later time. This system was used to observe the condition of the borehole materials including the type of materials and the degree of fracturing.

A.1.2 Acoustic Televiewer Logging

The ATV survey was performed using a Robertson Geologging, Ltd. ATV sonde, control console, winch, and acquisition and processing software. The ATV log is an ultrasonic borehole device that images the relief of the borehole wall. This system operates by measuring the amplitude

and travel-time of the reflected acoustic energy of a 500 kilohertz (center frequency) ultrasonic pulse. The sonde contains a transducer that rotates 10 times per second and generates 128 pulses per rotation. A magnetic compass contained within the sonde is used to orient each rotational scan with respect to magnetic north. Due to the high sampling rate only digital data are obtained with this system. During logging the digital data are continuously transmitted to and recorded on a portable computer.

A.1.3 Heat Pulse Flowmeter Logging

The HPF survey was performed using Mt. Sopris Instruments, Inc. HFP-2293 Heat Pulse Flow Meter sonde, MGX series portable digital data logger portable digital computer, and SBCFLOW interpretation software. The HPF uses two temperature sensors above and below a heating grid. The heating grid heats the borehole fluid. The flow rate and direction is then determined by measuring the time it takes for the pulse of heated water to pass by one of the two temperature sensors. The MGX logger receives the time data from the HPF sonde and then transfers it to a computer for interpretation with the SBCFLOW program. This procedure is repeated at several discrete intervals within the borehole.

A.1.4 Standard Logging Methods

The remaining surveys were performed using a Mount Sopris Instruments, Inc., Model II logging system and four logging sondes. The system consists of a dual channel analog chart recorder, console, motorized cable winch with depth encoder, portable digital computer, and downhole sondes. The first sonde measures the borehole fluid temperature. The second sonde measures 3 different well parameters; natural gamma, spontaneous potential (SP), and single point resistance (PR). The third sonde measures normal resistivities for two electrode spacings: the 16 inch and 64 inch normal resistivities. The

fourth sonde is the three-arm caliper that measures the borehole diameter. The downhole sondes are operated through an armored coaxial cable. Depth and cable speed are displayed on the module console and recorded on the chart. Logging measurements are processed within the sondes and transmitted up the cable in digital pulse format. The pulses are shaped, differentiated, and converted to an analog signal voltage by the modular rate meter. The resultant signal is then recorded on both the analog chart for real time viewing and on the digital computer.

Temperature Logging

The temperature sonde measures temperature by use of a thermistor coupled to a sensor which translates the temperature into a series of pulses. The frequency of these pulses can then be correlated to the temperature, in degrees Celsius, of the borehole fluid. Changes in borehole fluid temperature are generally considered to reflect fluid flow across the borehole.

Natural Gamma Logging

The natural gamma log provides an indication of the clay content of subsurface materials. The measurement system consists of a sodium iodide crystal coupled to a photomultiplier. The crystal intercepts incoming gamma photons from naturally occurring earth materials normally found in clays. The photons are counted, shaped, and converted to a voltage signal that is proportional to the intensity of gamma radiation in the subsurface layers (measured in counts per second [cps]). The usual interpretation of the natural gamma log for hydrology applications is that measured count rates are directly proportional to the quantity of clay minerals present (specifically potassium-rich clays).

Spontaneous Potential and Point Resistance Logging

The spontaneous potential and point resistance logs provide information on the nature of the groundwater and also provide an indication of grain size. The sonde for these logs (collected together) operates only when the tool's electrode is in contact with borehole fluids. The point resistance and spontaneous potential are

measured between the tool and surface electrodes. The spontaneous potential is a measurement of the naturally occurring electrical potential (voltage) in the borehole and requires the presence of a clay rich/porous media interface to occur. For the point resistance log, current is passed through the subsurface materials between the sonde and surface electrodes and voltage differences are measured. The voltage measured is directly proportional to the formation resistance. Since the current density is greatest near the sonde electrode, formation variations close to the electrode produce the resistance changes visible on the logs. This gives a very responsive measurement with good vertical resolution. In fresh water, the spontaneous potential is inversely proportional to grain size and the point resistance is directly proportional to grain size.

Normal Resistivity Logging

The normal resistivity sonde has several electrode configurations among which are the 16-inch and 64-inch normal resistivity electrode spacings. The method requires that four electrodes (A-M-N-B) be in contact with borehole fluids or the adjacent soils. A current is applied between electrode A on the end of the sonde and electrode B in the mud pit on the ground surface. The resultant electrical potential (voltage) developed between electrode M on the sonde and electrode N on the cable shield 25 feet above the sonde, is directly proportional to the resistivity of the surrounding geologic formation. Formation resistivity is dependent upon the formation and borehole fluid salinity, the permeability of the formation, and the number of connected fracture paths within the formation. The radius of investigation is approximately equal to the A-M electrode spacing. The normal resistivity runs were made using the standard A-M short and long normal spacings of 16- and 64-inches.

Caliper Logging

The three-arm caliper uses spring-loaded arms to measure the average borehole diameter. The measurement of the borehole diameter is determined by the change in voltage developed across a variable resistor in the probe which is internally connected to one of the caliper arms. The average diameter of the borehole is directly

proportional to the voltage developed across the resistor. One important application of the caliper log is to indicate those intervals where rough borehole walls or washouts can introduce large errors into such logs as the natural gamma log.

A.1.5 Calibration Methods

Except for the natural gamma sondes, all sondes are calibrated during the well logging survey. Calibration for the temperature sonde consists of using a container of ice water (zero degrees Celsius) and a container of water at ambient temperature (measured with a thermometer). Digital and analog data is recorded for each of these fluids and a calibration curve is created for the interpretation of the associated logs. Calibration standards for the caliper consist of rings of known diameter that are placed over the arms of the sonde and the response at these diameters is recorded. The electric log sondes are calibrated using a calibration source of accurately measured voltage and resistance values connected to the appropriate electrodes. Calibration of the natural gamma sonde is not usually necessary since, in hydrology, interpretation of the natural gamma log relies on relative changes in the gamma response within the borehole. The stability and repeatability of all logs are routinely checked by repeat logging of a section of the borehole.

A.2 Seismic Refraction Method

The seismic refraction method is generally used to measure the compressional (P) wave velocity of near surface earth materials. The P-wave velocity is determined by measuring the time it takes for acoustic energy to travel between two or more known points (travel time). The P-wave velocity of earth materials (e.g., dry and/or saturated soil and rock) is directly proportional to its compaction, density and/or hardness. These parameters typically increase with the depth of burial, therefore, seismic velocity also increases with depth. Seismic velocity is inversely proportional to the degree of weathering or fracturing of earth materials. Therefore, the more deeply weathered or highly fractured rock will generally have lower seismic velocities.

For this study we used a Geometrics model R24 24-channel seismograph with 14Hz Mark

Products geophones. The seismic energy was produced by repeated impacts of a 20 pound sledge hammer against a metal plate placed on the ground surface. The P-wave travel times were detected by linear arrays (spreads) of detectors (geophones) at 5 to 10 foot intervals along the ground surface. This resulted in spread lengths of 230 feet. Travel times for seismic energy was recorded for 5 to 7 shot points along each line in an attempt to generate complete coverage of each refracting horizon identified on the field plots. These data were then digitally recorded and stored for further processing.

A.3 Packer Testing

Test Apparatus

Packer testing was performed using a double packer system. Each test interval was isolated using Aardvark 610 pneumatic packers. A schematic diagram of the packer assembly is presented in Appendix B. A 4-inch-diameter variable speed electric submersible pump capable of flow rates ranging from 0.1 to 12 gallons per minute (gpm) was placed between two packers, approximately 4 feet above the lower packer. Each packer has a deflated outside diameter of approximately 6 inches and is capable of a maximum inflated diameter of approximately 10 inches. Two 100 psig pressure transducer intake ports placed immediately below and immediately above the lower packer were used to monitor proper seating of the lower packer and to record pressure variations within the test interval. To ensure proper seating of the packers, the transducer bodies were placed above the upper packer and 1/4-inch-diameter color coded polyethylene tubing extended through the packers to the test interval and below test interval respectively. A third 10 psig pressure transducer was placed above the upper packer, approximately 20 feet below the water-level recorded at the start of each packer test to monitor the seating of the upper packer. The test interval length was adjusted by adding or removing electric submersible pump cable, packer inflation tubing, transducer port tubing and discharge pipe until the desired length is obtained. The packer assembly is then lowered into the well to the desired depth.

Packer Inflation

A Hermit (by In Situ, Inc.) data logger was used to record water level (or pressure) changes below, within, and above the test interval. Prior to installation of the packer assembly, the two 100 psig pressure transducers were calibrated by setting the intakes at a depth of 290 feet and calibrated to a reference water level. The transducers were then attached to the packer assembly and lowered to the desired test interval. The 10 psig pressure transducer was then installed to a depth of approximately 15 to 20 feet below and calibrated to the reference water-level measured at the start of each test interval. Prior to inflation of the packers, the Hermit data logger recorded continuous water level readings at 1 minute intervals from the three transducers to develop stabilized baseline readings to which water-level or pressure changes can be compared. Packers were then inflated by increasing the pressure incrementally until no significant pressure increases were recorded within or outside the test interval.

APPENDIX B

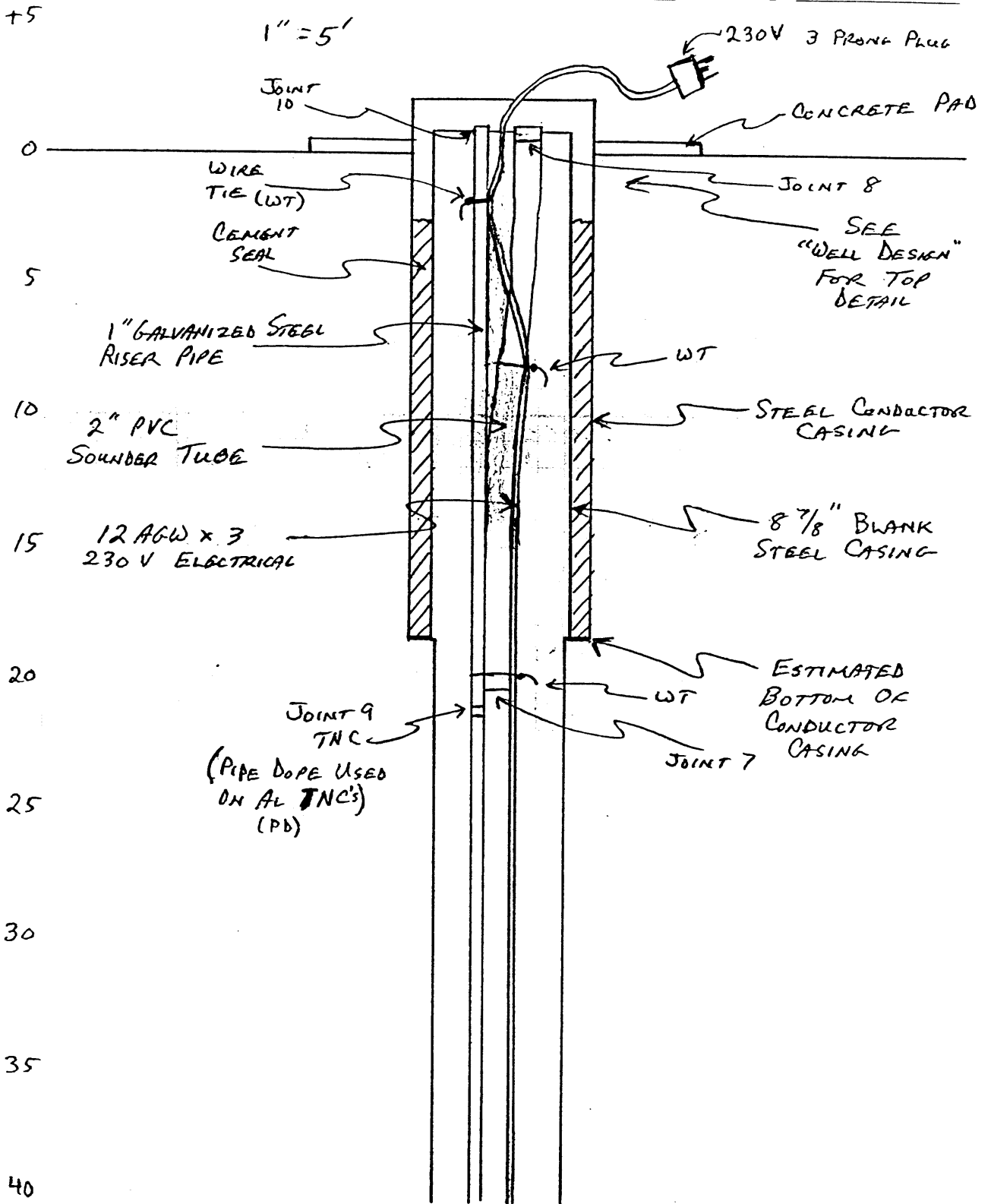
SCHEMATIC DIAGRAMS OF WELLS RD-7 AND RD-50



Harding Lawson Associates
Engineering
and
Environmental Services

SHEET 1 OF 5
JOB NO. 32531-0022
DATE 8-5-95
COMPUTED BY BJH
CHECKED BY _____

PROJECT ROCKETDYNE - SANTA SUSANA - PUMP PULL
SUBJECT SCHEMATIC DIAGRAM OF MONITOR WELL RD-50

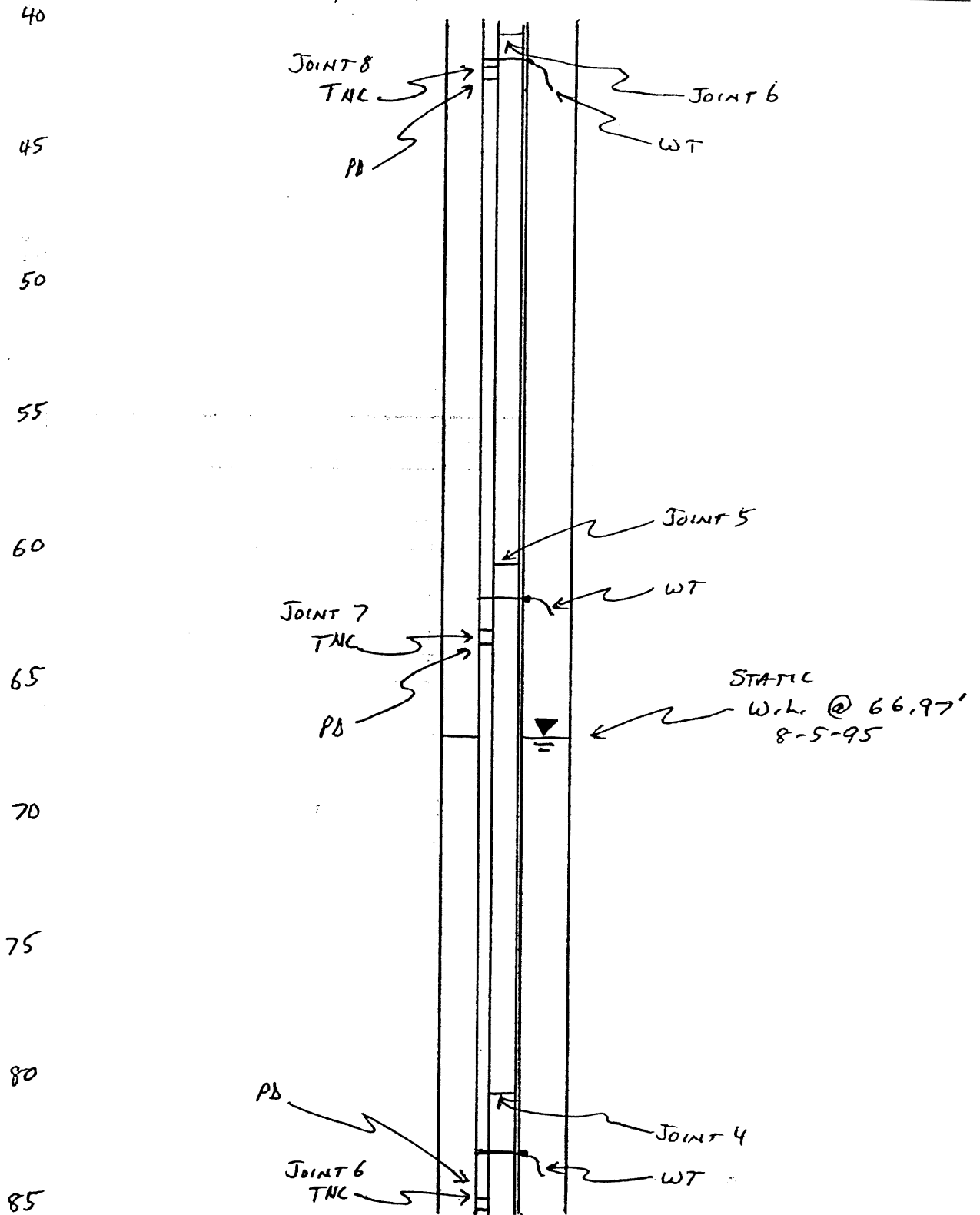




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and
Environmental Services

SHEET 2 OF 5
JOB NO. 33531-0022
DATE 8-5-95
COMPUTED BY BJH
CHECKED BY _____

PROJECT Rocketdyne - Santa Susana - Pump Pull
SUBJECT Schematic Diagram of Monitor Well RD-50

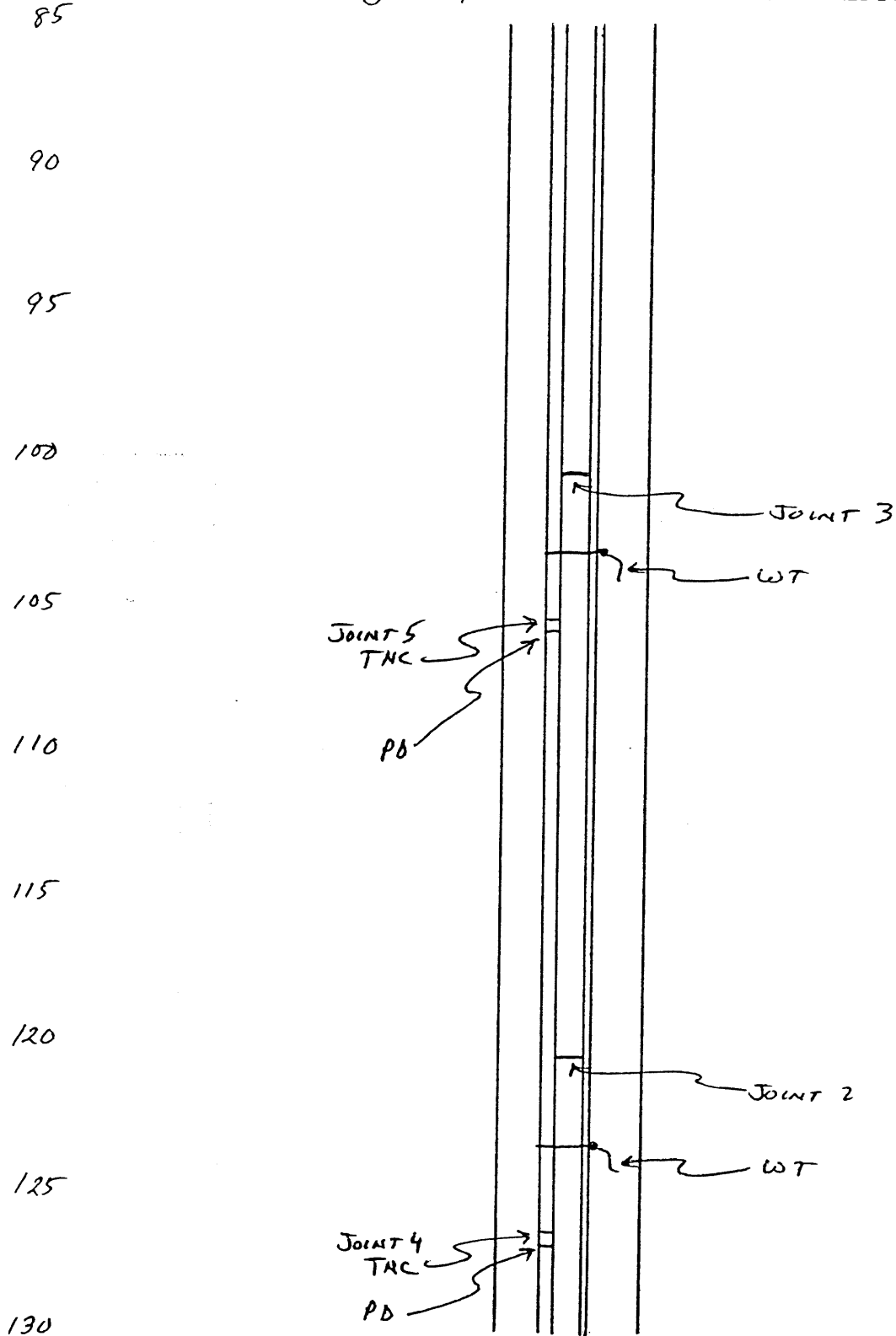




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and
Environmental Services

SHEET 3 OF 5
JOB NO. 32531-0022
DATE 8-5-95
COMPUTED BY BJH
CHECKED BY _____

PROJECT Rocketdyne - Santa Susana - Pump Pull
SUBJECT Schematic Diagram of Monitor Well RD-50





Harding Lawson Associates
 Engineering
 and
 Environmental Services

SHEET 4 OF 5
 JOB NO. 32531-0022
 DATE 8-5-95
 COMPUTED BY BJH
 CHECKED BY _____

PROJECT Rocketdyne - Santa Susana - Pump Pull
 SUBJECT Schematic Diagram of Monitor Well RD-50

130

135

140

145

150

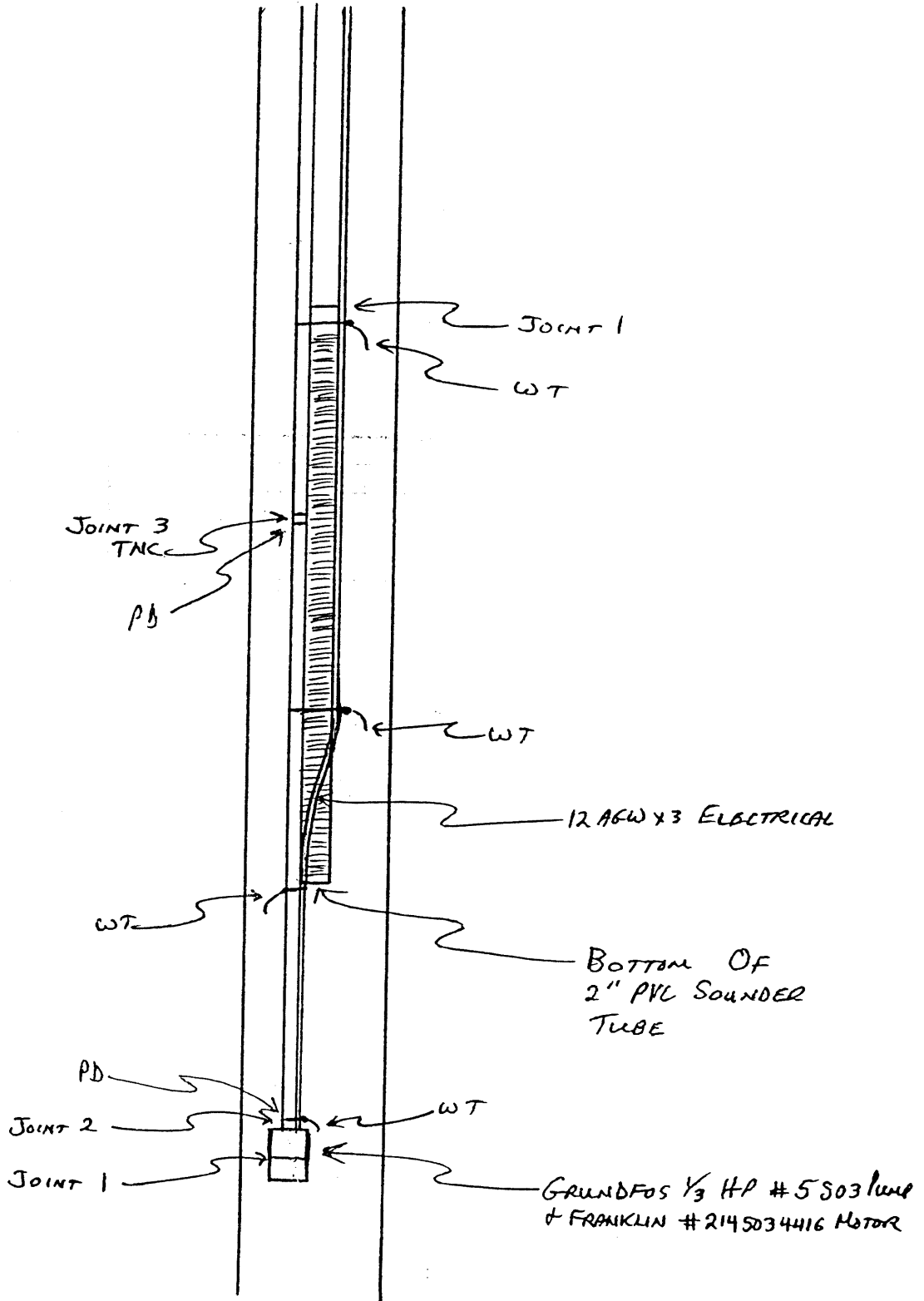
155

160

165

170

175





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and
Environmental Services

SHEET 5 OF 5

JOB NO. 32531-0022

DATE 8-5-95

PROJECT Rocketdyne - Santa Susana - Pump Pull

COMPUTED BY BJH

SUBJECT Schematic Diagram of Monitor Well RD-50

CHECKED BY _____

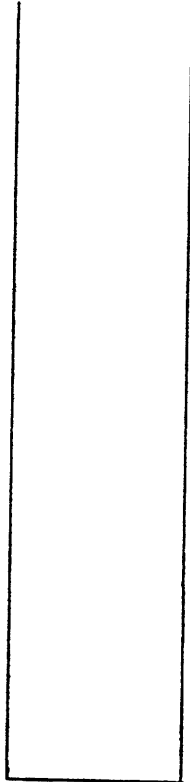
175

180

185

190

195



← TD @ 197.5'



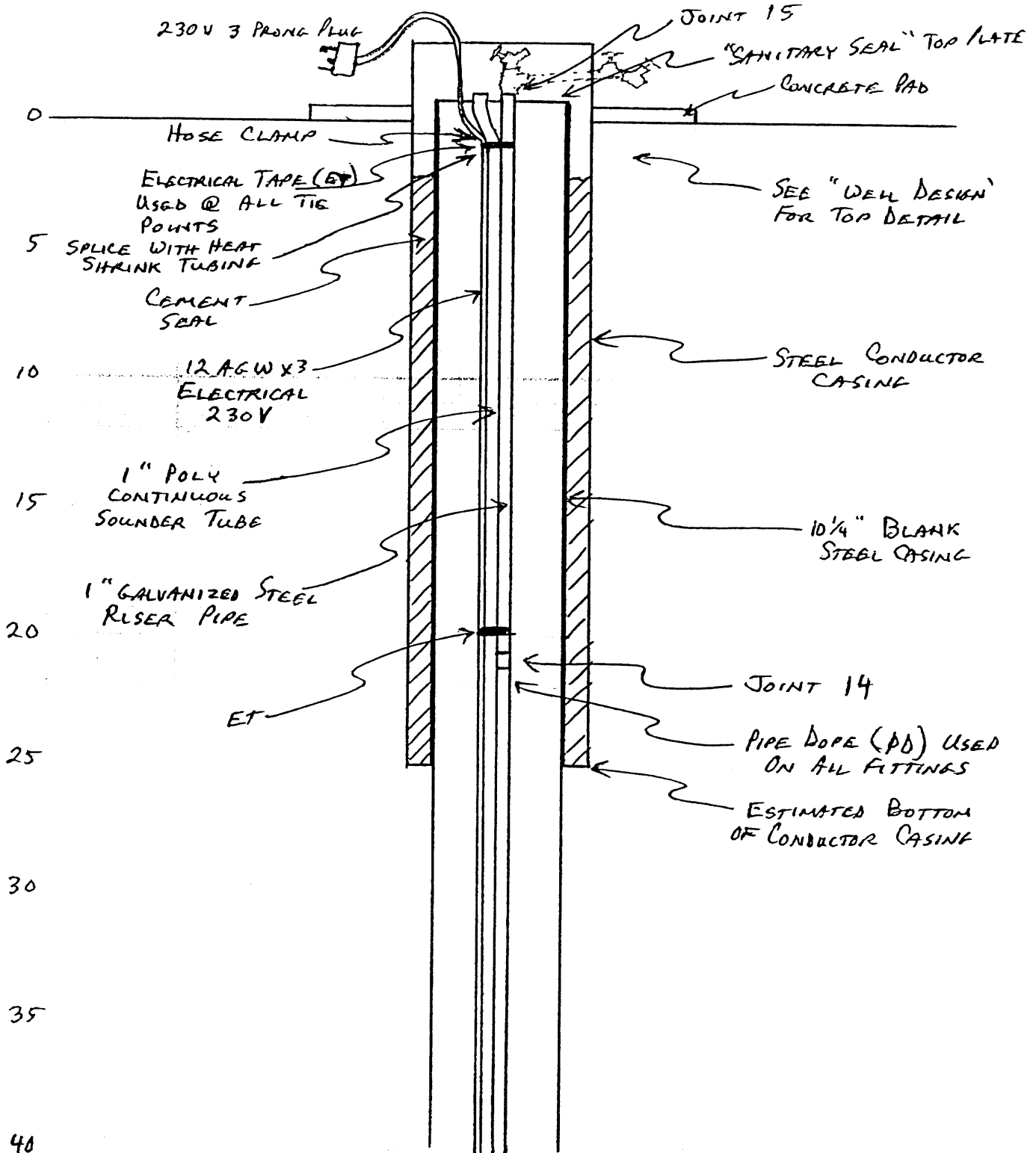
Harding Lawson Associates
 Engineering
 and
 Environmental Services

SHEET 1 OF 7
 JOB NO. 32531-0022
 DATE 8-5-95
 COMPUTED BY BJH
 CHECKED BY _____

PROJECT Rocketdyne - Santa Susana - Pump Pull
 SUBJECT Schematic Diagram of Monitor Well RD-7

+5

1" = 5'





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SHEET 2 OF 7

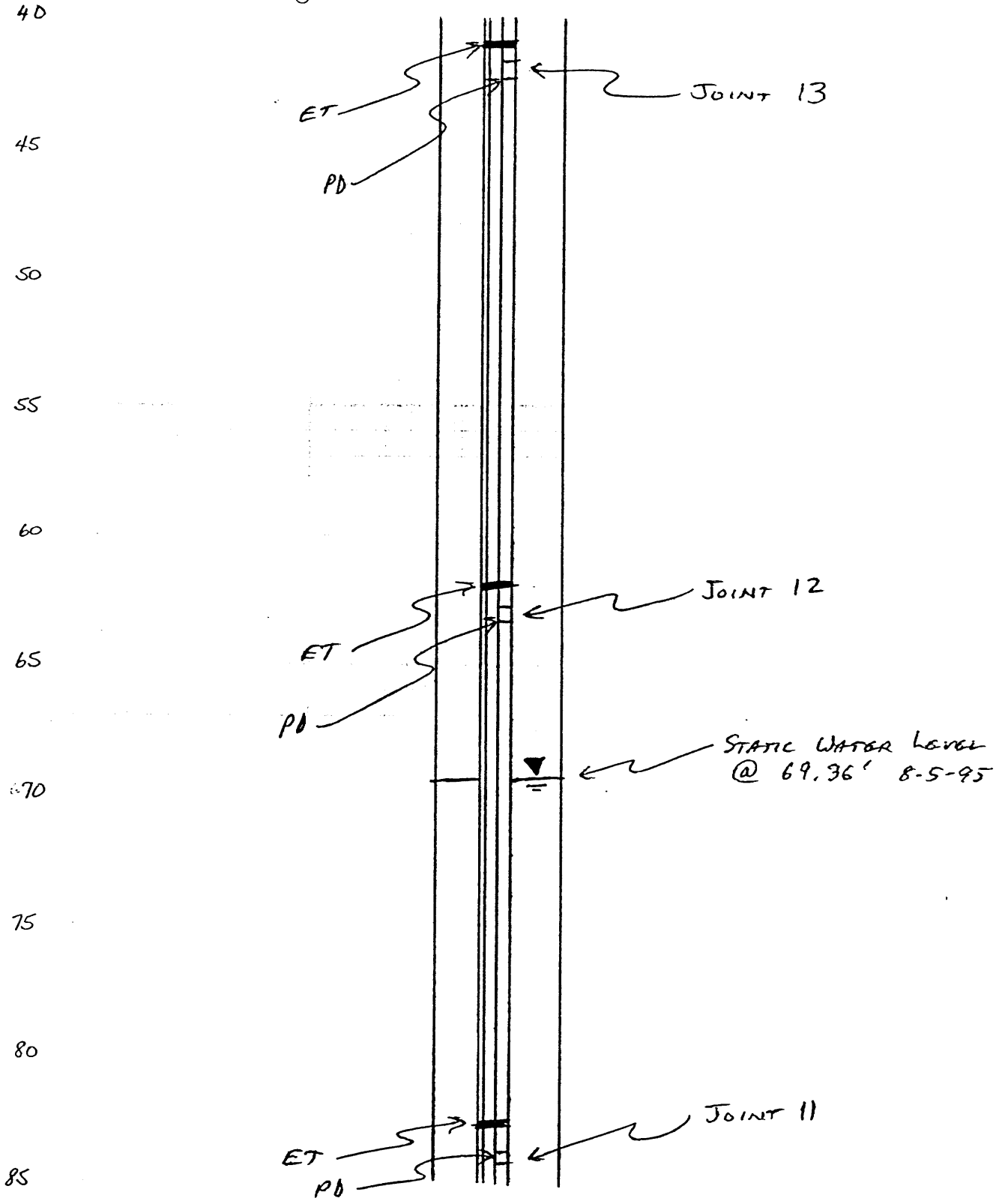
JOB NO. 32531-0022

DATE 8-5-95

COMPUTED BY BJH

CHECKED BY _____

PROJECT Rocketdyne - Santa Susana - Pump Pull
SUBJECT Schematic Diagram of Monitor Well RD-7

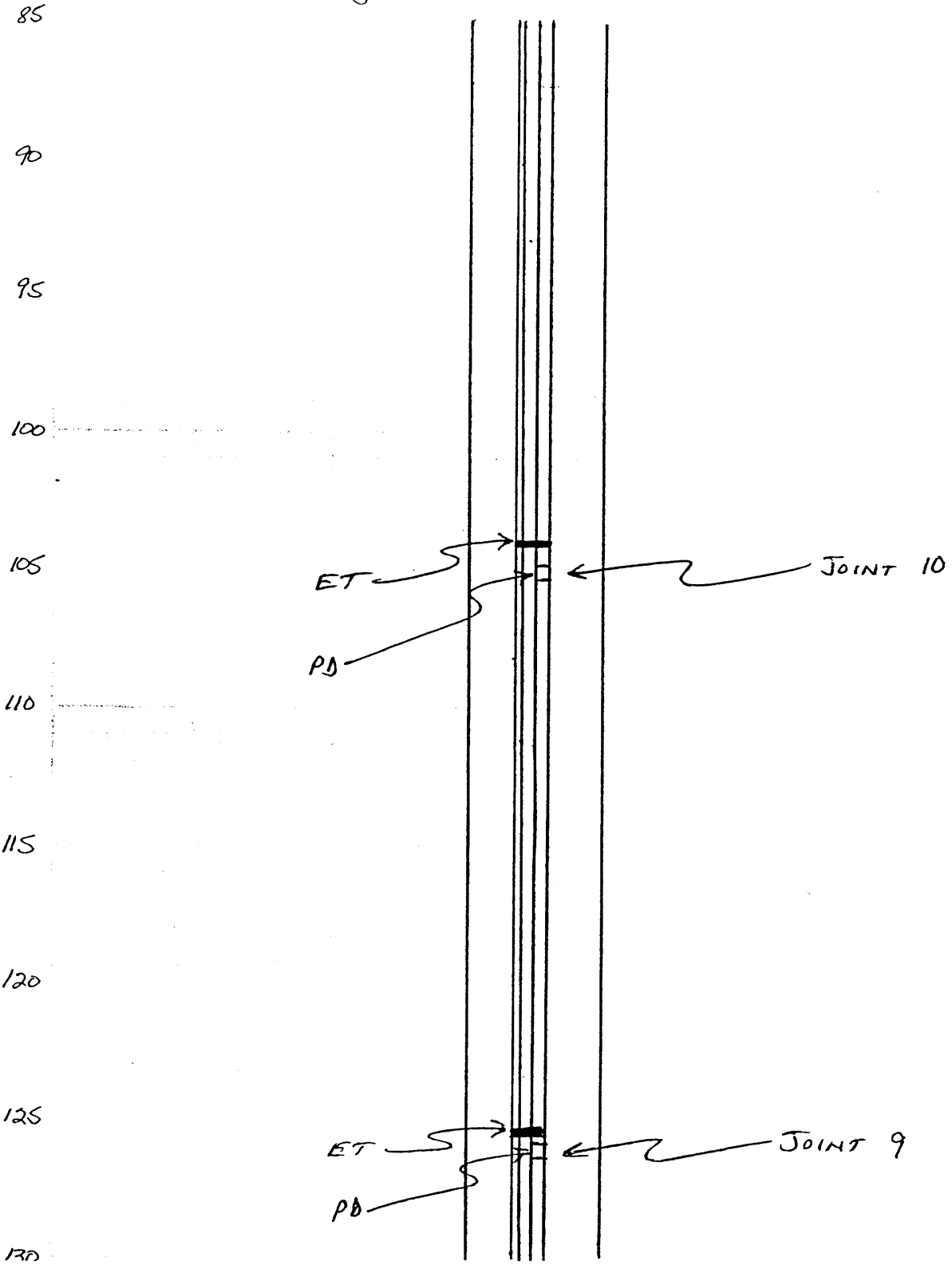




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and
Environmental Services

SHEET 3 OF 7
JOB NO. 32531-0022
DATE 8-5-95
COMPUTED BY BJH
CHECKED BY _____

PROJECT Rocketdyne - Santa Susana - Pump Pull
SUBJECT Schematic Diagram of Monitor Well RD-7





Harding Lawson Associates
Engineering
and
Environmental Services

SHEET 4 OF 7

JOB NO. 32531-0022

DATE 8-5-95

PROJECT Rocketdyne - Santa Susana - Pump Pull

COMPUTED BY BJH

SUBJECT Schematic Diagram of Monitor Well RD-7

CHECKED BY _____

130

135

140

145

150

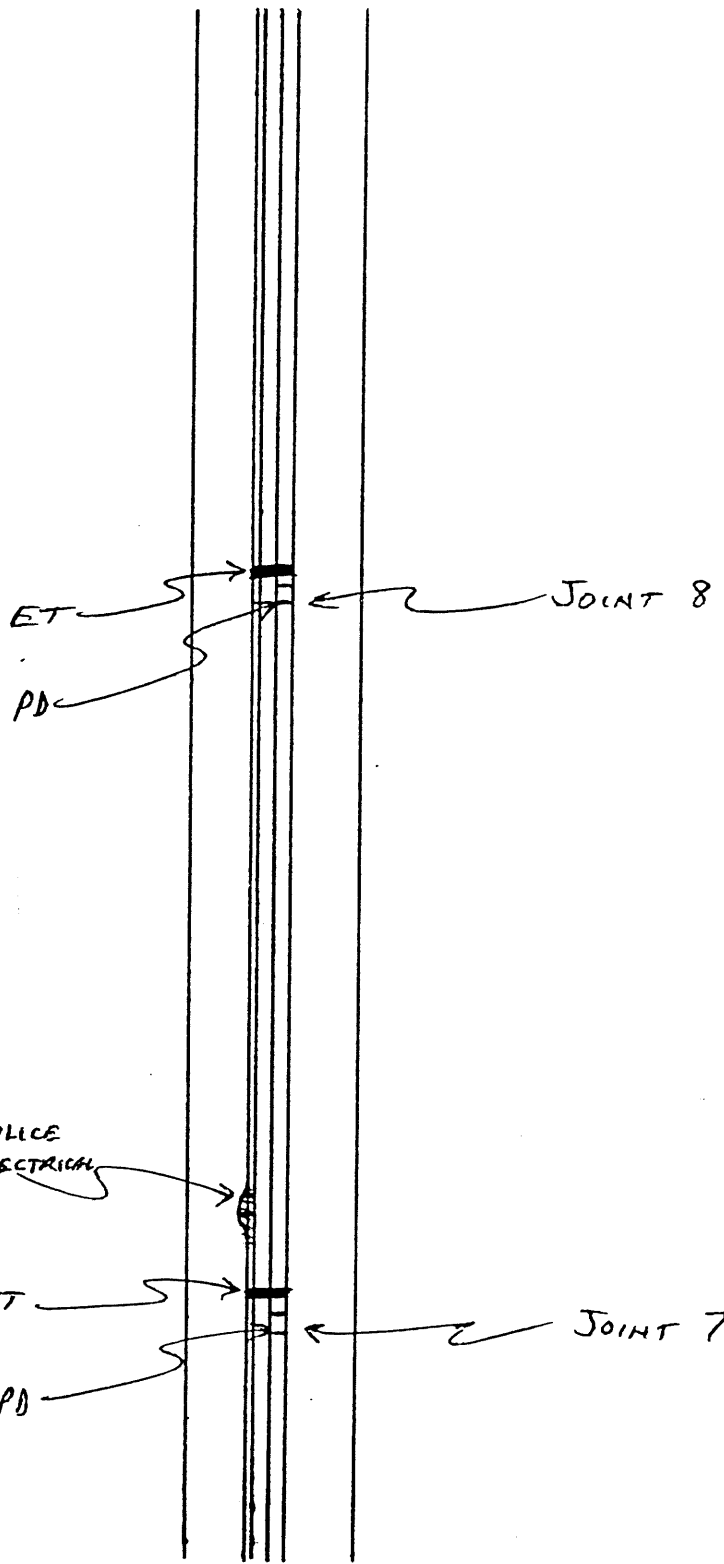
155

160

165

170

175

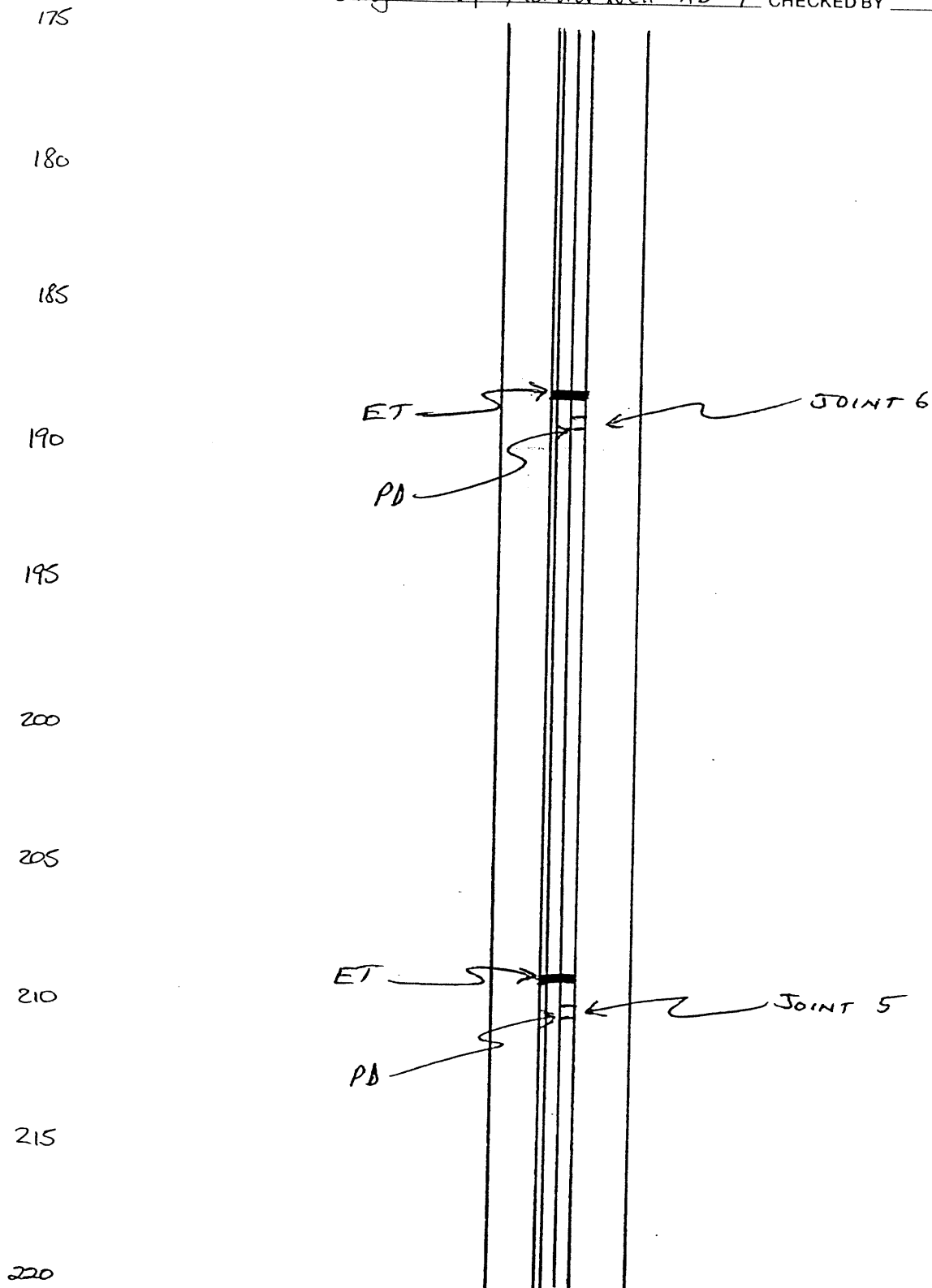




Harding Lawson Associates
Engineering
and
Environmental Services

SHEET 5 OF 7
JOB NO. 32531-0022
DATE 8-5-95
COMPUTED BY BJH
CHECKED BY _____

PROJECT Rocketdyne - Santa Susana - Pump Pull
SUBJECT Schematic Diagram of Monitor Well RD-7

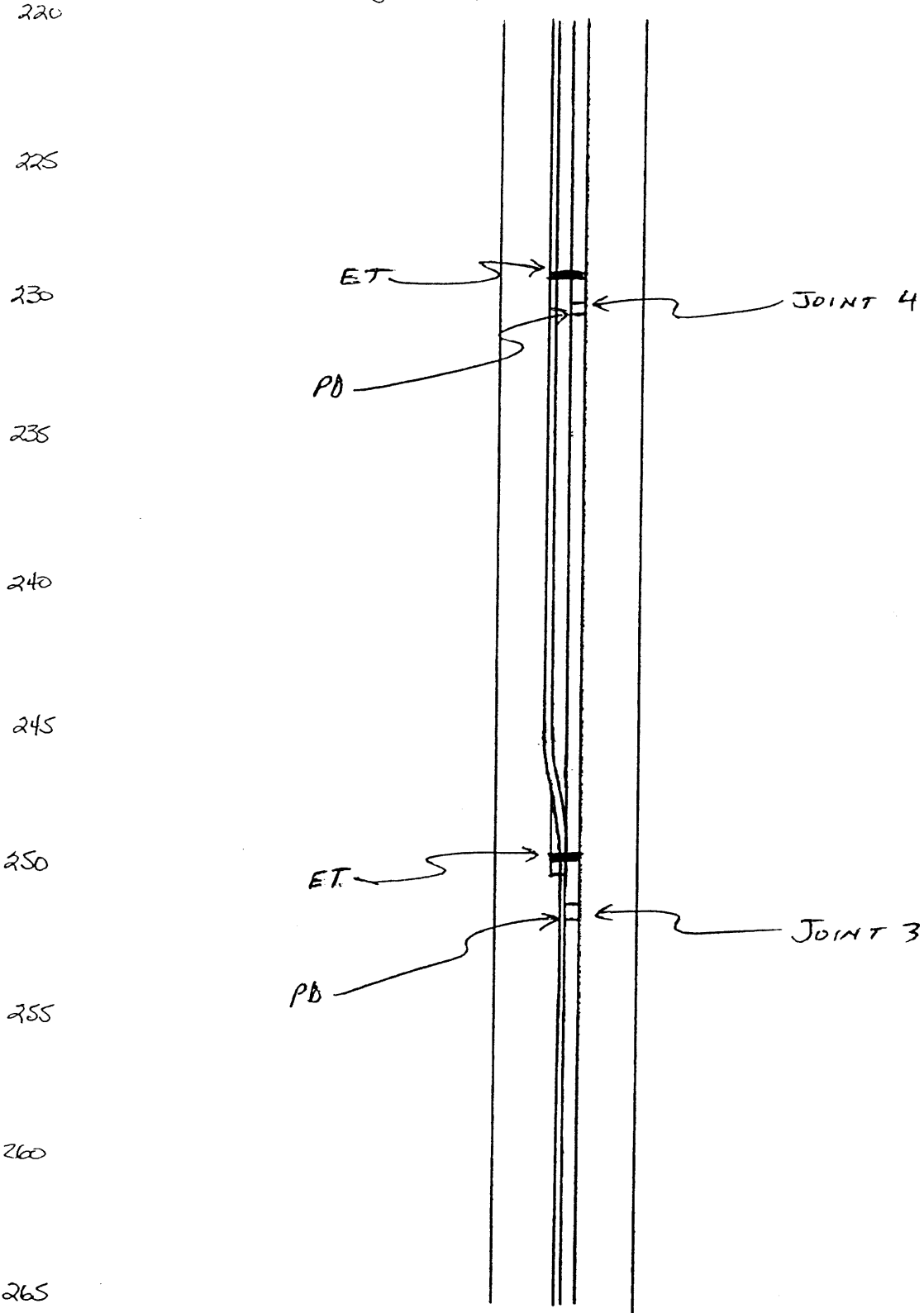




Harding Lawson Associates
Engineering
and
Environmental Services

SHEET 6 OF 7
JOB NO. 32531-0022
DATE 8-5-95
COMPUTED BY BJH
CHECKED BY _____

PROJECT Rocketdyne - Santa Susana - Pump Pull
SUBJECT Schematic Diagram of Monitor Well RD-7





PROJECT Rocketdyne - Santa Susana - Pump Pull
 SUBJECT Schematic Diagram of Monitor Well RD-7

265

270

275

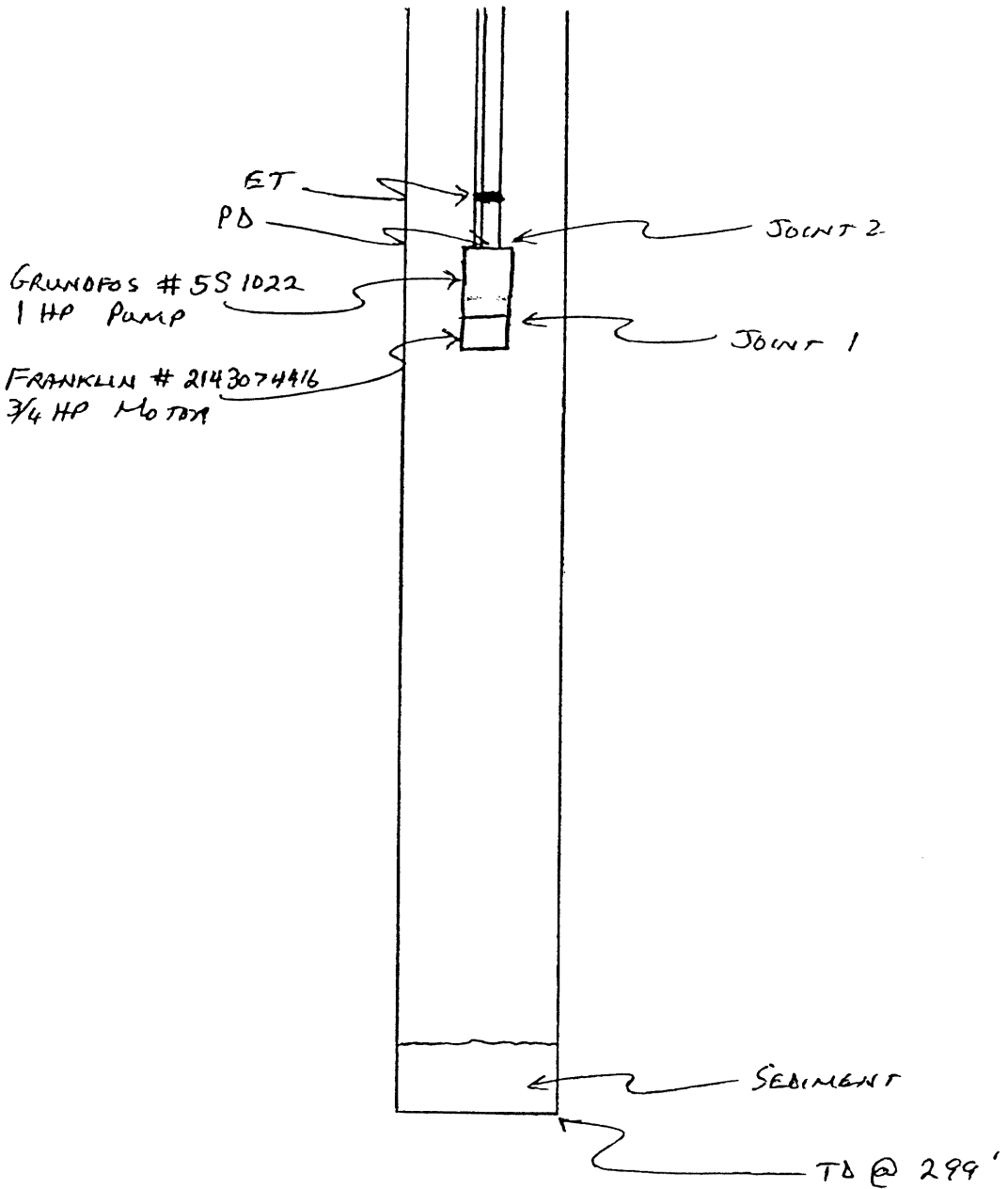
280

285

290

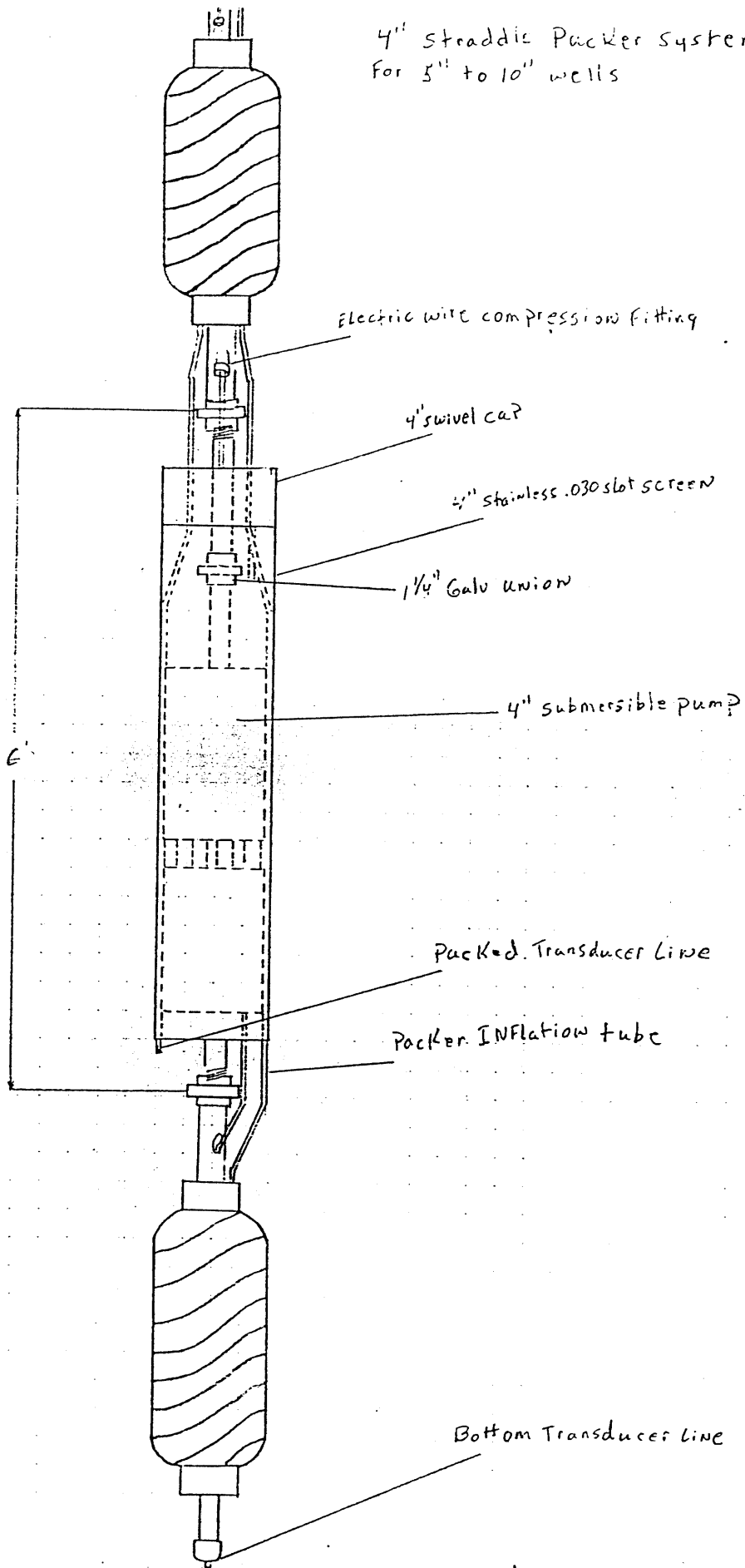
295

300



APPENDIX C
SCHEMATIC DIAGRAM OF PACKER ASSEMBLY

4" Straddle Packer System
for 5" to 10" wells



APPENDIX D
CHAIN OF CUSTODY RECORD

CHAIN OF CUSTODY FORM

Job Number: 325310022
 Name/Location: Rocketdyne/Santa Susana
 Project Manager: Tom E. Lindros

Samplers: W. Cablik

Recorder: [Signature]
(Signature Required)

113939
Quayterra

Lab: [Signature]

ANALYSIS REQUESTED	
EPA 601/8010	
EPA 602/8020	
EPA 624/8240	X
EPA 625/8270	
METALS	
EPA 8015M/TPHQ	
EPA 8020/TEX	
EPA 8015M/TPHD	
ADHS BLS-181	
EM/NO/IDS	XX X
EPA/SD/PH	
EPA/NO/Inductivity	
EPA/SD/1 Carbonyls	
EPA/SD/1 Bicarboates	
EPA/SD/300 Aerosols/CL/SH/NO _x	

SOURCE CODE	MATRIX		# CONTAINERS & PRESERV.	SAMPLE NUMBER OR LAB NUMBER		DATE			STATION DESCRIPTION/NOTES			
	Water	Soil		Oil	Unpres.	H ₂ O	HCL	Fe		Yr	Mo	Day
10			3		RD-7-100'	95	08	16	16	40		VOAs
			1		RD-7-100'			16	45			Plastic
			1		RD-7-100'			16	45			Plastic - Filtered w/ 45 micron filter
			1		RD-7-100'			16	45			Plastic
			1		RD-7-100'			16	45			Plastic
			2		RD-7-100'							VOAs
					Trip Blank							VOAs

LAB NUMBER		DEPTH IN FEET	COL MTD CD	QA CODE	MISCELLANEOUS	CHAIN OF CUSTODY RECORD	
Yr	Wk					Seq	RELINQUISHED BY: (Signature)
					Note: PH has 24 hour holding time + observe others!	RELINQUISHED BY: (Signature) <u>[Signature]</u>	RECEIVED BY: (Signature) <u>Ray Mancetta</u> 8/19/95 1800
						RELINQUISHED BY: (Signature) <u>[Signature]</u>	RECEIVED BY: (Signature) <u>S. Pine</u> 8/16/95 20-
						RELINQUISHED BY: (Signature)	RECEIVED BY: (Signature)
						RELINQUISHED BY: (Signature)	RECEIVED BY: (Signature)
						DISPATCHED BY: (Signature)	RECEIVED FOR LAB BY: (Signature)
						METHOD OF SHIPMENT	
					SAMPLE CONDITION WHEN RECEIVED BY THE LABORATORY		

APPENDIX E
ACOUSTIC TELEVIEWER DATA

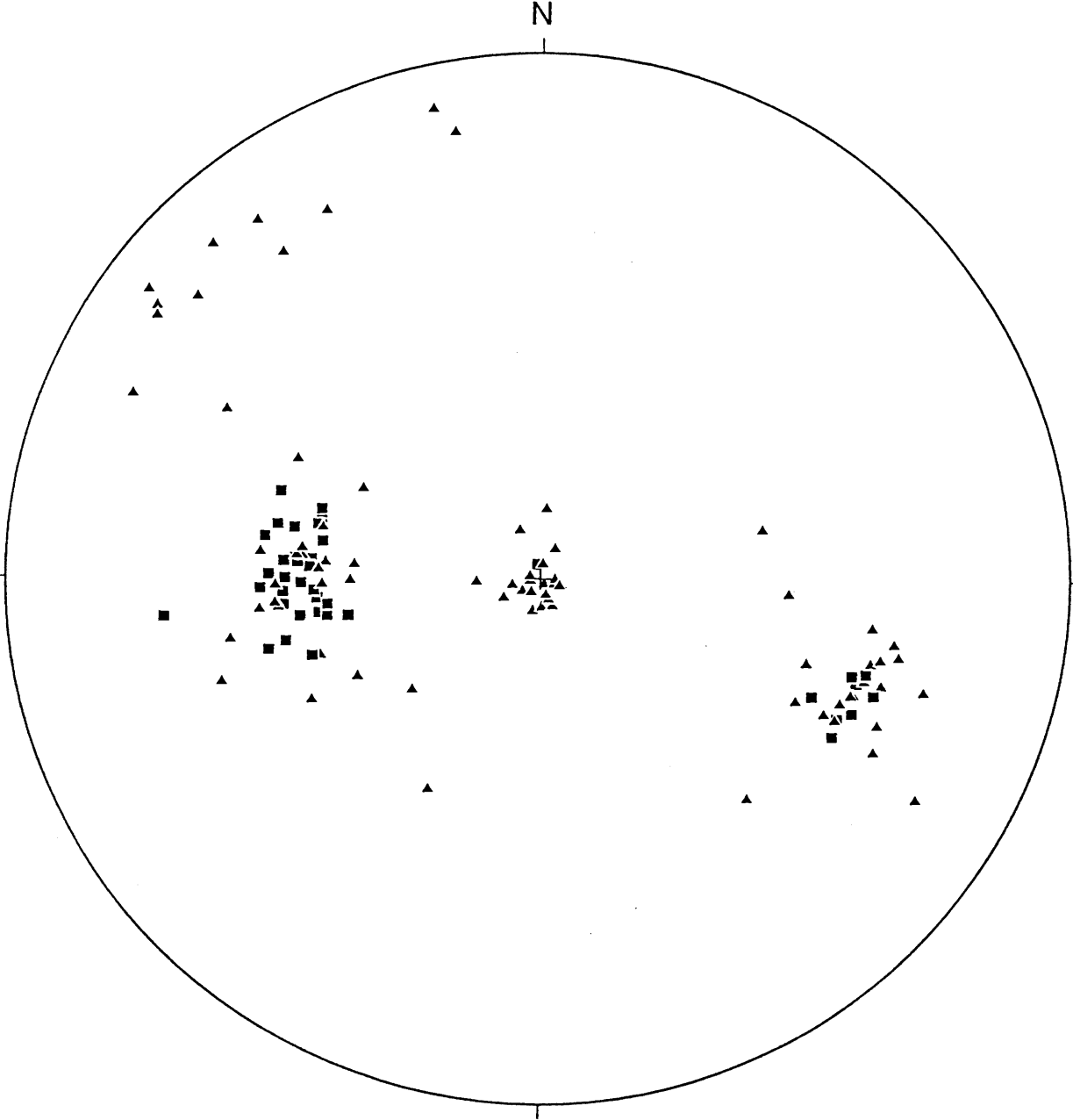
Interpreted Borehole ATV Images, Well RD-7

Depth(s) (feet)	Feature (Number)	Notes
291 - 286	Fracture	Near vertical
282.7 - 280	Fracture	Near Vertical
270.1 - 269.1	Fractures (2)	Vertical
265.6	Fracture	
250.9	Fracture	Conjugate Set
247.2	Fracture	
242.6 - 231	Fractures (3)	Vertical
2334.4 to 729.4	Fracture	Vertical
219.7	Fracture	Minor
211.5 - 209.5	Fractures (2)	Vertical
208.7 - 205.7	Fractures (3)	Near 45°
199 - 196	Fractures (3)	45°
183.96	Fracture	Single
164.7	Fracture	Minor, tight, i.e., small aperture
145	Fractures (2)	Near 45° Degrees
142.7	Fracture	Minor, tight
138.11 - 136	Fractures/Bedding	Apparent aperture/ thickness equal ~ 0.5 feet
128.0	Fractures (2)	Conjugate shear set
125	Fracture	Near vertical
121	Bedding	
116 - 113	Bedding w/Fractures	
108.7	Bedding w/Fractures	
120	Fracture	Minor, tight
95	Fracture	Vertical
91	Fracture	Horizontal
71 - 69	Fractures (2-3)	Vertical
65.9 - 64.9	Fractures (2-3)	Vertical

Plot of poles to bedding planes and/or fracture planes from ATV data

Note: The distinction between bedding and fracture features is based on the interpretation of the ATV data alone.

- Bedding
- ▲ Fractures



APPENDIX F
LABORATORY DATA

Laboratory Number: 113939-0001/0002
Date Sampled: 16-Aug-95



Quanterra Incorporated
1721 South Grand Avenue
Santa Ana, California 92705

714 258-8610 Telephone
714 258-0921 Fax

September 14, 1995

HARDING LAWSON ASSOCIATES
3 HUTTON CENTRE DRIVE, STE 200
SANTA ANA, CA 92707
ATTN: MR. TOM LINDROS

LAB NO.: 113939-0001/0002
DATE SAMPLED: 16-AUG-1995
DATE SAMPLE REC'D: 16-1UG-1995
PROJECT: (32531.0022) ROCKETDYNE-
SANTA SUSANA

Enclosed with this letter is the report of the analytical results for the project specified above. Anomalies associated with this report are described in the Narrative section.

Report data sheets contain a list of the constituents measured in each test, the analytical results and the Quanterra Incorporated reporting limit. Reporting limits are adjusted to reflect any dilution factors or dry weight correction, when applicable. Solid and waste samples are reported on an "as received" basis, unless dry-weight correction is requested.

PRELIMINARY DATA

Preliminary 8240 data were provided on August 25, 1995 at 2:55 P.M. to Tom Lindros. Preliminary general chemistry results were provided on August 31, 1995 at 5:30 P.M. to Tom Lindros. Preliminary metals results were provided on September 1, 1995 at 12:30 A.M. to Tom Lindros. All preliminary results were refaxed on September 13, 1995 at 4:15 P.M. to Tom Lindros.


REVIEWED


APPROVED

QUANTERRA INCORPORATED LIMS REPORT KEY



Section	Description
Cover letter	Signature page, report narrative as applicable.
Sample Description Information	Tabulated cross-reference between the Lab ID and Client ID, including matrix, date and time sampled and the date received for all samples in the project.
Sample Analysis Results Sheets	Lists sample results, test components, reporting limit, dates prepared and analyzed and any data qualifiers. Pages are organized by test.
QC Lot Assignment Report	Cross-reference between lab ID's and applicable QC batches (DCS, LCS, SCS, Blank, MS/SD, DU)
Duplicate Control Sample Report	Percent recovery and RPD results, with acceptance limits, for the laboratory duplicate control samples for each test are tabulated in this report. These are measures of accuracy and precision for each test. Acceptance limits are based upon laboratory historical data.
Laboratory Control Sample Report	Percent recovery results for a single Laboratory Control Sample (if applicable) are tabulated in this report, with the applicable acceptance limits for each test.
Matrix Spike/Matrix Spike Duplicate Report	Percent recovery and RPD results for matrix-specific QC samples and acceptance limits, where applicable. This report can be used to assess matrix effects on an analysis.
Single Control Sample Report	A tabulation of the surrogate recoveries for the blank for organic analyses.
Method Blank Report	A summary of the results of the analysis of the method blank for each test.

List of Abbreviations and Terms

DCS	Duplicate Control Sample	MSD	Matrix Spike Duplicate
DU	Sample Duplicate	QC Run	Preparation batch
EB	Equipment Blank	QC Category	LIMS QC Category
FB	Field Blank	QC Lot	DCS batch
FD	Field Duplicate	ND	Not Detected at the reporting limit expressed
IDL	Instrument Detection Limit (Metals)	QC Matrix	Matrix of the laboratory control sample (s)
LCS	Laboratory Control Sample	RL	Reporting Limit
MB	Method Blank	QC	Quality Control
MDL	Method Detection Limit (Organics)	SA	Sample
MS	Matrix Spike	SD	See MSD
RPD	Relative Percent Difference	TB	Trip Blank
ppm (parts per million)	mg/L or mg/kg	ppb (parts per billion)	ug/L or ug/kg
QUAL	Qualifier flag	DIL	Dilution Factor

Refer to the Quanterra Incorporated Quality Assurance Program Plan for detailed explanations of terms summarized above.

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LIMS # 113939

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II. Chain of Custody and Sample Description Information

III. Analytical Results Summary (LIMS Report)

 A. LIMS Datasheets

 B. QC Summaries

NARRATIVE

LIMS # 113939

GENERAL COMMENTS

The samples were received by Quanterra Incorporated in a chilled state, intact, and with the chain of custody.

There were no anomalies associated with this report.

SAMPLE DESCRIPTION INFORMATION
for
Harding Lawson Associates

Lab ID	Client ID	Matrix	Sampled Date	Time	Received Date
113939-0001-SA	RD-7-100'	WATER	16 AUG 95	16:45	16 AUG 95
113939-0002-TB	TRIP BLANK	WATER-QA	16 AUG 95		16 AUG 95



Environmental
Services

METALS
(Water - Total)

Client Name: Harding Lawson Associates
Client ID: RD-7-100'
LAB ID: 113939-0001-SA
Matrix: WATER
Authorized: 17 AUG 95

Sampled: 16 AUG 95
Prepared: See Below

Received: 16 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Calcium	98.8		1.0	0.20	mg/L	SW6010	30 AUG 95	01 SEP 95
Magnesium	14.5		1.0	0.20	mg/L	SW6010	30 AUG 95	01 SEP 95
Potassium	ND		1.0	5.0	mg/L	SW6010	30 AUG 95	01 SEP 95
Sodium	35.7		1.0	5.0	mg/L	SW6010	30 AUG 95	01 SEP 95

ND = Not Detected



Environmental
Services

GENERAL INORGANICS

Client Name: Harding Lawson Associates
Client ID: RD-7-100'
LAB ID: 113939-0001-SA
Matrix: WATER
Authorized: 17 AUG 95

Sampled: 16 AUG 95
Prepared: See Below

Received: 16 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Alkalinity, Carb. as CaCO3	ND		1.0	4.0	mg/L	E310.1	NA	29 AUG 95
Alkalinity, Bicarb. as CaCO3	265		1.0	4.0	mg/L	E310.1	NA	29 AUG 95
Chloride	39.5		10	1.0	mg/L	E300.0	NA	17 AUG 95
Nitrate as N	4.5		1.0	0.10	mg/L	E300.0	NA	17 AUG 95
pH	7.2		1.0	NA	units	150.1	NA	16 AUG 95
Sulfate	90.7		10	2.0	mg/L	E300.0	NA	17 AUG 95
Specific Conductance at 25 deg. C	869		1.0	1.0	umhos/cm	9050	NA	31 AUG 95
Total Dissolved Solids	586		2.0	20.0	mg/L	160.1	NA	23 AUG 95

ND = Not Detected



Environmental
Services

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
Client ID: RD-7-100'
LAB ID: 113939-0001-SA
Matrix: WATER
Authorized: 17 AUG 95
Instrument: PTGC/MS

Sampled: 16 AUG 95
Prepared: 23 AUG 95
Dilution: 1.0

Received: 16 AUG 95
Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
Dichlorodifluoromethane	ND		10	ug/L
Chloromethane	ND		10	ug/L
Bromomethane	ND		10	ug/L
Vinyl chloride	ND		10	ug/L
Chloroethane	ND		10	ug/L
1,1,2-Trichloro-1,2,2-trifluoroethane	ND		5.0	ug/L
Methylene chloride	ND		5.0	ug/L
Acetone	ND		10	ug/L
Trichlorofluoromethane	ND		5.0	ug/L
1,1-Dichloroethene	ND		5.0	ug/L
Nitromethane	ND		200	ug/L
trans-1,2-Dichloroethene	ND		5.0	ug/L
cis-1,2-Dichloroethene	3.5	J	5.0	ug/L
1,1-Dichloroethane	ND		5.0	ug/L
2,2-Dichloropropane	ND		5.0	ug/L
Bromochloromethane	ND		5.0	ug/L
Chloroform	ND		5.0	ug/L
1,1-Dichloropropene	ND		5.0	ug/L
1,2-Dichloroethane	ND		5.0	ug/L
Dibromomethane	ND		5.0	ug/L
1,1,1-Trichloroethane	ND		5.0	ug/L
Carbon tetrachloride	ND		5.0	ug/L
Bromodichloromethane	ND		5.0	ug/L
1,2-Dichloropropane	ND		5.0	ug/L
1,3-Dichloropropane	ND		5.0	ug/L
Trichloroethene	67		5.0	ug/L
Dibromochloromethane	ND		5.0	ug/L
1,1,2-Trichloroethane	ND		5.0	ug/L
Benzene	ND		5.0	ug/L
Bromoform	ND		5.0	ug/L
Tetrachloroethene	ND		5.0	ug/L
1,2-Dibromoethane (EDB)	ND		5.0	ug/L
1,1,1,2-Tetrachloroethane	ND		5.0	ug/L
1,1,2,2-Tetrachloroethane	ND		5.0	ug/L
Toluene	ND		5.0	ug/L
Chlorobenzene	ND		5.0	ug/L
Ethylbenzene	ND		5.0	ug/L
Styrene	ND		5.0	ug/L
Xylenes (total)	ND		5.0	ug/L
1-Methylethylbenzene	ND		5.0	ug/L
Bromobenzene	ND		5.0	ug/L
1,2,3-Trichloropropane	ND		5.0	ug/L
2-Chlorotoluene	ND		5.0	ug/L
n-Propyl benzene	ND		5.0	ug/L

J = Result is detected below the reporting limit or is an estimated concentration.
ND = Not Detected



Environmental
Services (cont.)

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
Client ID: RD-7-100'
LAB ID: 113939-0001-SA
Matrix: WATER
Authorized: 17 AUG 95
Instrument: PTGC/MS

Sampled: 16 AUG 95
Prepared: 23 AUG 95
Dilution: 1.0

Received: 16 AUG 95
Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
1,3,5-Trimethylbenzene	ND		5.0	ug/L
4-Chlorotoluene	ND		5.0	ug/L
tert-Butylbenzene	ND		5.0	ug/L
1,2,4-Trimethylbenzene	ND		5.0	ug/L
sec-Butylbenzene	ND		5.0	ug/L
Isopropyltoluene	ND		5.0	ug/L
1,3-Dichlorobenzene	ND		5.0	ug/L
1,4-Dichlorobenzene	ND		5.0	ug/L
n-Butylbenzene	ND		5.0	ug/L
1,2-Dichlorobenzene	ND		5.0	ug/L
1,2,4-Trichlorobenzene	ND		5.0	ug/L
1,2-Dibromo-3-chloro- propane (DBCP)	ND		5.0	ug/L
Hexachlorobutadiene	ND		5.0	ug/L
Naphthalene	ND		5.0	ug/L
1,2,3-Trichlorobenzene	ND		5.0	ug/L

Surrogate	Recovery		Acceptable Range
1,2-Dichloroethane-d4	90	%	79 - 127
Toluene-d8	98	%	88 - 110
Bromofluorobenzene	96	%	86 - 115

ND = Not Detected



Environmental
Services

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
Client ID: TRIP BLANK
LAB ID: 113939-0002-TB
Matrix: WATER-QA
Authorized: 17 AUG 95
Instrument: PTGC/MS

Sampled: 16 AUG 95
Prepared: 22 AUG 95
Dilution: 1.0

Received: 16 AUG 95
Analyzed: 22 AUG 95

Parameter	Result	Qualifier	RL	Units
Dichlorodifluoromethane	ND		10	ug/L
Chloromethane	ND		10	ug/L
Bromomethane	ND		10	ug/L
Vinyl chloride	ND		10	ug/L
Chloroethane	ND		10	ug/L
1,1,2-Trichloro-1,2,2-trifluoroethane	ND		5.0	ug/L
Methylene chloride	ND		5.0	ug/L
Acetone	ND		10	ug/L
Trichlorofluoromethane	ND		5.0	ug/L
1,1-Dichloroethene	ND		5.0	ug/L
Nitromethane	ND		200	ug/L
trans-1,2-Dichloroethene	ND		5.0	ug/L
cis-1,2-Dichloroethene	ND		5.0	ug/L
1,1-Dichloroethane	ND		5.0	ug/L
2,2-Dichloropropane	ND		5.0	ug/L
Bromochloromethane	ND		5.0	ug/L
Chloroform	ND		5.0	ug/L
1,1-Dichloropropene	ND		5.0	ug/L
1,2-Dichloroethane	ND		5.0	ug/L
Dibromomethane	ND		5.0	ug/L
1,1,1-Trichloroethane	ND		5.0	ug/L
Carbon tetrachloride	ND		5.0	ug/L
Bromodichloromethane	ND		5.0	ug/L
1,2-Dichloropropane	ND		5.0	ug/L
1,3-Dichloropropane	ND		5.0	ug/L
Trichloroethene	ND		5.0	ug/L
Dibromochloromethane	ND		5.0	ug/L
1,1,2-Trichloroethane	ND		5.0	ug/L
Benzene	ND		5.0	ug/L
Bromoform	ND		5.0	ug/L
Tetrachloroethene	ND		5.0	ug/L
1,2-Dibromoethane (EDB)	ND		5.0	ug/L
1,1,1,2-Tetrachloroethane	ND		5.0	ug/L
1,1,2,2-Tetrachloroethane	ND		5.0	ug/L
Toluene	ND		5.0	ug/L
Chlorobenzene	ND		5.0	ug/L
Ethylbenzene	ND		5.0	ug/L
Styrene	ND		5.0	ug/L
Xylenes (total)	ND		5.0	ug/L
1-Methylethylbenzene	ND		5.0	ug/L
Bromobenzene	ND		5.0	ug/L
1,2,3-Trichloropropane	ND		5.0	ug/L
2-Chlorotoluene	ND		5.0	ug/L
n-Propyl benzene	ND		5.0	ug/L
1,3,5-Trimethylbenzene	ND		5.0	ug/L

ND = Not Detected



Environmental
Services (cont.)

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
Client ID: TRIP BLANK
LAB ID: 113939-0002-TB
Matrix: WATER-QA
Authorized: 17 AUG 95
Instrument: PTGC/MS

Sampled: 16 AUG 95
Prepared: 22 AUG 95
Dilution: 1.0

Received: 16 AUG 95
Analyzed: 22 AUG 95

Parameter	Result	Qualifier	RL	Units
4-Chlorotoluene	ND		5.0	ug/L
tert-Butylbenzene	ND		5.0	ug/L
1,2,4-Trimethylbenzene	ND		5.0	ug/L
sec-Butylbenzene	ND		5.0	ug/L
Isopropyltoluene	ND		5.0	ug/L
1,3-Dichlorobenzene	ND		5.0	ug/L
1,4-Dichlorobenzene	ND		5.0	ug/L
n-Butylbenzene	ND		5.0	ug/L
1,2-Dichlorobenzene	ND		5.0	ug/L
1,2,4-Trichlorobenzene	ND		5.0	ug/L
1,2-Dibromo-3-chloro- propane (DBCP)	ND		5.0	ug/L
Hexachlorobutadiene	ND		5.0	ug/L
Naphthalene	ND		5.0	ug/L
1,2,3-Trichlorobenzene	ND		5.0	ug/L

Surrogate	Recovery		Acceptable Range
1,2-Dichloroethane-d4	86	%	79 - 127
Toluene-d8	102	%	88 - 110
Bromofluorobenzene	97	%	86 - 115

ND = Not Detected



QC LOT ASSIGNMENT REPORT - MS QC
Metals Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
113939-0001-SA	AQUEOUS	ICP-AT		30 AUG 95-AX	30 AUG 95-AA

LABORATORY CONTROL SAMPLE REPORT
Metals Analysis and Preparation
Project: 113939

Category: ICP-AT ICP Metals
Matrix: AQUEOUS
QC Run: 30 AUG 95-AX
Concentration Units: mg/L

Date Analyzed: 31 AUG 95

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	LCS	Limits
Calcium	100	97.6	98	81-112
Magnesium	100	99.2	99	89-107
Potassium	100	102	102	83-105
Sodium	100	101	101	85-112

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Metals Analysis and Preparation
Project: 113939

Category: ICP-AT ICP Metals
Matrix: AQUEOUS
Sample: 113939-0001
MS Run: 30 AUG 95-AA
Units: mg/L

Concentration

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Calcium	98.8	190	186	100	91	87	4.5	59-119	31
Magnesium	14.5	110	107	100	95	92	3.2	66-120	38
Potassium	ND	99.7	96.7	100	100	97	3.1	60-130	27
Sodium	35.7	133	129	100	97	93	4.2	60-128	29

} = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Metals Analysis and Preparation
Project: 113939

Test: ICP-AT Method 6010 - ICP Metals (Total)
Matrix: AQUEOUS
QC Run: 30 AUG 95-AX

Date Analyzed: 31 AUG 95
Reporting
Limit

Analyte	Result	Units	Limit
Calcium	ND	mg/L	0.20
Magnesium	ND	mg/L	0.20
Potassium	ND	mg/L	5.0
Sodium	ND	mg/L	5.0

ND = Not Detected

QC LOT ASSIGNMENT REPORT - MS QC
Wet Chemistry Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
113939-0001-SA	AQUEOUS	ALK-AF-A	29 AUG 95-A	29 AUG 95-A	21 AUG 95-AB
113939-0001-SA	AQUEOUS	CL-IC-A		17 AUG 95-AX	17 AUG 95-AB
113939-0001-SA	AQUEOUS	SO4-A		17 AUG 95-AX	17 AUG 95-AB
113939-0001-SA	AQUEOUS	TDS-A	23 AUG 95-A	23 AUG 95-A	23 AUG 95-AA
113939-0001-SA	AQUEOUS	COND-A	31 AUG 95-A	31 AUG 95-A	31 AUG 95-AA
113939-0001-SA	AQUEOUS	NO3-A		17 AUG 95-AX	17 AUG 95-AB

DUPLICATE CONTROL SAMPLE REPORT
Wet Chemistry Analysis and Preparation
Project: 113939

Category: ALK-AF-A Alkalinity, Total as CaCO₃
Matrix: AQUEOUS
QC Lot: 29 AUG 95-A
Concentration Units: mg/L

Date Analyzed: 29 AUG 95

Analyte	Spiked	Concentration			Accuracy		Precision	
		DCS1	DCS2	AVG	Average (%)	(RPD)		
					DCS	Limits	DCS	Limit
Alkalinity, Total as CaCO ₃	1600	1670	1670	1670	104	85-111	0.24	5

Category: TDS-A Total Dissolved Solids
Matrix: AQUEOUS
QC Lot: 23 AUG 95-A
Concentration Units: mg/L

Date Analyzed: 23 AUG 95

Analyte	Spiked	Concentration			Accuracy		Precision	
		DCS1	DCS2	AVG	Average (%)	(RPD)		
					DCS	Limits	DCS	Limit
Total Dissolved Solids	1400	1440	1460	1450	104	83-114	1.7	29

Category: COND-A Specific Conductance by Automatic Titrator
Matrix: AQUEOUS
QC Lot: 31 AUG 95-A
Concentration Units: umhos/cm

Date Analyzed: 31 AUG 95

Analyte	Spiked	Concentration			Accuracy		Precision	
		DCS1	DCS2	AVG	Average (%)	(RPD)		
					DCS	Limits	DCS	Limit
Specific Conductance at 25 deg. C	1410	1420	1410	1420	100	80-120	0.35	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE REPORT
Wet Chemistry Analysis and Preparation
Project: 113939

Category: CL-IC-A Chloride, Ion Chromatography (300.0)
Matrix: AQUEOUS Date Analyzed: 17 AUG 95
QC Run: 17 AUG 95-AX
Concentration Units: mg/L

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	LCS	Limits
Chloride	5.00	4.95	99	85-115

Category: SO4-A Sulfate
Matrix: AQUEOUS Date Analyzed: 17 AUG 95
QC Run: 17 AUG 95-AX
Concentration Units: mg/L

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	LCS	Limits
Sulfate	8.00	7.92	99	85-113

Category: NO3-A Nitrate, Ion Chromatography (300.0)
Matrix: AQUEOUS Date Analyzed: 17 AUG 95
QC Run: 17 AUG 95-AX
Concentration Units: mg/L

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	LCS	Limits
Nitrate as N	4.00	3.88	97	90-110

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Wet Chemistry Analysis and Preparation
Project: 113939

Category: CL-IC-A Chloride, Ion Chromatography (300.0)
Matrix: AQUEOUS
Sample: 113934-0001
MS Run: 17 AUG 95-AB
Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Chloride	57.4	106	107	50.0	98	99	1.2	66-133	18

Category: SO4-A Sulfate
Matrix: AQUEOUS
Sample: 113934-0001
MS Run: 17 AUG 95-AB
Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Sulfate	17.6	91.7	92.4	80.0	93	94	0.9	74-126	6

Category: NO3-A Nitrate, Ion Chromatography (300.0)
Matrix: AQUEOUS
Sample: 113934-0001
MS Run: 17 AUG 95-AB
Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Nitrate as N	1.54	38.1	38.2	40.0	91	92	0.2	84-112	4

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX DUPLICATE QC REPORT
Wet Chemistry Analysis and Preparation
Project: 113939

Category: ALK-AF-A Alkalinity, Total as CaCO₃
Matrix: AQUEOUS
Sample: 113742-0002
MS Run: 21 AUG 95-AB
Units: mg/L

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
Alkalinity, Carb. as CaCO ₃	260	250	3.9	20

Category: TDS-A Total Dissolved Solids
Matrix: AQUEOUS
Sample: 113934-0009
MS Run: 23 AUG 95-AA
Units: mg/L

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
Total Dissolved Solids	417	428	2.6	30

Category: COND-A Specific Conductance by Automatic Titrator
Matrix: AQUEOUS
Sample: 113939-0001
MS Run: 31 AUG 95-AA
Units: umhos/cm

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
Specific Conductance at 25 deg. C	869	869	0.0	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Wet Chemistry Analysis and Preparation
Project: 113939

Test: ALK-AF-AT Method E310.1 - Alkalinity, Total as CaCO3
Matrix: AQUEOUS
QC Run: 29 AUG 95-A Date Analyzed: 29 AUG 95

Analyte	Result	Units	Reporting Limit
Alkalinity, Carb. as CaCO3	ND	mg/L	4.0
Alkalinity, Bicarb. as CaCO3	ND	mg/L	4.0

Test: CL-IC-A Method 300.0 - Chloride, Ion Chromatography
Matrix: AQUEOUS
QC Run: 17 AUG 95-AX Date Analyzed: 17 AUG 95

Analyte	Result	Units	Reporting Limit
Chloride	ND	mg/L	0.10

Test: SO4-IC-A Method 300.0 - Sulfate, Ion Chromatography
Matrix: AQUEOUS
QC Run: 17 AUG 95-AX Date Analyzed: 17 AUG 95

Analyte	Result	Units	Reporting Limit
Sulfate	ND	mg/L	0.20

Test: TDS-A Method 160.1 - Total Dissolved Solids (TDS)
Matrix: AQUEOUS
QC Run: 23 AUG 95-A Date Analyzed: 23 AUG 95

Analyte	Result	Units	Reporting Limit
Total Dissolved Solids	ND	mg/L	10.0

Test: COND-A Method 9050 - Specific Conductance
Matrix: AQUEOUS
QC Run: 31 AUG 95-A Date Analyzed: 31 AUG 95

Analyte	Result	Units	Reporting Limit
Specific Conductance at 25 deg. C	ND	umhos/cm	1.0

ND = Not Detected

METHOD BLANK REPORT
Wet Chemistry Analysis and Preparation
Project: 113939

(cont.)

Test: NO3-IC-A
Matrix: AQUEOUS
QC Run: 17 AUG 95-AX

Method 300.0 - Nitrate, Ion Chromatography

Date Analyzed: 17 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Nitrate as N	ND	mg/L	0.10

ND = Not Detected

QC LOT ASSIGNMENT REPORT - MS QC
GC/MS Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
113939-0001-SA	AQUEOUS	PH-A	16 AUG 95-D		16 AUG 95-DD

DUPLICATE CONTROL SAMPLE REPORT
GC/MS Preparation
Project: 113939

Category: PH-A pH for Aqueous Samples
Matrix: AQUEOUS
QC Lot: 16 AUG 95-D
Concentration Units: units

Date Analyzed: 16 AUG 95

Analyte	Concentration Spiked	Concentration		AVG	Accuracy Average (%)		Precision (RPD)	
		DCS1	DCS2		DCS	Limits	DCS	Limit
pH	9.18	9.14	9.14	9.14	100	98-102	0.0	1

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX DUPLICATE QC REPORT
GC/MS Preparation
Project: 113939

Category: PH-A pH for Aqueous Samples
Matrix: AQUEOUS
Sample: 113939-0001
MS Run: 16 AUG 95-DD
Units: units

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
pH	7.20	7.20	0.0	30

Calculations are performed before rounding to avoid round-off errors in calculated results.

QC LOT ASSIGNMENT REPORT - MS QC
Volatile Organics by GC/MS

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA,MS,SD,DU)
113939-0001-SA	AQUEOUS	8240-A		22 AUG 95-ADX	23 AUG 95-AD
113939-0002-TB	AQUEOUS	8240-A		22 AUG 95-ADX	23 AUG 95-AD

LABORATORY CONTROL SAMPLE REPORT
Volatile Organics by GC/MS
Project: 113939

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX
Concentration Units: ug/L

Date Analyzed: 22 AUG 95

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	LCS	Limits
1,1-Dichloroethene	50.0	46.3	93	34-145
Trichloroethene	50.0	49.1	98	70-132
Benzene	50.0	50.9	102	49-140
Toluene	50.0	50.2	100	66-129
Chlorobenzene	50.0	53.0	106	71-134

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT

Volatile Organics by GC/MS

Project: 113939

Category: 8240-A Volatile Organics

Matrix: AQUEOUS

Sample: 114000-0001

MS Run: 23 AUG 95-AD

Units: ug/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
1,1-Dichloroethene	ND	46.1	45.8	50.0	92	92	0.6	45-126	18
Trichloroethene	40.7	87.6	85.1	50.0	94	89	5.5	74-131	17
Benzene	ND	50.4	50.0	50.0	101	100	0.8	76-128	14
Toluene	ND	50.7	49.3	50.0	101	99	2.8	73-128	15
Chlorobenzene	ND	51.6	50.4	50.0	103	101	2.4	80-131	16

ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

SINGLE CONTROL SAMPLE REPORT
Volatile Organics by GC/MS
Project: 113939

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX
Concentration Units: ug/L

Date Analyzed: 22 AUG 95

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	SCS	Limits
1,2-Dichloroethane-d4	50.0	47.8	96	82-121
Toluene-d8	50.0	52.0	104	88-110
Bromofluorobenzene	50.0	50.3	101	86-114

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Volatile Organics by GC/MS
Project: 113939

Test: 8240-HLA-A
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX

Method 8240 - Volatile Organics, EPA 8240 Extended List

Date Analyzed: 22 AUG 95
Reporting
Limit

Analyte	Result	Units	Limit
Dichlorodifluoromethane	ND	ug/L	10
Chloromethane	ND	ug/L	10
Bromomethane	ND	ug/L	10
Vinyl chloride	ND	ug/L	10
Chloroethane	ND	ug/L	10
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	ug/L	5.0
Methylene chloride	ND	ug/L	5.0
Acetone	ND	ug/L	10
Trichlorofluoromethane	ND	ug/L	5.0
1,1-Dichloroethene	ND	ug/L	5.0
Nitromethane	ND	ug/L	200
trans-1,2-Dichloroethene	ND	ug/L	5.0
cis-1,2-Dichloroethene	ND	ug/L	5.0
1,1-Dichloroethane	ND	ug/L	5.0
2,2-Dichloropropane	ND	ug/L	5.0
Bromochloromethane	ND	ug/L	5.0
Chloroform	ND	ug/L	5.0
1,1-Dichloropropene	ND	ug/L	5.0
1,2-Dichloroethane	ND	ug/L	5.0
Dibromomethane	ND	ug/L	5.0
1,1,1-Trichloroethane	ND	ug/L	5.0
Carbon tetrachloride	ND	ug/L	5.0
Bromodichloromethane	ND	ug/L	5.0
1,2-Dichloropropane	ND	ug/L	5.0
1,3-Dichloropropane	ND	ug/L	5.0
Trichloroethene	ND	ug/L	5.0
Dibromochloromethane	ND	ug/L	5.0
1,1,2-Trichloroethane	ND	ug/L	5.0
Benzene	ND	ug/L	5.0
Bromoform	ND	ug/L	5.0
Tetrachloroethene	ND	ug/L	5.0
1,2-Dibromoethane (EDB)	ND	ug/L	5.0
1,1,1,2-Tetrachloroethane	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	5.0
Toluene	ND	ug/L	5.0
Chlorobenzene	ND	ug/L	5.0
Ethylbenzene	ND	ug/L	5.0
Styrene	ND	ug/L	5.0
Xylenes (total)	ND	ug/L	5.0
1-Methylethylbenzene	ND	ug/L	5.0
Bromobenzene	ND	ug/L	5.0
1,2,3-Trichloropropane	ND	ug/L	5.0
2-Chlorotoluene	ND	ug/L	5.0
n-Propyl benzene	ND	ug/L	5.0
1,3,5-Trimethylbenzene	ND	ug/L	5.0

ND = Not Detected

METHOD BLANK REPORT
Volatile Organics by GC/MS
Project: 113939

(cont.)

Test: 8240-HLA-A
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX

Method 8240 - Volatile Organics, EPA 8240 Extended List

Date Analyzed: 22 AUG 95
Reporting
Limit

Analyte	Result	Units	Limit
4-Chlorotoluene	ND	ug/L	5.0
tert-Butylbenzene	ND	ug/L	5.0
1,2,4-Trimethylbenzene	ND	ug/L	5.0
sec-Butylbenzene	ND	ug/L	5.0
Isopropyltoluene	ND	ug/L	5.0
1,3-Dichlorobenzene	ND	ug/L	5.0
1,4-Dichlorobenzene	ND	ug/L	5.0
n-Butylbenzene	ND	ug/L	5.0
1,2-Dichlorobenzene	ND	ug/L	5.0
1,2,4-Trichlorobenzene	ND	ug/L	5.0
1,2-Dibromo-3-chloro-propane (DBCP)	ND	ug/L	5.0
Hexachlorobutadiene	ND	ug/L	5.0
Naphthalene	ND	ug/L	5.0
1,2,3-Trichlorobenzene	ND	ug/L	5.0

ND = Not Detected

Laboratory Number: 113982-0001/0009
Date Sampled: 17-Aug-95



Quanterra Incorporated
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September 14, 1995

HARDING LAWSON ASSOCIATES
3 HUTTON CENTRE DRIVE, STE 200
SANTA ANA, CA 92707
ATTN: MR. TOM LINDROS

LAB NO.: 113982-0001/0009
DATE SAMPLED: 17-AUG-1995
DATE SAMPLE REC'D: 17-AUG-1995
PROJECT: (32531.0022) ROCKETDYNE-
SANTA SUSANA

Enclosed with this letter is the report of the analytical results for the project specified above. Anomalies associated with this report are described in the Narrative section.

Report data sheets contain a list of the constituents measured in each test, the analytical results and the Quanterra Incorporated reporting limit. Reporting limits are adjusted to reflect any dilution factors or dry weight correction, when applicable. Solid and waste samples are reported on an "as received" basis, unless dry-weight correction is requested.

PRELIMINARY DATA

Preliminary 8240 data were provided on August 25, 1995 at 7:00 P.M. to Tom Lindros. All preliminary results were provided on September 13, 1995 at 4:15 P.M. to Tom Lindros.


REVIEWED


APPROVED

QUANTERRA INCORPORATED LIMS REPORT KEY



Section	Description
Cover letter	Signature page, report narrative as applicable.
Sample Description Information	Tabulated cross-reference between the Lab ID and Client ID, including matrix, date and time sampled and the date received for all samples in the project.
Sample Analysis Results Sheets	Lists sample results, test components, reporting limit, dates prepared and analyzed and any data qualifiers. Pages are organized by test.
QC Lot Assignment Report	Cross-reference between lab ID's and applicable QC batches (DCS, LCS, SCS, Blank, MS/SD, DU)
Duplicate Control Sample Report	Percent recovery and RPD results, with acceptance limits, for the laboratory duplicate control samples for each test are tabulated in this report. These are measures of accuracy and precision for each test. Acceptance limits are based upon laboratory historical data.
Laboratory Control Sample Report	Percent recovery results for a single Laboratory Control Sample (if applicable) are tabulated in this report, with the applicable acceptance limits for each test.
Matrix Spike/Matrix Spike Duplicate Report	Percent recovery and RPD results for matrix-specific QC samples and acceptance limits, where applicable. This report can be used to assess matrix effects on an analysis.
Single Control Sample Report	A tabulation of the surrogate recoveries for the blank for organic analyses.
Method Blank Report	A summary of the results of the analysis of the method blank for each test.

List of Abbreviations and Terms

DCS	Duplicate Control Sample	MSD	Matrix Spike Duplicate
DU	Sample Duplicate	QC Run	Preparation batch
EB	Equipment Blank	QC Category	LIMS QC Category
FB	Field Blank	QC Lot	DCS batch
FD	Field Duplicate	ND	Not Detected at the reporting limit expressed
IDL	Instrument Detection Limit (Metals)	QC Matrix	Matrix of the laboratory control sample (s)
LCS	Laboratory Control Sample	RL	Reporting Limit
MB	Method Blank	QC	Quality Control
MDL	Method Detection Limit (Organics)	SA	Sample
MS	Matrix Spike	SD	See MSD
RPD	Relative Percent Difference	TB	Trip Blank
ppm (parts per million)	mg/L or mg/kg	ppb (parts per billion)	ug/L or ug/kg
QUAL	Qualifier flag	DIL	Dilution Factor

Refer to the Quanterra Incorporated Quality Assurance Program Plan for detailed explanations of terms summarized above.

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 A. LIMS Datasheets

 B. QC Summaries

NARRATIVE

LIMS # 113982

GENERAL COMMENTS

The samples were received by Quanterra Incorporated in a chilled state, intact, and with the chain of custody.

There were no anomalies associated with this report.

SAMPLE DESCRIPTION INFORMATION
for
Harding Lawson Associates

Lab ID	Client ID	Matrix	Sampled		Received
			Date	Time	Date
113982-0001-SA	RD-7-150'	AQUEOUS	17 AUG 95	10:55	17 AUG 95
113982-0002-SA	RD-7-150'	AQUEOUS	17 AUG 95	11:20	17 AUG 95
113982-0003-SA	RD-7-150' (0.45 MICRON FILTERE	AQUEOUS	17 AUG 95	10:55	17 AUG 95
113982-0004-SA	PD-1 (0.45 MICRON FILTERED)	AQUEOUS	17 AUG 95	13:00	17 AUG 95
113982-0005-SA	PD-1	AQUEOUS	17 AUG 95	13:00	17 AUG 95
113982-0006-TB	TRIP BLANK	WATER-QA	17 AUG 95	11:30	17 AUG 95
113982-0007-SA	RD-7-249'	AQUEOUS	17 AUG 95	18:35	17 AUG 95
113982-0008-SA	RD-7-249' (0.45 MICRON FILTERE	AQUEOUS	17 AUG 95	18:20	17 AUG 95
113982-0009-SA	RD-7-249'	AQUEOUS	17 AUG 95	18:20	17 AUG 95



Environmental
Services

METALS
(Water - Total)

Client Name: Harding Lawson Associates
Client ID: RD-7-150' (0.45 MICRON FILTERED)
LAB ID: 113982-0003-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95
Sampled: 17 AUG 95
Prepared: See Below
Received: 17 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Calcium	106		1.0	0.20	mg/L	SW6010	23 AUG 95	25 AUG 95
Magnesium	13.9		1.0	0.20	mg/L	SW6010	23 AUG 95	25 AUG 95
Potassium	ND		1.0	5.0	mg/L	SW6010	23 AUG 95	25 AUG 95
Sodium	38.3		1.0	5.0	mg/L	SW6010	23 AUG 95	25 AUG 95

ND = Not Detected



Environmental Services

METALS
(Water - Total)

Client Name: Harding Lawson Associates
Client ID: PD-1 (0.45 MICRON FILTERED)
LAB ID: 113982-0004-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95

Sampled: 17 AUG 95
Prepared: See Below

Received: 17 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Calcium	14.6		1.0	0.20	mg/L	SW6010	23 AUG 95	25 AUG 95
Magnesium	7.0		1.0	0.20	mg/L	SW6010	23 AUG 95	25 AUG 95
Potassium	ND		1.0	5.0	mg/L	SW6010	23 AUG 95	25 AUG 95
Sodium	41.6		1.0	5.0	mg/L	SW6010	23 AUG 95	25 AUG 95

ND = Not Detected



Environmental
Services

METALS
(Water - Total)

Client Name: Harding Lawson Associates
Client ID: RD-7-249' (0.45 MICRON FILTERED)
LAB ID: 113982-0008-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95

Sampled: 17 AUG 95
Prepared: See Below

Received: 17 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Calcium	99.6		1.0	0.20	mg/L	SW6010	23 AUG 95	25 AUG 95
Magnesium	14.3		1.0	0.20	mg/L	SW6010	23 AUG 95	25 AUG 95
Potassium	ND		1.0	5.0	mg/L	SW6010	23 AUG 95	25 AUG 95
Sodium	36.8		1.0	5.0	mg/L	SW6010	23 AUG 95	25 AUG 95

ND = Not Detected



GENERAL INORGANICS

Client Name: Harding Lawson Associates
Client ID: RD-7-150'
LAB ID: 113982-0001-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95

Sampled: 17 AUG 95
Prepared: See Below

Received: 17 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
pH	7.3		1.0	NA	units	150.1	NA	17 AUG 95
Specific Conductance at 25 deg. C	848		1.0	1.0	umhos/cm	9050	NA	31 AUG 95
Total Dissolved Solids	540		2.0	20.0	mg/L	160.1	NA	24 AUG 95



GENERAL INORGANICS

Client Name: Harding Lawson Associates
Client ID: RD-7-150' (0.45 MICRON FILTERED)
LAB ID: 113982-0003-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95

Sampled: 17 AUG 95
Prepared: See Below

Received: 17 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Alkalinity, Carb. as CaCO3	ND		2.0	8.0	mg/L	E310.1	NA	25 AUG 95
Alkalinity, Bicarb. as CaCO3	269		2.0	8.0	mg/L	E310.1	NA	25 AUG 95
Chloride	45.8		10	1.0	mg/L	E300.0	NA	18 AUG 95
Nitrate as N	4.9		1.0	0.10	mg/L	E300.0	NA	18 AUG 95
Sulfate	73.5		10	2.0	mg/L	E300.0	NA	18 AUG 95

ND = Not Detected



Environmental
Services

GENERAL INORGANICS

Client Name: Harding Lawson Associates
Client ID: PD-1 (0.45 MICRON FILTERED)
LAB ID: 113982-0004-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95

Sampled: 17 AUG 95
Prepared: See Below

Received: 17 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Alkalinity, Carb. as CaCO3	16.6		2.0	8.0	mg/L	E310.1	NA	25 AUG 95
Alkalinity, Bicarb. as CaCO3	88.5		2.0	8.0	mg/L	E310.1	NA	25 AUG 95
Chloride	17.4		5.0	0.50	mg/L	E300.0	NA	18 AUG 95
Nitrate as N	0.18		1.0	0.10	mg/L	E300.0	NA	18 AUG 95
Sulfate	22.4		5.0	1.0	mg/L	E300.0	NA	18 AUG 95



GENERAL INORGANICS

Client Name: Harding Lawson Associates
Client ID: PD-1
LAB ID: 113982-0005-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95

Sampled: 17 AUG 95
Prepared: See Below

Received: 17 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
pH	9.1		1.0	NA	units	150.1	NA	17 AUG 95
Specific Conductance at 25 deg. C	340		1.0	1.0	umhos/cm	9050	NA	31 AUG 95
Total Dissolved Solids	198		1.0	10.0	mg/L	160.1	NA	24 AUG 95

GENERAL INORGANICS

Client Name: Harding Lawson Associates
 Client ID: RD-7-249' (0.45 MICRON FILTERED)
 LAB ID: 113982-0008-SA
 Matrix: AQUEOUS
 Authorized: 18 AUG 95
 Sampled: 17 AUG 95
 Prepared: See Below
 Received: 17 AUG 95
 Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Alkalinity, Carb. as CaCO3	ND		2.0	8.0	mg/L	E310.1	NA	25 AUG 95
Alkalinity, Bicarb. as CaCO3	272		2.0	8.0	mg/L	E310.1	NA	25 AUG 95
Chloride	42.6		10	1.0	mg/L	E300.0	NA	18 AUG 95
Nitrate as N	4.6		1.0	0.10	mg/L	E300.0	NA	18 AUG 95
Sulfate	82.4		10	2.0	mg/L	E300.0	NA	18 AUG 95

ND = Not Detected



GENERAL INORGANICS

Client Name: Harding Lawson Associates
Client ID: RD-7-249'
LAB ID: 113982-0009-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95

Sampled: 17 AUG 95
Prepared: See Below

Received: 17 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
pH	7.2		1.0	NA	units	150.1	NA	17 AUG 95
Specific Conductance at 25 deg. C	841		1.0	1.0	umhos/cm	9050	NA	31 AUG 95
Total Dissolved Solids	546		2.0	20.0	mg/L	160.1	NA	24 AUG 95



Environmental
Services

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates

Client ID: RD-7-150'

LAB ID: 113982-0002-SA

Matrix: AQUEOUS

Authorized: 18 AUG 95

Instrument: PTGC/MS

Sampled: 17 AUG 95

Prepared: 23 AUG 95

Dilution: 1.0

Received: 17 AUG 95

Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
Dichlorodifluoromethane	ND		10	ug/L
Chloromethane	ND		10	ug/L
Bromomethane	ND		10	ug/L
Vinyl chloride	ND		10	ug/L
Chloroethane	ND		10	ug/L
1,1,2-Trichloro-1,2,2-trifluoroethane	ND		10	ug/L
Methylene chloride	ND		5.0	ug/L
Acetone	ND		5.0	ug/L
Trichlorofluoromethane	ND		10	ug/L
1,1-Dichloroethene	ND		5.0	ug/L
Nitromethane	ND		5.0	ug/L
trans-1,2-Dichloroethene	ND		200	ug/L
cis-1,2-Dichloroethene	1.6	J	5.0	ug/L
1,1-Dichloroethane	ND		5.0	ug/L
2,2-Dichloropropane	ND		5.0	ug/L
Bromochloromethane	ND		5.0	ug/L
Chloroform	ND		5.0	ug/L
1,1-Dichloropropene	ND		5.0	ug/L
1,2-Dichloroethane	ND		5.0	ug/L
Dibromomethane	ND		5.0	ug/L
1,1,1-Trichloroethane	ND		5.0	ug/L
Carbon tetrachloride	ND		5.0	ug/L
Bromodichloromethane	ND		5.0	ug/L
1,2-Dichloropropane	ND		5.0	ug/L
1,3-Dichloropropane	ND		5.0	ug/L
Trichloroethene	39		5.0	ug/L
Dibromochloromethane	ND		5.0	ug/L
1,1,2-Trichloroethane	ND		5.0	ug/L
Benzene	ND		5.0	ug/L
Bromoform	ND		5.0	ug/L
Tetrachloroethene	ND		5.0	ug/L
1,2-Dibromoethane (EDB)	ND		5.0	ug/L
1,1,1,2-Tetrachloroethane	ND		5.0	ug/L
1,1,2,2-Tetrachloroethane	ND		5.0	ug/L
Toluene	ND		5.0	ug/L
Chlorobenzene	ND		5.0	ug/L
Ethylbenzene	ND		5.0	ug/L
Styrene	ND		5.0	ug/L
Xylenes (total)	ND		5.0	ug/L
1-Methylethylbenzene	ND		5.0	ug/L
Bromobenzene	ND		5.0	ug/L
1,2,3-Trichloropropane	ND		5.0	ug/L
2-Chlorotoluene	ND		5.0	ug/L
n-Propyl benzene	ND		5.0	ug/L

J = Result is detected below the reporting limit or is an estimated concentration.
ND = Not Detected

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
Client ID: RD-7-150'
LAB ID: 113982-0002-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95
Instrument: PTGC/MS

Sampled: 17 AUG 95
Prepared: 23 AUG 95
Dilution: 1.0

Received: 17 AUG 95
Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
1,3,5-Trimethylbenzene	ND			
4-Chlorotoluene	ND		5.0	ug/L
tert-Butylbenzene	ND		5.0	ug/L
1,2,4-Trimethylbenzene	ND		5.0	ug/L
sec-Butylbenzene	ND		5.0	ug/L
Isopropyltoluene	ND		5.0	ug/L
1,3-Dichlorobenzene	ND		5.0	ug/L
1,4-Dichlorobenzene	ND		5.0	ug/L
n-Butylbenzene	ND		5.0	ug/L
1,2-Dichlorobenzene	ND		5.0	ug/L
1,2,4-Trichlorobenzene	ND		5.0	ug/L
1,2-Dibromo-3-chloro- propane (DBCP)	ND		5.0	ug/L
Hexachlorobutadiene	ND		5.0	ug/L
Naphthalene	ND		5.0	ug/L
1,2,3-Trichlorobenzene	ND		5.0	ug/L
Surrogate				
	Recovery		Acceptable Range	
1,2-Dichloroethane-d4	92	%	79 - 127	
Toluene-d8	102	%	88 - 110	
Bromofluorobenzene	99	%	86 - 115	

ND = Not Detected

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
 Client ID: TRIP BLANK
 LAB ID: 113982-0006-TB
 Matrix: WATER-QA
 Authorized: 18 AUG 95
 Instrument: PTGC/MS

Sampled: 17 AUG 95
 Prepared: 22 AUG 95
 Dilution: 1.0

Received: 17 AUG 95
 Analyzed: 22 AUG 95

Parameter	Result	Qualifier	RL	Units
Dichlorodifluoromethane	ND		10	ug/L
Chloromethane	ND		10	ug/L
Bromomethane	ND		10	ug/L
Vinyl chloride	ND		10	ug/L
Chloroethane	ND		10	ug/L
1,1,2-Trichloro-1,2,2-trifluoroethane	ND		10	ug/L
Methylene chloride	ND		5.0	ug/L
Acetone	ND		5.0	ug/L
Trichlorofluoromethane	ND		10	ug/L
1,1-Dichloroethene	ND		5.0	ug/L
Nitromethane	ND		5.0	ug/L
trans-1,2-Dichloroethene	ND		200	ug/L
cis-1,2-Dichloroethene	ND		5.0	ug/L
1,1-Dichloroethane	ND		5.0	ug/L
2,2-Dichloropropane	ND		5.0	ug/L
Bromochloromethane	ND		5.0	ug/L
Chloroform	ND		5.0	ug/L
1,1-Dichloropropene	ND		5.0	ug/L
1,2-Dichloroethane	ND		5.0	ug/L
Dibromomethane	ND		5.0	ug/L
1,1,1-Trichloroethane	ND		5.0	ug/L
Carbon tetrachloride	ND		5.0	ug/L
Bromodichloromethane	ND		5.0	ug/L
1,2-Dichloropropane	ND		5.0	ug/L
1,3-Dichloropropane	ND		5.0	ug/L
Trichloroethene	ND		5.0	ug/L
Dibromochloromethane	ND		5.0	ug/L
1,1,2-Trichloroethane	ND		5.0	ug/L
Benzene	ND		5.0	ug/L
Bromoform	ND		5.0	ug/L
Tetrachloroethene	ND		5.0	ug/L
1,2-Dibromoethane (EDB)	ND		5.0	ug/L
1,1,1,2-Tetrachloroethane	ND		5.0	ug/L
1,1,2,2-Tetrachloroethane	ND		5.0	ug/L
Toluene	ND		5.0	ug/L
Chlorobenzene	ND		5.0	ug/L
Ethylbenzene	ND		5.0	ug/L
Styrene	ND		5.0	ug/L
Xylenes (total)	ND		5.0	ug/L
1-Methylethylbenzene	ND		5.0	ug/L
Bromobenzene	ND		5.0	ug/L
1,2,3-Trichloropropane	ND		5.0	ug/L
2-Chlorotoluene	ND		5.0	ug/L
n-Propyl benzene	ND		5.0	ug/L
1,3,5-Trimethylbenzene	ND		5.0	ug/L

ND = Not Detected

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
Client ID: TRIP BLANK
LAB ID: 113982-0006-TB
Matrix: WATER-QA
Authorized: 18 AUG 95
Instrument: PTGC/MS

Sampled: 17 AUG 95
Prepared: 22 AUG 95
Dilution: 1.0

Received: 17 AUG 95
Analyzed: 22 AUG 95

Parameter	Result	Qualifier	RL	Units
4-Chlorotoluene	ND			
tert-Butylbenzene	ND		5.0	ug/L
1,2,4-Trimethylbenzene	ND		5.0	ug/L
sec-Butylbenzene	ND		5.0	ug/L
Isopropyltoluene	ND		5.0	ug/L
1,3-Dichlorobenzene	ND		5.0	ug/L
1,4-Dichlorobenzene	ND		5.0	ug/L
n-Butylbenzene	ND		5.0	ug/L
1,2-Dichlorobenzene	ND		5.0	ug/L
1,2,4-Trichlorobenzene	ND		5.0	ug/L
1,2-Dibromo-3-chloro- propane (DBCP)	ND		5.0	ug/L
Hexachlorobutadiene	ND		5.0	ug/L
Naphthalene	ND		5.0	ug/L
1,2,3-Trichlorobenzene	ND		5.0	ug/L
Surrogate				
	Recovery		Acceptable Range	
1,2-Dichloroethane-d4	90	%	79 - 127	
Toluene-d8	99	%	88 - 110	
Bromofluorobenzene	96	%	86 - 115	

ND = Not Detected

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
Client ID: RD-7-249'
LAB ID: 113982-0007-SA
Matrix: AQUEOUS
Authorized: 18 AUG 95
Instrument: PTGC/MS

Sampled: 17 AUG 95
Prepared: 23 AUG 95
Dilution: 1.0

Received: 17 AUG 95
Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
Dichlorodifluoromethane	ND			
Chloromethane	ND		10	ug/L
Bromomethane	ND		10	ug/L
Vinyl chloride	ND		10	ug/L
Chloroethane	ND		10	ug/L
1,1,2-Trichloro-1,2,2-trifluoroethane	ND		10	ug/L
Methylene chloride	ND		5.0	ug/L
Acetone	ND		5.0	ug/L
Trichlorofluoromethane	ND		10	ug/L
1,1-Dichloroethene	ND		5.0	ug/L
Nitromethane	ND		5.0	ug/L
trans-1,2-Dichloroethene	ND		200	ug/L
cis-1,2-Dichloroethene	ND		5.0	ug/L
1,1-Dichloroethane	2.7	J	5.0	ug/L
2,2-Dichloropropane	ND		5.0	ug/L
Bromochloromethane	ND		5.0	ug/L
Chloroform	ND		5.0	ug/L
1,1-Dichloropropene	ND		5.0	ug/L
1,2-Dichloroethane	ND		5.0	ug/L
Dibromomethane	ND		5.0	ug/L
1,1,1-Trichloroethane	ND		5.0	ug/L
Carbon tetrachloride	ND		5.0	ug/L
Bromodichloromethane	ND		5.0	ug/L
1,2-Dichloropropane	ND		5.0	ug/L
1,3-Dichloropropane	ND		5.0	ug/L
Trichloroethene	ND		5.0	ug/L
Dibromochloromethane	47		5.0	ug/L
1,1,2-Trichloroethane	ND		5.0	ug/L
Benzene	ND		5.0	ug/L
Bromoform	ND		5.0	ug/L
Tetrachloroethene	ND		5.0	ug/L
1,2-Dibromoethane (EDB)	ND		5.0	ug/L
1,1,1,2-Tetrachloroethane	ND		5.0	ug/L
1,1,2,2-Tetrachloroethane	ND		5.0	ug/L
Toluene	ND		5.0	ug/L
Chlorobenzene	ND		5.0	ug/L
Ethylbenzene	ND		5.0	ug/L
Styrene	ND		5.0	ug/L
Xylenes (total)	ND		5.0	ug/L
1-Methylethylbenzene	ND		5.0	ug/L
Bromobenzene	ND		5.0	ug/L
1,2,3-Trichloropropane	ND		5.0	ug/L
2-Chlorotoluene	ND		5.0	ug/L
n-Propyl benzene	ND		5.0	ug/L

J = Result is detected below the reporting limit or is an estimated concentration.
ND = Not Detected

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
 Client ID: RD-7-249'
 LAB ID: 113982-0007-SA
 Matrix: AQUEOUS
 Authorized: 18 AUG 95
 Instrument: PTGC/MS

Sampled: 17 AUG 95
 Prepared: 23 AUG 95
 Dilution: 1.0

Received: 17 AUG 95
 Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
1,3,5-Trimethylbenzene	ND		5.0	ug/L
4-Chlorotoluene	ND		5.0	ug/L
tert-Butylbenzene	ND		5.0	ug/L
1,2,4-Trimethylbenzene	ND		5.0	ug/L
sec-Butylbenzene	ND		5.0	ug/L
Isopropyltoluene	ND		5.0	ug/L
1,3-Dichlorobenzene	ND		5.0	ug/L
1,4-Dichlorobenzene	ND		5.0	ug/L
n-Butylbenzene	ND		5.0	ug/L
1,2-Dichlorobenzene	ND		5.0	ug/L
1,2,4-Trichlorobenzene	ND		5.0	ug/L
1,2-Dibromo-3-chloro- propane (DBCP)	ND		5.0	ug/L
Hexachlorobutadiene	ND		5.0	ug/L
Naphthalene	ND		5.0	ug/L
1,2,3-Trichlorobenzene	ND		5.0	ug/L
Surrogate	Recovery		Acceptable Range	
1,2-Dichloroethane-d4	93	%	79 - 127	
Toluene-d8	101	%	88 - 110	
Bromofluorobenzene	96	%	86 - 115	

ND = Not Detected

QC LOT ASSIGNMENT REPORT - MS QC
Metals Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
113982-0003-SA	AQUEOUS	ICP-AT		23 AUG 95-EX	23 AUG 95-EA
113982-0004-SA	AQUEOUS	ICP-AT		23 AUG 95-EX	23 AUG 95-EA
113982-0008-SA	AQUEOUS	ICP-AT		23 AUG 95-EX	23 AUG 95-EA

LABORATORY CONTROL SAMPLE REPORT
Metals Analysis and Preparation
Project: 113982

Category: ICP-AT ICP Metals
Matrix: AQUEOUS
QC Run: 23 AUG 95-EX
Concentration Units: mg/L

Date Analyzed: 01 SEP 95

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Calcium	100	96.4	96	81-112
Magnesium	100	96.7	97	89-107
Potassium	100	99.9	100	83-105
Sodium	100	97.7	98	85-112

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Metals Analysis and Preparation
Project: 113982

Category: ICP-AT ICP Metals
Matrix: AQUEOUS
Sample: 113982-0003
MS Run: 23 AUG 95-EA
Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Calcium	106	188	196	100	82	90	9.3	59-119	31
Magnesium	13.9	101	107	100	87	93	6.7	66-120	38
Potassium	ND	94.3	100	100	94	100	5.9	60-130	27
Sodium	38.3	128	135	100	90	97	7.5	60-128	29

ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

QC LOT ASSIGNMENT REPORT - MS QC
Wet Chemistry Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
113982-0001-SA	AQUEOUS	TDS-A	24 AUG 95-A	24 AUG 95-A	24 AUG 95-AA
113982-0001-SA	AQUEOUS	COND-A	31 AUG 95-A	31 AUG 95-A	31 AUG 95-AA
113982-0003-SA	AQUEOUS	ALK-AF-A	25 AUG 95-A	25 AUG 95-A	21 AUG 95-AB
113982-0003-SA	AQUEOUS	CL-IC-A		18 AUG 95-AX	17 AUG 95-AB
113982-0003-SA	AQUEOUS	SO4-A		18 AUG 95-AX	17 AUG 95-AB
113982-0003-SA	AQUEOUS	NO3-A		18 AUG 95-AX	17 AUG 95-AB
113982-0004-SA	AQUEOUS	ALK-AF-A	25 AUG 95-A	25 AUG 95-A	21 AUG 95-AB
113982-0004-SA	AQUEOUS	CL-IC-A		18 AUG 95-AX	17 AUG 95-AB
113982-0004-SA	AQUEOUS	SO4-A		18 AUG 95-AX	17 AUG 95-AB
113982-0004-SA	AQUEOUS	NO3-A		18 AUG 95-AX	17 AUG 95-AB
113982-0005-SA	AQUEOUS	TDS-A	24 AUG 95-A	24 AUG 95-A	24 AUG 95-AA
113982-0005-SA	AQUEOUS	COND-A	31 AUG 95-A	31 AUG 95-A	31 AUG 95-AA
113982-0008-SA	AQUEOUS	ALK-AF-A	25 AUG 95-A	25 AUG 95-A	21 AUG 95-AB
113982-0008-SA	AQUEOUS	CL-IC-A		18 AUG 95-AX	17 AUG 95-AB
113982-0008-SA	AQUEOUS	SO4-A		18 AUG 95-AX	17 AUG 95-AB
113982-0008-SA	AQUEOUS	NO3-A		18 AUG 95-AX	17 AUG 95-AB
113982-0009-SA	AQUEOUS	TDS-A	24 AUG 95-A	24 AUG 95-A	24 AUG 95-AA
113982-0009-SA	AQUEOUS	COND-A	31 AUG 95-A	31 AUG 95-A	31 AUG 95-AA



DUPLICATE CONTROL SAMPLE REPORT
 Wet Chemistry Analysis and Preparation
 Project: 113982

Category: TDS-A Total Dissolved Solids
 Matrix: AQUEOUS
 QC Lot: 24 AUG 95-A
 Concentration Units: mg/L

Date Analyzed: 24 AUG 95

Analyte	Spiked	Concentration			Accuracy		Precision	
		DCS1	DCS2	AVG	Average (%)	(RPD)		
Total Dissolved Solids	1400	1390	1440	1410	DCS Limits	DCS Limit		
					101	83-114	3.5	29

Category: COND-A Specific Conductance by Automatic Titrator
 Matrix: AQUEOUS
 QC Lot: 31 AUG 95-A
 Concentration Units: umhos/cm

Date Analyzed: 31 AUG 95

Analyte	Spiked	Concentration			Accuracy		Precision	
		DCS1	DCS2	AVG	Average (%)	(RPD)		
Specific Conductance at 25 deg. C	1410	1420	1410	1420	DCS Limits	DCS Limit		
					100	80-120	0.35	20

Category: ALK-AF-A Alkalinity, Total as CaCO3
 Matrix: AQUEOUS
 QC Lot: 25 AUG 95-A
 Concentration Units: mg/L

Date Analyzed: 25 AUG 95

Analyte	Spiked	Concentration			Accuracy		Precision	
		DCS1	DCS2	AVG	Average (%)	(RPD)		
Alkalinity, Total as CaCO3	1600	1680	1670	1680	DCS Limits	DCS Limit		
					105	85-111	0.30	5

Calculations are performed before rounding to avoid round-off errors in calculated results.



Environmental
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LABORATORY CONTROL SAMPLE REPORT
Wet Chemistry Analysis and Preparation
Project: 113982

Category: ALK-AF-A Alkalinity, Total as CaCO₃
Matrix: AQUEOUS
QC Run: 25 AUG 95-A
Concentration Units: mg/L

Date Analyzed: 25 AUG 95

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Alkalinity, Total as CaCO ₃	146	160	110	80-120

Category: CL-IC-A Chloride, Ion Chromatography (300.0)
Matrix: AQUEOUS
QC Run: 18 AUG 95-AX
Concentration Units: mg/L

Date Analyzed: 18 AUG 95

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Chloride	5.00	4.92	98	85-115

Category: SO₄-A Sulfate
Matrix: AQUEOUS
QC Run: 18 AUG 95-AX
Concentration Units: mg/L

Date Analyzed: 18 AUG 95

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Sulfate	8.00	7.90	99	85-113

Category: NO₃-A Nitrate, Ion Chromatography (300.0)
Matrix: AQUEOUS
QC Run: 18 AUG 95-AX
Concentration Units: mg/L

Date Analyzed: 18 AUG 95

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Nitrate as N	4.00	3.89	97	90-110

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
 Wet Chemistry Analysis and Preparation
 Project: 113982

Category: CL-IC-A Chloride, Ion Chromatography (300.0)
 Matrix: AQUEOUS
 Sample: 113934-0001
 MS Run: 17 AUG 95-AB
 Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Chloride	57.4	106	107	50.0	98	99	1.2	66-133	18

Category: SO4-A Sulfate
 Matrix: AQUEOUS
 Sample: 113934-0001
 MS Run: 17 AUG 95-AB
 Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Sulfate	17.6	91.7	92.4	80.0	93	94	0.9	74-126	6

Category: NO3-A Nitrate, Ion Chromatography (300.0)
 Matrix: AQUEOUS
 Sample: 113934-0001
 MS Run: 17 AUG 95-AB
 Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Nitrate as N	1.54	38.1	38.2	40.0	91	92	0.2	84-112	4

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX DUPLICATE QC REPORT
Wet Chemistry Analysis and Preparation
Project: 113982

Category: TDS-A Total Dissolved Solids
Matrix: AQUEOUS
Sample: 113982-0009
MS Run: 24 AUG 95-AA
Units: mg/L

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
Total Dissolved Solids	546	552	1.1	30

Category: COND-A Specific Conductance by Automatic Titrator
Matrix: AQUEOUS
Sample: 113939-0001
MS Run: 31 AUG 95-AA
Units: umhos/cm

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
Specific Conductance at 25 deg. C	869	869	0.0	20

Category: ALK-AF-A Alkalinity, Total as CaCO₃
Matrix: AQUEOUS
Sample: 113742-0002
MS Run: 21 AUG 95-AB
Units: mg/L

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
Alkalinity, Carb. as CaCO ₃	260	250	3.9	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Wet Chemistry Analysis and Preparation
Project: 113982

Test: TDS-A
Matrix: AQUEOUS
QC Run: 24 AUG 95-A

Method 160.1 - Total Dissolved Solids (TDS)

Date Analyzed: 24 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Total Dissolved Solids	ND	mg/L	10.0

Test: COND-A
Matrix: AQUEOUS
QC Run: 31 AUG 95-A

Method 9050 - Specific Conductance

Date Analyzed: 31 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Specific Conductance at 25 deg. C	ND	umhos/cm	1.0

Test: ALK-AF-AT
Matrix: AQUEOUS
QC Run: 25 AUG 95-A

Method E310.1 - Alkalinity, Total as CaCO3

Date Analyzed: 25 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Alkalinity, Carb. as CaCO3	ND	mg/L	4.0
Alkalinity, Bicarb. as CaCO3	ND	mg/L	4.0

Test: CL-IC-A
Matrix: AQUEOUS
QC Run: 18 AUG 95-AX

Method 300.0 - Chloride, Ion Chromatography

Date Analyzed: 18 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Chloride	ND	mg/L	0.10

Test: SO4-IC-A
Matrix: AQUEOUS
QC Run: 18 AUG 95-AX

Method 300.0 - Sulfate, Ion Chromatography

Date Analyzed: 18 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Sulfate	ND	mg/L	0.20

ND = Not Detected

METHOD BLANK REPORT
Wet Chemistry Analysis and Preparation
Project: 113982

(cont.)

Test: NO3-IC-A
Matrix: AQUEOUS
QC Run: 18 AUG 95-AX

Method 300.0 - Nitrate, Ion Chromatography

Date Analyzed: 18 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Nitrate as N	ND	mg/L	0.10

ND = Not Detected

QC LOT ASSIGNMENT REPORT - MS QC
GC/MS Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
113982-0001-SA	AQUEOUS	PH-A	17 AUG 95-C		17 AUG 95-CC
113982-0005-SA	AQUEOUS	PH-A	17 AUG 95-C		17 AUG 95-CC
113982-0009-SA	AQUEOUS	PH-A	17 AUG 95-C		17 AUG 95-CC

DUPLICATE CONTROL SAMPLE REPORT
GC/MS Preparation
Project: 113982

Category: PH-A pH for Aqueous Samples
Matrix: AQUEOUS
QC Lot: 17 AUG 95-C
Concentration Units: units

Date Analyzed: 17 AUG 95

Analyte	Concentration Spiked	Concentration			AVG	Accuracy Average (%)		Precision (RPD)	
		DCS1	DCS2	DCS		DCS Limits	DCS Limit		
pH	9.18	9.13	9.13	9.13	99	98-102	0.0	1	

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX DUPLICATE QC REPORT
GC/MS Preparation
Project: 113982

Category: PH-A pH for Aqueous Samples
Matrix: AQUEOUS
Sample: 113982-0001
MS Run: 17 AUG 95-CC
Units: units

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
pH	7.30	7.30	0.0	30

Calculations are performed before rounding to avoid round-off errors in calculated results.

QC LOT ASSIGNMENT REPORT - MS QC
Volatile Organics by GC/MS

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
113982-0002-SA	AQUEOUS	8240-A		22 AUG 95-ADX	23 AUG 95-AD
113982-0006-TB	AQUEOUS	8240-A		22 AUG 95-ADX	23 AUG 95-AD
113982-0007-SA	AQUEOUS	8240-A		22 AUG 95-ADX	23 AUG 95-AD

LABORATORY CONTROL SAMPLE REPORT
Volatile Organics by GC/MS
Project: 113982

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX
Concentration Units: ug/L

Date Analyzed: 22 AUG 95

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	LCS	Limits
1,1-Dichloroethene	50.0	46.3	93	34-145
Trichloroethene	50.0	49.1	98	70-132
Benzene	50.0	50.9	102	49-140
Toluene	50.0	50.2	100	66-129
Chlorobenzene	50.0	53.0	106	71-134

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Volatile Organics by GC/MS
Project: 113982

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
Sample: 114000-0001
MS Run: 23 AUG 95-AD
Units: ug/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
1,1-Dichloroethene	ND	46.1	45.8	50.0	92	92	0.6	45-126	18
Trichloroethene	40.7	87.6	85.1	50.0	94	89	5.5	74-131	17
Benzene	ND	50.4	50.0	50.0	101	100	0.8	76-128	14
Toluene	ND	50.7	49.3	50.0	101	99	2.8	73-128	15
Chlorobenzene	ND	51.6	50.4	50.0	103	101	2.4	80-131	16

ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

SINGLE CONTROL SAMPLE REPORT
Volatile Organics by GC/MS
Project: 113982

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX
Concentration Units: ug/L

Date Analyzed: 22 AUG 95

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	SCS	Limits
1,2-Dichloroethane-d4	50.0	47.8	96	82-121
Toluene-d8	50.0	52.0	104	88-110
Bromofluorobenzene	50.0	50.3	101	86-114

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Volatile Organics by GC/MS
Project: 113982

Test: 8240-HLA-A Method 8240 - Volatile Organics, EPA 8240 Extended List
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX

Date Analyzed: 22 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Dichlorodifluoromethane	ND	ug/L	10
Chloromethane	ND	ug/L	10
Bromomethane	ND	ug/L	10
Vinyl chloride	ND	ug/L	10
Chloroethane	ND	ug/L	10
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	ug/L	5.0
Methylene chloride	ND	ug/L	5.0
Acetone	ND	ug/L	10
Trichlorofluoromethane	ND	ug/L	5.0
1,1-Dichloroethene	ND	ug/L	5.0
Nitromethane	ND	ug/L	200
trans-1,2-Dichloroethene	ND	ug/L	5.0
cis-1,2-Dichloroethene	ND	ug/L	5.0
1,1-Dichloroethane	ND	ug/L	5.0
2,2-Dichloropropane	ND	ug/L	5.0
Bromochloromethane	ND	ug/L	5.0
Chloroform	ND	ug/L	5.0
1,1-Dichloropropene	ND	ug/L	5.0
1,2-Dichloroethane	ND	ug/L	5.0
Dibromomethane	ND	ug/L	5.0
1,1,1-Trichloroethane	ND	ug/L	5.0
Carbon tetrachloride	ND	ug/L	5.0
Bromodichloromethane	ND	ug/L	5.0
1,2-Dichloropropane	ND	ug/L	5.0
1,3-Dichloropropane	ND	ug/L	5.0
Trichloroethene	ND	ug/L	5.0
Dibromochloromethane	ND	ug/L	5.0
1,1,2-Trichloroethane	ND	ug/L	5.0
Benzene	ND	ug/L	5.0
Bromoform	ND	ug/L	5.0
Tetrachloroethene	ND	ug/L	5.0
1,2-Dibromoethane (EDB)	ND	ug/L	5.0
1,1,1,2-Tetrachloroethane	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	5.0
Toluene	ND	ug/L	5.0
Chlorobenzene	ND	ug/L	5.0
Ethylbenzene	ND	ug/L	5.0
Styrene	ND	ug/L	5.0
Xylenes (total)	ND	ug/L	5.0
1-Methylethylbenzene	ND	ug/L	5.0
Bromobenzene	ND	ug/L	5.0
1,2,3-Trichloropropane	ND	ug/L	5.0
2-Chlorotoluene	ND	ug/L	5.0
n-Propyl benzene	ND	ug/L	5.0
1,3,5-Trimethylbenzene	ND	ug/L	5.0

ND = Not Detected

METHOD BLANK REPORT
Volatile Organics by GC/MS
Project: 113982

(cont.)

Test: 8240-HLA-A
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX

Method 8240 - Volatile Organics, EPA 8240 Extended List

Date Analyzed: 22 AUG 95
Reporting
Limit

Analyte	Result	Units	Limit
4-Chlorotoluene	ND	ug/L	5.0
tert-Butylbenzene	ND	ug/L	5.0
1,2,4-Trimethylbenzene	ND	ug/L	5.0
sec-Butylbenzene	ND	ug/L	5.0
Isopropyltoluene	ND	ug/L	5.0
1,3-Dichlorobenzene	ND	ug/L	5.0
1,4-Dichlorobenzene	ND	ug/L	5.0
n-Butylbenzene	ND	ug/L	5.0
1,2-Dichlorobenzene	ND	ug/L	5.0
1,2,4-Trichlorobenzene	ND	ug/L	5.0
1,2-Dibromo-3-chloro-propane (DBCP)	ND	ug/L	5.0
Hexachlorobutadiene	ND	ug/L	5.0
Naphthalene	ND	ug/L	5.0
1,2,3-Trichlorobenzene	ND	ug/L	5.0

ND = Not Detected

Laboratory Number: 114000-0001/0003
Date Sampled: 18-Aug-95



Quanterra Incorporated
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September 14, 1995

HARDING LAWSON ASSOCIATES
3 HUTTON CENTRE DRIVE, STE 200
SANTA ANA, CA 92707
ATTN: MR. TOM LINDROS

LAB NO.: 114000-0001/0003
DATE SAMPLED: 18-AUG-1995
DATE SAMPLE REC'D: 18-AUG-1995
PROJECT: (32531.0022) ROCKETDYNE-
SANTA SUSANA

Enclosed with this letter is the report of the analytical results for the project specified above. Anomalies associated with this report are described in the Narrative section.

Report data sheets contain a list of the constituents measured in each test, the analytical results and the Quanterra Incorporated reporting limit. Reporting limits are adjusted to reflect any dilution factors or dry weight correction, when applicable. Solid and waste samples are reported on an "as received" basis, unless dry-weight correction is requested.

PRELIMINARY DATA

Preliminary 8240 data were provided on August 25, 1995 at 3:55 P.M. to Tom Lindros. All preliminary results were provided on September 13, 1995 at 4:15 P.M. to Tom Lindros.


REVIEWED


APPROVED

QUANTERRA INCORPORATED LIMS REPORT KEY



Section	Description
Cover letter	Signature page, report narrative as applicable.
Sample Description Information	Tabulated cross-reference between the Lab ID and Client ID, including matrix, date and time sampled and the date received for all samples in the project.
Sample Analysis Results Sheets	Lists sample results, test components, reporting limit, dates prepared and analyzed and any data qualifiers. Pages are organized by test.
QC Lot Assignment Report	Cross-reference between lab ID's and applicable QC batches (DCS, LCS, SCS, Blank, MS/SD, DU)
Duplicate Control Sample Report	Percent recovery and RPD results, with acceptance limits, for the laboratory duplicate control samples for each test are tabulated in this report. These are measures of accuracy and precision for each test. Acceptance limits are based upon laboratory historical data.
Laboratory Control Sample Report	Percent recovery results for a single Laboratory Control Sample (if applicable) are tabulated in this report, with the applicable acceptance limits for each test.
Matrix Spike/Matrix Spike Duplicate Report	Percent recovery and RPD results for matrix-specific QC samples and acceptance limits, where applicable. This report can be used to assess matrix effects on an analysis.
Single Control Sample Report	A tabulation of the surrogate recoveries for the blank for organic analyses.
Method Blank Report	A summary of the results of the analysis of the method blank for each test.

List of Abbreviations and Terms

DCS	Duplicate Control Sample	MSD	Matrix Spike Duplicate
DU	Sample Duplicate	QC Run	Preparation batch
EB	Equipment Blank	QC Category	LIMS QC Category
FB	Field Blank	QC Lot	DCS batch
FD	Field Duplicate	ND	Not Detected at the reporting limit expressed
IDL	Instrument Detection Limit (Metals)	QC Matrix	Matrix of the laboratory control sample (s)
LCS	Laboratory Control Sample	RL	Reporting Limit
MB	Method Blank	QC	Quality Control
MDL	Method Detection Limit (Organics)	SA	Sample
MS	Matrix Spike	SD	See MSD
RPD	Relative Percent Difference	TB	Trip Blank
ppm (parts per million)	mg/L or mg/kg	ppb (parts per billion)	ug/L or ug/kg
QUAL	Qualifier flag	DIL	Dilution Factor

Refer to the Quanterra Incorporated Quality Assurance Program Plan for detailed explanations of terms summarized above.

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NARRATIVE

LIMS # 114000

GENERAL COMMENTS

The samples were received by Quanterra Incorporated in a chilled state, intact, and with the chain of custody.

Upon receipt of the samples, the unfiltered sample (114000-0001) was accidentally given to the lab for nitrate analysis, which has a 48 hour hold time. The client was notified on August 21, 1995, and instructed the lab to proceed with the nitrate analysis on the filtered sample (-0002) although the hold time had expired. The nitrate results from both the filtered and unfiltered samples are comparable.

SAMPLE DESCRIPTION INFORMATION
for
Harding Lawson Associates

Lab ID	Client ID	Matrix	Sampled		Received
			Date	Time	Date
114000-0001-SA	RD-7-296.5'	AQUEOUS	18 AUG 95	16:55	18 AUG 95
114000-0002-SA	RD-7-296.5' (.45 micron filter	AQUEOUS	18 AUG 95	16:55	18 AUG 95
114000-0003-TB	TRIP BLANK	WATER-QA	18 AUG 95	16:50	18 AUG 95



Environmental
Services

METALS
(Water - Total)

Client Name: Harding Lawson Associates
Client ID: RD-7-296.5' (.45 micron filter)
LAB ID: 114000-0002-SA
Matrix: AQUEOUS
Authorized: 19 AUG 95

Sampled: 18 AUG 95
Prepared: See Below

Received: 18 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Calcium	103		1.0	0.20	mg/L	SW6010	23 AUG 95	25 AUG 95
Magnesium	14.8		1.0	0.20	mg/L	SW6010	23 AUG 95	25 AUG 95
Potassium	ND		1.0	5.0	mg/L	SW6010	23 AUG 95	25 AUG 95
Sodium	38.3		1.0	5.0	mg/L	SW6010	23 AUG 95	25 AUG 95

ND = Not Detected



Environmental
Services

GENERAL INORGANICS

Client Name: Harding Lawson Associates
Client ID: RD-7-296.5'
LAB ID: 114000-0001-SA
Matrix: AQUEOUS
Authorized: 19 AUG 95

Sampled: 18 AUG 95
Prepared: See Below

Received: 18 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Nitrate as N	4.5	a	1.0	0.10	mg/L	E300.0	NA	19 AUG 95
pH	7.3		1.0	NA	units	150.1	NA	18 AUG 95
Specific Conductance at 25 deg. C	834		1.0	1.0	umhos/cm	9050	NA	31 AUG 95
Total Dissolved Solids	536		2.0	20.0	mg/L	160.1	NA	24 AUG 95

a = See narrative.



Environmental
Services

GENERAL INORGANICS

Client Name: Harding Lawson Associates
Client ID: RD-7-296.5' (.45 micron filter)
LAB ID: 114000-0002-SA
Matrix: AQUEOUS
Authorized: 19 AUG 95

Sampled: 18 AUG 95
Prepared: See Below

Received: 18 AUG 95
Analyzed: See Below

Parameter	Result	Qual	DIL	RL	Units	Method	Prep Date	Analyzed Date
Alkalinity, Carb. as CaCO3	ND		2.0	8.0	mg/L	E310.1	NA	25 AUG 95
Alkalinity, Bicarb. as CaCO3	269		2.0	8.0	mg/L	E310.1	NA	25 AUG 95
Chloride	42.0		10	1.0	mg/L	E300.0	NA	23 AUG 95
Nitrate as N	4.7	a	1.0	0.10	mg/L	E300.0	NA	22 AUG 95
Sulfate	83.3		10	2.0	mg/L	E300.0	NA	23 AUG 95

a = See narrative.
ND = Not Detected



Environmental
Services

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
Client ID: RD-7-296.5'
LAB ID: 114000-0001-SA
Matrix: AQUEOUS
Authorized: 19 AUG 95
Instrument: PTGC/MS

Sampled: 18 AUG 95
Prepared: 23 AUG 95
Dilution: 1.0

Received: 18 AUG 95
Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
Dichlorodifluoromethane	ND		10	ug/L
Chloromethane	ND		10	ug/L
Bromomethane	ND		10	ug/L
Vinyl chloride	ND		10	ug/L
Chloroethane	ND		10	ug/L
1,1,2-Trichloro-1,2,2-trifluoroethane	ND		5.0	ug/L
Methylene chloride	ND		5.0	ug/L
Acetone	ND		10	ug/L
Trichlorofluoromethane	ND		5.0	ug/L
1,1-Dichloroethene	ND		5.0	ug/L
Nitromethane	ND		200	ug/L
trans-1,2-Dichloroethene	ND		5.0	ug/L
cis-1,2-Dichloroethene	1.8	J	5.0	ug/L
1,1-Dichloroethane	ND		5.0	ug/L
2,2-Dichloropropane	ND		5.0	ug/L
Bromochloromethane	ND		5.0	ug/L
Chloroform	ND		5.0	ug/L
1,1-Dichloropropene	ND		5.0	ug/L
1,2-Dichloroethane	ND		5.0	ug/L
Dibromomethane	ND		5.0	ug/L
1,1,1-Trichloroethane	ND		5.0	ug/L
Carbon tetrachloride	ND		5.0	ug/L
Bromodichloromethane	ND		5.0	ug/L
1,2-Dichloropropane	ND		5.0	ug/L
1,3-Dichloropropane	ND		5.0	ug/L
Trichloroethene	41		5.0	ug/L
Dibromochloromethane	ND		5.0	ug/L
1,1,2-Trichloroethane	ND		5.0	ug/L
Benzene	ND		5.0	ug/L
Bromoform	ND		5.0	ug/L
Tetrachloroethene	ND		5.0	ug/L
1,2-Dibromoethane (EDB)	ND		5.0	ug/L
1,1,1,2-Tetrachloroethane	ND		5.0	ug/L
1,1,2,2-Tetrachloroethane	ND		5.0	ug/L
Toluene	ND		5.0	ug/L
Chlorobenzene	ND		5.0	ug/L
Ethylbenzene	ND		5.0	ug/L
Styrene	ND		5.0	ug/L
Xylenes (total)	ND		5.0	ug/L
1-Methylethylbenzene	ND		5.0	ug/L
Bromobenzene	ND		5.0	ug/L
1,2,3-Trichloropropane	ND		5.0	ug/L
2-Chlorotoluene	ND		5.0	ug/L
n-Propyl benzene	ND		5.0	ug/L

J = Result is detected below the reporting limit or is an estimated concentration.
ND = Not Detected

Volatile Organic Compounds
 Method 8240

Client Name: Harding Lawson Associates
 Client ID: RD-7-296.5'
 LAB ID: 114000-0001-SA
 Matrix: AQUEOUS
 Authorized: 19 AUG 95
 Instrument: PTGC/MS

Sampled: 18 AUG 95
 Prepared: 23 AUG 95
 Dilution: 1.0

Received: 18 AUG 95
 Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
1,3,5-Trimethylbenzene	ND		5.0	ug/L
4-Chlorotoluene	ND		5.0	ug/L
tert-Butylbenzene	ND		5.0	ug/L
1,2,4-Trimethylbenzene	ND		5.0	ug/L
sec-Butylbenzene	ND		5.0	ug/L
Isopropyltoluene	ND		5.0	ug/L
1,3-Dichlorobenzene	ND		5.0	ug/L
1,4-Dichlorobenzene	ND		5.0	ug/L
n-Butylbenzene	ND		5.0	ug/L
1,2-Dichlorobenzene	ND		5.0	ug/L
1,2,4-Trichlorobenzene	ND		5.0	ug/L
1,2-Dibromo-3-chloro- propane (DBCP)	ND		5.0	ug/L
Hexachlorobutadiene	ND		5.0	ug/L
Naphthalene	ND		5.0	ug/L
1,2,3-Trichlorobenzene	ND		5.0	ug/L

Surrogate	Recovery		Acceptable Range
1,2-Dichloroethane-d4	89	%	79 - 127
Toluene-d8	98	%	88 - 110
Bromofluorobenzene	94	%	86 - 115

ND = Not Detected

Volatile Organic Compounds
Method 8240

Client Name: Harding Lawson Associates
 Client ID: TRIP BLANK
 LAB ID: 114000-0003-TB
 Matrix: WATER-QA
 Authorized: 19 AUG 95
 Instrument: PTGC/MS

Sampled: 18 AUG 95
 Prepared: 23 AUG 95
 Dilution: 1.0

Received: 18 AUG 95
 Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
Dichlorodifluoromethane	ND		10	ug/L
Chloromethane	ND		10	ug/L
Bromomethane	ND		10	ug/L
Vinyl chloride	ND		10	ug/L
Chloroethane	ND		10	ug/L
1,1,2-Trichloro-1,2,2-trifluoroethane	ND		10	ug/L
Methylene chloride	ND		5.0	ug/L
Acetone	7.4	J	10	ug/L
Trichlorofluoromethane	ND		5.0	ug/L
1,1-Dichloroethene	ND		5.0	ug/L
Nitromethane	ND		200	ug/L
trans-1,2-Dichloroethene	ND		5.0	ug/L
cis-1,2-Dichloroethene	ND		5.0	ug/L
1,1-Dichloroethane	ND		5.0	ug/L
2,2-Dichloropropane	ND		5.0	ug/L
Bromochloromethane	ND		5.0	ug/L
Chloroform	ND		5.0	ug/L
1,1-Dichloropropene	ND		5.0	ug/L
1,2-Dichloroethane	ND		5.0	ug/L
Dibromomethane	ND		5.0	ug/L
1,1,1-Trichloroethane	ND		5.0	ug/L
Carbon tetrachloride	ND		5.0	ug/L
Bromodichloromethane	ND		5.0	ug/L
1,2-Dichloropropane	ND		5.0	ug/L
1,3-Dichloropropane	ND		5.0	ug/L
Trichloroethene	ND		5.0	ug/L
Dibromochloromethane	ND		5.0	ug/L
1,1,2-Trichloroethane	ND		5.0	ug/L
Benzene	ND		5.0	ug/L
Bromoform	ND		5.0	ug/L
Tetrachloroethene	ND		5.0	ug/L
1,2-Dibromoethane (EDB)	ND		5.0	ug/L
1,1,1,2-Tetrachloroethane	ND		5.0	ug/L
1,1,2,2-Tetrachloroethane	ND		5.0	ug/L
Toluene	ND		5.0	ug/L
Chlorobenzene	ND		5.0	ug/L
Ethylbenzene	ND		5.0	ug/L
Styrene	ND		5.0	ug/L
Xylenes (total)	ND		5.0	ug/L
1-Methylethylbenzene	ND		5.0	ug/L
Bromobenzene	ND		5.0	ug/L
1,2,3-Trichloropropane	ND		5.0	ug/L
2-Chlorotoluene	ND		5.0	ug/L
n-Propyl benzene	ND		5.0	ug/L

J = Result is detected below the reporting limit or is an estimated concentration.
 ND = Not Detected

Volatile Organic Compounds
 Method 8240

Client Name: Harding Lawson Associates
 Client ID: TRIP BLANK
 LAB ID: 114000-0003-TB
 Matrix: WATER-QA
 Authorized: 19 AUG 95
 Instrument: PTGC/MS

Sampled: 18 AUG 95
 Prepared: 23 AUG 95
 Dilution: 1.0

Received: 18 AUG 95
 Analyzed: 23 AUG 95

Parameter	Result	Qualifier	RL	Units
1,3,5-Trimethylbenzene	ND		5.0	ug/L
4-Chlorotoluene	ND		5.0	ug/L
tert-Butylbenzene	ND		5.0	ug/L
1,2,4-Trimethylbenzene	ND		5.0	ug/L
sec-Butylbenzene	ND		5.0	ug/L
Isopropyltoluene	ND		5.0	ug/L
1,3-Dichlorobenzene	ND		5.0	ug/L
1,4-Dichlorobenzene	ND		5.0	ug/L
n-Butylbenzene	ND		5.0	ug/L
1,2-Dichlorobenzene	ND		5.0	ug/L
1,2,4-Trichlorobenzene	ND		5.0	ug/L
1,2-Dibromo-3-chloro- propane (DBCP)	ND		5.0	ug/L
Hexachlorobutadiene	ND		5.0	ug/L
Naphthalene	ND		5.0	ug/L
1,2,3-Trichlorobenzene	ND		5.0	ug/L

Surrogate	Recovery		Acceptable Range
1,2-Dichloroethane-d4	93	%	79 - 127
Toluene-d8	101	%	88 - 110
Bromofluorobenzene	99	%	86 - 115

ND = Not Detected

QC LOT ASSIGNMENT REPORT - MS QC
Metals Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA,MS,SD,DU)
114000-0002-SA	AQUEOUS	ICP-AT		23 AUG 95-EX	23 AUG 95-EA



Environmental
Services

LABORATORY CONTROL SAMPLE REPORT
Metals Analysis and Preparation
Project: 114000

Category: ICP-AT ICP Metals
Matrix: AQUEOUS
QC Run: 23 AUG 95-EX
Concentration Units: mg/L

Date Analyzed: 01 SEP 95

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	LCS	Limits
Calcium	100	96.4	96	81-112
Magnesium	100	96.7	97	89-107
Potassium	100	99.9	100	83-105
Sodium	100	97.7	98	85-112

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Metals Analysis and Preparation
Project: 114000

Category: ICP-AT ICP Metals
Matrix: AQUEOUS
Sample: 113982-0003
MS Run: 23 AUG 95-EA
Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Calcium	106	188	196	100	82	90	9.3	59-119	31
Magnesium	13.9	101	107	100	87	93	6.7	66-120	38
Potassium	ND	94.3	100	100	94	100	5.9	60-130	27
Sodium	38.3	128	135	100	90	97	7.5	60-128	29

] = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Metals Analysis and Preparation
Project: 114000

Test: ICP-AT
Matrix: AQUEOUS
QC Run: 23 AUG 95-EX

Method 6010 - ICP Metals (Total)

Date Analyzed: 25 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Calcium	ND	mg/L	0.20
Magnesium	ND	mg/L	0.20
Potassium	ND	mg/L	5.0
Sodium	ND	mg/L	5.0

ND = Not Detected

QC LOT ASSIGNMENT REPORT - MS QC
Wet Chemistry Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
114000-0001-SA	AQUEOUS	TDS-A	24 AUG 95-A	24 AUG 95-A	24 AUG 95-AA
114000-0001-SA	AQUEOUS	COND-A	31 AUG 95-A	31 AUG 95-A	31 AUG 95-AA
114000-0001-SA	AQUEOUS	NO3-A		19 AUG 95-AX	17 AUG 95-AB
114000-0002-SA	AQUEOUS	NO3-A		22 AUG 95-AX	17 AUG 95-AB
114000-0002-SA	AQUEOUS	ALK-AF-A	25 AUG 95-A	25 AUG 95-A	21 AUG 95-AB
114000-0002-SA	AQUEOUS	CL-IC-A		23 AUG 95-AX	17 AUG 95-AB
114000-0002-SA	AQUEOUS	SO4-A		23 AUG 95-AX	17 AUG 95-AB

DUPLICATE CONTROL SAMPLE REPORT
Wet Chemistry Analysis and Preparation
Project: 114000

Category: TDS-A Total Dissolved Solids
Matrix: AQUEOUS
QC Lot: 24 AUG 95-A
Concentration Units: mg/L

Date Analyzed: 24 AUG 95

Analyte	Spiked	Concentration			Accuracy		Precision
		DCS1	DCS2	AVG	Average (%)	(RPD)	
Total Dissolved Solids	1400	1390	1440	1410	DCS Limits	DCS Limit	
					101 83-114	3.5	29

Category: COND-A Specific Conductance by Automatic Titrator
Matrix: AQUEOUS
QC Lot: 31 AUG 95-A
Concentration Units: umhos/cm

Date Analyzed: 31 AUG 95

Analyte	Spiked	Concentration			Accuracy		Precision
		DCS1	DCS2	AVG	Average (%)	(RPD)	
Specific Conductance at 25 deg. C	1410	1420	1410	1420	DCS Limits	DCS Limit	
					100 80-120	0.35	20

Category: ALK-AF-A Alkalinity, Total as CaCO₃
Matrix: AQUEOUS
QC Lot: 25 AUG 95-A
Concentration Units: mg/L

Date Analyzed: 25 AUG 95

Analyte	Spiked	Concentration			Accuracy		Precision
		DCS1	DCS2	AVG	Average (%)	(RPD)	
Alkalinity, Total as CaCO ₃	1600	1680	1670	1680	DCS Limits	DCS Limit	
					105 85-111	0.30	5

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE REPORT
 Wet Chemistry Analysis and Preparation
 Project: 114000

Category: NO3-A Nitrate, Ion Chromatography (300.0)
 Matrix: AQUEOUS Date Analyzed: 22 AUG 95
 QC Run: 22 AUG 95-AX
 Concentration Units: mg/L

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Nitrate as N	4.00	3.93	98	90-110

Category: NO3-A Nitrate, Ion Chromatography (300.0)
 Matrix: AQUEOUS Date Analyzed: 19 AUG 95
 QC Run: 19 AUG 95-AX
 Concentration Units: mg/L

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Nitrate as N	4.00	3.83	96	90-110

Category: ALK-AF-A Alkalinity, Total as CaCO3
 Matrix: AQUEOUS Date Analyzed: 25 AUG 95
 QC Run: 25 AUG 95-A
 Concentration Units: mg/L

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Alkalinity, Total as CaCO3	146	160	110	80-120

Category: CL-IC-A Chloride, Ion Chromatography (300.0)
 Matrix: AQUEOUS Date Analyzed: 23 AUG 95
 QC Run: 23 AUG 95-AX
 Concentration Units: mg/L

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Chloride	5.00	5.01	100	85-115

Category: SO4-A Sulfate
 Matrix: AQUEOUS Date Analyzed: 23 AUG 95
 QC Run: 23 AUG 95-AX
 Concentration Units: mg/L

Analyte	Concentration		Accuracy(%)	
	Spiked	Measured	LCS	Limits
Sulfate	8.00	7.97	100	85-113

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Wet Chemistry Analysis and Preparation
Project: 114000

Category: NO3-A Nitrate, Ion Chromatography (300.0)
Matrix: AQUEOUS
Sample: 113934-0001
MS Run: 17 AUG 95-AB
Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Nitrate as N	1.54	38.1	38.2	40.0	91	92	0.2	84-112	4

Category: CL-IC-A Chloride, Ion Chromatography (300.0)
Matrix: AQUEOUS
Sample: 113934-0001
MS Run: 17 AUG 95-AB
Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Chloride	57.4	106	107	50.0	98	99	1.2	66-133	18

Category: SO4-A Sulfate
Matrix: AQUEOUS
Sample: 113934-0001
MS Run: 17 AUG 95-AB
Units: mg/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
Sulfate	17.6	91.7	92.4	80.0	93	94	0.9	74-126	6

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX DUPLICATE QC REPORT
Wet Chemistry Analysis and Preparation
Project: 114000

Category: TDS-A Total Dissolved Solids
Matrix: AQUEOUS
Sample: 113982-0009
MS Run: 24 AUG 95-AA
Units: mg/L

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
Total Dissolved Solids	546	552	1.1	30

Category: COND-A Specific Conductance by Automatic Titrator
Matrix: AQUEOUS
Sample: 113939-0001
MS Run: 31 AUG 95-AA
Units: umhos/cm

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
Specific Conductance at 25 deg. C	869	869	0.0	20

Category: ALK-AF-A Alkalinity, Total as CaCO₃
Matrix: AQUEOUS
Sample: 113742-0002
MS Run: 21 AUG 95-AB
Units: mg/L

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
Alkalinity, Carb. as CaCO ₃	260	250	3.9	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Wet Chemistry Analysis and Preparation
Project: 114000

Test: TDS-A Method 160.1 - Total Dissolved Solids (TDS)
Matrix: AQUEOUS
QC Run: 24 AUG 95-A
Date Analyzed: 24 AUG 95

Analyte	Result	Units	Reporting Limit
Total Dissolved Solids	ND	mg/L	10.0

Test: COND-A Method 9050 - Specific Conductance
Matrix: AQUEOUS
QC Run: 31 AUG 95-A
Date Analyzed: 31 AUG 95

Analyte	Result	Units	Reporting Limit
Specific Conductance at 25 deg. C	ND	umhos/cm	1.0

Test: NO3-IC-A Method 300.0 - Nitrate, Ion Chromatography
Matrix: AQUEOUS
QC Run: 19 AUG 95-AX
Date Analyzed: 19 AUG 95

Analyte	Result	Units	Reporting Limit
Nitrate as N	ND	mg/L	0.10

QC Run: 22 AUG 95-AX
Date Analyzed: 22 AUG 95

Analyte	Result	Units	Reporting Limit
Nitrate as N	ND	mg/L	0.10

Test: ALK-AF-AT Method E310.1 - Alkalinity, Total as CaCO3
Matrix: AQUEOUS
QC Run: 25 AUG 95-A
Date Analyzed: 25 AUG 95

Analyte	Result	Units	Reporting Limit
Alkalinity, Carb. as CaCO3	ND	mg/L	4.0
Alkalinity, Bicarb. as CaCO3	ND	mg/L	4.0

ND = Not Detected

METHOD BLANK REPORT
Wet Chemistry Analysis and Preparation
Project: 114000

(cont.)

Test: CL-IC-A
Matrix: AQUEOUS
QC Run: 23 AUG 95-AX

Method 300.0 - Chloride, Ion Chromatography

Date Analyzed: 23 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Chloride	ND	mg/L	0.10

Test: SO4-IC-A
Matrix: AQUEOUS
QC Run: 23 AUG 95-AX

Method 300.0 - Sulfate, Ion Chromatography

Date Analyzed: 23 AUG 95
Reporting
Limit

Analyte	Result	Units	Reporting Limit
Sulfate	ND	mg/L	0.20

ND = Not Detected

QC LOT ASSIGNMENT REPORT - MS QC
GC/MS Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
114000-0001-SA	AQUEOUS	PH-A	18 AUG 95-C		18 AUG 95-CA

DUPLICATE CONTROL SAMPLE REPORT
 GC/MS Preparation
 Project: 114000

Category: PH-A pH for Aqueous Samples
 Matrix: AQUEOUS
 QC Lot: 18 AUG 95-C
 Concentration Units: units

Date Analyzed: 18 AUG 95

Analyte	Concentration			AVG	Accuracy		Precision
	Spiked	DCS1	DCS2		Average (%)	(RPD)	
pH	9.18	9.12	9.12	9.12	DCS Limits	DCS Limit	
					99 98-102	0.0	1

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX DUPLICATE QC REPORT
GC/MS Preparation
Project: 114000

Category: PH-A pH for Aqueous Samples
Matrix: AQUEOUS
Sample: 114000-0001
MS Run: 18 AUG 95-CA
Units: units

Analyte	Concentration		%RPD SA-DU	Acceptance Limit
	Sample	Duplicate		
pH	7.30	7.30	0.0	30

Calculations are performed before rounding to avoid round-off errors in calculated results.

QC LOT ASSIGNMENT REPORT - MS QC
Volatile Organics by GC/MS

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK/LCS)	MS QC Run Number (SA, MS, SD, DU)
114000-0001-SA	AQUEOUS	8240-A		23 AUG 95-ADX	23 AUG 95-AD
114000-0003-TB	AQUEOUS	8240-A		22 AUG 95-ADX	23 AUG 95-AD

LABORATORY CONTROL SAMPLE REPORT
Volatile Organics by GC/MS
Project: 114000

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
QC Run: 23 AUG 95-ADX
Concentration Units: ug/L

Date Analyzed: 23 AUG 95

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	LCS	Limits
1,1-Dichloroethene	50.0	45.9	92	34-145
Trichloroethene	50.0	47.2	94	70-132
Benzene	50.0	49.7	99	49-140
Toluene	50.0	49.3	99	66-129
Chlorobenzene	50.0	49.7	99	71-134

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX
Concentration Units: ug/L

Date Analyzed: 22 AUG 95

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	LCS	Limits
1,1-Dichloroethene	50.0	46.3	93	34-145
Trichloroethene	50.0	49.1	98	70-132
Benzene	50.0	50.9	102	49-140
Toluene	50.0	50.2	100	66-129
Chlorobenzene	50.0	53.0	106	71-134

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Volatile Organics by GC/MS
Project: 114000

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
Sample: 114000-0001
MS Run: 23 AUG 95-AD
Units: ug/L

Analyte	Sample Result	Concentration		Amount Spiked MS/MSD	%Recovery		%RPD	Acceptance Limit	
		MS Result	MSD Result		MS	MSD		Recov.	RPD
1,1-Dichloroethene	ND	46.1	45.8	50.0	92	92	0.6	45-126	18
Trichloroethene	40.7	87.6	85.1	50.0	94	89	5.5	74-131	17
Benzene	ND	50.4	50.0	50.0	101	100	0.8	76-128	14
Toluene	ND	50.7	49.3	50.0	101	99	2.8	73-128	15
Chlorobenzene	ND	51.6	50.4	50.0	103	101	2.4	80-131	16

ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

SINGLE CONTROL SAMPLE REPORT
Volatile Organics by GC/MS
Project: 114000

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
QC Run: 23 AUG 95-ADX
Concentration Units: ug/L

Date Analyzed: 23 AUG 95

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	SCS	Limits
1,2-Dichloroethane-d4	50.0	45.7	91	82-121
Toluene-d8	50.0	49.2	98	88-110
Bromofluorobenzene	50.0	46.4	93	86-114

Category: 8240-A Volatile Organics
Matrix: AQUEOUS
QC Run: 22 AUG 95-ADX
Concentration Units: ug/L

Date Analyzed: 22 AUG 95

Analyte	Concentration		Accuracy (%)	
	Spiked	Measured	SCS	Limits
1,2-Dichloroethane-d4	50.0	47.8	96	82-121
Toluene-d8	50.0	52.0	104	88-110
Bromofluorobenzene	50.0	50.3	101	86-114

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT
Volatile Organics by GC/MS
Project: 114000

Test: 8240-HLA-A
Matrix: AQUEOUS
QC Run: 23 AUG 95-ADX

Method 8240 - Volatile Organics, EPA 8240 Extended List

Date Analyzed: 23 AUG 95
Reporting
Limit

Analyte	Result	Units	Limit
Dichlorodifluoromethane	ND	ug/L	10
Chloromethane	ND	ug/L	10
Bromomethane	ND	ug/L	10
Vinyl chloride	ND	ug/L	10
Chloroethane	ND	ug/L	10
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	ug/L	10
Methylene chloride	ND	ug/L	5.0
Acetone	ND	ug/L	5.0
Trichlorofluoromethane	ND	ug/L	10
1,1-Dichloroethene	ND	ug/L	5.0
Nitromethane	ND	ug/L	5.0
trans-1,2-Dichloroethene	ND	ug/L	200
cis-1,2-Dichloroethene	ND	ug/L	5.0
1,1-Dichloroethane	ND	ug/L	5.0
2,2-Dichloropropane	ND	ug/L	5.0
Bromochloromethane	ND	ug/L	5.0
Chloroform	ND	ug/L	5.0
1,1-Dichloropropene	ND	ug/L	5.0
1,2-Dichloroethane	ND	ug/L	5.0
Dibromomethane	ND	ug/L	5.0
1,1,1-Trichloroethane	ND	ug/L	5.0
Carbon tetrachloride	ND	ug/L	5.0
Bromodichloromethane	ND	ug/L	5.0
1,2-Dichloropropane	ND	ug/L	5.0
1,3-Dichloropropane	ND	ug/L	5.0
Trichloroethene	ND	ug/L	5.0
Dibromochloromethane	ND	ug/L	5.0
1,1,2-Trichloroethane	ND	ug/L	5.0
Benzene	ND	ug/L	5.0
Bromoform	ND	ug/L	5.0
Tetrachloroethene	ND	ug/L	5.0
1,2-Dibromoethane (EDB)	ND	ug/L	5.0
1,1,1,2-Tetrachloroethane	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	5.0
Toluene	ND	ug/L	5.0
Chlorobenzene	ND	ug/L	5.0
Ethylbenzene	ND	ug/L	5.0
Styrene	ND	ug/L	5.0
Xylenes (total)	ND	ug/L	5.0
1-Methylethylbenzene	ND	ug/L	5.0
Bromobenzene	ND	ug/L	5.0
1,2,3-Trichloropropane	ND	ug/L	5.0
2-Chlorotoluene	ND	ug/L	5.0
n-Propyl benzene	ND	ug/L	5.0
1,3,5-Trimethylbenzene	ND	ug/L	5.0

ND = Not Detected

METHOD BLANK REPORT
Volatile Organics by GC/MS
Project: 114000

(cont.)

Test: 8240-HLA-A
Matrix: AQUEOUS
QC Run: 23 AUG 95-ADX

Method 8240 - Volatile Organics, EPA 8240 Extended List

Date Analyzed: 23 AUG 95
Reporting
Limit

Analyte	Result	Units	Limit
4-Chlorotoluene	ND	ug/L	5.0
tert-Butylbenzene	ND	ug/L	5.0
1,2,4-Trimethylbenzene	ND	ug/L	5.0
sec-Butylbenzene	ND	ug/L	5.0
Isopropyltoluene	ND	ug/L	5.0
1,3-Dichlorobenzene	ND	ug/L	5.0
1,4-Dichlorobenzene	ND	ug/L	5.0
n-Butylbenzene	ND	ug/L	5.0
1,2-Dichlorobenzene	ND	ug/L	5.0
1,2,4-Trichlorobenzene	ND	ug/L	5.0
1,2-Dibromo-3-chloro-propane (DBCP)	ND	ug/L	5.0
Hexachlorobutadiene	ND	ug/L	5.0
Naphthalene	ND	ug/L	5.0
1,2,3-Trichlorobenzene	ND	ug/L	5.0

ND = Not Detected

METHOD BLANK REPORT
Volatile Organics by GC/MS
Project: 114000

(cont.)

Test: 8240-HLA-A
Matrix: AQUEOUS

Method 8240 - Volatile Organics, EPA 8240 Extended List

QC Run: 22 AUG 95-ADX

Date Analyzed: 22 AUG 95
Reporting
Limit

Analyte	Result	Units	Limit
Dichlorodifluoromethane	ND	ug/L	10
Chloromethane	ND	ug/L	10
Bromomethane	ND	ug/L	10
Vinyl chloride	ND	ug/L	10
Chloroethane	ND	ug/L	10
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	ug/L	5.0
Methylene chloride	ND	ug/L	5.0
Acetone	ND	ug/L	10
Trichlorofluoromethane	ND	ug/L	5.0
1,1-Dichloroethene	ND	ug/L	5.0
Nitromethane	ND	ug/L	200
trans-1,2-Dichloroethene	ND	ug/L	5.0
cis-1,2-Dichloroethene	ND	ug/L	5.0
1,1-Dichloroethane	ND	ug/L	5.0
2,2-Dichloropropane	ND	ug/L	5.0
Bromochloromethane	ND	ug/L	5.0
Chloroform	ND	ug/L	5.0
1,1-Dichloropropene	ND	ug/L	5.0
1,2-Dichloroethane	ND	ug/L	5.0
Dibromomethane	ND	ug/L	5.0
1,1,1-Trichloroethane	ND	ug/L	5.0
Carbon tetrachloride	ND	ug/L	5.0
Bromodichloromethane	ND	ug/L	5.0
1,2-Dichloropropane	ND	ug/L	5.0
1,3-Dichloropropane	ND	ug/L	5.0
Trichloroethene	ND	ug/L	5.0
Dibromochloromethane	ND	ug/L	5.0
1,1,2-Trichloroethane	ND	ug/L	5.0
Benzene	ND	ug/L	5.0
Bromoform	ND	ug/L	5.0
Tetrachloroethene	ND	ug/L	5.0
1,2-Dibromoethane (EDB)	ND	ug/L	5.0
1,1,1,2-Tetrachloroethane	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	5.0
Toluene	ND	ug/L	5.0
Chlorobenzene	ND	ug/L	5.0
Ethylbenzene	ND	ug/L	5.0
Styrene	ND	ug/L	5.0
Xylenes (total)	ND	ug/L	5.0
1-Methylethylbenzene	ND	ug/L	5.0
Bromobenzene	ND	ug/L	5.0
1,2,3-Trichloropropane	ND	ug/L	5.0
2-Chlorotoluene	ND	ug/L	5.0
n-Propyl benzene	ND	ug/L	5.0

ND = Not Detected

METHOD BLANK REPORT
Volatile Organics by GC/MS
Project: 114000

(cont.)

Test: 8240-HLA-A
Matrix: AQUEOUS

Method 8240 - Volatile Organics, EPA 8240 Extended List

QC Run: 22 AUG 95-ADX

Date Analyzed: 22 AUG 95
Reporting
Limit

Analyte	Result	Units	Limit
1,3,5-Trimethylbenzene	ND	ug/L	5.0
4-Chlorotoluene	ND	ug/L	5.0
tert-Butylbenzene	ND	ug/L	5.0
1,2,4-Trimethylbenzene	ND	ug/L	5.0
sec-Butylbenzene	ND	ug/L	5.0
Isopropyltoluene	ND	ug/L	5.0
1,3-Dichlorobenzene	ND	ug/L	5.0
1,4-Dichlorobenzene	ND	ug/L	5.0
n-Butylbenzene	ND	ug/L	5.0
1,2-Dichlorobenzene	ND	ug/L	5.0
1,2,4-Trichlorobenzene	ND	ug/L	5.0
1,2-Dibromo-3-chloro-propane (DBCP)	ND	ug/L	5.0
Hexachlorobutadiene	ND	ug/L	5.0
Naphthalene	ND	ug/L	5.0
1,2,3-Trichlorobenzene	ND	ug/L	5.0

ND = Not Detected

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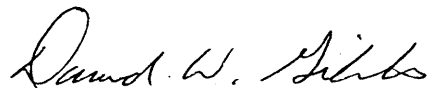
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