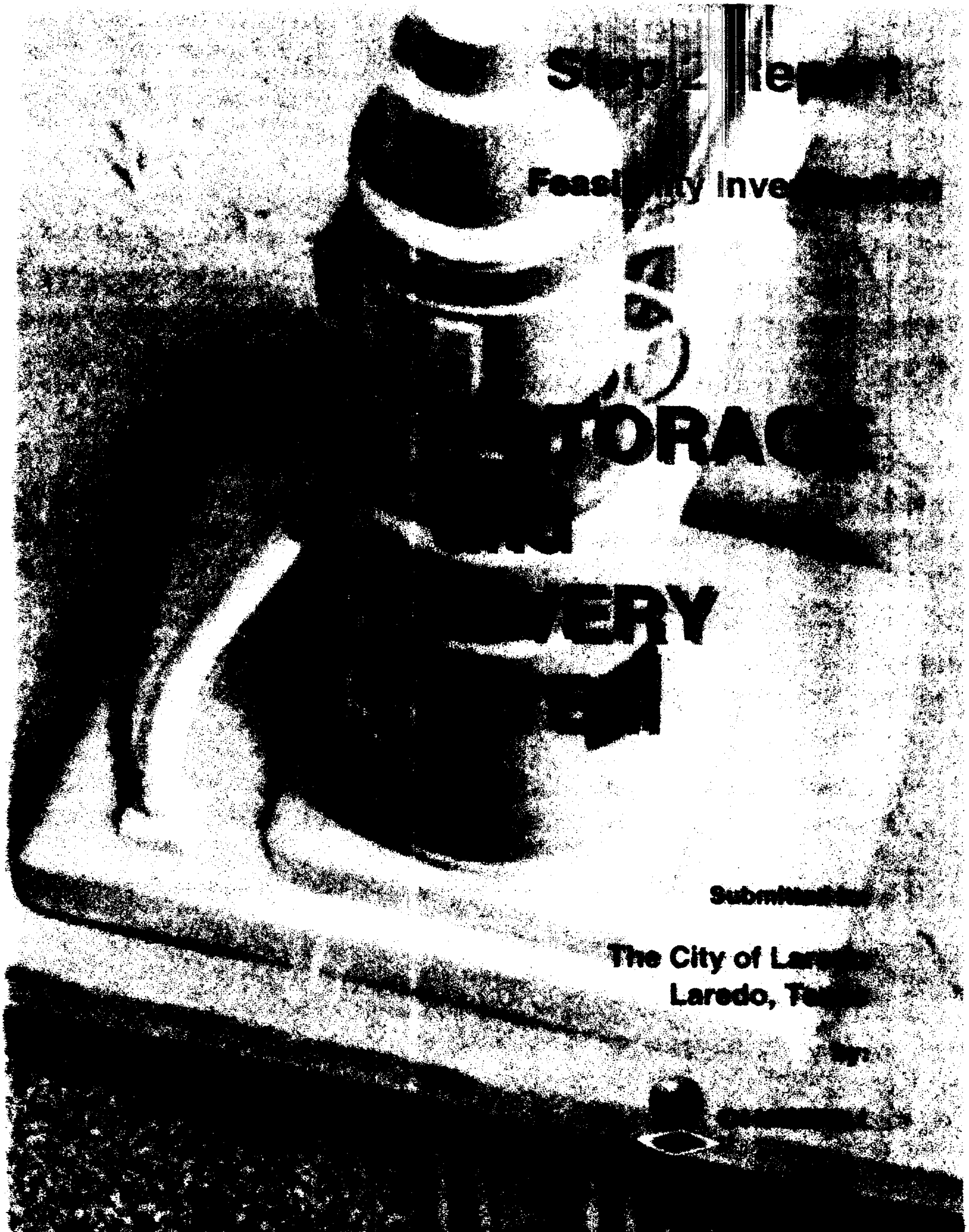

Step 2 Report

Feasibility Investigation

TORAG

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Submitted to:

The City of Laredo
Laredo, Texas

by:

CH2MHILL

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San Antonio, TX
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January 25, 1999

118069.N0.ZZ

Mr. Jerry Pinzon, P.E.
Assistant Utilities Director
4002 N. Bartlett Ave.
P.O. Box 2950
Laredo, TX 78044

Subject: Aquifer Storage and Recovery Feasibility Investigation - Step 2 Report

Dear Mr. Pinzon:

CH2M HILL is pleased to transmit this Step 2 Report for the Aquifer Storage and Recovery Feasibility Investigation. This phase of the investigation consisted of extensive fieldwork performed in conjunction with the development and testing of observation wells. This followed the completion of an initial desktop study phase and was performed to further the understanding of the Laredo Formation in the Laredo area.

One of the most important criteria considered during the project was understanding the ability of local aquifers to accept injected water and return that water when needed. This characteristic is known as the aquifer's permeability and in the case of the Laredo Formation, the permeability is very low. Although injection and recovery is possible the rates will be lower than desired and physical plugging of the aquifer is possible. The Conclusions and Recommendations section of the report discuss the findings in more detail. In the future, we recommend that the City consider options for enhancing the permeability of the aquifer to improve injection and recovery rates.

We have enjoyed working with the City on this project. City personnel were instrumental in the conduct of this study and their efforts are greatly appreciated.

Sincerely,

CH2M HILL

Michael Anglea

J. Michael Anglea, P.E., DEE
Project Manager

SAN/WP/118069/001.DOC

c: Fernando Roman, P.E.
Rogelio Rivera, P.E.

Step 2 Report

Feasibility Investigation

AQUIFER STORAGE and RECOVERY SYSTEM

Submitted to:

The City of Laredo
Laredo, Texas

by:

CH2MHILL

January 1999

STATE OF TEXAS
MICHAEL ANGLEA
79700
REGISTERED
PROFESSIONAL ENGINEER

1/25/99

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Acronyms and Abbreviations

ASR	Aquifer Storage Recovery
bgs	below ground surface
gpm	a measure of the quantity of water
MFI	modified fouling index
mg/l	milligrams per liter
mL	milliliters
Mv	millivolts
O&M	operation and maintenance
Psi	pounds per square inch
SAP	sodium acid polyphosphate
SP	spontaneous potential
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
TSS	total suspended solids
TWDB	Texas Water Development Board

Glossary

Anion. An ion that bears a negative charge.

Aquifer. Any zone below the surface of the earth, which stores, transmits, and yields water in sufficient quantities for human use.

Cation. An ion that bears a positive charge.

Dip. The angle at which a geologic layer or stratum is inclined from the horizontal.

Drawdown. The amount of drop in water level from the original, or static, water level as a result of the pumping of a well.

Eh. The oxidation-reduction potential of water. Measured with a hydrogen electrode, in units of millivolts.

Friable. Easily crumbled, as with rock that is poorly cemented.

Groundwater. Water contained underground within an aquifer.

Native groundwater. The groundwater that occupied the storage zone before ASR was initiated, also the groundwater that surrounds the ASR storage "bubble."

Outcrop. An exposure of bedrock or strata through the overlying soil.

pH. The measure of the acidity of water, with a pH of 7 being considered neutral. A lower pH indicates a more acidic solution.

Raw water. Water that is used in its current state, without additional treatment.

Recharge. The injection of water underground for storage in an aquifer, as in ASR operations.

Recovered Water. Water pumped from an ASR well after recharge has occurred. Typically consists of a mixture of stored water and formation water.

Recovery. The withdrawal of stored water from underground.

Rock cores. Cylindrical samples of rock typically collected by drilling.

Sandstone. A cemented sediment composed of quartz grains.

Shale. A sediment formed by laminated material primarily of clay grade (less than 1/256 millimeters in size).

Siltstone. A very fine grained rock consisting of particles of silt grade (1/16 millimeters to 1/256 millimeters in size).

Specific capacity. A measure of well capacity defined as the amount of well yield per foot of water level drawdown in the pumped well.

Total dissolved solids (TDS). An indicator of a water's salinity, defined as the mass of dissolved solids per unit volume of water (commonly expressed in mg/l).

Transmissivity. The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of an aquifer under a unit hydraulic gradient.

1.0 Introduction

1.1 Overview

The City of Laredo, Texas, operates a water supply system that serves residential, commercial, industrial, and wholesale customers in the City and surrounding areas. The Rio Grande River is currently the sole source of raw water. The City is located along a reach of the river between the Amistad and Falcon Reservoirs.

The City is experiencing growth in population and water demand, particularly in areas north and south of the City. The current and projected growth is resulting in increased water demands and the requirement for expanded water system facilities. Additionally, the population growth will result in the City requiring additional municipal water rights in the near future. While there is an active market in water rights purchase and sales, the amount of water available to meet continued growth in this area has a finite limit, especially during drought conditions. The Rio Grande Watermaster has periodically implemented restrictions on agricultural water rights and has the authority to prorate municipal water rights should this ever become necessary.

Due to continued growth, the City of Laredo applied for, and received, partial grant funding from the Texas Water Development Board (TWDB) to begin evaluating whether Aquifer Storage and Recovery (ASR) would be feasible and beneficial to the City. The City applied for the grant funding in July 1995.

The ASR concept works by storing large volumes of water through wells drilled into existing underground water bearing geologic formations known as aquifers. Water is typically produced for ASR storage during times of the year when excess treated water supplies are available. The stored water is later recovered by pumping the wells to meet demands when supply is limited, or treatment capacity is exceeded. Experience with ASR systems for other utilities has shown that ASR systems can typically be implemented for substantially less cost than the more conventional alternatives to meeting peak water demands.

This report on the preliminary feasibility of ASR for the City of Laredo represents the second step in a three-step investigative process. The report presents the results and recommendations from an extensive field investigation and analytical testing program.

1.2 Report Organization

Section 2.0 of this report presents the various activities performed during the project. Results of the field investigation are presented in Section 3.0. Section 4.0 presents a summary of the findings and the results of an economic analysis. Section 5.0 presents conclusions and recommendations.

2.0 Description of Investigation

2.1 Introduction

The investigation reported herein consisted of several tasks to evaluate the subsurface conditions in the Laredo area. The work as reported is divided into two sets of tasks. The first set describes the preliminary field investigation activities, which included a geologic evaluation based on existing geophysical logs, and an existing well survey and groundwater quality sampling program. The second set of tasks were the construction and testing activities, which included a test drilling program and an aquifer compatibility test designed to evaluate and characterize the Laredo Formation. The preliminary field investigation activities were conducted between September 1996 and January 1997. The construction and testing activities were conducted between January 1997 and February 1998.

The TWDB provided construction labor and equipment for the well installations and exploratory drilling, an existing well survey and groundwater sampling, and geophysical logging. The TWDB also provided substantial testing assistance. TWDB labor and equipment were provided through an agreement between the City and the TWDB. The involvement of the TWDB through this arrangement provided the construction services for this work at substantial savings to the City, and helped greatly in the success of this project. Engineering costs and direct costs incurred by the City were partially offset by a Research and Development grant from the TWDB.

2.2 Preliminary Field Investigation Activities

2.2.1 Supplemental Geophysical Evaluation

The results of the Step 1 investigation for this program recommended proceeding with a test-drilling program in the Laredo Formation. This formation is the shallowest of three geologic units identified in the Laredo area with the capability to transmit groundwater. However, during much of the Step 1 investigation, deeper geologic units were the primary focus and limited information was obtained regarding the Laredo Formation. As a result, a supplemental geophysical evaluation was conducted as a precursor to the subsequent field investigation. The goal of the geophysical evaluation was to assess potential drilling locations in the Laredo area based on the distribution, thickness, and continuity of sand layers within the Laredo Formation. The area investigated was selected to coincide with the logical location of future ASR facilities (near potable water transmission lines and water storage tanks). A map showing the location of the City of Laredo major water system facilities is presented as **Figure 2-1**.

The findings of this evaluation were summarized in a CH2M HILL draft memorandum dated November 20, 1996, that was distributed to the TWDB and City of Laredo. The evaluation was later updated to include data from the field investigation and is presented in **Appendix A**. The evaluation is based on analyses of existing geophysical logs from oil and gas wells, and water wells in the Laredo area. Included are geophysical profiles and a net sand thickness distribution map. The findings of the evaluation are summarized below:

- The Laredo Formation consists of relatively fine-grained sediments including clays, silts, and very fine sand and sandstone. The formation contains relatively thicker and more permeable sediments in the upper portions of the formation relative to its entire thickness. This zone is referred to as the upper sand zone.
- The Laredo Formation outcrops within the City in a southwest to northeast strike and dips to the southeast. The formation thickens to the southeast along the dip. Because the outcrop occurs within the City, shallower portions of the formation, including the upper sand zone, are absent or only partially present in some areas, particularly in the southern and western portions of the City.
- In areas where the entire formation is present, a distinct pattern relating the thickness of the upper sand zone and geographic area is not evident based on existing information.
- Based on the geophysical profiles, four of the seven locations originally selected for test drilling appeared to contain thin or incomplete sequences of the "upper sand zone". Complete sections of the upper sand zone were identified at the three selected test sites: the Del Mar and McPherson storage tanks and the East Corridor storage tank and booster station (**Figure 2-1**).

More specific information regarding the Laredo Formation and findings from the geophysical evaluation are discussed in Section 3.0.

2.2.2 Existing Well Survey

In December 1996, an existing well survey and groundwater sampling task was conducted. The TWDB provided most of the labor to conduct this task. The objectives of this study were to identify and locate existing water wells screened in the Laredo Formation; to obtain water samples for laboratory analysis; and to obtain measurements of water levels and pumping rates in the wells. This information was used to further evaluate potential drilling locations. **Table 2-1** summarizes wells identified during the survey. The well locations are shown on **Figure 2-2** and include, where available, construction information obtained from drillers' logs on file with the TWDB. The locations of the wells were obtained using a hand-held global positioning system unit. A copy of the location and other field information the TWDB obtained during this task is included in **Appendix B**.

Eleven existing wells were sampled by TWDB or City of Laredo personnel between early December (1966) and late January (1997). Three of the 14 wells identified by the TWDB were not accessible for sampling. Based on construction information, it was determined that two of the wells sampled, 85-29-301 and 85-37-204, are not screened in the Laredo Formation.

The groundwater samples were submitted to the City of Laredo Water Pollution Control Laboratory for analysis of cations, anions, and general chemistry parameters. Selected cations were analyzed at Core Laboratories of Corpus Christi, Texas. Analytical results associated with this effort are discussed in Section 3 along with analyses performed later in the project.

TABLE 2-1
Summary of TWDB Water Well Survey and Sampling
Laredo Aquifer Storage and Recovery Project

Sampler	SWN	Owner	Lab Sample?	Status	Remarks
TWDB	85-20-901	Laredo Reddy Mix Co.	AQ-01		Pumps into 8' x 20" concrete tank
TWDB	85-28-301	Flores	No	Abandoned	Was used for domestic, except drinking water
TWDB	85-28-601	Anzon, Inc.	No	Unused	
TWDB	85-29-708	Trevino	AQ-02		Was used for domestic, yard water, wash
TWDB	85-37-404	Minne	AQ-03		Domestic
TWDB	85-37-406	Whiteside	AQ-04		Domestic
TWDB	85-29-301	Killam Cattle Co.	AQ-05		Domestic
TWDB	85-29-102	Laredo Country Club	AQ-06		Irrigation
TWDB	85-29-401	Mann	AQ-07		
TWDB	85-29-706	Catholic Cemetary	AQ-08		Irrigation
TWDB	85-29-709	Mercy Hospital	AQ-12		Irrigation - good water reported
City of Laredo	85-29-804	Polston	AQ-13	In Use - Temporarily	Industrial
TWDB	85-37-204	Garcia	AQ-14		Stock
TWDB	85-29-203	Enron Oil & Gas Co.	No	Inoperative	Near gas production well #2
TWDB	85-29-402	Benavides	No	Inoperative	
TWDB	85-29-707	Bermudez	No		Did not visit this well, unable to contact owner

Notes: SWN = state well number

2.3 Construction and Testing Activities

Based on the results of the preliminary field activities, test hole sites were selected at the following locations: McPherson storage tank, Del Mar storage tank, and the East Corridor storage tank and booster station (**Figure 2-1**). As discussed earlier, it was determined that each of these sites could serve as a future location for operational ASR facilities and all three are located above relatively complete sections of the upper sand zone within the Laredo Formation.

A typical construction cycle included several tasks, beginning with the drilling of an exploratory boring, followed by mudded borehole geophysical logging, monitor well installation, well development, aquifer testing, and groundwater sampling. Later tasks include modified fouling index (MFI) testing and aquifer compatibility testing. A summary of each of these activities is presented below.

2.3.1 Borings and Well Installations

A total of four exploratory borings and four monitor wells were constructed at the three sites. Two exploratory borings and two monitor wells were constructed at the Del Mar site. A summary of the borings and well completions is presented in **Table 2-2**.

Table 2-2 Borings and Wells Completed

Laredo Aquifer Storage and Recovery Project

Construction Dates	Location	Wells Completed
1/7/97 – 1/13/97	McPherson Storage Tank	TW-1
2/9/97 – 2/20/97	Del Mar Storage Tank	TW-2
3/19/97 - 4/7/97	East Corridor Storage Tank	TW-3
7/9/97 – 7/15/97	Del Mar Storage Tank	TW-2A

Each of the first three well sites (TW-1, TW-2, and TW-3) were drilled through nearly the entire thickness of the Laredo Formation (800 to 1000 feet). These drilling depths were chosen to verify the results of the supplemental geologic evaluation and confirm the stratigraphic position of the upper sand zone.

Following data review and a discussion with the TWDB and City of Laredo in early June, 1997, a fourth boring, TW-2A, was scheduled at the Del Mar site for the purpose of obtaining rock core samples. TW-2A was drilled within 200 feet of TW-2 and was advanced to the base of the upper sand zone (430 feet).

All four borings were advanced using the mud rotary drilling technique. Prior to or concurrent with TWDB mobilizing to each site, selected sites were secured by temporary fencing and mud pits were constructed. During the drilling of all borings, cuttings were obtained at 10-foot intervals and stored onsite in sample bags. Boring logs were prepared for each boring and are presented in **Appendix C**. In general, a 7 7/8-inch diameter pilot hole was drilled to the target depth. After reviewing the geophysical logs (discussed in

Section 2.3.3), a completion depth was selected and the borehole was then reamed with a 10 5/8-inch (9 7/8-inch in the case of TW-2A) bit. Each of the first three wells was plugged with drill cuttings to within 10 to 20 feet of the completion depth. The bottom of the hole was then tremie grouted with neat cement to the base of the planned well bottom. The fourth boring, TW-2A, was drilled and reamed to the base of the selected construction depth and plug back was not needed.

The well construction details for each location varied depending on the subsurface conditions encountered. A summary of construction information and sand zone intervals identified on geophysical logs is listed in **Table 2-3**. More detailed information may be found on well construction logs in **Appendix C**.

Table 2-3 Test Well Construction Details

Laredo Aquifer Storage and Recovery Project

Monitoring Well	Total Depth Drilled (feet)	Plug Back Depth (feet)	[1]Sand Zone Intervals (feet)	Screen Material, Size, and Type	Screen Interval (feet)
TW-1	885	495	330-390; 440-490	304 SS, 0.030-inch louver screen	330-390; 440-490
TW-2	800	460	276-312; 330-358; 376-392; 406-420; 450-500	Carbon steel, 0.030 & 0.040-inch louver screen	270-430
TW-3	914	630	446-458; 476-492; 498-506; 532-572; 590-604	Carbon steel, 0.040-inch louver screen	430-610
TW-2A	430	430	262-272; 276-298; 316-324; 330-346; 392-398	Schedule 80 PVC; 0.020-inch slotted pipe	260-300; 315-345; 390-410

Note: [1] Sand intervals identified from geophysical logs

Each of the first three wells was constructed with 6-inch steel casing and well screen (0.030 to 0.040 slot). Stainless steel was used on the first well and carbon steel on the latter two. The last well, TW-2A, was constructed of 4-inch PVC casing and 0.020 slotted well screen.

Two screen intervals were installed in the first well, TW-1. One screen interval was installed in wells TW-2 and TW-3. The entire assemblage of sand zones was screened in these later wells to investigate if the lower permeability units between the sand zones may yield water via secondary porosity (fractures). The potential for the fine sediments from the low permeability zones to pass through the screen was not thought to be significant based on the relative consolidation of the formation.

A fluid velocity log was run on well TW-2 to identify the most productive zones. Information from this log and other TW-2 geophysical logs (discussed below) was used to select rock coring intervals and the screen interval for observation well TW-2A. Based on these logs, TW-2A was screened in three distinct zones and rock coring was performed.

2.3.2 Rock Coring

Rock coring was performed at the Del Mar site during the construction of the fourth well, TW-2A. Core intervals were selected across stratigraphic zones that were identified from the geophysical logs run on the adjacent well, TW-2. The rock cores were obtained for laboratory analysis to further evaluate characteristics of potential ASR storage zones. A rock core sample from each of the three sand intervals encountered in the boring were submitted to Mineralogy, Inc., of Tulsa, Oklahoma, for the following analyses:

- Porosity, grain density, horizontal and vertical air permeability
- X-ray defraction
- Scanning electron microscopy
- Cation exchange capacity with leachate analysis
- Specific gravity
- Laser particle size distribution
- Acid residue

2.3.3 Geophysical Logging

Geophysical logs were run on mudded boreholes and cased wells by the TWDB and two separate subcontractors. A summary of the geophysical logs obtained is provided in **Table 2-4**. A complete copy of the logs run is provided in **Appendix D**.

Table 2-4 Laredo Geophysical Logging Summary

Laredo Aquifer Storage and Recovery Project

Well	Location	Depth Drilled	Date Logged	Geophysical Log Run and Operator
TW-1	McPherson	884	1/21/97	Resistivity, Spontaneous Potential (SP), Gamma Ray—TWDB
			4/16/97	Fluid Velocity, Fluid Resistivity, Temperature—TWDB
TW-2	Del Mar Storage Tank	800	2/20/97	Resistivity, SP, Gamma Ray—TWDB
			4/16/97	Fluid Resistivity and Temperature—TWDB
			7/26/97	Fluid Velocity, Fluid Resistivity and Gamma Ray—Century Geophysical
TW-3	East Corridor	914	3/25/97	Resistivity—TWDB
TW-2A	Del Mar Storage Tank	430	7/15/97	Resistivity, SP, Gamma Ray—Sigma Data

Immediately following completion of drilling and prior to well installation, mudded borehole geophysical logs were run to evaluate the site stratigraphy and occurrence of upper sand zone deposits. Within each mudded borehole, resistivity, spontaneous potential

(SP), gamma ray, and conductivity logs were run. Mudded borehole logs for wells TW-1, TW-2, and TW-3 were completed by the TWDB. A complete set of logs was not obtained for TW-3 due to equipment problems. Sigma Data of Pleasanton, Texas, logged the TW-2A borehole.

After completion of the first three wells, logging in the screened borehole was conducted to evaluate water producing zones and water quality. The TWDB ran fluid resistivity, temperature, and fluid velocity logs at TW-1 and TW-2. However, as a result of equipment problems, fluid velocity logs were only obtained at TW-1, and no logs were obtained at TW-3. Temperature and fluid resistivity logs were run at TW-1 and TW-2. Century Geophysical of Elko, Nevada, ran fluid velocity, resistivity, and gamma logs at TW-2.

2.3.4 Well Development

Following well installation, well development was performed to remove fine grained materials from the borehole and well casing. Typically, a mud cake forms within the boring during drilling, which tends to plug the formation. The mud cake is a vital part of drilling as it helps to minimize borehole collapse. However, after well installation, development is performed to remove the mud cake and native sediments that can pass through the well screen. During the investigation, development included several cycles of flushing the well with water and purging the well by airlift pumping. Development typically was performed during a 6 to 8-hour period and ended after relatively clear water was encountered.

2.3.5 Aquifer Testing

In the Step 1 report, existing water well records were reviewed to determine general pumping rates and aquifer characteristics. While a range of values was reported, data used to calculate these values were very limited and often considered unreliable. On the basis of this information, the field investigation sought to obtain additional aquifer information.

Multiple aquifer tests were performed on all three of the test wells installed during the investigation. The aquifer tests performed included step drawdown tests, and short and long-term constant rate pumping tests. The duration and chronology of aquifer testing is summarized in **Table 2-5**.

The tests were run using a 4-inch submersible pump and 2-inch discharge piping provided by the TWDB. Flow rates were measured with a standard water meter provided by the City of Laredo and were recorded manually. All water generated during the testing was directed to a sanitary sewer. For most of the tests, water level responses were measured automatically with a data logger and transducer. At the end of pumping, recovery measurements were also obtained during most tests.

The first three aquifer tests were run between 24 and 48 hours and included a step-pumping test at each location. In early May, additional step pumping tests were run at the TW-2 and TW-3 locations to evaluate the effects of redevelopment discussed later in this report. In mid July, following construction of an observation well (TW-2A) at the Del Mar site, a third test was run and water levels were obtained from both the pumping well (TW2) and TW-2A. Additional aquifer test data were obtained during the pumping and recovery phases of the January 1998 aquifer compatibility test at the Del Mar site.

Table 2-5 Aquifer Test Summary
Laredo Aquifer Storage and Recovery Project

Test Designation	Date Conducted	Pumping Well	Pumping Rate (constant rate)	Duration	Observation Well
McPherson	2/5/97	TW-1	50	40 hours	None
Del Mar	3/11/97	TW-2	50	42 hours	None
East Corridor	4/8/97	TW-3	54	24 hours	None
East Corridor	5/8/97	TW-3	54	13 hours	None
Del Mar	5/13/97	TW-2	68	5 hours	None
Del Mar	7/28/97	TW-2	40	8 hours	TW-2A
Del Mar	1/23/98	TW-2	54	7 Days	TW-2A

Note: The 1/23/98 Pump Test was actually conducted as part of the aquifer compatibility testing discussed in Section 2.3.9

2.3.6 Water Sampling

Groundwater samples were obtained throughout the project on both new and existing water wells. As discussed earlier, several samples were obtained in December and January from existing water wells located by the TWDB and City of Laredo. Additional samples were obtained by CH2M HILL and City of Laredo personnel following the construction of each new monitor well. All samples were collected through existing well appurtenances. Temporary submersible pumps were installed within the new monitor wells for this purpose. Prior to sampling, a minimum of three well volumes was purged during which time measurements were recorded for pH, temperature, and conductivity. Dissolved oxygen and oxygen redox potential measurements were also made on selected samples obtained near the end of the project. All samples were retained in laboratory containers and stored in coolers prior to submittal to the laboratory. Treatment plant water samples were also obtained from two different locations across the City to evaluate the quality and variability of water originating from the Jefferson Water Treatment plant. These samples were handled in a similar manner to the groundwater samples.

2.3.7 Well Redevelopment

Between May 6 and May 8, 1997, well redevelopment activities were performed at TW-2 and TW-3 following the initial pump testing and groundwater sampling. The purpose of the redevelopment was to determine if well yields could be improved with additional development. Relatively low specific capacity values obtained during the initial pump tests and the accumulation of fine-grained materials in the wells TW-2 and TW-3 led to the belief that drilling mud used during the construction process had not been sufficiently removed from the borehole during initial development.

The redevelopment process included a three-step procedure. First, the well screen was flushed with clean water using a jetting tool, beginning from the base of the screen. After jetting with clean water, a sodium acid polyphosphate (SAP) solution was prepared at the surface and injected through the jetting tool directly against the well screen. The SAP is used as mud dispersant to facilitate mud cake removal. Approximately two well volumes of SAP were injected into the screen zone. Clean water was added at the top of the well to maintain flow and carry the SAP solution into the well screen zone. Following a 12-hour period, the well was flushed with clean water and then airlifted for approximately 3 hours to remove the solution. Within one day after flushing, short duration aquifer tests were run at both locations to evaluate the effects of redevelopment. All water pumped to waste was directed to a sanitary sewer.

2.3.8 MFI and TSS Analyses

In order to assess the overall ability of the City of Laredo treated water to be injected into porous media, MFI tests were conducted. These tests are run by passing the test water through a 0.45-micron filter and measuring timed volumes of water through the filter. Times and volumes are recorded to identify the time and volume required to plug the filter. The filter is then weighed, the total suspended solids (TSS) of the test water calculated, and an MFI value calculated from the results. These values, the TSS and the MFI, are then compared to other ASR facilities and an assessment of the ability of the water to be injected into an aquifer determined. A comparison of the results to other sites can then also be used to yield an estimated potential clogging rate in the well. This clogging rate would represent the head buildup over time in the wellbore associated with injection. This rate is in addition to the head buildup associated with the aquifer hydraulics and wellbore losses calculated from pumping tests.

The MFI tests were run at several locations in the City of Laredo distribution system to assess the plugging potential of the treated water as a function of location in the distribution system. The testing was conducted at the Jefferson Street WTP to measure the plugging potential of the water immediately following treatment, and then at several distant locations in the distribution system to determine whether residence time in the pipelines may increase the plugging potential of the water. In addition to the testing conducted at the Jefferson Street WTP, tests were run at the East Corridor testing site, the Northwest Storage tank, and the Del Mar testing site.

2.3.9 Aquifer Compatibility Testing

In August 1997, all the information obtained from the testing to date, including analytical data obtained from previous groundwater sampling, rock coring, MFI, and TSS analysis, were reviewed to evaluate whether a full scale ASR system could be developed for the City. The results revealed some potential geochemical issues, but found no serious problems with the native groundwater or the quality of the City's treated water supply that might be detrimental to such a facility. Of overriding concern, however, was the very low aquifer transmissivity of the Laredo Formation. Low aquifer transmissivity results in low yielding wells, and substantially increases the risk of aquifer plugging from injection.

The results of the testing indicated most issues surrounding ASR implementation were satisfactory but that the aquifer transmissivity was low. For this reason, a small-scale aquifer compatibility test was conducted to directly measure the effects of injecting City of Laredo water into the Laredo Formation. The testing plan was developed to directly measure water quality changes and borehole hydraulic response to injection of the City water and subsequent recovery by pumping.

In preparation for the test, a Class V temporary injection permit was submitted to the TNRCC on behalf of the City and subsequently approved on November 3, 1997. In January 1998, the aquifer compatibility test was performed at well TW-2.

The testing had two specific objectives: to evaluate geochemical changes associated with the injection and subsequent removal of injected surface water and to evaluate aquifer hydraulics associated with these activities. The testing was initiated with a four-hour shake down test to assess operation of the injection and recovery system as a precursor to a longer, two-week injection and recovery test.

If the results of this phase of the investigation find the feasibility of ASR implementation high, the next step will be to construct an ASR prototype facility and actually test the ASR concept at full scale. This type of test is usually conducted as a final step in ASR feasibility testing and the testing results in finalizing the design parameters for a full scale ASR facility that may include several wells and sites.

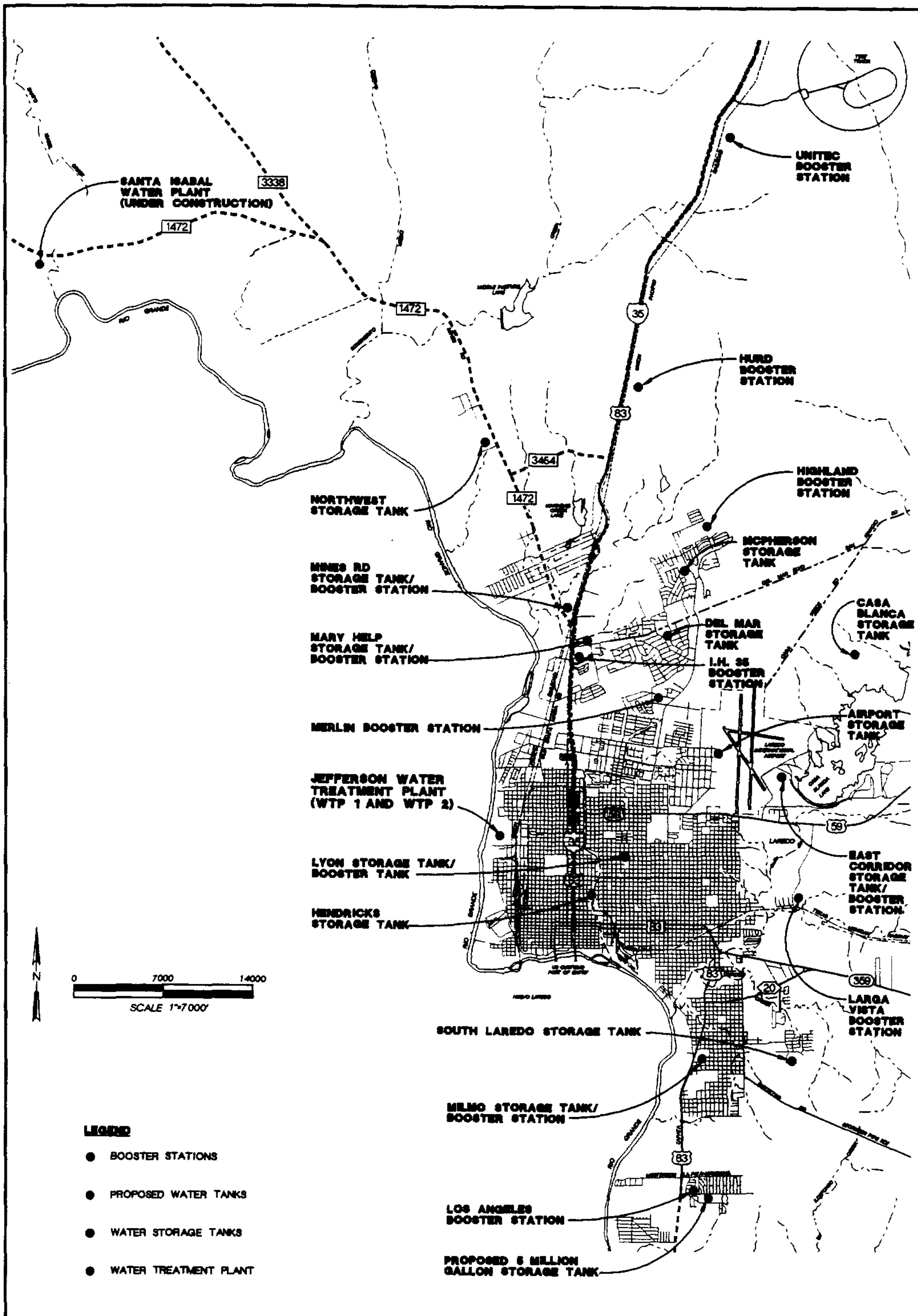


FIGURE 2-1
FACILITY LOCATIONS
AQUIFER STORAGE AND RECOVERY PROJECT
CITY OF LAREDO, TEXAS

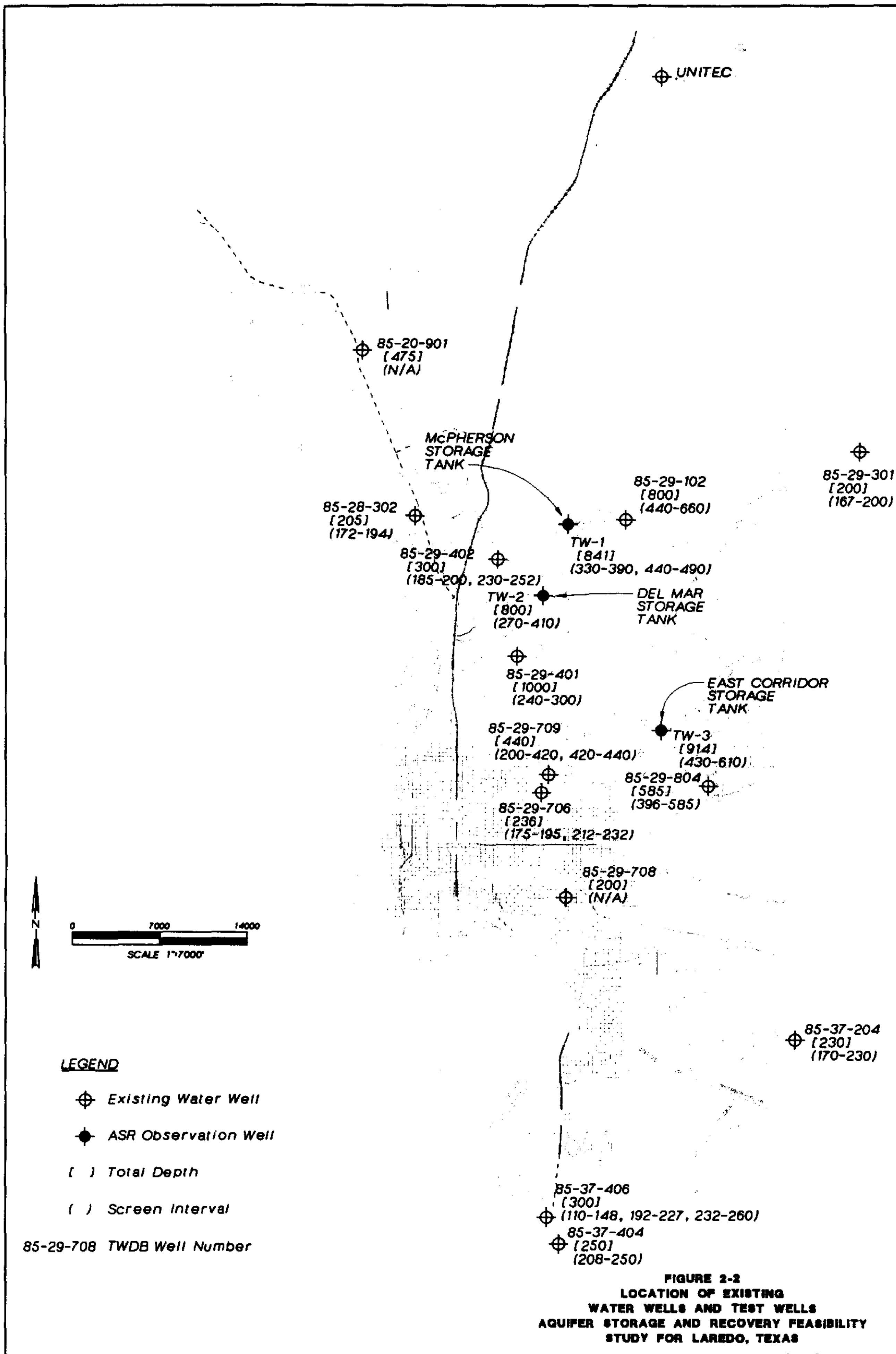


FIGURE 2-2
LOCATION OF EXISTING WATER WELLS AND TEST WELLS
AQUIFER STORAGE AND RECOVERY FEASIBILITY STUDY FOR LAREDO, TEXAS

CH2MHILL

Results

3.1 Aquifer Characteristics

The Step 1 report contains an overview of the regional geology in the Laredo area. The following section discusses specifically the Laredo Formation, which was the focus of the second phase of the investigation.

3.1.1 Aquifer Setting and Distribution

The Laredo Formation was deposited within a transitional deltaic and marine system. The Formation consists of interbedded sands, sandstones, clays, shale, and siltstone. The coarsest materials encountered within the Formation are likely to have originated from southeasterly flowing rivers that were subsequently reworked by wave action and redeposited parallel to the ancient shoreline.

The Formation is present at the surface in Laredo and outcrops in a north-south trending band that occurs between Sombrerito Creek located northwest of the City, and Chacon Creek, located east of the City. The limits of outcrop are shown on **Figure 3-1.** The thickness of the Formation ranges from 620 feet at the outcrop to more than 875 feet in wells located east of the outcrop. **Figures 3-2 and 3-3** are geophysical profiles that depict the distribution of the Laredo Formation in the subsurface beneath Laredo. The location of the profiles is shown in **Figure 3-1**. The profiles were generated from resistivity logs obtained during the geophysical log review discussed in the previous section. High resistivity layers generally correlate with higher permeability layers such as sand. Low permeability sediments such as clays and silts are inferred from low resistivity responses. The west to east profile shown in **Figure 3-2** illustrates that the formation dips and thickens to the east. There are few significant changes shown on the north-south profile.

The depth to water at most locations is between 100 and 120 feet below ground surface (bgs). The principal water bearing units within the formation are interbedded sands and sandstone layers that are separated by clay, shale, silt, and siltstone. Unconsolidated materials generally occur only within the upper 100 feet of the formation. The geophysical profiles indicate that many of the stratigraphic layers can be correlated across great distances in Laredo.

The geophysical evaluation summarized in **Appendix A** identified an upper sand zone within the Formation that contains the greatest concentration and thickness of waterbearing sandstone layers (**Figure 3-2**). The saturated upper sand zone appears to occur within a relatively narrow, north-south trending band that encompasses most of central and eastern Laredo. The upper sand zone is approximately 200 to 250 feet thick across most of eastern Laredo, which is where the complete section is present (**Figure 3-2**). In western Laredo, the upper sand zone is present at the surface and is only partially saturated. While the entire formation thickens to the east and southeast, in this direction it also becomes finer grained and contains fewer and thinner sand layers.

There are approximately 3 to 5 individual sand intervals that are the predominant waterbearing units in the upper sand zone. The resistivity of these intervals is generally between 10 and 20 ohms, which is relatively low as compared with coarser and more permeable waterbearing units typically used for water resource development. The sand layers range in thickness from 15 to 60 feet. Sand layer thicknesses identified on geophysical logs from test borings are summarized in **Table 2-3** and were used as the basis for selection of screen interval in the test well. The total cumulative thickness of sand layers within the upper sand zone ranges from about 140 to 190 feet. Additional information on the thickness and distribution of the upper sand zone may be found in **Appendix A, Figure A-1.**

3.1.2 Aquifer Properties

3.1.2.1 Aquifer Test Results

Several aquifer tests were performed to evaluate specific aquifer properties, principally the aquifer transmissivity. Transmissivity was calculated as a function of time and the drawdown measured in the well during the pumping. All test data was plotted as time versus drawdown on semi-log paper. Time versus drawdown graphs for representative well tests from locations TW-1, TW-2, TW-2A, and TW-3 are shown in **Figures 3-4** through 3-7. Additional aquifer test plots from all the tests may be found in **Appendix E.**

Where multiple pump tests were performed at a single well (TW-2 and TW-3), values for transmissivity were estimated by generating a theoretical drawdown curve that was matched to the actual drawdown response. The theoretical curve was generated for the pumping well using the Theis equation modified to include a well loss term (CQ^2). The relationship is as follows:

$$s = Q\,W(u)/4\pi tT + CQ^2$$

Where:

s = drawdown (feet)

Q = discharge (gpm)

W(u) = well function, where $u = r^2S/4tT$ and r=well radius and S = Storage coefficient

t = time (minutes)

T = aquifer transmissivity (ft^2/day)

C = well loss coefficient

The value for storage coefficient was calculated from the July 1997 aquifer test at TW-2, which utilized an observation well. The storage coefficient for TW-3 calculations was estimated from the TW-2 test. Because T and S are aquifer constants that should not vary between tests at the same well location and Q is measured directly during pumping, well losses are the only other variable that can define changes in the drawdown observed between tests in the same well. Additional discussion of well losses is provided in the following section.

Transmissivity values were also evaluated using the Cooper-Jacob straight-line method. In general, a good match was achieved for each of the drawdown curves analyzed using best fit values of aquifer properties and the well loss coefficient and the Cooper-Jacob method. Deviations from the straight line were uncommon but where present are thought to have resulted from flow rates that varied slightly during testing. This approach proved to be a more reliable and prudent method of analyzing the data as compared with calculating discrete values of transmissivity and then averaging the results. There were no boundary conditions identified during any of the aquifer tests performed.

A summary of the values derived for transmissivity and storage coefficient is summarized in **Table 3-1**. As shown, the calculated transmissivities range from 141 to 195 square feet per day (ft^2/day) in the pumping wells (TW-1, TW-2, and TW-3). All the calculated transmissivity values are consistent with regional information reported in the Step 1 investigation. The calculated storage coefficient from the July 1997 test performed at TW-2 is approximately 9×10^{-5}, indicating confined aquifer conditions.

Table 3-1 Summary of Aquifer Test Results

Laredo Aquifer Storage and Recovery Project

Well Location	Observation Well	Transmissivity (ft^2/day)	Storage Coefficient
TW-1	N/A	141	N/A
TW-2	TW-2A	168	0.0000904
TW-3	N/A	195	N/A

Note: N/A = not applicable

3.1.2.2 Step Test Analysis

Step pumping tests were performed as part of the aquifer testing to evaluate the components of wellbore and other head losses. Initially, there was speculation that the low specific capacities calculated from initial tests at each test well were a reflection of inadequate well development. Following the preliminary development and initial pump tests, both TW-2 and TW-3 were redeveloped (Section 2.3.7). After redevelopment, a second step test was conducted at both wells for the purpose of evaluating changes in the well loss associated with redevelopment. TW-1 was not redeveloped because of concerns regarding the well construction. During placement of the gravel pack in this well, part of the formation collapsed in the upper portions of the well screen.

The drawdown data from testing before and after redevelopment were analyzed using the Hantush-Bierschenk method of determining well losses. The method involves calculation of both well losses and aquifer losses that are based on measured changes in the drawdown that occurs with different flow rates. Step test graphs and well efficiency calculations that include evaluation of well losses are found in **Appendix E**. Calculated well losses and well loss coefficients for TW-2 and TW-3 before and after redevelopment are shown in **Table 3-2**. The well losses in both wells decreased following development, reflecting improvement in well efficiencies, particularly in the case of TW-2. Only a slight improvement was observed in TW-3.

Table 3-2 Step Pumping Test Evaluation

Laredo Aquifer Storage and Recovery Project

Well Location	Pre-redevelopment Well Losses		Post-redevelopment Well Losses	
	C	CQ^2	C	CQ^2
TW-2	0.0137	34	0.0044	11
TW-3	0.0062	16	0.0047	12

Note: Q = Discharge
C = Well Loss Coefficient
CQ^2 = Well Loss

3.1.2.3 Spatial Distribution of Specific Capacity

Specific capacity calculations were performed using the data obtained from the aquifer tests and compared with specific capacity data from existing water wells (Section 2.1). Specific capacity is a parameter used to assess the general condition and permeability of a well. It is a measure of the quantity of water (gpm) obtained from a well for each foot of drawdown during pumping. The distribution of specific capacity measurements is shown on **Figure 3-8**. In general, very low specific capacities occur in the Laredo area and there does not appear to be a strong trend to the reported values. Higher specific capacity values generally occur in the central and northeastern areas of the City where upper sand zone deposits may be thicker and/or more permeable. The specific capacity values calculated after 100 minutes of pumping for test wells TW-1, TW-2, and TW-3 were 0.36, 0.72, and 0.82 gpm/ft, respectively. Values around 1 gpm/ft appear typical for the Laredo area.

There are three wells screened in the Laredo Formation for which specific capacity values of one or greater were reported on well completion logs on file with the TNRCC. These wells include 85-21-7(1) (Union Pacific), 85-29-102 (Laredo Country Club), and 85-29-709 (Mercy Hospital) and the reported specific capacities are 2.65, 2.8, and 1.05 gpm/ft, respectively. It is unclear whether the reported values reflect more permeable deposits in the area of the wells. Of the three wells, only the Union Pacific well was not identified during the preliminary well survey. All three wells were installed by Woods Drilling using the air rotary drilling method and are constructed with a minimum seven-inch ID casing. A limited drawdown test was performed at the Country Club well in 1997 by City and TWDB personnel and a value of about 1.5 gpm per foot of drawdown was estimated. This suggests that either the original test was inaccurate or the well has fouled since construction. A more extensive pump test was attempted at this well but downhole well appurtenances limited access to monitoring equipment.

3.1.3 Groundwater Quality

Groundwater analytical data from existing wells are presented in **Table 3-3**. Three of the locations sampled, including the Unitec well, well 85-29-301, and well 85-37-204, were determined not to be screened in the Laredo Formation and were not consider further in this evaluation. Test well analytical data is provided in **Table 3-4**. Laboratory analytical data reports can be found in **Appendix F**. Test parameters generally included major anions and cations and general water quality parameters. Metals were also analyzed at some locations.

Table 3-3
Groundwater Analytical Results
Existing Water Wells
Laredo Aquifer Storage and Recovery Project

	Lab ID	AQ-1	AQ-2	AQ-3	AQ-4	AQ-5	AQ-6	AQ-7	AQ-8	AQ-12	AQ-13	AQ-14	* LCC	* UNITEC
	Field ID & Location	85-20-901 (Laredo Redi Mix)	85-29-708 (Catholic Cemetery)	85-37-404	85-37-406 (Not in Laredo FM)	85-29-301 (Killam Cattle Co)	85-29-102 (Laredo Country Club)	85-29-401	85-29-706	85-29-709 (Mercy Well)	85-29-804 (Lake Well)	85-37-204 (Not in Laredo FM)	85-29-102 Country Club	Uniroyal Tire Track (Not in Laredo FM)
	Date Collected	12/4/96	12/4/96	12/5/96	12/3/96	12/3/96	12/3/96	12/4/96	12/4/96	1/21/97	1/21/97	1/30/97	7/13/97	7/13/97
Parameter	Units													
Temperature	C	27.5	25.3	27.4	27.3	27.6	29.4	27.3	27	27.2	28.9	15.6	38	49
TDS	mg/l	2065	5163	2243	3410	3465	1785	1465	1420	1366	2200	1654	1552	2164
pH	S.U.	7.47	7.48	7.38	7.43	8.7	8.92	8.85	8.74	8.48	8.13	7.48	8.5	8
Field pH	S.U.	7.3	7.59	7.3	7.18	8.34	8.59	8.84	8.7	8.72	NA	7.7	8.63	7.92
Cond.	S.U.	2970	7070	3200	4510	4980	2800	2170	2290	2080	4030	3000	3250	4730
Field Cond	S.U.		7110		4505	5050	2830	2210	2340	NA	4020	2730	3314	3745
Pheno Alk	mg/l												8.5	20
Alkalinity	mg/l	268	244	328	352	280	220	276	340	325	970	500	244	1196
Hardness	mg/l	389	323	322	271	103	2.2	24	9.23	11	10.3	165	20	20
Dissolved Oxygen (%)	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.7	21.1
ORP	millivolts	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	58.6	504
Nitrogen (TKN)	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		1.2
Organic Carbon	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	2
Silica Dioxide	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.5	
Cations														
Aluminum	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.07	
Iron	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Manganese	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Calcium	mg/l	88	83	76	107	10	3.19	1.69	2.22	2.4	2.5	37	6	6
Sodium	mg/l	422	982	521	892	695	349	445	512	473	956	639	618	422
Potassium	mg/l	7.096	39	5.52	7.56	1.63	0.9	0.67	1.28	1.5	2.1	6.3	1	5
Magnesium	mg/l	41	28	32	67	1	0.31	0.16	0.9	0.6	1.3	18	0.09	0.9725
Lithium	mg/l	0.117	0.073		0.14	0.1	0.03	0.02	0.02	0.06	0.11	0.2		0.18
Anions														
Bromide	mg/l	0.924	1.74	0.64	1.03	1.08	1.11	0.78	0.74	0	1.3	5.1	1.846	3.275
Chloride	mg/l	315	743	243	356	358	397	378	271	278	482	280	495	943
Sulfate	mg/l	876	2830	1027	1801	1855	521	329	341	472	629	541	590	
Floride	mg/l	2.629	5.84	3.23	4.6	4.62	2.35	0.83	0.87	0.7	1.7	1.9	1.7	2.9
Phosphate	mg/l										0			
Ammonium	mg/l													
Nitrate	mg/l	0.49												
Nitrite	mg/l													
Bicarbonate	mg/l	326.7	297	399	429.2	321.9	234.1	278.0	365.8	379.2	1134	610		
Carbonate	mg/l		0	0		18.8	32.9	56.5	47.1	49.4	24	0		
Mass Balance	%	-10.7	-25.8	-8.9	-4.7	-28.0	-27.3	-10.4	0.3	-10.3	-11.7	3.3	-7.8	-7.8

Note:
* Samples collected for metals analysis were field filtered
NA = Not Analyzed

Table 3-4
Groundwater Analytical Results Test Wells
Laredo Aquifer Storage and Recovery Project

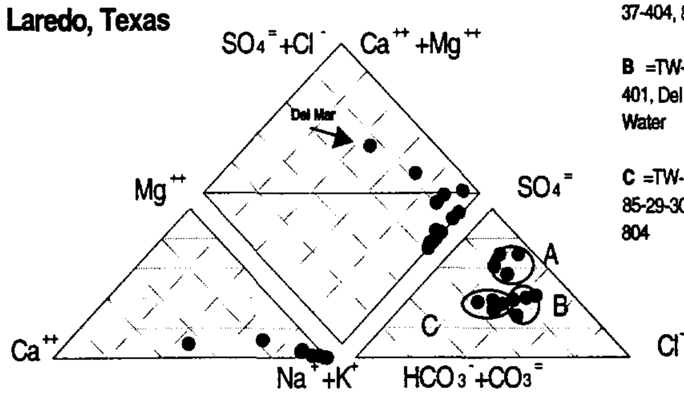
	Lab ID	AQ-15	AQ-16	AQ-17	AQ-18	AQ-19	AQ-20	AQ-21	AQ-22	AQ-23	AQ-24	AQ-50	AQ-51	AQ-52	AQ-53	* TW-2
	Field ID & Location	TW-1 (McPherson)	TW-1	TW-1	TW-1	TW-1	TW-1	TW-1	TW-2 (Del Mar)	TW-2	TW-2	TW-2	TW-2	TW-3	TW-3 (East Corridor)	Same
	Date Collected	2/6/97	2/6/97	2/6/97	2/7/97	2/7/97	2/7/97	2/7/97	3/8/97	3/9/97	3/9/97	3/9/97	3/10/97	4/9/97	4/11/97	7/28/97
Parameter	Units															
Temperature	C	26.2	25	25.2	24.1	25.2	26.8	NA	26.3	27.9	27.8	28	26.8	28.9	29.1	NA
TDS	mg/l	1752	1282	1224	1204	1240	1300	1764	1660	1692	1670	1674	1670	1470	1266	1440
pH	S.U.	8.95	9	8.79	8.83	8.82	8.88	8.58	8.6	8.6	8.8	8.7	8.8	8.7	8.5	8.8
Field pH	S.U.	9.13	9.02	8.92	9	8.98	8.98	na	8.76	8.77	8.8	8.74	8.81	8.69	8.75	8.91
Cond.	S.U.	2890	2880	2900	2900	2900	2910	2930	2830	2800	2800	2820	2820	2390	2060	2550
Field Cond	S.U.	3000	2995	3250	3400	3250	3050	na	1900	2750	2800	2700	2700	2610	2300	2401
Pheno Alk	mg/l	27	20	18	18	25	15	16	16	15	14	14	13	19	20	17
Alkalinity	mg/l	185	184	180	181	180	182	182	215	220	219	219	218	298	302	228
Hardness	mg/l	21	20	19	18		17	17	40	24	32	32	22	40	18	15
Dissolved Oxygen (%)	%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	114.1
ORP	millivolts	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	167.1
Nitrogen (TKN)	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Organic Carbon	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1
Silica Dioxide	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.5
Cations																
Aluminum	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	mg/l	7.61	6.72	6.2	5.74	5.71	5.48	5.1	10	7	6	6	5	9.6	3	3
Sodium	mg/l	736	739	718	712	715	703	708	557	581	553	514	599	488	422	501
Potassium	mg/l	2.36	1.98	1.76	1.65	1.67	1.7	1.54	2	2	2	2	1	1	1	2
Magnesium	mg/l	0.194	0.308	0.38	0.47	0.524	0.871	0.59	2	1.38	1.12	1	1.03	3.88	1.9	0.49
Lithium	mg/l	0.06														0.03
Anions																
Bromide	mg/l	0.924	1.15	1.17	1.24	1.13	1.23	1.27	1.46	1.44	1.46	1.48	1.46	1.06	0.27	1.43
Chloride	mg/l	469	481	426	413	549	549	489	429	425	425	425	418	317	259	357.1
Sulfate	mg/l	616	593	609	605	614	593	631	491	484	484	483	476	438	343	**
Floride	mg/l	2.4	2.2	2.22	2.26	2.2	2.34	2.3								
Phosphate	mg/l															
Ammonium	mg/l															
Nitrate	mg/l															
Nitrite	mg/l															
Bicarbonate	mg/l	159.7171422	175.6	175.6	176.8	158.5	178.0	182.9	262.1	268.2	267.0	267.0	265.8	386.5	388.9	
Carbonate	mg/l	63.52941176	47.1	43.9	42.4	58.8	35.3	37.6	22.4	21.2	20.0	20.0	18.8	26.8	28.2	
Mass Balance	%	2.45	3.28	4.03	4.41	-2.31	-1.74	-0.29	-4.95	-3.08	-5.60	-9.16	-1.104	-7.05	-7.82	-7.82

Note:
* Samples collected for metals analysis were field filtered
** Sulfate value is erroneous
NA = Not Analyzed

Data quality and control included an evaluation of holding times as well as mass balance calculations for the major anions and cations. Ideally, the difference in the concentrations of cations and anions (expressed in milli equivalents) should be in the range of 10 percent or less. Laboratory data quality problems were identified during the initial analysis of samples and are reflected in the mass balance calculations included in **Table 3-3**. The mass balances for samples AQ-2, AQ-5, and AQ-6 were in excess of 20 percent. Laboratory staff indicated that the holding times for several of the original samples (AQ-1 through AQ-8) were exceeded in the laboratory. As a result, data from these locations need to be considered estimates.

Percentages of various cations and anions are summarized in **Table 3-5** and are plotted in a Piper diagram shown in **Figure 3-9**. All the groundwater samples have sodium as the dominant cation but the relative proportion of the anions varies between bicarbonate, sulfate, and chloride. Three water types are shown on **Figure 3-9** including a sulfate-dominated water chemistry, (type "A"), a mixed water chemistry (type "B"), and a mixed chloride-sulfate type (type "C"). **Figure 3-10** shows the spatial distribution of pH, and the anions chloride, sulfate, and bicarbonate. Along the western margin of the City, type A groundwater is present that is relatively low in pH and high in TDS and sulfate. In the north central areas, type C water is present. Wells screened in this area have an intermediate TDS (1,670 to 1,785 mg/l) and a high pH ranging from 8.58 to 8.92. The reason for the high pH is due to the relatively low concentration of calcium. In the central to east-central areas of the city, groundwater is mixed with relatively equal amounts of bicarbonate, sulfate, and chloride. Wells in this area have an intermediate TDS (1,266 to 2,200 mg/l) and a high pH ranging from 8.13 to 8.85.

Figure 3-9
Piper Plot, Laredo ASR Project
Laredo, Texas



Groundwater Types:

A = 85-20-901, 85-29-708, 85-37-404, 85-37-406

B =TW-1, 85-29-102, 85-29-401, Del Mar Distribution Water

C =TW-2, TW-3, 85-29-709, 85-29-301, 85-29-706, 85-29-804

Table 3-5
Percentages of Various Anions and Cations
Laredo Aquifer Storage and Recovery Project

Location	Sample ID	%Calcium	%Magnesium	%Sodium and Potassium	% Bicarbonate and Carbonate	%Chloride	%Sulfate
85-20-901	AQ-1	16.69	12.83	70.48	16.49	27.36	56.15
85-29-708	AQ-2	4.51	2.51	92.98	5.74	24.73	69.52
85-37-404	AQ-3	7.33	5.09	87.58	18.80	19.71	61.48
85-37-406	AQ-4	6.04	6.23	87.73	12.89	18.40	68.71
85-29-706	AQ-8	0.25	0.17	99.59	33.90	34.27	31.83
85-29-401	AQ-7	0.22	0.03	99.75	26.88	44.52	28.60
85-29-301	AQ-5	0.82	0.13	99.05	10.81	18.49	70.70
85-29-102	AQ-6	0.52	0.08	99.40	17.79	41.76	40.45
Del Mar Storage Tank (surface water)	Del Mar	45.44	9.83	44.73	23.06	37.70	39.24
85-29-804	AQ-13	0.15	0.13	99.72	36.66	25.71	37.63
85-29-709	AQ-12	0.29	0.12	99.59	30.77	30.69	38.54
TW-1	AQ-21	0.82	0.16	99.03	13.64	44.24	42.13
TW-2	AQ-52	1.82	1.45	96.73	28.58	35.36	36.06
TW-3	AQ-53	0.80	0.42	98.78	33.61	33.57	32.81

3.1.4 Aquifer Characteristics at the Del Mar Test Site

Following preliminary testing at each of the three test sites, the Del Mar site was selected for additional testing, which included geophysical logging, a second monitor well construction, rock coring, and eventually, a limited aquifer compatibility test. The selection was based on factors such as security and accessibility as well as its location relative to service areas considered most appropriate for ASR applications.

Based on the geophysical logs run in well TW-2, the upper sand zone was determined to occur between 270 and 500 feet bgs. Within this zone, prominent sand units were identified in five different depth intervals (**Table 2-3**). The three shallowest zones occurring between 270 and 420 feet bgs appeared to contain the greatest thickness and highest permeability layers relative to the deeper units. As result, TW-2 was subsequently screened across the entire 165-foot interval encompassing the three sand units.

Fluid velocity logs were run in TW-2 to evaluate both the occurrence of distinct fractures and the relative permeability of the sand zones occurring within the screen zone. The logs are included in **Appendix D, Attachment D-2**, and show flow contribution from four primary zones: 290-306, 330-360, 373-386, and 410-420 feet bgs. The 330-360 foot interval appears to be contributing the most flow during pumping. Similar flow contributions were observed from both the 330-360 and 410-420 foot zones, suggesting that they have similar permeabilities. This was later confirmed by the core permeability tests performed on TW-2A samples from these intervals (see below).

Rock cores from TW-2A suggest groundwater flow occurs principally within the sand bearing units. Few secondary porosity features (fractures, partings, bedding planes, vugs) were observed within the lower permeability units (siltstone and shale) and where present, they showed little evidence of groundwater flow. Within the sandstone units, groundwater flow is believed to occur primarily with the primary rock porosity as opposed to secondary porosity features. However, it was not possible to directly observe the presence of secondary porosity features within many of the more friable sandstone cores. These cores were often broken, primarily along bedding planes, and it is likely that many of the observed fractures were induced by drilling and are not necessarily naturally occurring.

Field and laboratory examination of rock cores obtained from test well TW-2A reveal that the primary waterbearing units consist of relatively fine-grained, friable sandstone. Additional rock core descriptions may be found in **Appendix C**. Rock core samples were obtained for laboratory analysis from three representative sand zones (292-293.4, 330-330.4, and 400.65-401.9) and were determined to be relatively similar with respect to mineralogy, texture, and reservoir quality. The mineralogic content of these cores is approximately 89 percent quartz, 9 percent clay minerals, and about 2 percent feldspar minerals. The bulk of the clay is present as glauconite pellets, and sedimentary mudstone and shale fragments. A mixed layer illite/smectite and relatively minor volumes of chlorite and illite dominate the clay mineralogy. A helium porosity of approximately 30 percent was measured in each core and the horizontal permeability of the cores ranged from 631 to 809 millidarcies. The laboratory identified minor occurrences of pore throats filled or "clogged" with clay materials. The laboratory determined that some clays were susceptible to expansion but suggested that under a relatively constant hydration state and stable salinity values, formation damage caused by expansion of clays would be minor. Additional information regarding the laboratory rock core analyses may be found in **Appendix G**.

Three aquifer tests were performed at the Del Mar site including two single well, constant rate tests and one constant rate test utilizing TW-2A as an observation well. As discussed earlier, specific capacity values were calculated for each test and compared to evaluate changes in well losses. **Table 3-6** is a comparison of the values for specific capacity and well loss coefficients.

Table 3-6 Comparison of Aquifer Test Properties, Del Mar Test Site
Laredo Aquifer Storage and Recovery Project, Laredo, TX

Date	TW-2 Pumping Rate (gallons per minute)	Specific Capacity (gallons per foot of drawdown)	Well Loss Coefficient
March 1997	49	0.50	0.0137
May 1997 (Constant Rate test)	68	0.72	0.0044
July 1997	54	0.59	0.008

As shown, there was an increase in the specific capacity following the redevelopment activities that occurred in May. The specific capacity subsequently fell during the period when the well was idle. The reason for the drop in specific capacity following development is unknown. However, the change may be the result of chemical precipitation caused by the addition of the surface water during development, and possibly bacteria growth within the well screen.

The July 1997 groundwater from well TW-2 (**Table 3-4**) contains a significantly lower TDS (1440 mg/l) than the average of five analyses from samples collected in March 1997 (1673 mg/l) and the pH is slightly higher (8.91 vs. 8.78). The groundwater is a sodium-chloride-sulfate water chemistry type and does not change with the change in TDS. The implication of the difference in TDS is simply dilution not chemical reaction. The groundwater is under moderately oxidizing conditions with an Eh (the oxidation-reduction potential of water) of 367 millivolts (mv). The low iron and non-detected manganese concentrations confirm the oxidized condition of the aquifer.

The total organic carbon (TOC) at the Del Mar site is about average for groundwater, as is the nitrate, but the ammonium and organic forms of nitrogen are slightly higher than the average groundwater. Normally, the nitrate (oxidized) form of nitrogen would dominate the nitrogen speciation under these oxidizing conditions. The alkaline pH coupled with these forms of nitrogen suggest a relatively healthy, natural, aerobic microbial population in the aquifer.

3.2 Surface Water Characteristics

Surface water quality was evaluated through laboratory analysis and field measurements.

3.2.1 Modified Fouling Index Results

Summary results of the MFI tests are presented in **Table 3-7**. Complete results are included in Appendix H. The results indicate the plugging potential of the treated City of Laredo water is relatively low and that the potential for plugging did not increase with distance from the Jefferson Street WTP.

Table 3-7 MFI Test Results
Laredo Aquifer Storage and Recovery Project, Laredo, TX

Testing Site	Average MFI Value	Average TSS (mg/l)
Jefferson Street WTP	3.41	1.35
East Corridor Site	2.39	1.19
Northwest Storage Tank	2.66	1.01
Del Mar Testing Site	3.86	0.69

The above MFI values indicate that with an aquifer transmissivity in the range of 150 to 200 square feet per day (ft^2/day), an annual clogging rate of 4 to 6 feet would be expected. This value is based on a comparison of MFI values at several ASR sites with varying transmissivities. However, the transmissivities at these other sites are all much higher than those reported in Laredo. The value can be interpreted to imply that in a 6-inch well with 160 feet of screen recharging at about 33 gpm, an increase in water level in the well due to clogging of the screen should only be about 4 to 6 feet during a one year injection duration.

3.2.2 Laboratory Analytical Results

Surface water samples were obtained from the Jefferson Treatment Plant and the Del Mar Storage Tank area. These results are presented in **Table 3-8**. The surface water quality is characterized as sodium-sulfate water chemistry. However, several distribution system water samples were obtained during the aquifer compatibility test. These samples were analyzed for similar constituents and also included iron and manganese. The results of testing performed during the compatibility test are discussed later in this section.

3.3 Aquifer Compatibility Test Results

3.3.1 Testing Methodology and Overview

The aquifer compatibility testing was conducted at the Del Mar site using the two test wells, TW-2 and TW-2A, discussed previously. Well TW-2 was selected as the test well in which water would be recharged and recovered and well TW-2A was selected as the monitor well in which aquifer water levels would be monitored. Well TW-2 was selected for the recharge and recovery testing primarily because of its size, a 6-inch diameter compared to the 4-inch diameter of well TW-2A.

A temporary piping setup was constructed at well TW-2 that conveyed water from existing onsite piping through a 2-inch fire hose to well TW-2. The source of the water was the elevated storage tank on the Del Mar site, although the connection point was an existing buried 2-inch pipe near an abandoned treatment vessel. Temporary piping was also installed to convey the recovered water to an onsite sanitary sewer.

Table 3-8
Surface Water Analytical Data
Laredo Aquifer Storage and Recovery Project

	Lab ID	* JEFFERSON Treat. Plant	* DEL MAR Treat. Plant
	Date Collected	7/16/97	7/15/97
Parameter	Units		
TDS	mg/l	516	NA
pH	S.U.	8.18	NA
Field pH	S.U.	8.75	7.21
Cond.	S.U.	1093	NA
Field Cond	S.U.	1075	1109
Pheno Alk	mg/l	1	NA
Alkalinity	mg/l	101	NA
Hardness	mg/l	266	262
Dissolved Oxygen (%)	%	109.3	88.9
ORP	millivolts	345.9	403.2
Nitrogen (TKN)	mg/l	3.4	
Organic Carbon	mg/l	5	2
Silica Dioxide	mg/l	9.5	8.3
Cations			
Aluminum	mg/l	0.35	0.18
Iron	mg/l		
Manganese	mg/l		
Calcium	mg/l	78	NA
Sodium	mg/l	121	119
Potassium	mg/l	4	4
Magnesium	mg/l	20.9	21.1
Lithium	mg/l		
Anions			
Bromide	mg/l	0.128	1.37
Chloride	mg/l	141	137
Sulfate	mg/l	179	Error, bad data
Floride	mg/l	0.724	
Phosphate	mg/l		
Ammonium	mg/l		0.44
Nitrate	mg/l		
Nitrite	mg/l		
Bicarbonate	mg/l		
Carbonate	mg/l		
Mass Balance	%	-7.82	-7.82

Notes: * Samples collected for metals analysis were field filtered
NA Not Analyzed

Well TW-2 was equipped with a 4-inch submersible pump, 2-inch drop pipe, and 2-inch above ground piping that allowed water to be injected into and pumped from the well. The check valve was removed from the pump body to allow water to be injected back through the pump during the recharge portion of the testing. Preliminary calculations and testing of the pump before installation into the well indicated a recharge rate back through the pump of approximately 25 gpm should be possible. In order to inject at higher rates into the well, a 1-inch injection tube was also installed in the well next to the pump. Preliminary calculations indicated that an additional 33 gpm could be injected through the injection tube and a combined injection rate of up to 50 gpm may be possible with the piping configuration installed. It is important to note that the injection rate into the well is dependent on both the system pressures delivered to the well, and the water level in the well. Both of these variables were expected to change during the testing and this variability had to be considered in selecting the target recharge rate.

The aquifer compatibility test was conducted at the Del Mar site beginning January 14, 1998, and ran through January 30, 1998. The test included a preliminary, or shakedown, test to check the operation of the equipment. The shakedown test consisted of recharging water into the aquifer through the pump and injection tubes for a short period of time, followed by pumping the well. The recharge portion of the shakedown testing was conducted by slowly increasing the injection rate while monitoring well water levels, flow rates, and line pressures. The intent of the test was to establish the performance range and limitations of the testing configuration. The recovery portion of the shakedown test was conducted in a similar fashion, with the well pumping rates varied to establish the performance range of the pump and piping configuration.

The shakedown testing indicated a maximum recharge rate of 30 gpm was possible through the pump and 26 gpm through the injection tube. A maximum combined rate of 52 gpm was measured with both recharge through the pump and injection pipe. These rates were measured with a depth to water level in well TW-2 of about 120 feet bgs. During the longer-term test, the water level in the well was expected to rise and the maximum possible recharge rate would decrease. Based on this fact and the shakedown test results, a target long-term recharge rate of 30 gpm was selected for the next test.

The pump installed in well TW-2 was tested during the shakedown test and pumping rates from 54 to 60 gpm were observed possible. The pump had the ability to pump against higher total heads than necessary for this test and the low rate possible from the pump required substantial throttling of the pumped flows. The low pumping rate is the result of throttling the pumped flows to a piping pressure of 100 psi. This pressure was considered the maximum piping pressure for the configuration installed.

Following the shakedown test, potable water from the City of Laredo distribution system was recharged into well TW-2 followed by recovery of the water by pumping the well. Once during the recharge portion of the test, recharge was shut off and the well was backflushed by pumping. A cumulative summary of the water injected versus recovered during the test is provided in **Figure 3-11**. A summary of the volumes and rates used during the testing is presented in **Table 3-9** below.

Table 3-9, Aquifer Compatibility Testing Summary
Laredo Aquifer Storage and Recovery Project, Laredo, TX

Test Component	Volume Recharged (gallons)	Volume Recovered (gallons)	Rate (gpm)	Duration (days:hours)
Shakedown Test	~3,600	5,600	variable	4 hours
Recharge	287,848	0	28	7 days 2 hours
Backflush	0	1,950	65	0.45 hours
Recovery	0	513,655	52	6 days 22 hours

During the test, water levels were monitored in both the test well, TW-2, and the onsite monitor well, TW-2A. The water level response observed in these wells is presented in **Figure 3-12.** Also during the testing, the water quality of the water recharged and recovered from well TW-2 was monitored regularly.

The water quality-monitoring program included two types of water sampling analyses. These were defined as field and laboratory analyses. Field samples were samples analyzed in the field using a sealed flow through sampling cell and field water quality instruments. Laboratory analyses were samples taken to the laboratory for different suites of parameters. Two types of laboratory analyses were performed, type A and type B. Type B parameters were collected daily whereas type A parameters were collected less frequently. The suite of analyses for each type of sample and the sampling schedule is presented in **Tables 3-10** and **3-11** below.

Table 3-10, Sampling Suite of Analyses
Laredo Aquifer Storage and Recovery Project, Laredo, TX

Field Analyses	Laboratory Analyses Type A	Laboratory Analyses Type B
Ph	pH	pH
Conductivity	Conductivity	Conductivity
Temperature	Chloride	Chloride
Oxidation Red. Potential	Alkalinity	Alkalinity
	Total Hardness	Total Hardness
	Turbidity	Turbidity
	Calcium	Sulfate
	TDS	Bicarbonate
	Sulfate	
	Bicarbonate	
	Magnesium	
	Sodium	
	Iron	
	Manganese	

Table 3-11, Sampling Schedule
Laredo Aquifer Storage and Recovery Project, Laredo, TX

Test	Sample Type	Frequency
Shakedown Test		
	Field	3 during injection, 4 during recovery
	Type A Laboratory	2 during injection, 3 during recovery
Cycle No. 1		
	Field	Daily
	Type B Laboratory	Daily
	Type A Laboratory	Every other day

3.3.2 Discussion of Test Results

3.3.2.1 Aquifer Hydraulics

Prior to the aquifer compatibility testing, three pumping tests were conducted on well TW-2. These tests were presented in the previous section discussing aquifer testing and were used to establish the baseline characteristics of TW-2 and the Laredo aquifer at the Del Mar site. As discussed in the previous section, the first aquifer test on TW-2 was conducted following its construction during March 1997. The next test was conducted following redevelopment of well TW-2 during May 1997. Both the March and May 1997 tests were single well tests utilizing only the pumping well for water level data. Finally, in July 1997, monitor well TW-2A was constructed at the site following coring activities and the third pumping test was conducted. The July 1997 test utilized the new monitor well for water level measurement.

The baseline characteristics of well TW-2 and the aquifer in the vicinity of the Del Mar site were used to compare the water level response observed during the aquifer compatibility test. Because the shakedown portion of the testing was run at varying rates of different durations, this part of the test was not hydraulically analyzed. The baseline well and aquifer parameters are listed below:

Transmissivity	168 ft^2/day
Storage Coefficient	0.000904
Well Loss Coefficient	0.008

The drawup observed in wells TW-2 and TW-2A during the recharge portion of the testing was compared to the drawup calculated from the above baseline parameters. The results are shown in **Figure 3-12.**

As seen in **Figure 3-12,** the water level rise in monitor well TW-2A matches fairly well with that calculated from the baseline parameters. It was expected that approximately 18 feet of water level rise should be observed in TW-2A over the duration of the test and approximately 22.6 feet were observed. However, in test well TW-2, it was expected that approximately 54.0 feet of water level rise would be observed. In well TW-2, approximately 157 feet of water level rise was observed.

During the recovery portion of the aquifer compatibility testing, drawdown observed in the two wells was again compared and then calculated from the baseline well and aquifer parameters. These results are shown in **Figure 3-13**.

The results shown in **Figure 3-13** indicates more drawdown was observed in well TW-2 during the recovery portion of the test than expected. It was expected that approximately 112 feet of drawdown would be observed in well TW-2 when 129.8 feet were actually observed. The drawdown results for well TW-2A also differ from the calculated amounts but less than that in TW-2. It was expected that approximately 35 feet of drawdown would be observed in well TW-2A during the recovery portion of the test and approximately 42 feet were observed.

3.3.3 Discussion of Geochemical Results

Analytical results from sampling conducted during the compatibility test are presented in **Table 3-12**. The groundwater at the Del Mar site was found to be dominated by sodium, chloride, and sulfate, and exhibited a relatively high pH of approximately 8.9. The recharge water was also found to be a sodium, chloride, sulfate type water but the pH is approximately 8.2, which is lower than the groundwater. The results of the geochemical analyses of these two waters and the aquifer matrix suggested that upon mixing, the calcium and magnesium in the recharge water would have a tendency to precipitate, and drop out of solution as a solid in the aquifer. The analyses also suggested that the precipitation would only occur when the two waters mixed, and if this mixing could be either minimized or kept away from the wellbore, damage to the aquifer may be minimized. The water quality-monitoring program presented previously was developed to track potential geochemical reactions during the testing and to evaluate if the hypothesized reactions were occurring.

The water quality results from the aquifer compatibility testing are presented as a series of graphical plots. These plots are **Figures 3-14 through 3-24** and present the recovery water quality (y-axis) against the percent recharged or recovered from the aquifer (x-axis). The recovery water quality (y-axis) is expressed as the concentration of the particular chemical constituent being presented. The percent recharged or recovered from the aquifer (x-axis) is expressed as the percentage of the recharged total volume that has been recharged or recovered at that point.

The results of the chloride monitoring are presented in the first plot, **Figure 3-14**. This figure shows the average concentration of chloride in the recharge water was about 134 mg/l while the average concentration of chloride in the groundwater was approximately 418 mg/l. As the recharged water was recovered from the aquifer, the recovered chloride concentration stayed close to that of the recharge water for over 20 percent recovery. Following this point, the recovered water exhibited a mixed quality of groundwater and recharge water. At 100 percent recovery, the recovered water quality exhibited a chloride concentration of about 230 mg/l, which is below drinking water standards.

Table 3-12
Aquifer Compatibility Test Analytical Results
Laredo Aquifer Storage and Recovery Project

				Iron	Manganese	Sulfate		Chloride	
Sample ID	Sample Type	Date	Time	* Result	* Result	* Result	MEQ	* Result	MEQ
CY1.I.01	LAB-A	01/15/98	1345	<0.05	<0.05	196.00	4.08	139.0	3.92
CY1.I.02	LAB-A	01/17/98	1045	<0.05	<0.05	187.00	3.89	132.0	3.72
CY1.I.03	LAB-A	01/19/98	0900	<0.05	<0.05	188.00	3.91	133.0	3.75
CY1.I.04	LAB-A	01/21/98	0900	0.05	<0.05	190.00	3.96	136.0	3.84
CY1.R.01	LAB-A	01/23/98	1340	0.17	<0.05	195.00	4.06	137.0	3.86
CY1.R.02	LAB-A	01/23/98	1620	0.10	<0.05	196.00	4.08	137.0	3.86
CY1.R.03	LAB-A	01/25/98	1305	<0.05	<0.05	250.00	5.21	191.0	5.39
CY1.R.04	LAB-A	01/26/98	1628	0.18	<0.05	264.00	5.50	211.0	5.95
CY1.R.05	LAB-A	01/27/98	0950	<0.05	<0.05	279.00	5.81	231.0	6.52
CY1.R.06	LAB-A	01/28/98	1405	0.06	<0.05	325.00	6.77	282.0	7.96
CY1.R.07	LAB-A	01/29/98	1000	<0.05	<0.05	351.00	7.31	306.0	8.63
CY1.R.08	LAB-A	01/30/98	0930	0.05	<0.05	359.00	7.47	324.0	9.14
DLY.CY1.01	LAB-B	01/15/98	1345	NA	NA	190.00	3.96	134.0	3.78
DLY.CY1.02	LAB-B	01/16/98	1105	NA	NA	189.00	3.93	133.0	3.75
DLY.CY1.03	LAB-B	01/17/98	1045	NA	NA	187.00	3.89	132.0	3.72
DLY.CY1.04	LAB-B	01/18/98	1010	NA	NA	181.00	3.77	128.0	3.61
DLY.CY1.05	LAB-B	01/19/98	0900	NA	NA	186.00	3.87	132.0	3.72
DLY.CY1.06	LAB-B	01/20/98	0950	NA	NA	192.00	4.00	137.0	3.86
DLY.CY1.07	LAB-B	01/21/98	0900	NA	NA	192.00	4.00	137.0	3.86
DLY.CY1.08	LAB-B	01/22/98	0900	NA	NA	192.00	4.00	137.0	3.86
DLY.CY1.09	LAB-B	01/23/98	1620	NA	NA	194.00	4.04	136.0	3.84
DLY.CY1.10	LAB-B	01/24/98	1225	NA	NA	191.00	3.98	136.0	3.84
DLY.CY1.11	LAB-B	01/25/98	1305	NA	NA	245.00	5.10	188.0	5.30
DLY.CY1.12	LAB-B	01/26/98	1005	NA	NA	260.00	5.41	202.0	5.70
DLY.CY1.13	LAB-B	01/27/98	0950	NA	NA	277.00	5.77	230.0	6.49
DLY.CY1.14	LAB-B	01/28/98	1405	NA	NA	323.00	6.72	281.0	7.93
DLY.CY1.15	LAB-B	01/29/98	1000	NA	NA	352.00	7.33	300.0	8.46
DLY.CY1.16	LAB-B	01/30/98	0930	NA	NA	362.00	7.54	326.0	9.20

Note:
* All results in milligrams per liter (mg/L)
MEQ = Millequivalents
NA = Not Analyzed - See Table 2-6 for sample type and parameters analyzed

Table 3-12
Aquifer Compatibility Test Analytical Results
Laredo Aquifer Storage and Recovery Project

Sample ID	Sample Type	Date	Time	Bicarbonate			Calicium		Magnesium	
				* Result	TALK²	MEQ	* Result	MEQ	* Result	MEQ
CY1.I.01	LAB-A	01/15/98	1345	146.00	146.31	2.3980	93.00	4.64	12.20	1.00
CY1.I.02	LAB-A	01/17/98	1045	148.00	147.52	2.4179	80.96	4.04	20.40	1.68
CY1.I.03	LAB-A	01/19/98	0900	145.00	145.09	2.3780	78.60	3.92	20.40	1.68
CY1.I.04	LAB-A	01/21/98	0900	154.00	153.62	2.5178	85.80	4.28	18.50	1.52
CY1.R.01	LAB-A	01/23/98	1340	155.00	154.84	2.5378	86.60	4.32	19.40	1.60
CY1.R.02	LAB-A	01/23/98	1620	151.00	151.18	2.4779	83.40	4.16	20.90	1.72
CY1.R.03	LAB-A	01/25/98	1305	183.00	195.07	3.1973	26.40	1.32	4.90	0.40
CY1.R.04	LAB-A	01/26/98	1628	216.00	232.87	3.8167	20.00	1.00	3.60	0.30
CY1.R.05	LAB-A	01/27/98	0950	231.00	249.94	4.0965	18.00	0.90	5.30	0.44
CY1.R.06	LAB-A	01/28/98	1405	234.00	256.04	4.1964	18.00	0.90	6.08	0.50
CY1.R.07	LAB-A	01/29/98	1000	239.00	263.35	4.3163	17.20	0.86	4.38	0.36
CY1.R.08	LAB-A	01/30/98	0930	233.00	259.69	4.2564	15.60	0.78	4.62	0.38
DLY.CY1.01	LAB-B	01/15/98	1345	146.00	146.31	2.40	NA	NA	NA	NA
DLY.CY1.02	LAB-B	01/16/98	1105	147.00	147.52	2.42	NA	NA	NA	NA
DLY.CY1.03	LAB-B	01/17/98	1045	146.00	146.31	2.40	NA	NA	NA	NA
DLY.CY1.04	LAB-B	01/18/98	1010	145.00	145.09	2.38	NA	NA	NA	NA
DLY.CY1.05	LAB-B	01/19/98	0900	144.00	143.87	2.36	NA	NA	NA	NA
DLY.CY1.06	LAB-B	01/20/98	0950	144.00	143.87	2.36	NA	NA	NA	NA
DLY.CY1.07	LAB-B	01/21/98	0900	157.00	151.18	2.48	NA	NA	NA	NA
DLY.CY1.08	LAB-B	01/22/98	0900	143.00	142.65	2.34	NA	NA	NA	NA
DLY.CY1.09	LAB-B	01/23/98	1620	149.00	148.74	2.44	NA	NA	NA	NA
DLY.CY1.10	LAB-B	01/24/98	1225	179.00	179.22	2.94	NA	NA	NA	NA
DLY.CY1.11	LAB-B	01/25/98	1305	183.00	195.07	3.20	NA	NA	NA	NA
DLY.CY1.12	LAB-B	01/26/98	1005	207.00	226.77	3.72	NA	NA	NA	NA
DLY.CY1.13	LAB-B	01/27/98	0950	226.00	249.94	4.10	NA	NA	NA	NA
DLY.CY1.14	LAB-B	01/28/98	1405	226.00	257.25	4.22	NA	NA	NA	NA
DLY.CY1.15	LAB-B	01/29/98	1000	238.00	264.57	4.34	NA	NA	NA	NA
DLY.CY1.16	LAB-B	01/30/98	0930	NA	262.13	4.30	NA	NA	NA	NA

Note:
* All results in milligrams per liter (mg/L)
MEQ = Millequivalents
NA = Not Analyzed - See Table 2-6 for sample type and parameters analyzed
² Bicarbonate value calculated by the following relationship: total alkalinity/.8202

Table 3-12
Aquifer Compatibility Test Analytical Results
Laredo Aquifer Storage and Recovery Project

Sample ID	Sample Type	Date	Time	Sodium * Result	Sodium MEQ	Total Alkalinity * Result	Phenolic Alkalinity * Result	Hardness * Result	Turbidity (NTU)	TDS * Result
CY1.I.01	LAB-A	01/15/98	1345	105.00	4.57	120.00	ND	292.00	0.30	642.00
CY1.I.02	LAB-A	01/17/98	1045	106.00	4.61	121.00	ND	286.00	0.46	658.00
CY1.I.03	LAB-A	01/19/98	0900	105.00	4.57	119.00	ND	280.00	0.13	668.00
CY1.I.04	LAB-A	01/21/98	0900	107.00	4.65	126.00	ND	290.00	0.19	666.00
CY1.R.01	LAB-A	01/23/98	1340	97.00	4.22	127.00	ND	296.00	1.67	716.00
CY1.R.02	LAB-A	01/23/98	1620	96.00	4.18	124.00	ND	294.00	0.76	618.00
CY1.R.03	LAB-A	01/25/98	1305	210.00	9.14	160.00	5.00	86.00	0.16	890.00
CY1.R.04	LAB-A	01/26/98	1628	250.00	10.88	191.00	7.00	65.00	0.10	1010.00
CY1.R.05	LAB-A	01/27/98	0950	260.00	11.31	205.00	8.00	67.00	0.10	1096.00
CY1.R.06	LAB-A	01/28/98	1405	350.00	15.23	210.00	9.00	70.00	0.07	1254.00
CY1.R.07	LAB-A	01/29/98	1000	380.00	16.53	216.00	10.00	61.00	0.07	1350.00
CY1.R.08	LAB-A	01/30/98	0930	410.00	17.84	213.00	11.00	58.00	0.07	1410.00
								0.00		
DLY.CY1.01	LAB-B	01/15/98	1345	NA	NA	120.00	ND	298.00	0.07	NA
DLY.CY1.02	LAB-B	01/16/98	1105	NA	NA	121.00	ND	300.00	0.07	NA
DLY.CY1.03	LAB-B	01/17/98	1045	NA	NA	120.00	ND	279.00	0.24	NA
DLY.CY1.04	LAB-B	01/18/98	1010	NA	NA	119.00	ND	274.00	0.68	NA
DLY.CY1.05	LAB-B	01/19/98	0900	NA	NA	118.00	ND	300.00	0.21	NA
DLY.CY1.06	LAB-B	01/20/98	0950	NA	NA	118.00	ND	284.00	0.26	NA
DLY.CY1.07	LAB-B	01/21/98	0900	NA	NA	124.00	ND	290.00	0.16	NA
DLY.CY1.08	LAB-B	01/22/98	0900	NA	NA	117.00	ND	290.00	0.17	NA
DLY.CY1.09	LAB-B	01/23/98	1620	NA	NA	122.00	ND	284.00	0.91	NA
DLY.CY1.10	LAB-B	01/24/98	1225	NA	NA	147.00	ND	148.00	0.28	NA
DLY.CY1.11	LAB-B	01/25/98	1305	NA	NA	160.00	5.00	88.00	0.16	NA
DLY.CY1.12	LAB-B	01/26/98	1005	NA	NA	186.00	8.00	70.00	0.16	NA
DLY.CY1.13	LAB-B	01/27/98	0950	NA	NA	205.00	10.00	67.00	0.18	NA
DLY.CY1.14	LAB-B	01/28/98	1405	NA	NA	211.00	13.00	62.00	0.10	NA
DLY.CY1.15	LAB-B	01/29/98	1000	NA	NA	217.00	11.00	59.00	0.07	NA
DLY.CY1.16	LAB-B	01/30/98	0930	NA	NA	215.00	12.00	55.00	0.18	NA

Note:
* All results in milligrams per liter (mg/L)
MEQ = Millequivalents
NA = Not Analyzed - See Table 2-6 for sample type and parameters analyzed
ND = Not Detected

Table 3-12
Aquifer Compatibility Test Analytical Results
Laredo Aquifer Storage and Recovery Project

				Conductivity	Field Parameters (Standard Units)					Mass Balance Calculation		
Sample ID	Sample Type	Date	Time	(µmoh's)	PH_RSLT	F-Cond	F-Temp	F-pH	F-Eh	Cations	Anions	Balance %
CY1.I.01	LAB-A	01/15/98	1345	1106.00	7.6	NA	NA	NA	NA	10.21	10.40	-0.91
CY1.I.02	LAB-A	01/17/98	1045	1105.00	7.9	NA	NA	NA	NA	10.33	10.03	1.45
CY1.I.03	LAB-A	01/19/98	0900	1104.00	7.6	NA	NA	NA	NA	10.17	10.04	0.61
CY1.I.04	LAB-A	01/21/98	0900	1105.00	7.6	NA	NA	NA	NA	10.46	10.31	0.71
CY1.R.01	LAB-A	01/23/98	1340	1124.00	7.6	NA	NA	NA	NA	10.14	10.46	-1.58
CY1.R.02	LAB-A	01/23/98	1620	1132.00	7.6	NA	NA	NA	NA	10.06	10.42	-1.79
CY1.R.03	LAB-A	01/25/98	1305	1514.00	8.4	NA	NA	NA	NA	10.86	13.79	-11.91
CY1.R.04	LAB-A	01/26/98	1628	1677.00	8.6	NA	NA	NA	NA	12.17	15.27	-11.29
CY1.R.05	LAB-A	01/27/98	0950	1809.00	8.6	NA	NA	NA	NA	12.64	16.42	-13.00
CY1.R.06	LAB-A	01/28/98	1405	2070.00	8.6	NA	NA	NA	NA	16.62	18.92	-6.46
CY1.R.07	LAB-A	01/29/98	1000	2230.00	8.6	NA	NA	NA	NA	17.75	20.26	-6.60
CY1.R.08	LAB-A	01/30/98	0930	2370.00	8.6	NA	NA	NA	NA	18.99	20.87	-4.71
DLY.CY1.01	LAB-B	01/15/98	1345	1089.00	7.60	1097.00	17.70	7.46	433.10	NA	NA	NA
DLY.CY1.02	LAB-B	01/16/98	1105	1094.00	7.60	1109.00	17.30	7.46	514.50	NA	NA	NA
DLY.CY1.03	LAB-B	01/17/98	1045	1107.00	7.60	1114.00	17.30	7.30	194.70	NA	NA	NA
DLY.CY1.04	LAB-B	01/18/98	1010	1095.00	7.60	1114.00	16.70	7.21	203.60	NA	NA	NA
DLY.CY1.05	LAB-B	01/19/98	0900	1099.00	7.60	1114.00	16.40	7.29	187.70	NA	NA	NA
DLY.CY1.06	LAB-B	01/20/98	0950	1102.00	7.60	1121.00	16.40	7.28	185.40	NA	NA	NA
DLY.CY1.07	LAB-B	01/21/98	0900	1114.00	7.60	1126.00	16.40	7.31	197.90	NA	NA	NA
DLY.CY1.08	LAB-B	01/22/98	0900	1112.00	7.60	1130.00	16.40	7.04	199.50	NA	NA	NA
DLY.CY1.09	LAB-B	01/23/98	1620	1120.00	7.60	1147.00	18.30	7.36	-30.90	NA	NA	NA
DLY.CY1.10	LAB-B	01/24/98	1225	1206.00	8.00	1219.00	19.80	7.77	-84.90	NA	NA	NA
DLY.CY1.11	LAB-B	01/25/98	1305	1491.00	8.40	1535.00	21.80	8.14	-112.00	NA	NA	NA
DLY.CY1.12	LAB-B	01/26/98	1005	1630.00	8.50	1653.00	23.00	8.15	-59.70	NA	NA	NA
DLY.CY1.13	LAB-B	01/27/98	0950	1807.00	8.60	1829.00	24.20	8.26	116.70	NA	NA	NA
DLY.CY1.14	LAB-B	01/28/98	1405	2060.00	8.60	2120.00	25.10	8.43	65.20	NA	NA	NA
DLY.CY1.15	LAB-B	01/29/98	1000	2230.00	8.60	2260.00	25.40	8.44	28.50	NA	NA	NA
DLY.CY1.16	LAB-B	01/30/98	0930	2370.00	8.60	NA	NA	NA	NA	NA	NA	NA

Note:
* All results in milligrams per liter (mg/L)
MEQ = Millequivalents
NA = Not Analyzed - See Table 2-6 for sample type and parameters analyzed

The chloride mixing response is a good indicator of the physical mixing of the recharged and native groundwater during an ASR cycle. Unlike many other chemical constituents, chloride in the two waters does not typically react and the observed chloride concentration represents the proportional mix of the two waters. The results shown in **Figure 3-14** indicate that the mixing of recharged and native groundwater is low and based on mixing alone, water recharged into the aquifer may be recoverable for subsequent drinking water use.

The results of the total dissolved solids (TDS) concentrations are presented in **Figure 3-15.** The results of the TDS monitoring indicate a similar response to chloride; however, if examined closely, the results suggest somewhat higher TDS concentrations are seen as recovery progresses, relative to the corresponding chloride concentrations. This observation is further reinforced in **Figure 3-16,** which compares the chloride and TDS response as a plot of percent recharge water against percent recovery. The percent recharge water represents the percentage of recharge water recovered (taken as a percent of the original recharge water concentration) in the sample taken at the corresponding percent volumetric recovery.

The TDS response as compared to the chloride response suggests that some chemical changes are occurring during aquifer storage that result in dissolved ions in the recovered water that are in addition to those resulting from the simple mixing of the two waters.

The observed calcium concentrations are shown in **Figure 3-17** and are plotted against chloride in **Figure 3-18.** The results indicate the calcium that was recharged into the aquifer remained there and was not removed in the recovered water. As shown on **Figure 3-18,** calcium concentrations in the injected water were approximately 85 mg/l. The recovered water calcium concentrations dropped to less than 30 mg/l by the time 50 percent of the recharged water was recovered. The reduction in calcium concentration is thought to be the result of calcium precipitation in the aquifer combined with calcium ion exchange with sodium on the aquifer clay minerals. This is supported in **Figures 3-19 and 3-20,** which indicate somewhat higher concentrations of sodium in the recovered water than would be expected based on mixing alone. Additionally, as shown in **Figures 3-21 and 3-22,** the alkalinity of the recovered water was higher than can be attributed to mixing alone. The increase in alkalinity may be a byproduct of calcium precipitation that reduced the pH **(Figure 3-23)** of the native groundwater and resulted in additional dissolution of bicarbonate in the aquifer matrix.

The observed temperature of the recharged and recovered water is presented in **Figure 3-24.** The recharged water was cooler than the native groundwater as shown in the figure, with the average recharged temperature approximately 17 °C, and the groundwater temperature approximately 27 °C.

3.3.4 Summary of Aquifer Compatibility Testing Results

The results of the aquifer compatibility testing indicate that substantial head buildup results from injection of potable water into the TW-2 well at the Del Mar site. As discussed earlier **(Figure 3-11),** approximately 157 feet of drawup was observed in the aquifer during recharge, which is approximately 100 feet more than would be expected if the well were being pumped. The well was backflushed during recharge to observe if any possible particulate plugging could be removed and reduce injection head buildup. Backflushing the well did appear to reduce the head buildup somewhat but not an appreciable amount.

The head increase observed is similar to that observed at other ASR sites where recharge of potable water occurs into an aquifer with a low transmissivity. Recharge into similar low transmissivity aquifers typically results in substantial head increases that only exhibit moderate improvements with backflushing, and that continue to build up head until injection ceases. The mechanisms responsible for substantial head buildup in a low transmissivity aquifer are not completely understood, but are believed to result from hydraulic resistance in the vicinity of the wellbore to injection, and small particles in the injected water that essentially close off the small pores available in the wellbore and immediate areas of the aquifer.

The recovery portion of the testing indicates additional drawdown in the well resulted from the testing. Based on the pumping tests conducted previously at well TW-2, approximately 17.5 feet of additional drawdown was observed during the recovery portion of the test. It is not certain that the reduction in capacity is directly the result of injection into the well, or if biological growth in the wellbore could have reduced the well capacity between the aquifer test performed in July 1997 and the date of this test. This was discussed previously as one possible mechanism to explain the differences between the observed results of the three pumping tests performed on this well. This is also supported by the observed increase in alkalinity during the recovery portion of the testing.

It was observed that the temperature of the recharged water was cooler than the native groundwater. This difference would result in higher heads required to recharge the aquifer as water viscosity increases as the water temperature decreases. The lower temperature of the recharge water results in a decrease in the apparent transmissivity of the aquifer as transmissivity is a function of both the aquifer matrix geometry and the fluid properties in the aquifer. In this case, if all the water in the aquifer were 17 °C instead of the observed 27 °C, the observed transmissivity would decrease from 168 ft^2/day to about 133 ft^2/day. However, recharge of the aquifer did not change all the water in the aquifer to a lower temperature and, therefore, the observed transmissivity would lie somewhere between the two values. It is also important to note that the maximum expected increase in head associated with a lowering of the transmissivity is only about 15 feet, which only accounts for a small percentage of that actually observed.

The geochemical analysis indicated that much of the calcium in the recharged water remained in the aquifer following recharge. It is likely that the calcium precipitated as calcium carbonate after being mixed with the native groundwater. Some of the calcium may also have exchanged for sodium in the aquifer clays. The precipitated calcium could become fixed to the aquifer matrix and result in a reduction of pore size in the aquifer. This type of reaction would result in a decrease in permeability of the aquifer matrix across the entire recharge although most the damage would occur near the wellbore. It is likely that this effect was responsible for a portion of the head increase observed during the aquifer compatibility testing; however, it is probable that this activity did not result in the total increase in head observed.

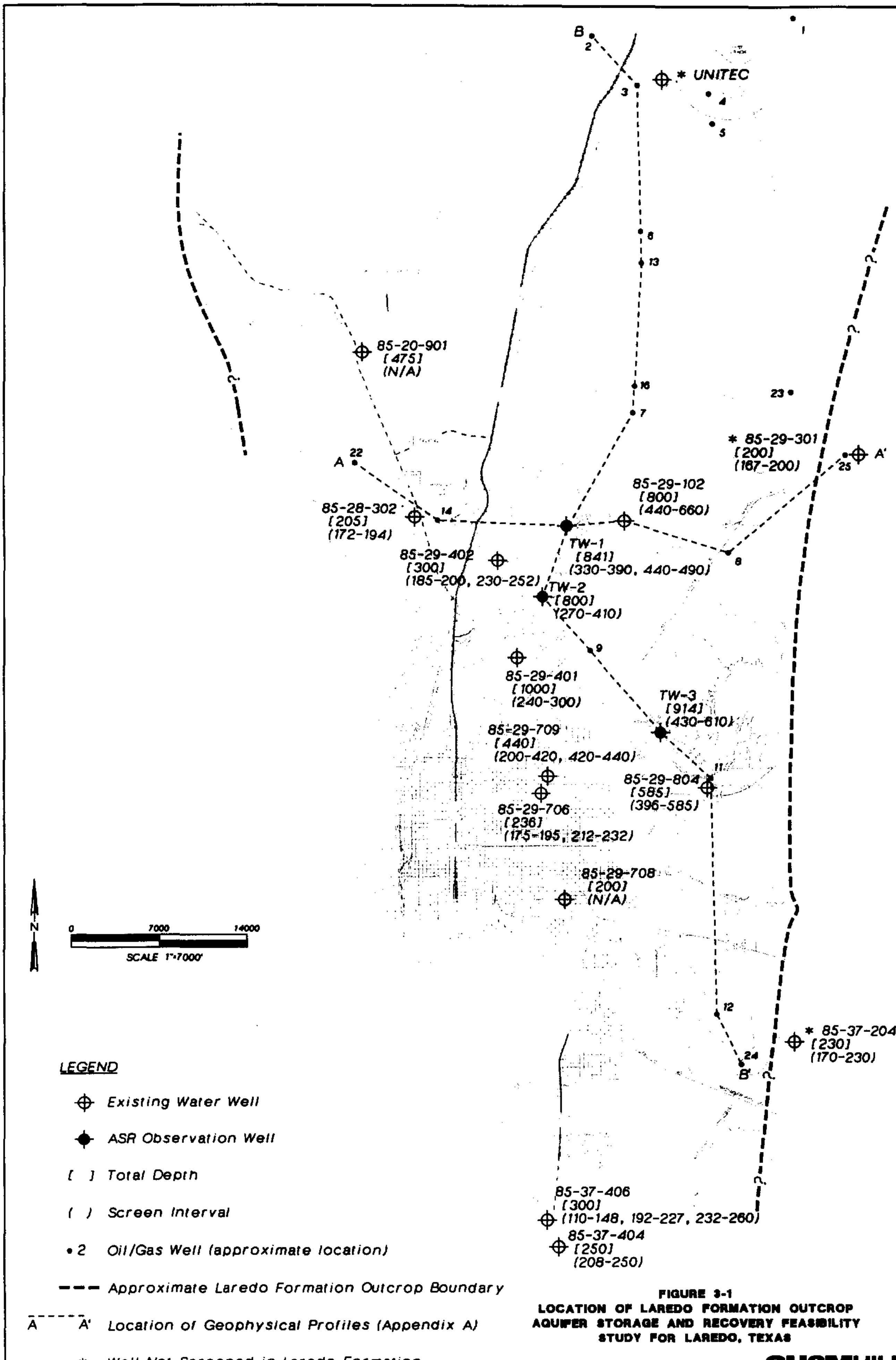
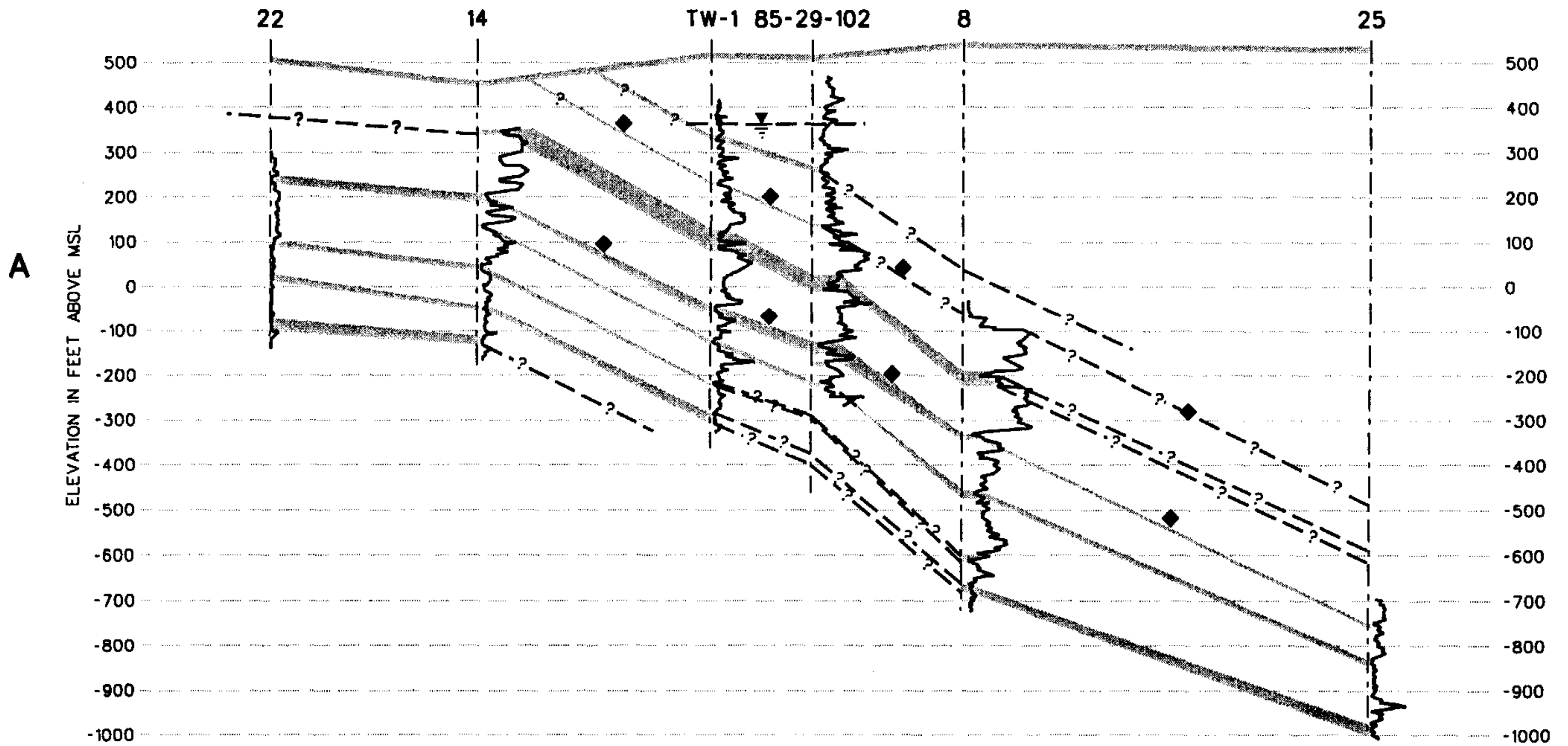


FIGURE 3-1
LOCATION OF LAREDO FORMATION OUTCROP
AQUIFER STORAGE AND RECOVERY FEASIBILITY
STUDY FOR LAREDO, TEXAS



LEGEND

LOW RESISTIVITY UNIT (SHALE, SILTSTONE)

SCALE: 1" = 7000' HORZ
1" = 400' VERT

0 20-100 ohms

GEOPHYSICAL CONTACT (RESISTIVITY CURVE)

---?--- INFERRED CONTACT

◆ TOP/BOTTOM OF INTERVAL CONTAINING THE HIGHEST RESITIVITY UNITS WITHIN UPPER SAND ZONE

APPROXIMATE TOP OF PIEZOMETRIC SURFACE

FIGURE 3-2
LAREDO FORMATION
GEOPHYSICAL PROFILE A-A'
AQUIFER STORAGE AND RECOVERY PROJECT
CITY OF LAREDO, TEXAS

18069P02.DGN

CH2MHILL

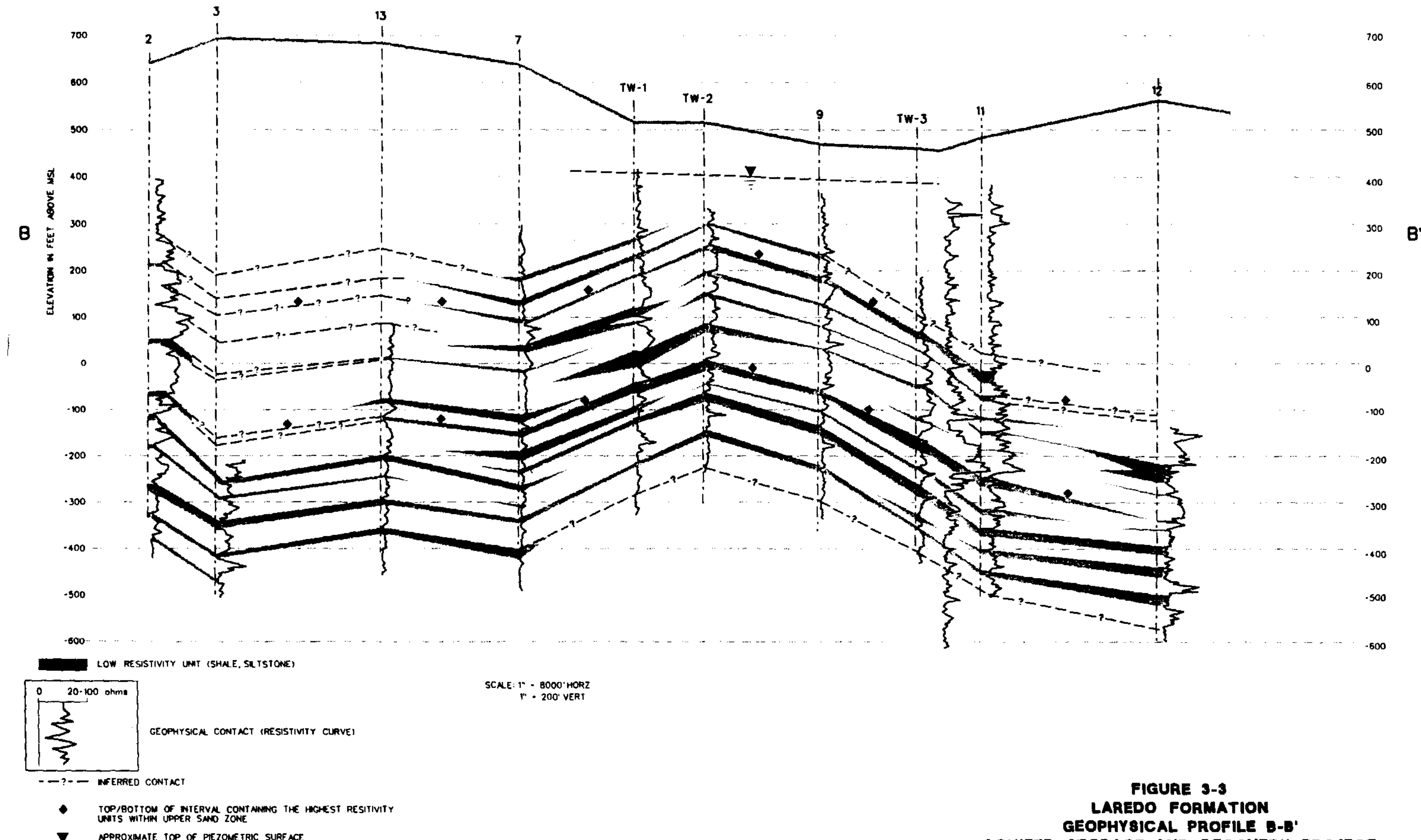


FIGURE 3-3
LAREDO FORMATION
GEOPHYSICAL PROFILE B-B'
AQUIFER STORAGE AND RECOVERY PROJECT
CITY OF LAREDO, TEXAS

18069F01.DGN

CH2MHILL

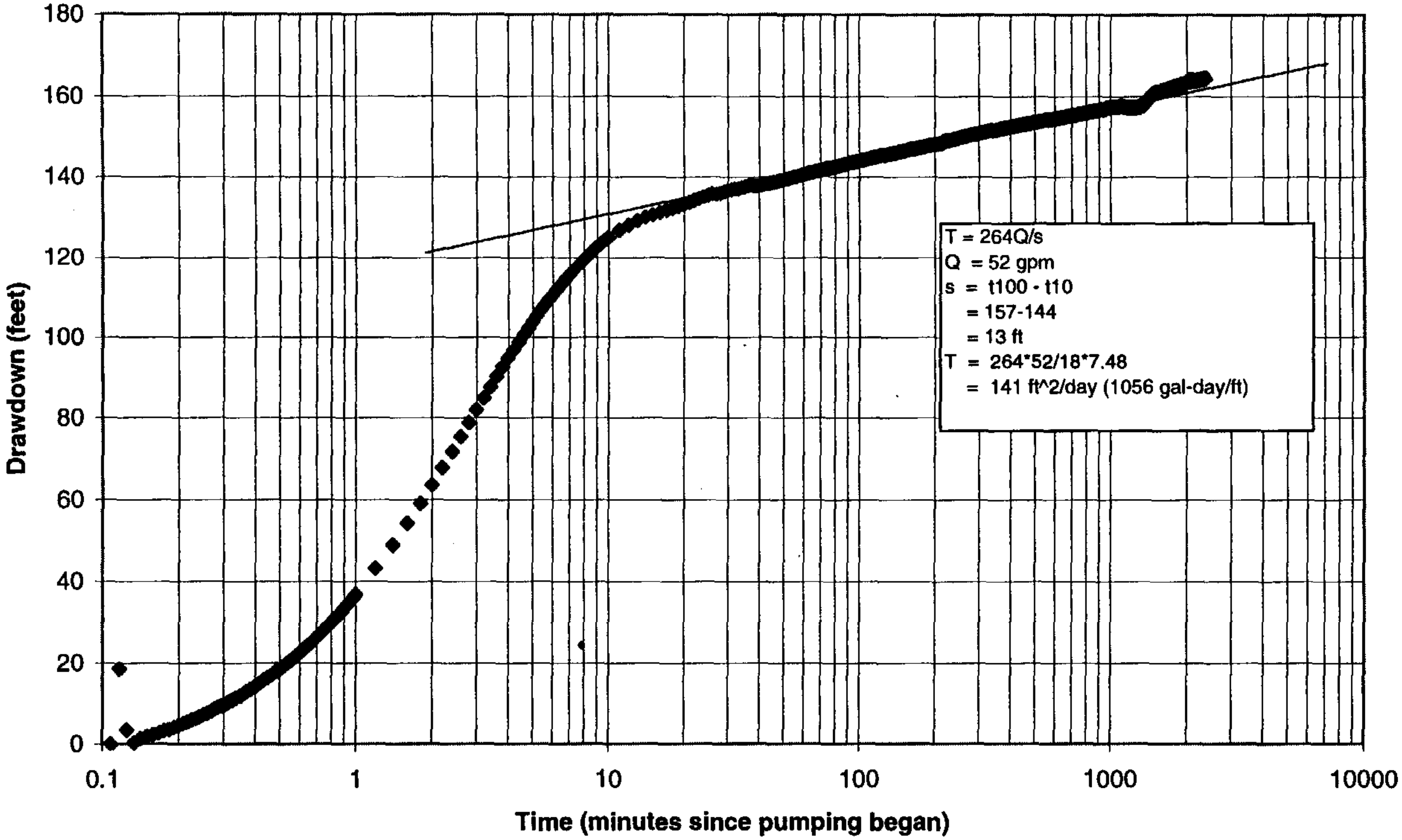


Figure 3-4
TW-1 March, 1997
40-Hour Aquifer Test

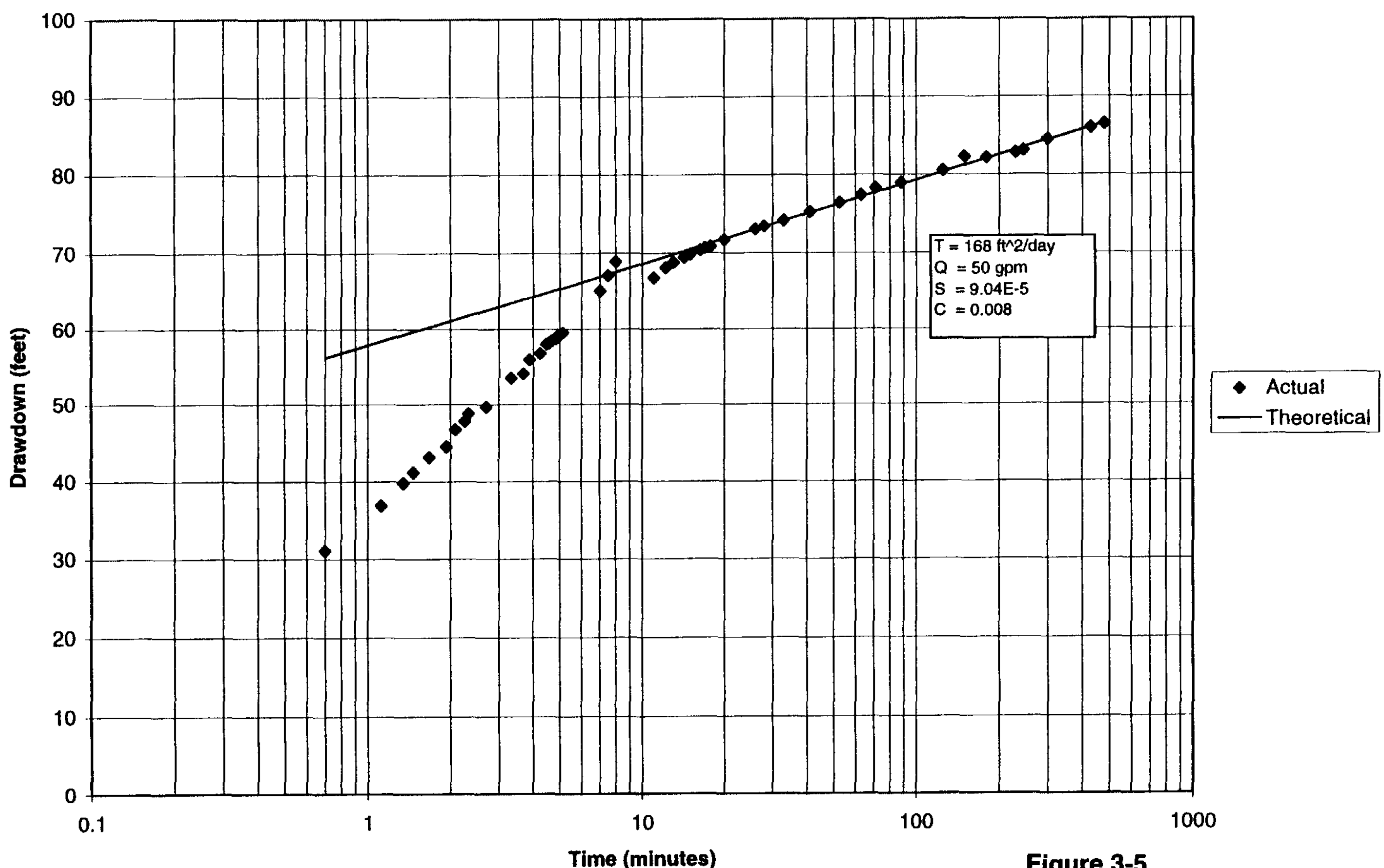


Figure 3-5
TW-2 July, 1997
Pumping Well Aquifer Test

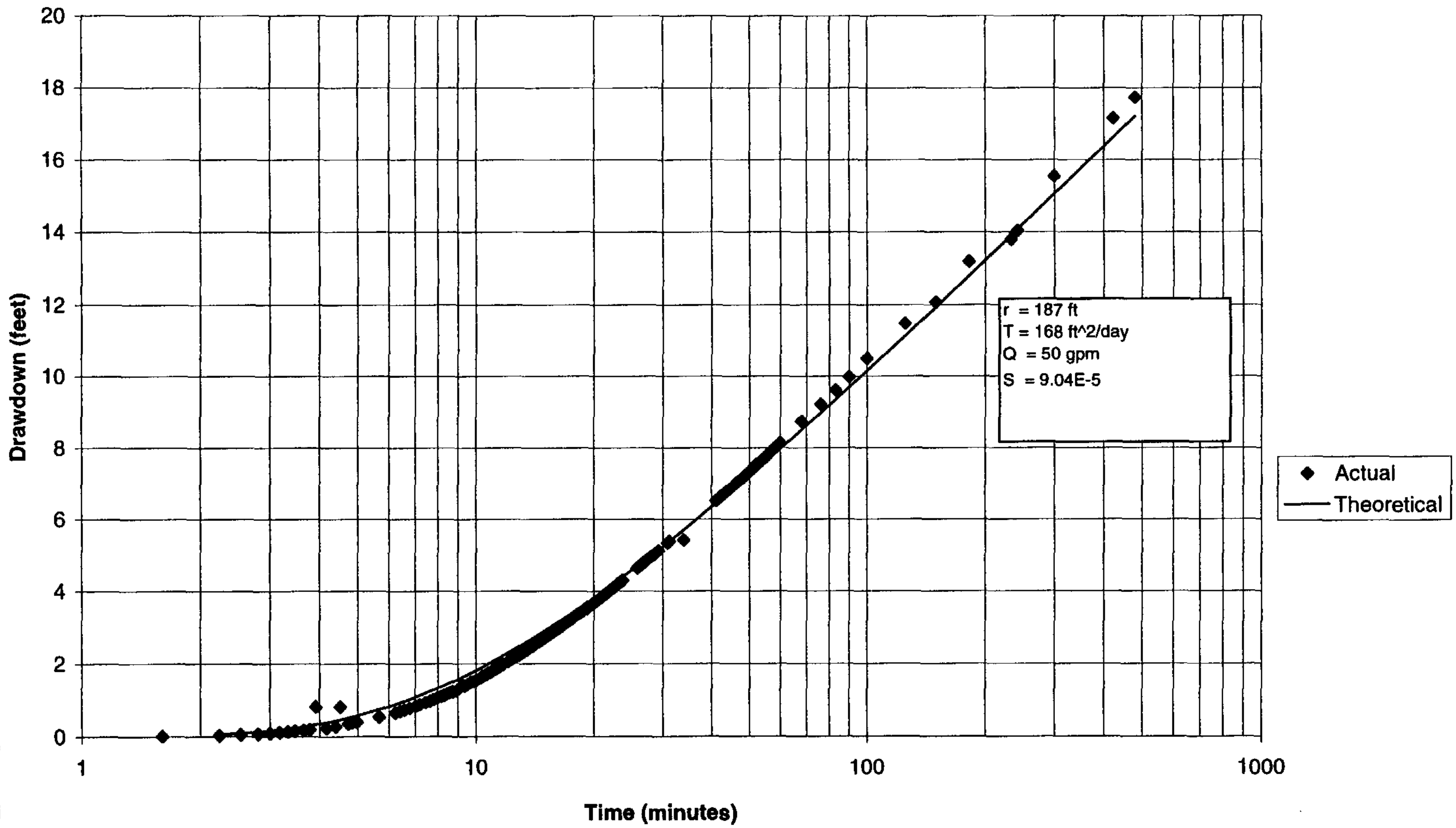


Figure 3-6
TW-2A July, 1997
Observation Well Aquifer Test

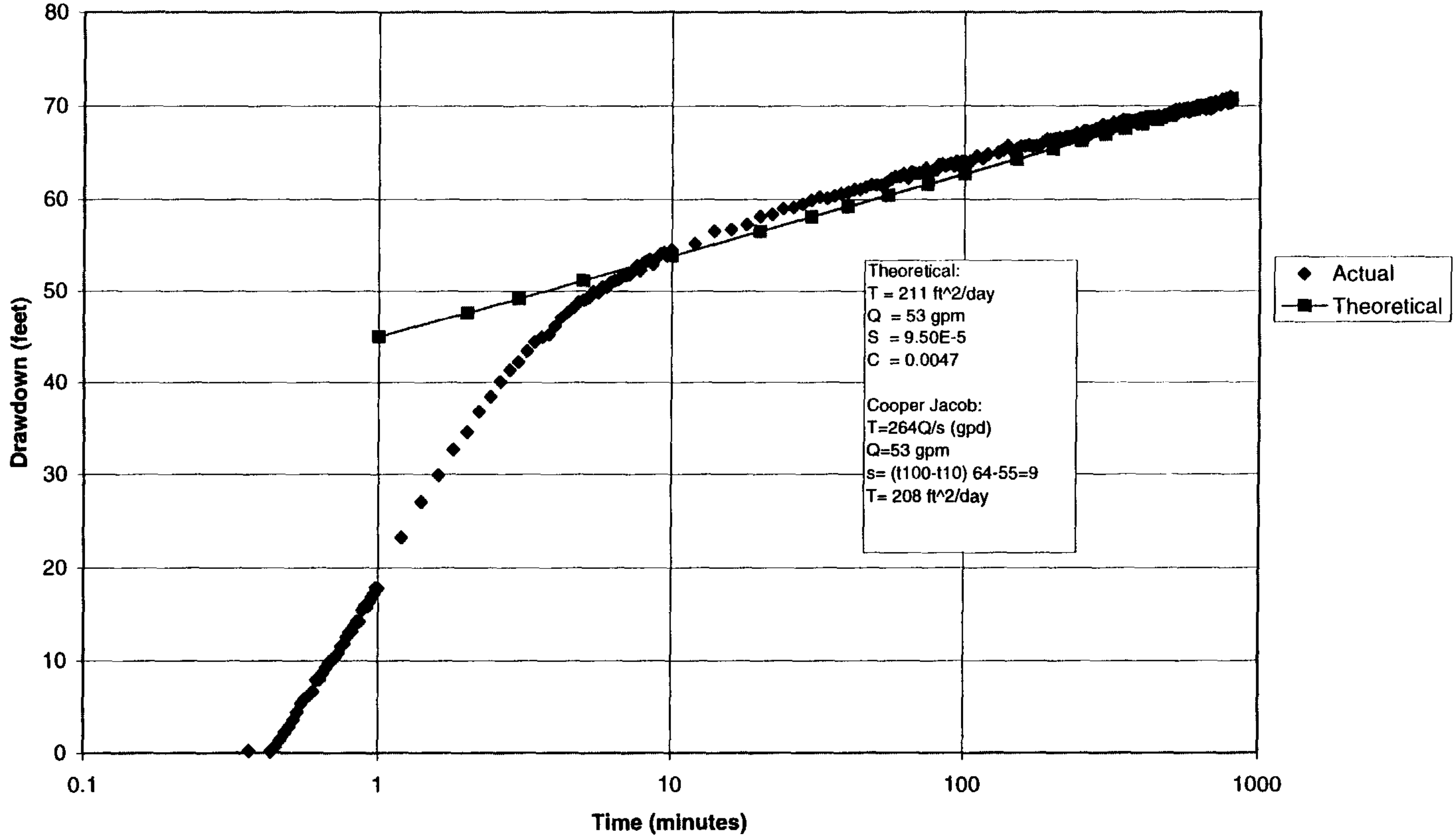


Figure 3-7
TW-3 May, 1997
13-Hour Aquifer Test

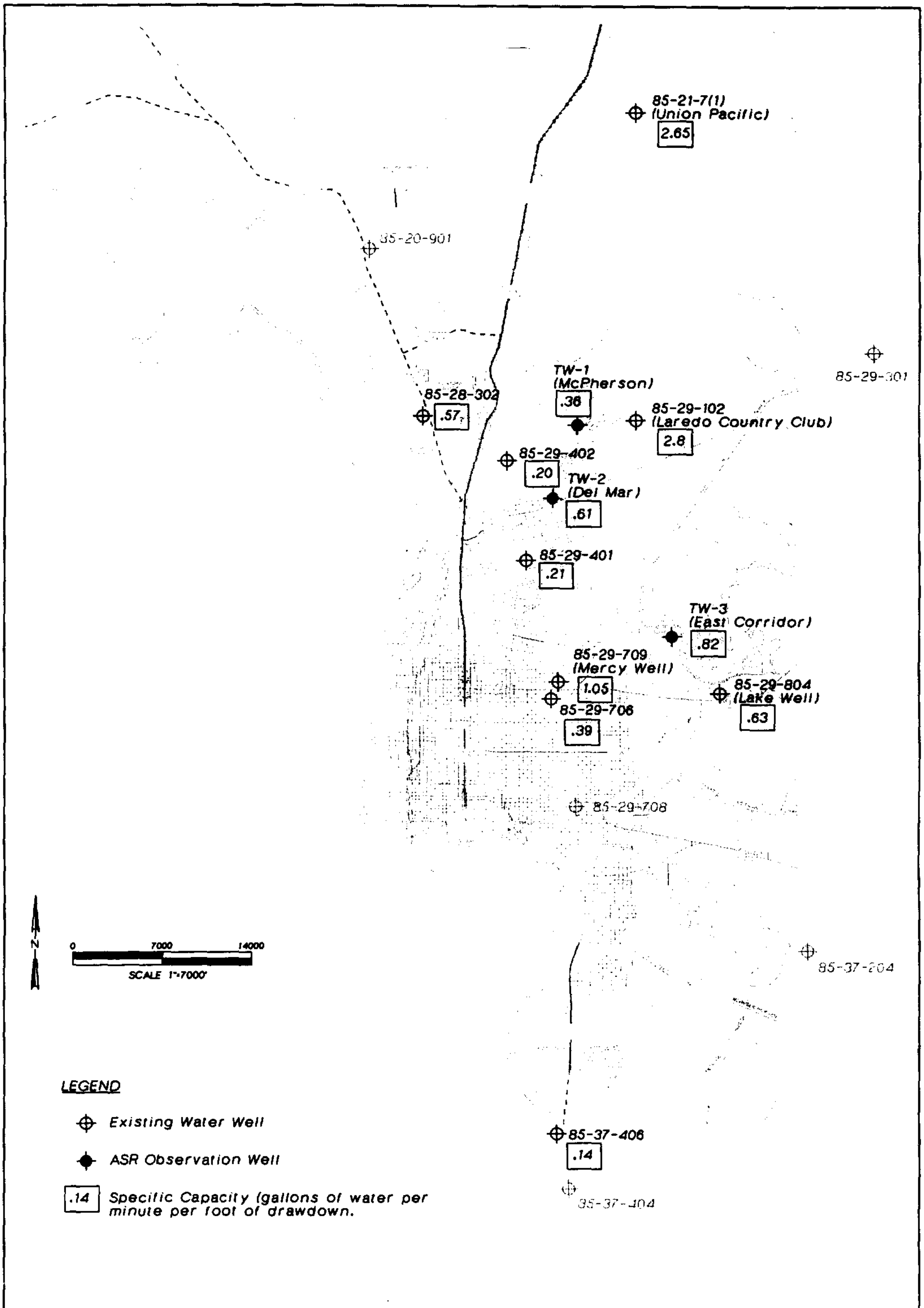


FIGURE 3-8
DISTRIBUTION OF SPECIFIC CAPACITY
AQUIFER STORAGE AND RECOVERY FEASIBILITY
STUDY FOR LAREDO, TEXAS
CH2MHILL

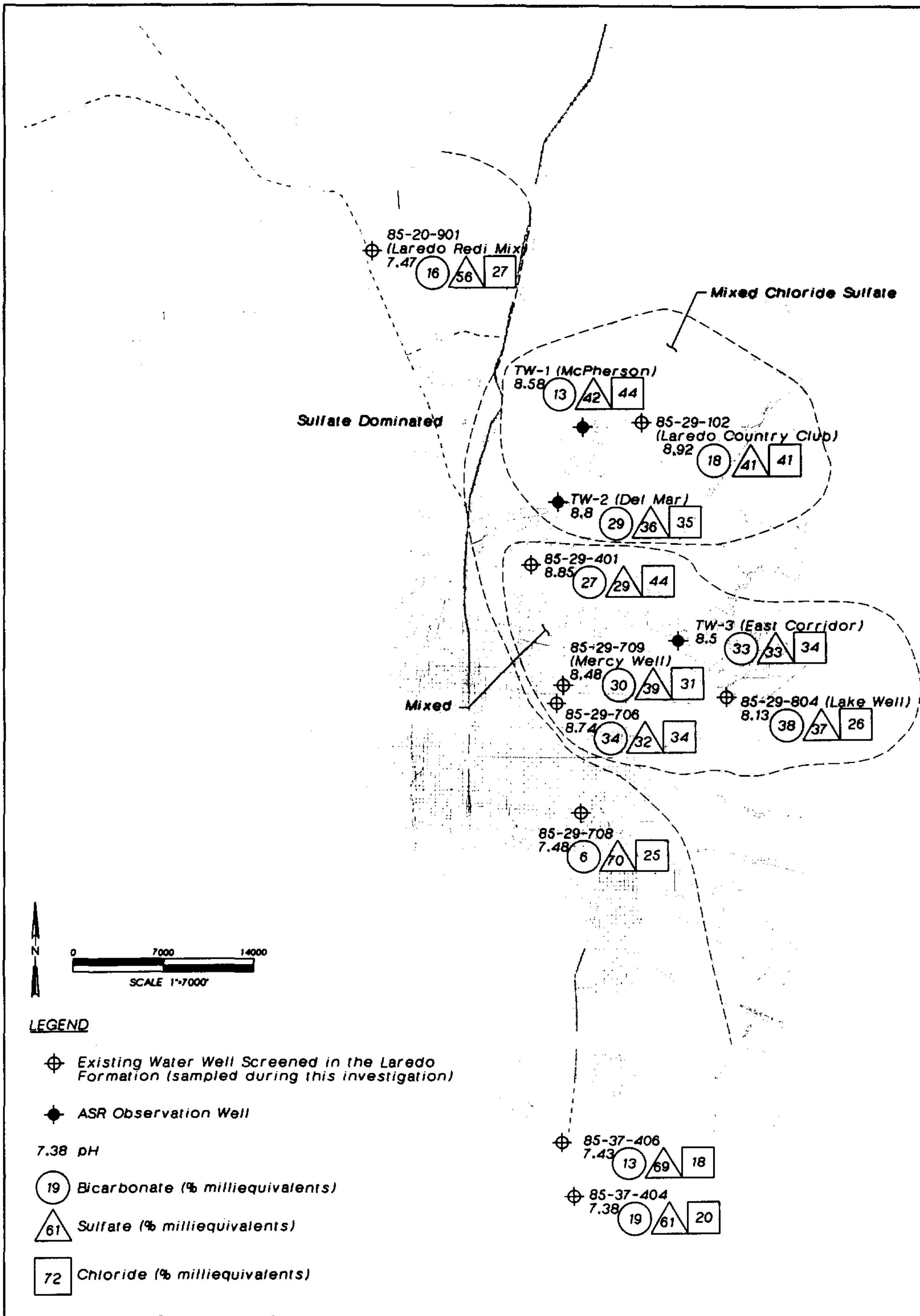


FIGURE 3-10
SPATIAL DISTRIBUTION OF GEOCHEMICAL DATA
AQUIFER STORAGE AND RECOVERY FEASIBILITY STUDY FOR LAREDO, TEXAS

CH2MHILL

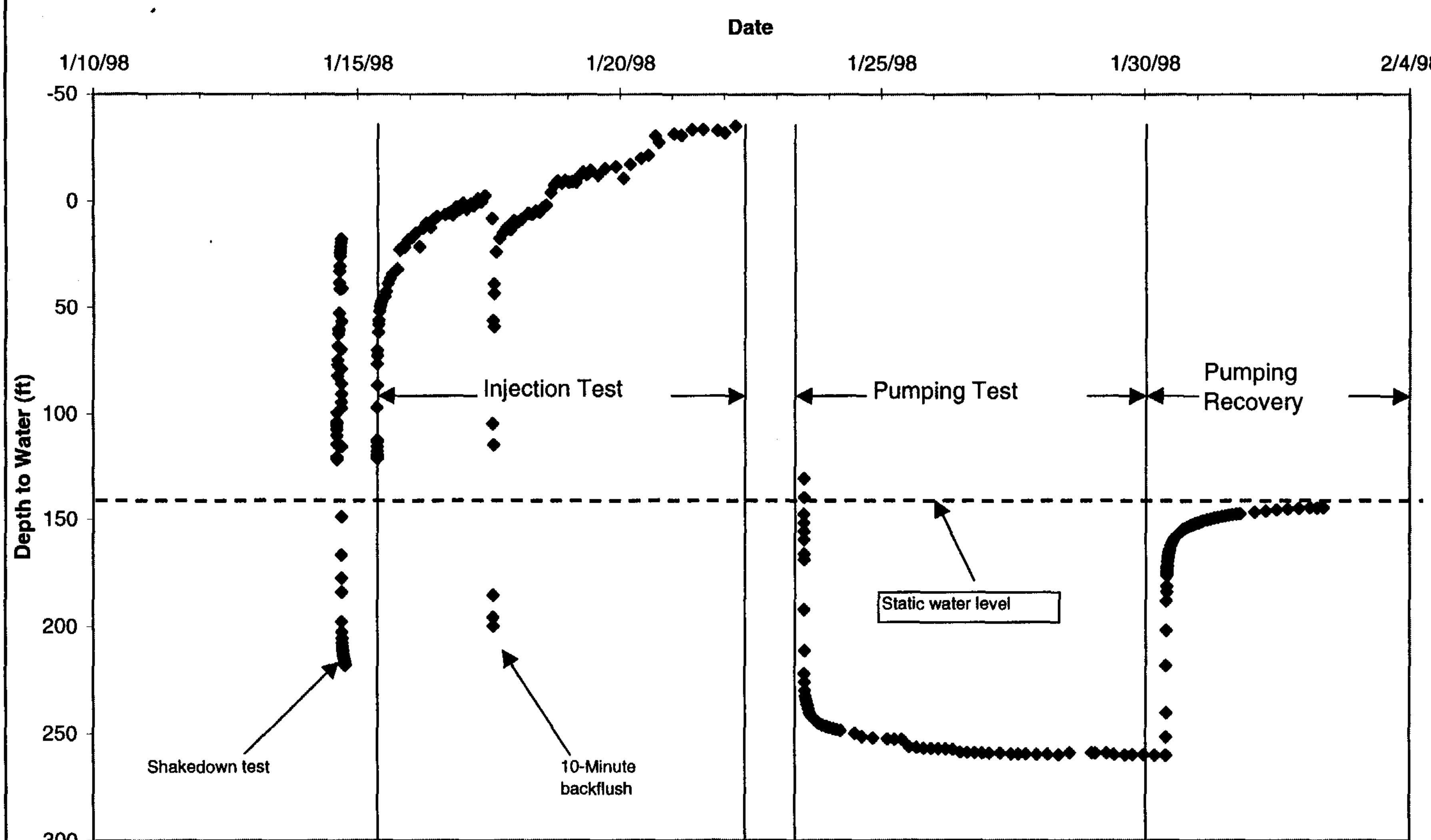


Figure 3-11
January, 1998
Injection Test Summary

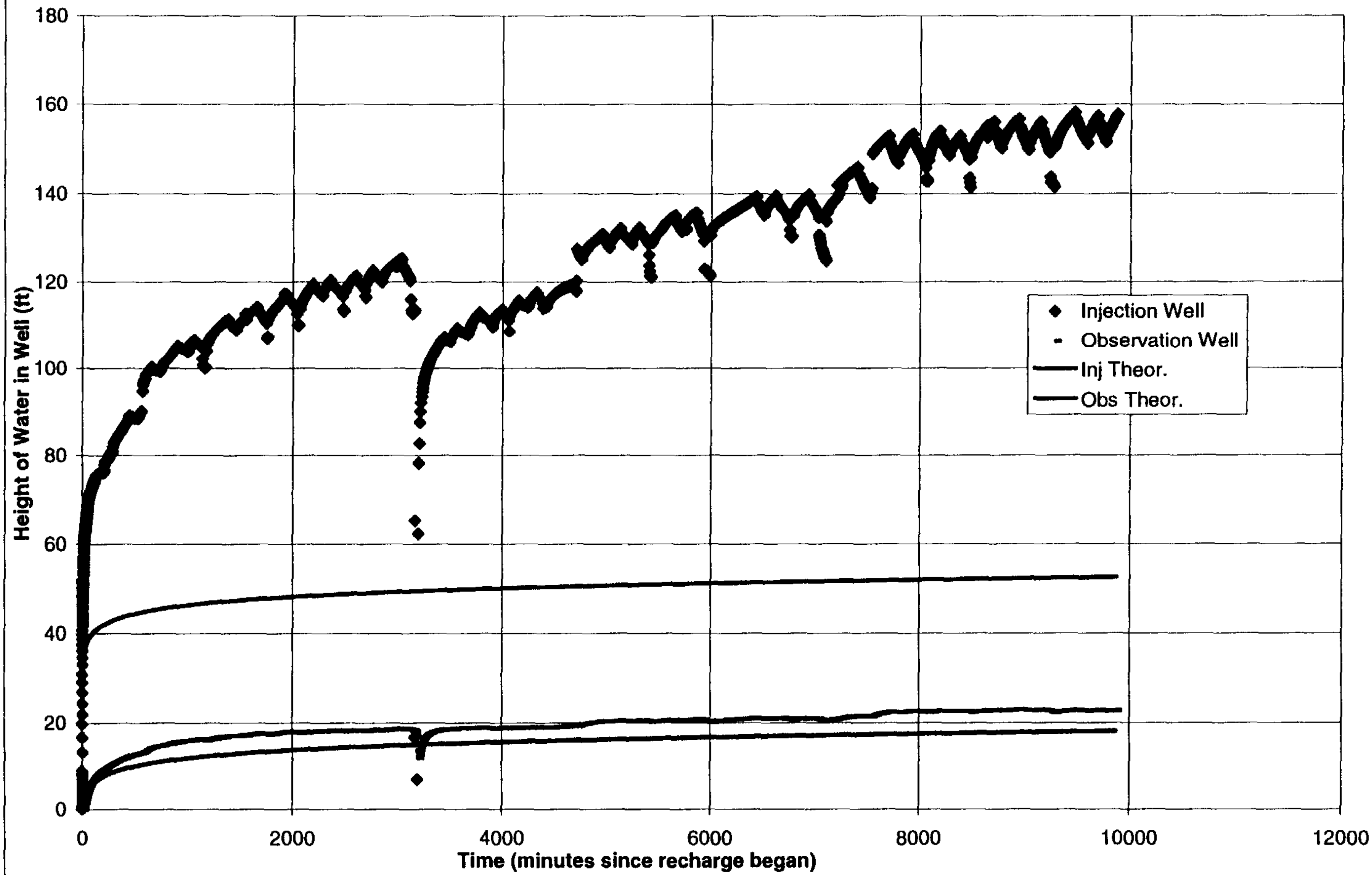


Figure 3-12
Recharge Water Levels January, 1998
Aquifer Compatibility Test

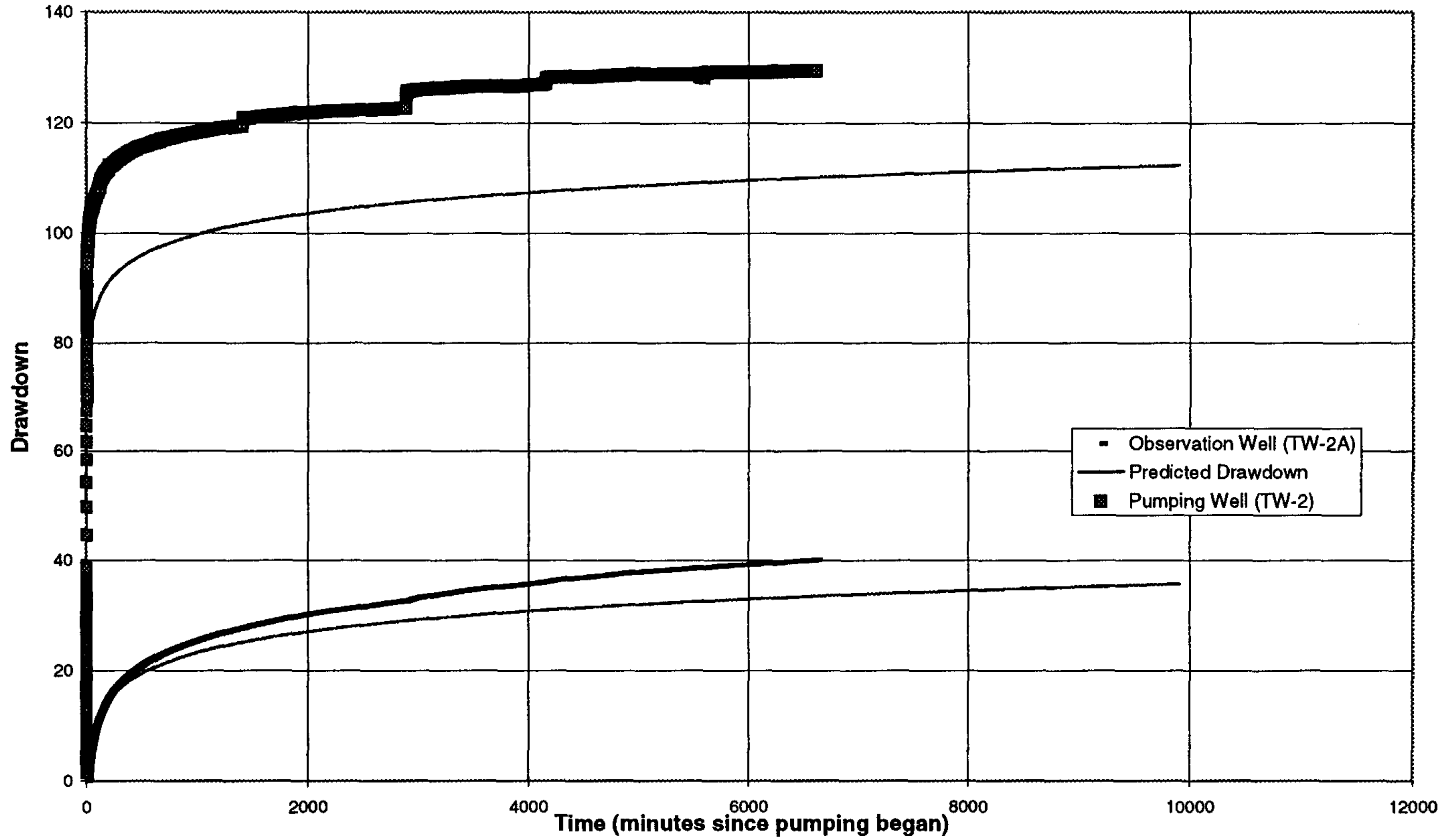


Figure 3-13
Recovery Water Levels January, 1998
Aquifer Compatibility Test

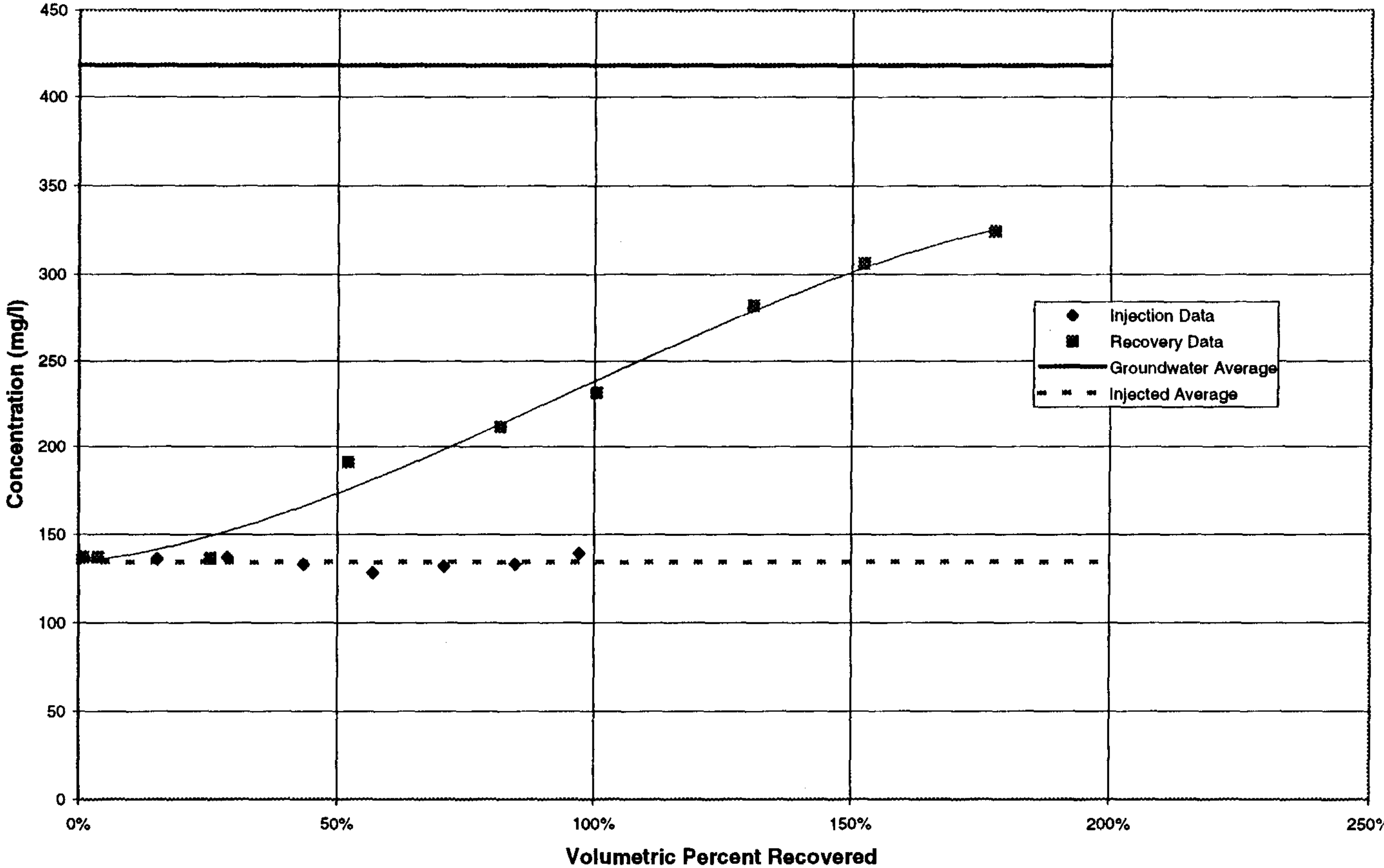


Figure 3-14
Chloride Response January, 1998
Aquifer Compatibility Test

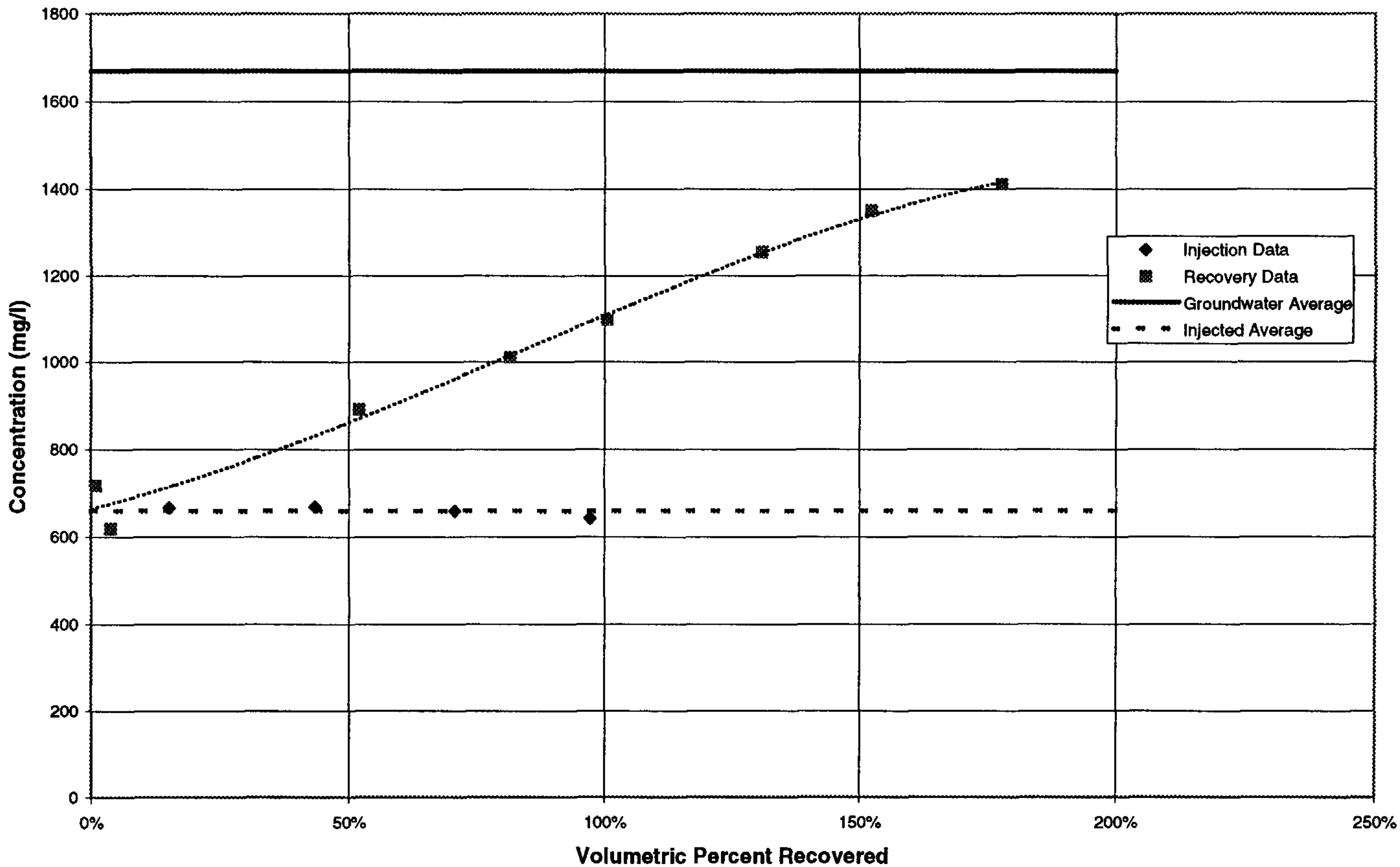


Figure 3-15
TDS Response January, 1998
Aquifer Compatibility Test

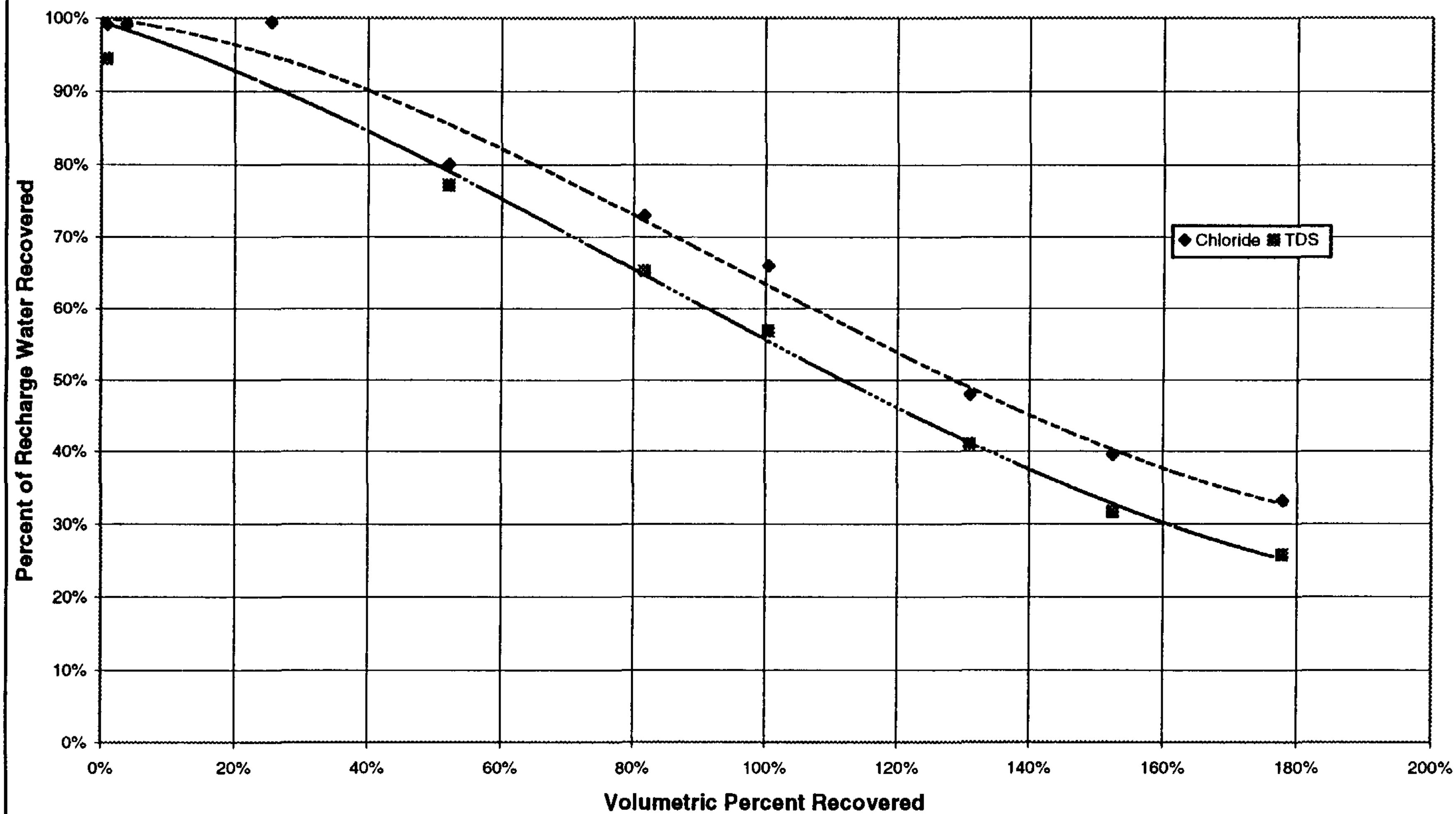


Figure 3-16
Chloride and TDS January, 1998
Aquifer Compatibility Test

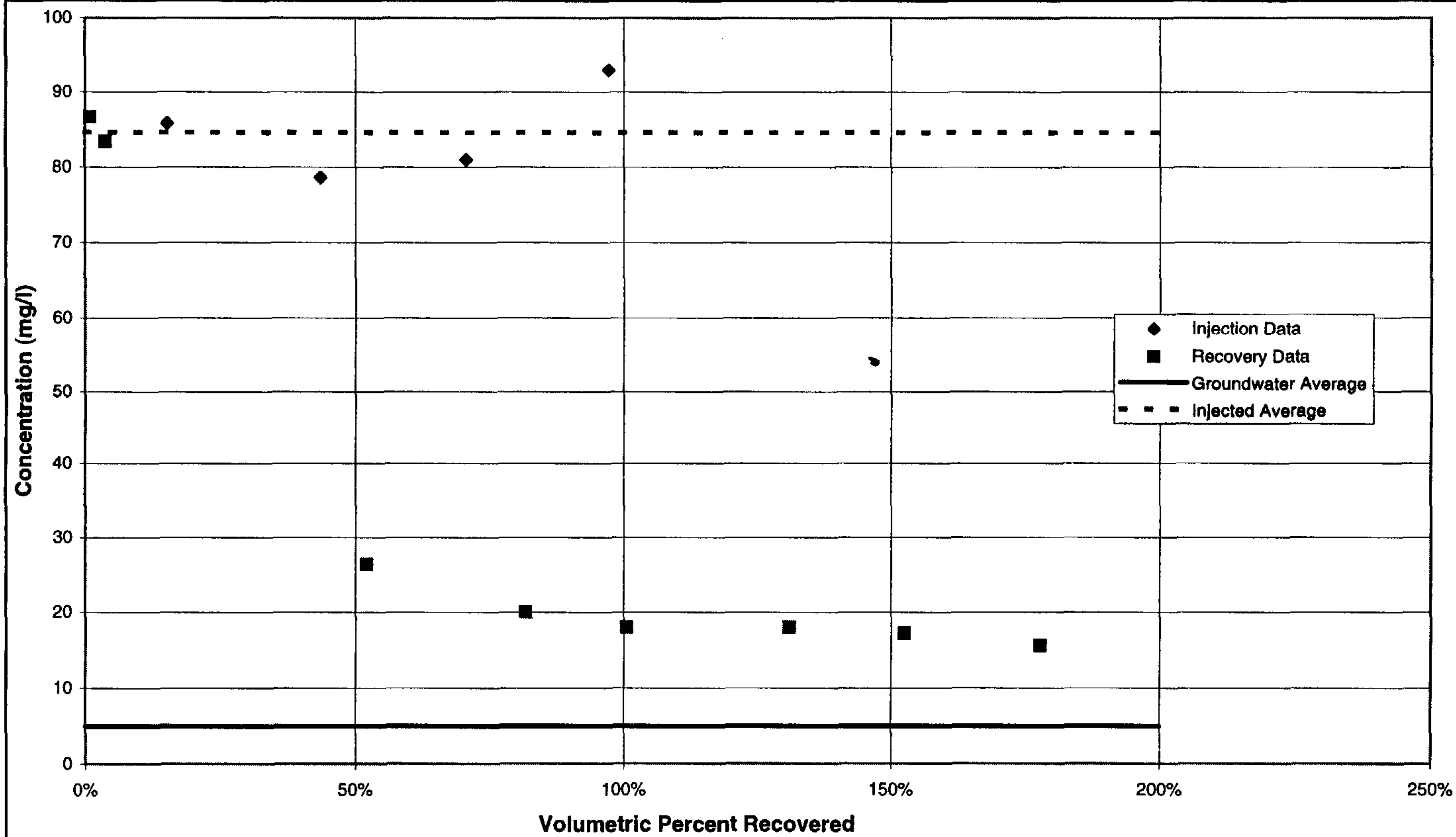


Figure 3-17
Calcium Response January, 1998
Aquifer Compatiblity Test

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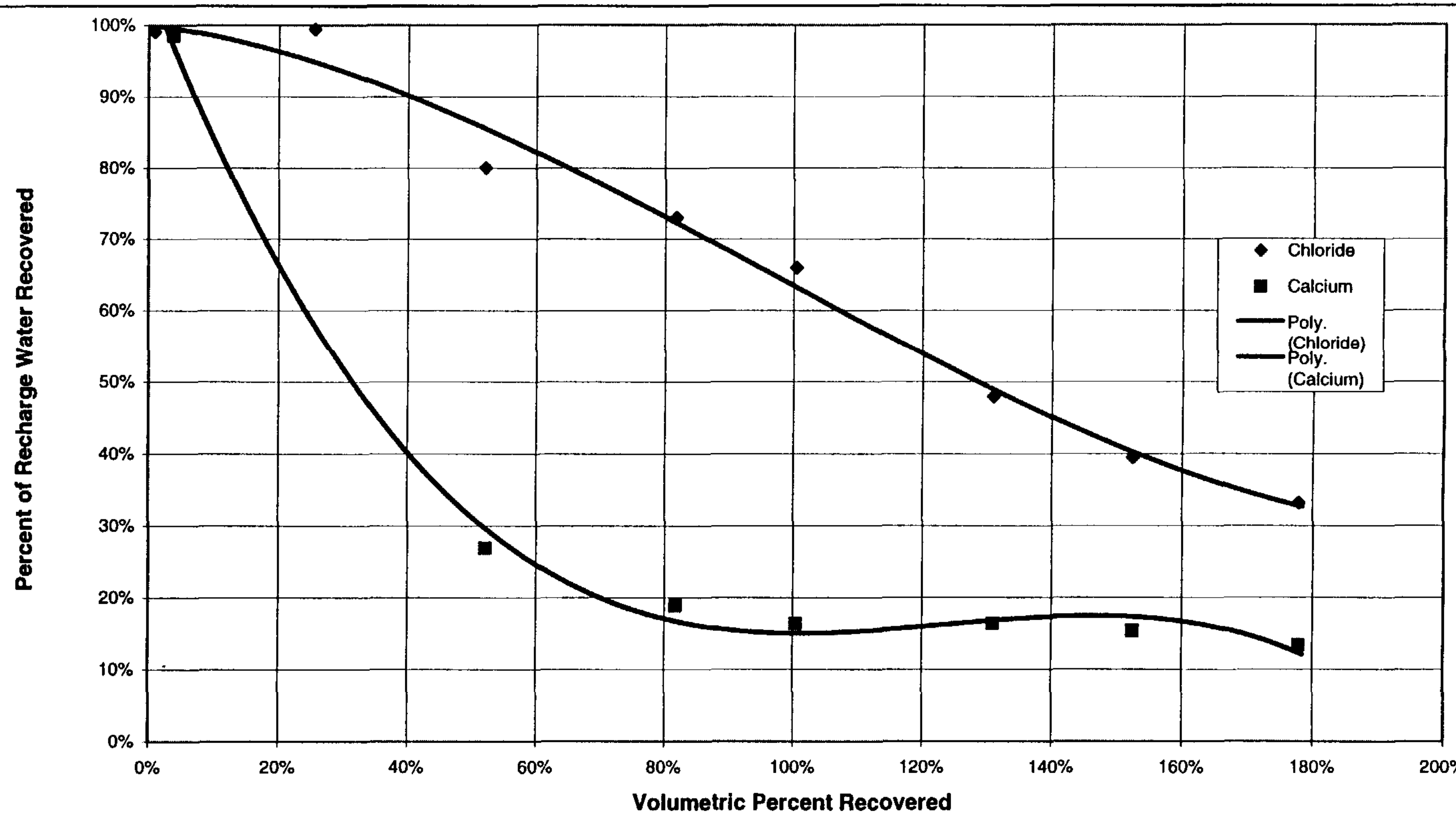

Figure 3-18
Chloride and Calcium January, 1998
Aquifer Compatibility Test

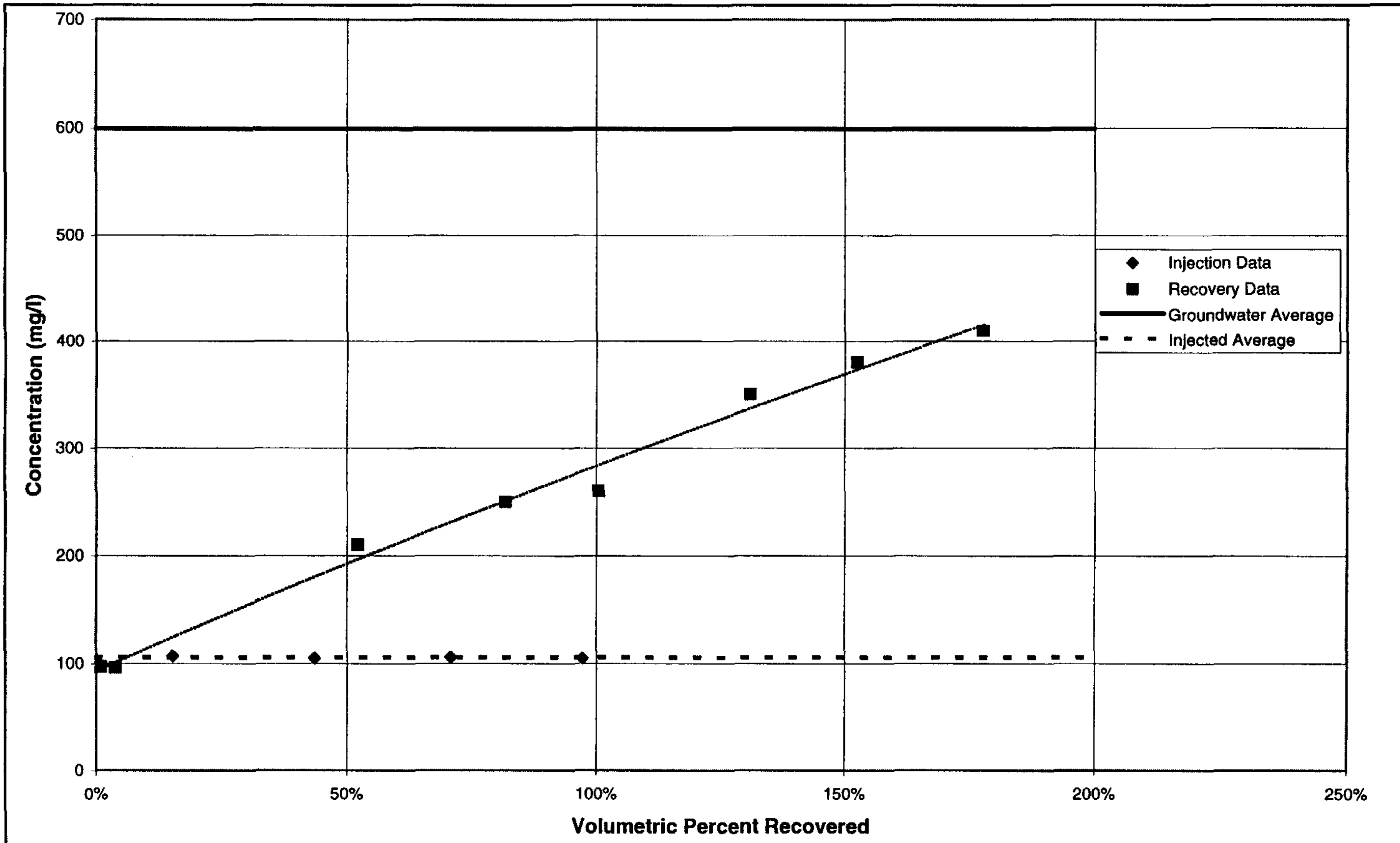

Figure 3-19
Sodium Response January, 1998
Aquifer Compatiblity Test

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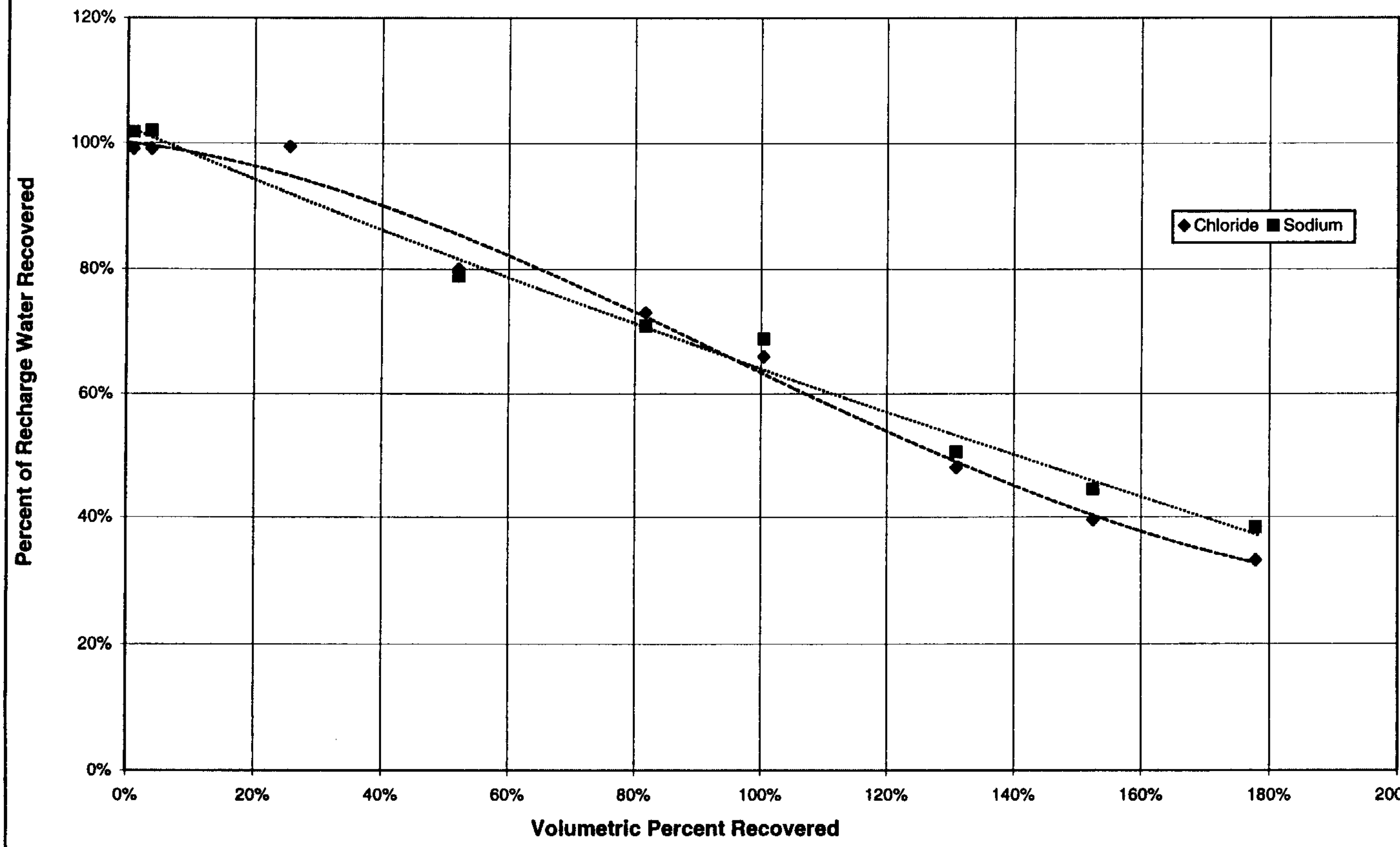

Figure 3-20
Chloride and Sodium January, 1998
Aquifer Compatibility Test

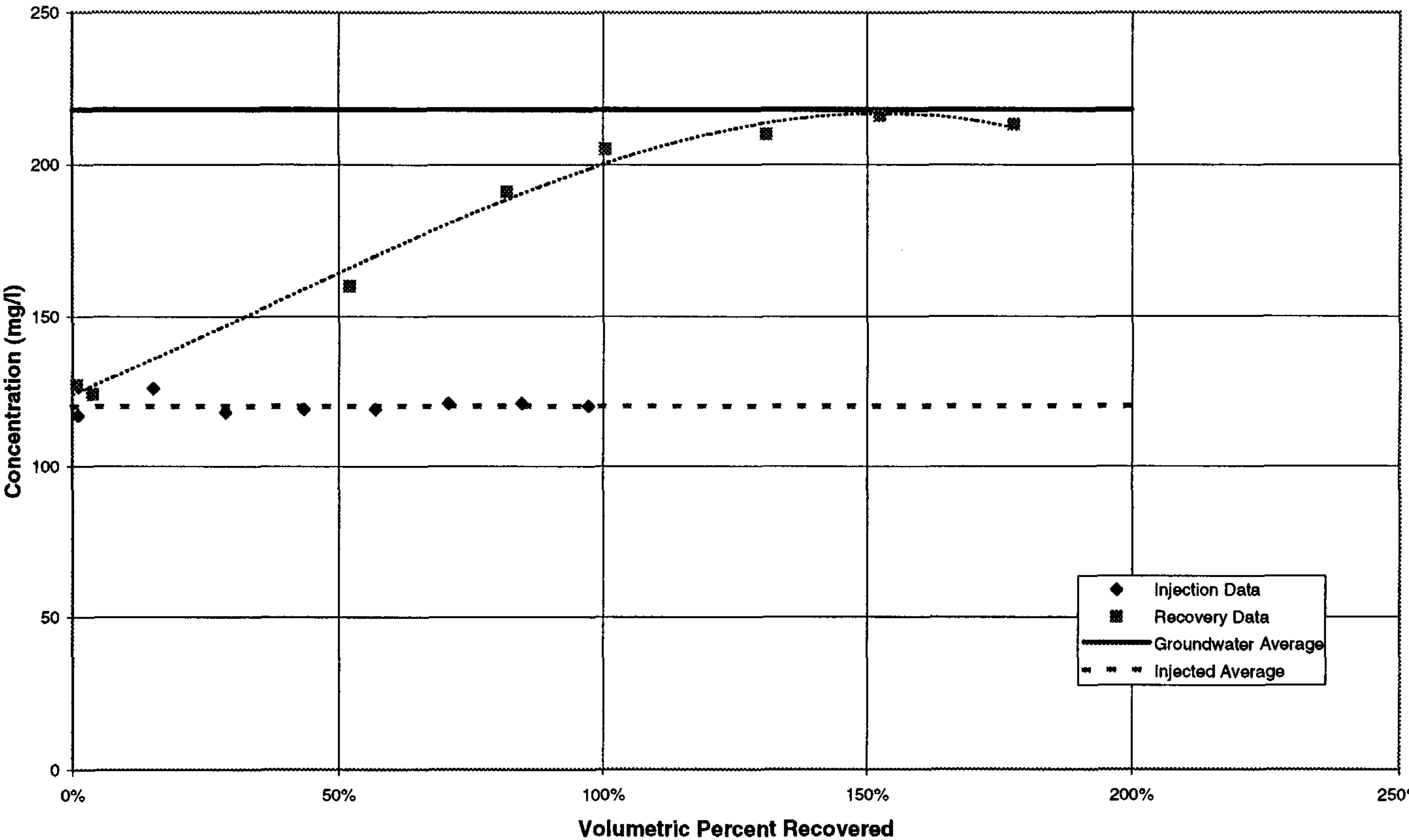

Figure 3-21
Alkalinity Response January, 1998
Aquifer Compatibilty Test

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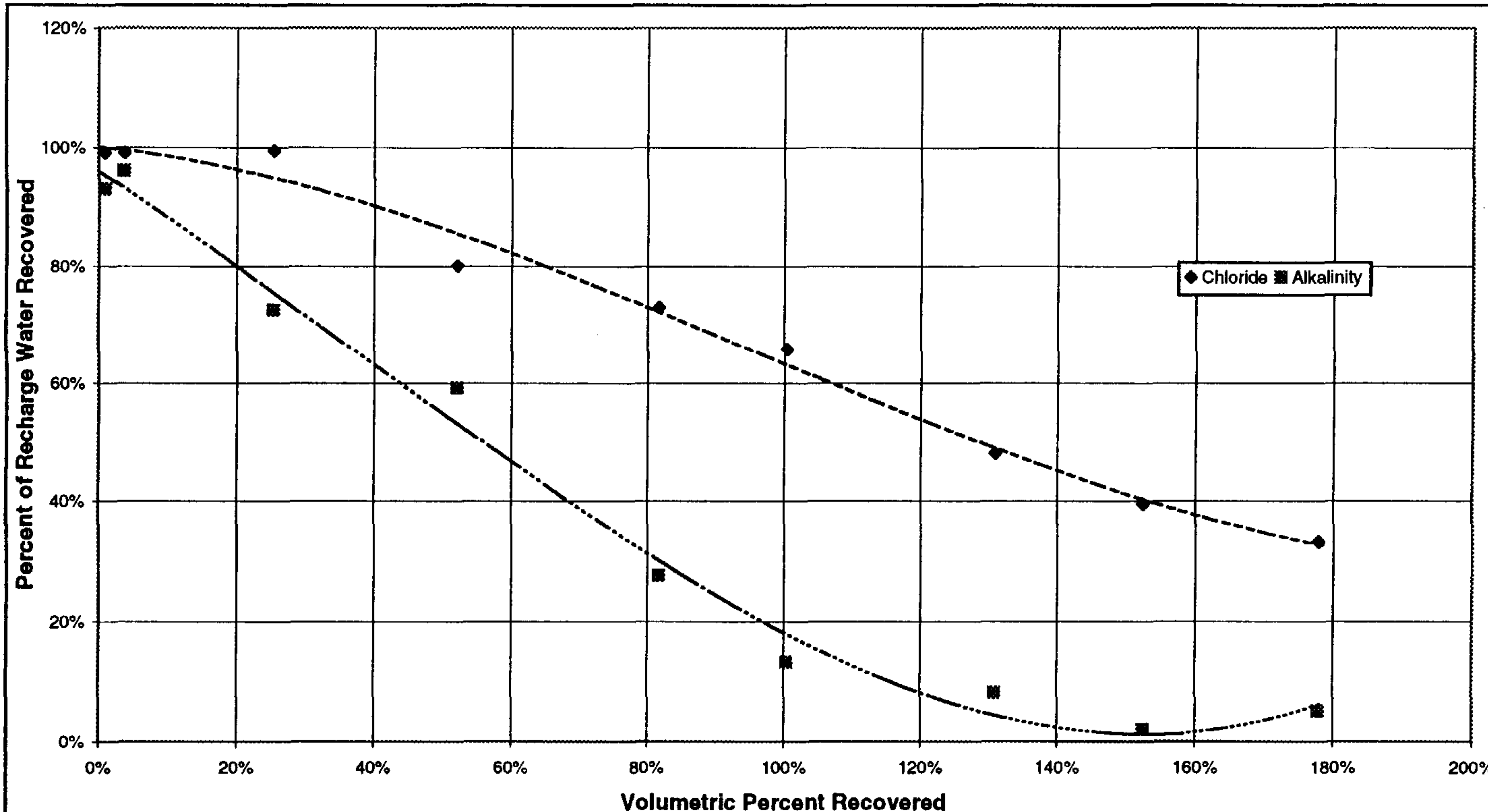


Figure 3-22
Chloride and Alkalinity January, 1998
Aquifer Compatbility Test

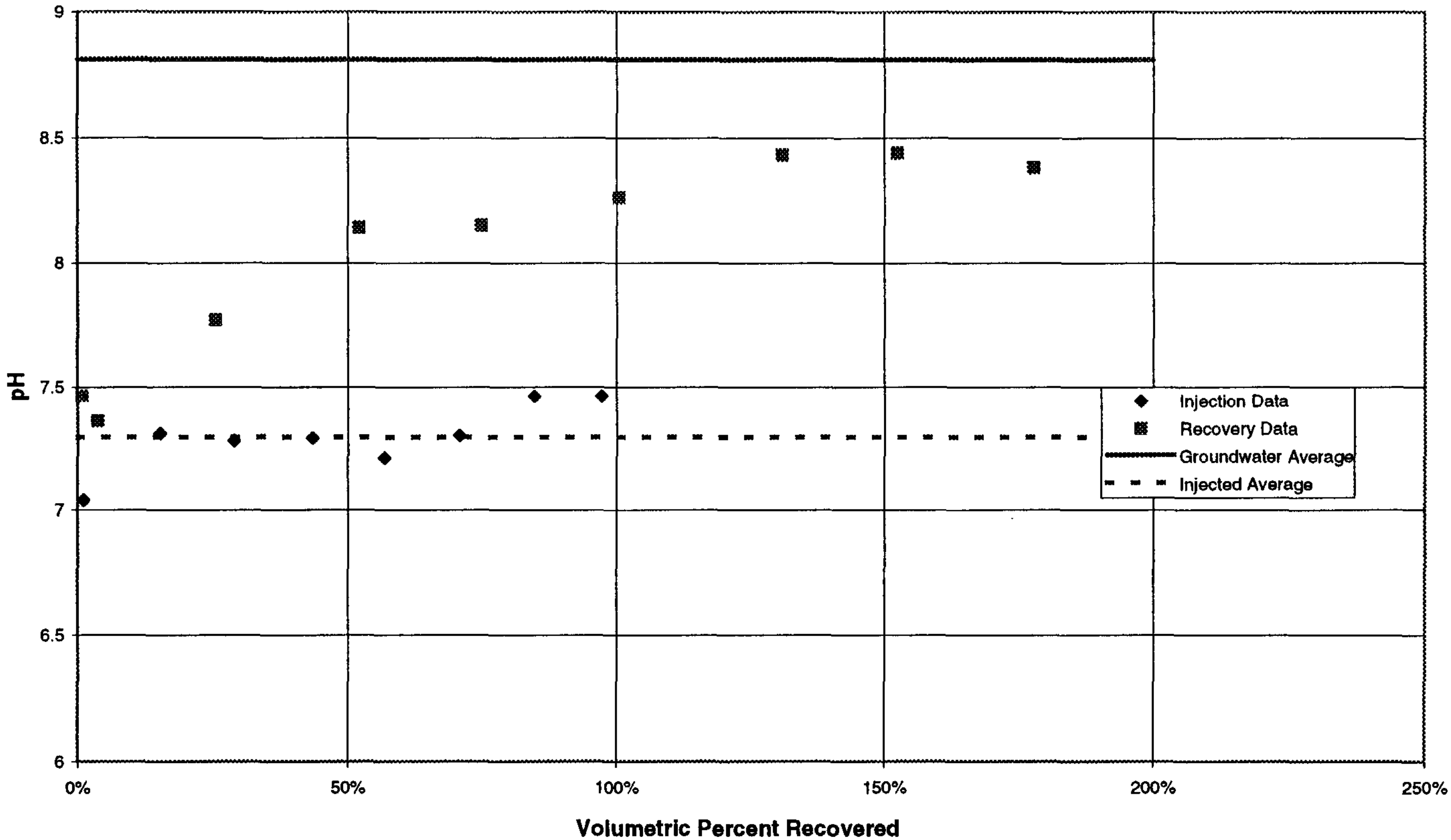


Figure 3-23
pH Response January, 1998
Aquifer Compatibility Test

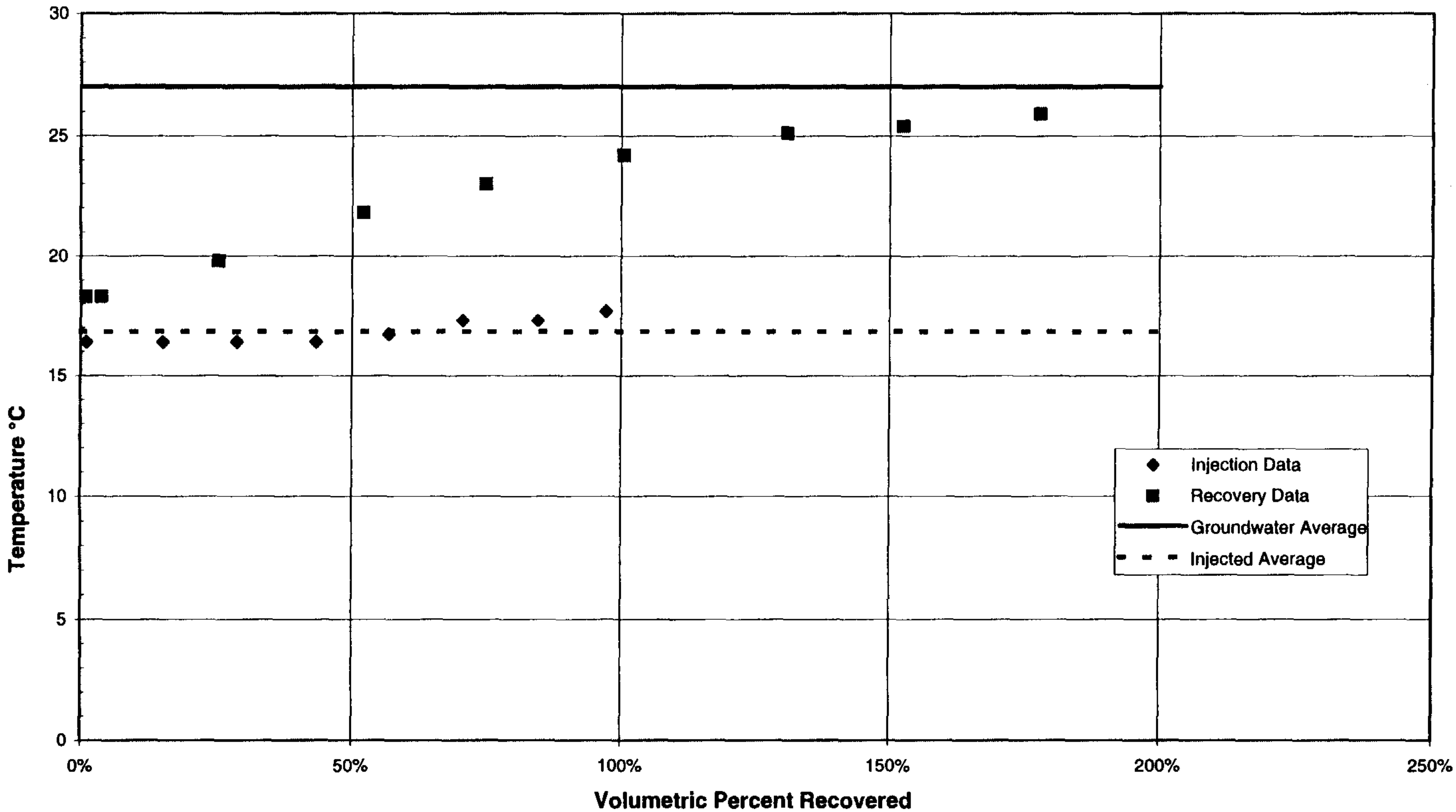


Figure 3-24
Temperature Response January, 1998
Aquifer Compatibility Test

4.0 Summary of Findings

4.1 Summary of Activities and Results

The City of Laredo overlies the Laredo Formation, a fine-grained aquifer that outcrops in a north-south band throughout the City and dips to the southeast. During this investigation, a limited test drilling program was conducted in the Laredo Formation to evaluate the potential for implementing an ASR program in the aquifer. The investigation included the construction of 4 boreholes at 3 locations in east-central and northeast Laredo. A monitor well was constructed in each borehole and several pumping tests were conducted and groundwater samples obtained. Additionally, 17 existing water wells were located and water samples obtained. This information was used to refine the understanding of the Laredo aquifer and supplement existing information. At one of the three test sites, the Del Mar storage tank site, a limited aquifer compatibility test was performed to further evaluate aquifer conditions.

The aquifer within the Laredo Formation was found to consist of multiple sandstone layers that are interbedded with low permeability shales and claystones. The upper portions of the Laredo Formation appear to have the best potential for water resource development and are referred to as the upper sand unit. The saturated upper sand zone appears to occur within a relatively narrow, north-south trending band that encompasses most of central and eastern Laredo. This unit is approximately 200 to 250 feet thick in central and eastern Laredo, about 150 feet of which consists of water-bearing sandstone layers. The depth to the saturated portions of the upper sand unit is controlled by the dip of the formation and ranges from about 100 feet in west-central Laredo to greater than 800 feet in east Laredo. In western Laredo, the upper sand zone is present at the surface and is only partially saturated. While the entire formation thickens to the east and southeast, in this direction it also becomes finer grained and contains fewer and thinner sand layers.

The Laredo Formation supports local water wells for limited supply. Yields to wells were found to be about 60 gpm, with drawdowns in the range of 50 to 70 feet. The results of this investigation indicate that well specific capacities from 0.5 to 2.5 are possible but generally 1.0 gpm/ft can reliably be developed in central and eastern areas of the City where the entire saturated thickness of the upper sand zone occurs. It is probably possible to construct wells with higher specific capacities using alternative drilling techniques.

Water quality of the Laredo Formation groundwater was generally found to be mineralized, with sodium and chloride concentrations in the range of 422 to 982 mg/l and 243 to 743 mg/l, respectively. Two primary groundwater types were identified across the City, the character of which appears to be dependent on the distribution of the upper sand zone. In western and southern Laredo, where the upper sand unit is thin or absent, the groundwater is low in pH and high in TDS. Sodium and sulfate are the dominant cations and anions. In central to eastern Laredo, the groundwater in the upper sand zone is characterized by high pH (8.81 – 9.13) and intermediate TDS (1,266 – 2,200 mg/l). The dominant cation is sodium and the anions chloride, bicarbonate, and sulfate generally occur in near equal concentrations.

Water quality samples of the finished water from the Jefferson WTP were obtained and analyzed during this investigation. The sample results were used with the geological core analysis and the groundwater quality analyses to evaluate potential chemical reactions that may occur during storage of the treated water in the aquifer. The evaluation utilized a thermodynamic equilibrium computer model, which predicted the potential chemical reactions that may occur if the recharge water, native groundwater, and the mineral composition of the aquifer matrix were intermixed.

Additionally, MFI tests were conducted on the WTP finished water. These tests measure the physical ability of the water to be pushed through small pore spaces by passing the water though 0.45 micron filters. The volumetric rate over time that water will pass through the 0.45 micron filter is related to how quickly the water may plug a wellbore over time.

The results of the geochemical modeling suggested that the native groundwater might have the potential to precipitate calcium carbonate when mixed with the treated WTP water. Additionally, it was observed that the native groundwater exhibits relatively high levels of TOC and nitrogen compounds. These parameters indicate that the aquifer has a high potential of developing biological growth. Bacterial growth in well casings and screens is a major concern in ASR systems as plugging of the wellbore can occur during injection.

The MFI test results indicated that the WTP finished water had a relatively low potential for aquifer plugging. The measured MFI values were in the range of 2 to 5, which indicate only a small buildup of head should occur during injection.

The results of the investigation following the above test drilling and water quality analyses indicated that storage of water in the Laredo Formation may be possible. However, the aquifer was known to have a very low transmissivity. The low transmissivity also indicates the pore spaces in the aquifer are small and that plugging of the aquifer during injection could occur with only little cause. Because some of the results to this point indicated potential problems with wellbore plugging, a field test, the aquifer compatibility test, was developed to test recharge of the aquifer on a small scale and measure the chemical and hydraulic aquifer reactions in an actual test.

The aquifer compatibility test was conducted on well TW-2 at the Del Mar site. The test involved recharging the aquifer with treated WTP water followed by recovery of the water through pumping the well. A total of 288 thousand gallons of treated water were recharged into the aquifer at 28 gpm through well TW-2 over a period of 7 days. Following recharge, a total of 514 thousand gallons were pumped from well TW-2 at 52 gpm over a period of 7 days. During the testing, numerous water quality samples were obtained and analyzed. Water levels in well TW-2 and monitor well TW-2A were measured on a regular basis.

The testing resulted in relatively high heads being required to inject water into the aquifer and confirmed that the aquifer has a high tendency to plug. The overall water quality during recovery was good but did confirm that calcium precipitation was occurring.

4.2 Discussion of Results

The investigation results indicate the north-central area of Laredo is best for water production and ASR applications. This area provides the best aquifer thickness at reasonable drilling depths. Further west, the aquifer thins and the better sand zones do not regularly occur. Further east the aquifer dips to greater depths and results in deeper wells and probably lower well yields. The area tested, in the vicinity of the Del Mar abandoned WTP, is one of the better potential locations for an ASR application.

The treated water from the Jefferson WTP tested low in TSS and the MFI values were low. This indicates that the treated water in Laredo has low or similar physical plugging potential relative to other ASR facilities in the United States. However, these other ASR facilities have much higher transmissivities and it is possible that even low MFI values can result in relatively significant plugging of low transmissivity aquifers.

The results of the aquifer compatibility testing indicate that calcium does precipitate when the treated water mixes with the native groundwater. This chemical reaction forms a solid, calcium carbonate, which can plug off a portion of the aquifer pores. Additionally, the potential for biological growth in the wellbore and aquifer is high, which provides another mechanism to potentially plug the aquifer.

The aquifer compatibility testing demonstrated that injection of the Laredo treated water into the Laredo Formation results in high head buildup and aquifer plugging. The mechanisms that cause this head increase were identified but the relative contribution of each is not yet understood. Calcium precipitation was observed and could be responsible for the observed behavior. Biological growth in the casing and screen is also possible but is not strongly supported by the geochemical data.

It may be possible to control either of these plugging mechanisms by proper design and operation of ASR facilities. Control of the biological growth is likely to be controlled by maintaining a chlorine residual in the well and wellbore at all times. The calcium precipitation can probably be controlled by keeping the mixing zone in the aquifer, away from the wellbore. This could be accomplished by not recovering all the water injected and thus permanently replacing the native groundwater with treated water and establishing a new equilibrium in the aquifer.

However, each of the above mechanisms to control the aquifer plugging may also have potential side effects. Chlorine contact time leads to higher disinfection byproducts and any calcium precipitation could negatively affect this aquifer because of its very fine grained nature. In summary, it may be possible to inject and store treated water in the Laredo Formation; however, it would require additional testing to obtain a full understanding of the plugging reactions, and the final ASR facilities would require careful operation to maintain their ability to inject and recover water.

4.3 Economics

The results of the Step 1 investigation presented preliminary costs associated with implementing a 5 mgd ASR system in the Laredo Formation. The preliminary costs were based on several assumptions regarding well size, depth, spacing and yield that were made during the Step 1 investigation. During the Step 2 work, these assumptions were updated from the field testing and are presented adjacent to the Step 1 findings in the following table:

Table 4-1 Step 1 and Step 2 Assumptions
Laredo Aquifer Storage and Recovery Project, Laredo, Texas

ASR Well Design Criteria	Step 1 Assumptions	Step 2 Refined Assumptions
Average Depth	650 feet	600 feet
Well Casing Diameter	12 inch	12 inch
Recovery Rate	300 gpm	150 gpm
Recharge Rate	250 gpm	75 gpm
Minimum Well Spacing	1,000 feet	1,500 feet

It must be noted that the above well yields and spacing assume that the larger full scale ASR wells will perform at higher efficiencies than the test wells and that they will be located in areas of the highest transmissivities. Based on the above values, the following cost estimate was developed:

Table 4-2 Cost Estimate – 5 Mgd ASR System
Laredo Aquifer Storage and Recovery Project, Laredo, Texas

Item	Unit	No. Required	Estimated Unit Cost	Estimated Total Cost
ASR Well 12-inch dia, 600 ft Total Depth, 200 foot screen	Each	28	$ 70,000	$1,960,000
25 hp Well Pump and piping	Each	28	$ 10,000	$ 280,000
Wellhead Piping	Foot	28	$ 50,000	$ 1,400,000
Disinfection Facility	Each	28	$ 6,000	$ 168,000
I & C Allowance	Each	28	$ 5,000	$ 140,000
Miscellaneous Other Construction	10 %	1	$ 3,948,000	$ 394,800
Engineering and Testing	Each	1	$ 900,000	$ 900,000
Contingency	20 %	1	$ 5,242,800	$ 1,048,560
Total for 5 mgd Wellfield				$ 6,291,360

The above cost estimate is seen to be considerably higher than the estimate developed in the Step 1 report. The largest difference is the assumed well capacity, which has decreased from 300 gpm to 150 gpm. This doubled the number of wells required for the 5 mgd recovery flow. The assumed well spacing also increased from 1,000 feet to 1,500 feet because of the areas of low transmissivity and the interference that would be caused between each well. The increased spacing changed the conceptual layout of the wellfield to consist of wells individually tied into existing distribution system piping. The layout in the Step 1 report assumed a common piping manifold connecting all the wells to a common disinfection facility. Because of the increased spacing, it is thought more economical to locate individual wells throughout the distribution system.

The estimated costs for engineering and testing were also increased to reflect the uncertainties identified in the testing program. In order to implement an operating ASR facility for the City, each well would require careful location selection, construction and testing.

The results of this investigation indicate that an ASR application in the Laredo Formation would require several low yield wells. It has been estimated that the potential injection rate in each well would be approximately 75 gpm, which is one half of the estimated potential recovery rate. Substantial well plugging was also observed during the testing, which will require investigation prior to implementation of the full concept. The work done indicates an ASR application for the City will require a substantial level of operation and maintenance (O&M). The estimated O&M costs for the above facility were based on the current level of understanding. These costs are approximate because neither the actual well yields that are obtainable, and nor the operations required to minimize the observed well plugging are well understood at this time. However, an estimate was developed to identify a potential range for these costs.

The O&M cost estimate assumes one person would operate the ASR facility full time, 8-hours per day. It was assumed that each well would require cleaning every 3 years at a cost of $ 10,000 each. Power costs were estimated at $0.07 per kilowatt-hour, and it was assumed the stored water would be recharged over a period of 8 months and recovered over a period of 4 months. Zero cost was assigned to the value of the treated water. The O&M costs are presented as an add-on cost to the finished water. Based on these assumptions, the estimated O&M cost for a 5-mgd ASR system is expected to be in the range of $0.60 to $0.65 per thousand gallons of water stored and recovered.

5.0 Conclusions and Recommendations

5.1 Conclusions

A limited geochemical and hydrogeologic evaluation indicates that injection of potable water into the Laredo Formation is possible. However, the results of the evaluation indicate that injection will be complicated by the low transmissivity aquifer conditions. These conditions make the aquifer very susceptible to physical plugging even though the distribution water has a very low plugging potential relative to other ASR sites where higher transmissivities exist. In addition, the geochemical characteristics of the surface water and groundwater are such that calcium has the tendency to precipitate (form a solid) within the mixing zone of these waters and/or destabilize the clay mineralogy, thus decreasing the size of the pores within the aquifer matrix. Also, biologic activity may be supported by the geochemical conditions and has the potential to further plug the aquifer. While it is possible that these plugging issues can be managed, additional evaluation of the geochemical and hydraulic factors is needed to better understand the situations that may occur during more lengthy injection and recovery cycles.

During the Step 1 evaluation, water balance estimates indicated that the optimum ASR system would have a 10 mgd recharge and recovery capacity to meet peak demand projections. A conceptual ASR system was proposed that would consist of two 5-mgd ASR facilities, each located in different areas of the City where demands and growth are highest. However, based on the current findings, it was determined that the geologic conditions may not be able to support two facilities, the estimated cost of the ASR system would be higher, and management of the system more technically oriented than previously considered. The low transmissivity conditions will result in lower well yields that require not only more wells but also a greater spacing between wells to limit interference effects. This constraint will probably limit the size of an ASR wellfield based on available land areas. For this reason, it is probably more realistic to consider a 5 mgd or smaller ASR facility as the largest size that the Laredo area could support.

The 5-mgd facility would consist of 28 injection wells, spaced at a minimum of 1,500 feet apart. As a result of the additional wells required, greater spacing between wells and potential plugging issues, the resulting system would require careful and consistent operational management as well as regular maintenance. The total cost of the facility is estimated to be approximately $5.8 million dollars. O&M costs are estimated to be in the range of $0.60 to $0.65 per thousand gallons of water stored and recovered.

5.2 Recommendations

If the City decides to pursue an ASR as a water management tool, the following activities are recommended:

1. Investigate options to enhance the well yield. Enhancement options could include techniques such as hydrofracting or chemical treatment to improve the specific capacity.

2. Optimize the location for the prototype facility by better delineation of the highest transmissivity zones within the Laredo Formation. Testing of existing wells, particularly more recently installed wells in the northern areas of the City, would be helpful to verify both aquifer conditions and the change in well yields associated with larger well diameters.

3. Conduct additional cycle testing on a new prototype ASR well to further evaluate geochemical and hydraulic changes. While it may be possible to manage plugging from calcium precipitation or possibly bacterial growth, appropriate remedies must be tested before large-scale implementation occurs.

4. Evaluate possible pretreatment options such as chemical addition to limit the precipitation of calcium and wellhead filtration to further reduce entrained solids.

5. Pursue an ordinance to protect stored water and stop well construction in large areas north of Laredo. Currently, there are no regulations or ordinances in place to control or manage well constructions in the City.

Appendix A

Geophysical Evaluation of the Laredo Formation

Appendix A Geophysical Evaluation of the Laredo Formation

A.1 Introduction

The purpose of this evaluation is to summarize the findings of a limited geologic study performed to assess potential drilling locations in the Laredo area based on the distribution, thickness, and continuity of sand layers within the Laredo Formation. This evaluation was originally performed in the Fall of 1996 and utilized oil and gas well geophysical data compiled in the Laredo area obtained by Alvin Schultz from the Post Cabrian Association log library in San Antonio. The evaluation was later updated to include information obtained during the 1997-1998 field investigation. The area studied was selected to coincide with the distribution of potable water transmission lines and structures.

Several hundred oil and gas well geophysical logs are available for the area. However, very few logs contain complete data for the Laredo Formation due the presence of surface casings. The surface casings are installed in accordance with Texas RailRoad Commission guidance to isolate shallow water bearing zones from potential brine contamination occurring in deeper formations.

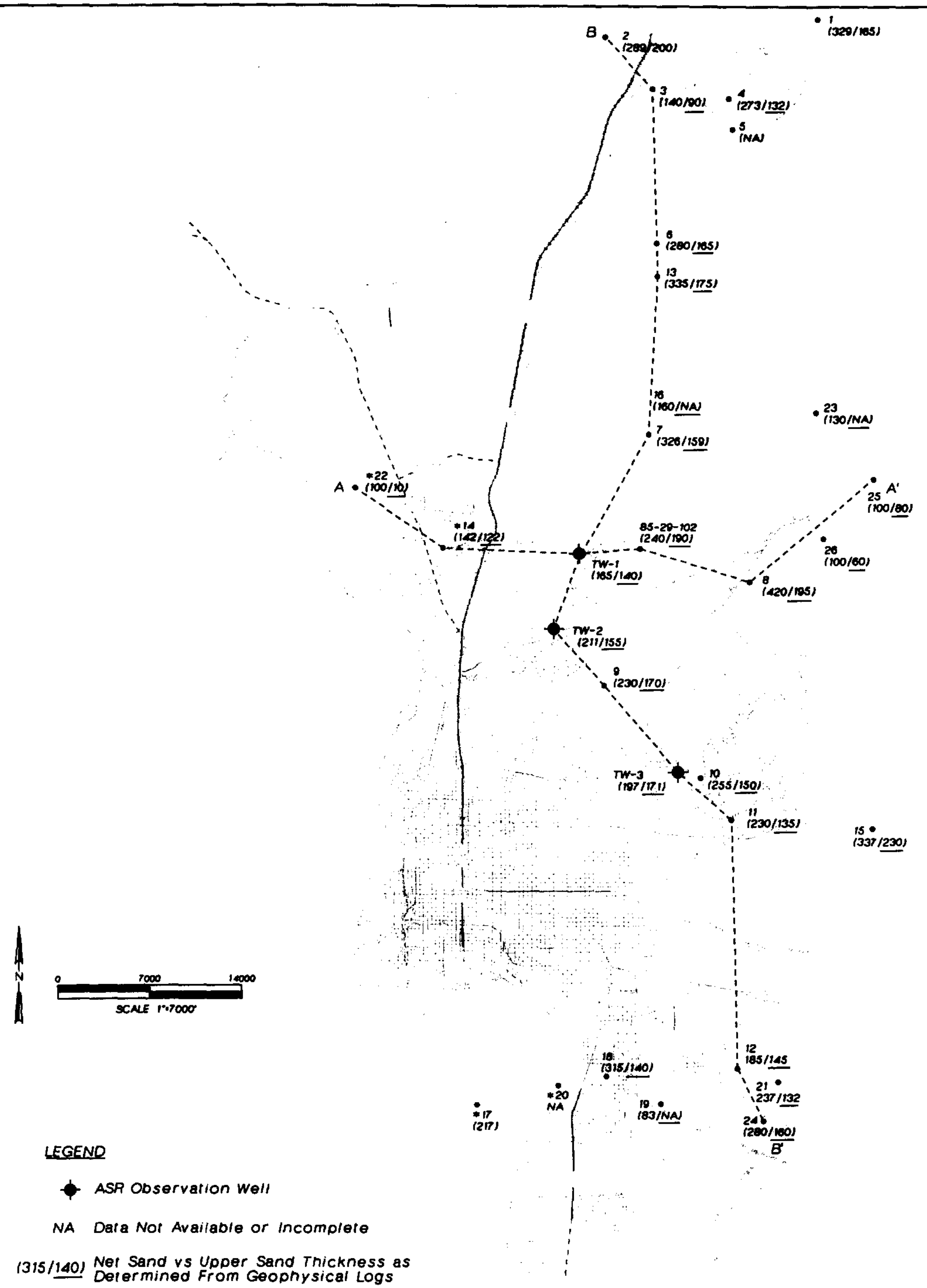
Twenty-nine geophysical logs that contained information on conditions in the Laredo Formation were selected for analysis and include logs from the three test holes drilled during the field investigation. These logs contain information on an area that extends from 11 miles north of the City to 3 miles south of the City. Many of the wells drilled south of the City are very recent (10 years or less) and do contain information for the Laredo Formation. The location of each well log is shown on **Figure A-1**.

Two activities were performed using the geophysical data: 1) calculation of approximate sand thickness measurements and 2) development of geophysical cross sections.

A.2 Sand Thickness Calculations

Table A-1 contains gross, net, and upper net sand thickness measurements for 29 wells in the area. Net and upper sand thicknesses are the most relevant measurements for purposes of this study. Gross sand refers to the entire thickness of the sand-bearing zone and includes numerous low resistivity layers (clays, silts). The net sand refers to the cumulative thickness of individual sand layers within the sand zone. These measurements were also plotted on Figure A-1 to evaluate the distribution of net and gross sand thicknesses.

Within the sand zone, a distinction was made between net upper sand and net lower sand zones. In general, the resistivity profiles indicate that the upper sand zone contains thicker and more permeable sand beds relative to the rest of the sand zone. This finding differs from preliminary conclusions presented in the Step 1 report, which indicated that the lower sands had higher yields and potentially better water quality relative to upper sand units.



LEGEND

ASR Observation Well

NA Data Not Available or Incomplete

(315/140) Net Sand vs Upper Sand Thickness as Determined From Geophysical Logs

A - - - - A' Location of Geophysical Profiles

• 17 Oil/Gas Well (approximate location)

* Upper Sand Zone is Incomplete or Partially Saturated

FIGURE A-1
NET SAND THICKNESS DISTRIBUTION
AQUIFER STORAGE AND RECOVERY FEASIBILITY
STUDY FOR LAREDO, TEXAS

CH2MHILL

Table A-1
Net Sand Measurements
Laredo Formation, Laredo, Texas

Log/Well #	Geophysical Log - Location ID	GROSS SAND	NET SAND	UPPER NET SAND
TW-1	McPherson Test Well	NM	165	140
TW-2	Del Mar Test Well	NM	211	155
TW-3	East Corridor Test Well	NM	197	171
89-29-102	Laredo Country Club Well	NM	240	190
1	Yarborough Hachar #1	495	329	166
2	Lamar Hunt Reuthinger #1	510	289	200
3	General Crude #1 Hachar	250	140	90
4	Clayton Williams #2 N.D.Hachar	482	273	132
5	Southland Drilling Co. #1 Hachar	Poor Log Quality - Use for Correlation Only - See #4		
6	Southland #1 Killam & Hurd	440	280	165'
7	AHERN #A-1 Hubbard	700	326	159'
8	Killam & Hurd #1-P24 Fee	580+	420	195'
9	Watson (Sanchez O'Brien - #1 A.F. Muller G&S Unit	510	230	170'
10	Watson (Sanchez O'Brien Jacaman #1	590	255	150'
11	Sanchez O'Brien #1 Webb Co.	650'	230'	125'
12	Michael Pet. #1 Hurd-Peko-Garcia	570	185	145
13	General Crude #1 Killam & Hurd	485	335	175'
14	Daigle & Young Park #1	300	142	122'
15	Good Hope Ref. #1 Killam & Hurd	445	337	230'
16	Hawkins/Rodriguez Cattle Co.	-	160	-
17	ReMex M-G Mexico	-	-	217
18	Morgan #1 McNary	520	315	140
19	Morgan #3 Link	-	83	-
20	C.F. Braun	-		-
21	TransAmerica #12 Schwarz	430	237	132
22	Cattle Land Oil Co. #1 A.F. Muller	-	100	10
23	AMOCO #2 Killam & Hurd - AMOCO Range	-	130	-
24	Gulf Oil Company M. Alexander #4a	500	280	160
25	Amoco Killam & Hurd - Amoco "G"	300	100	80
26	Amoco Killam & Hurd - Amoco "H"	280	100	80
	Data Incomplete - entire Laredo Formation not logged due to surface casing			

This latter finding is probably flawed because no consideration was given to the location of wells evaluated relative to the strike and dip of the Laredo Formation.

Attached to this memorandum are two geophysical logs from sites #7 and #12 that illustrate the occurrence of the upper versus gross sand zones relative to the entire thickness of the Laredo Formation (see **Attachment A-1**). These logs also contain calculations showing how gross, net, and upper net sand thicknesses were determined. As shown on the logs, within the upper sand zone, several individual sand layers occur that are separated by low resistivity units. It is inferred that low resistivity units correlate to low permeability clays and silts.

The net and upper sand thickness measurements shown on Figure A-1 illustrate that there are no significant trends in the thickness of sand across the area that was assessed. In general, the greatest thicknesses of upper net sands occur north and east of the City with a range of 160 to 200 feet. The thickness of sand generally decreases toward the west. Approximately 230 feet of upper net sand exists at log #15, located east of the City. South of the City, only three geophysical logs contain data for the entire thickness of the formation where net upper sand thicknesses are from 132 to 160 feet.

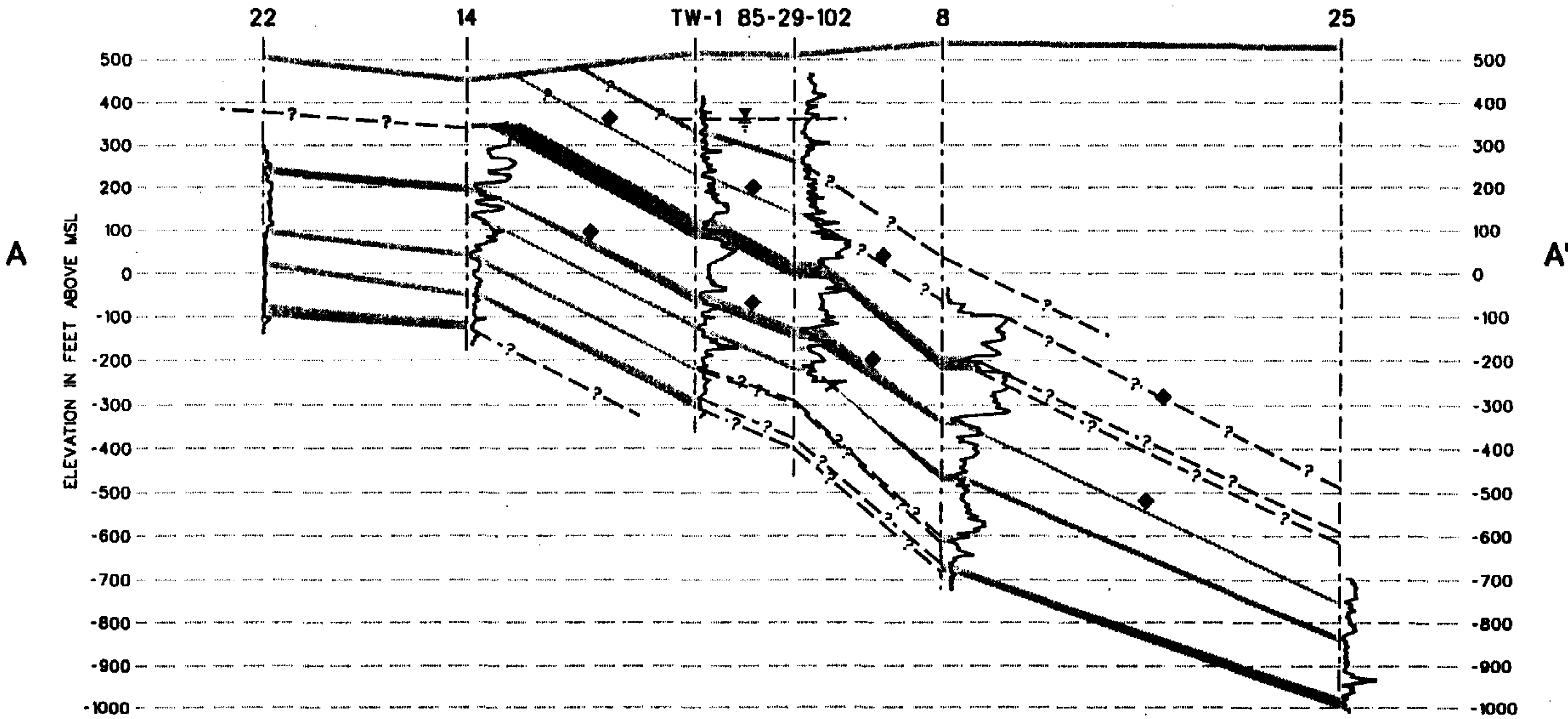
A.3 Geophysical Profiles

Two geophysical profiles were developed (a north-south section in A-A′ and a west-east section in B-B′) to illustrate the thickness and continuity of sand layers within the Laredo Formation. The profiles are shown in **Figures A-2** and **A-3** and their locations shown on **Figure A-1**. Note that the profiles show correlations only for those portions of the geophysical logs containing information on the Laredo Formation. Shaded zones refer to low resistivity zones composed of clays, silts, and fine sands. The profiles shown were interpreted from geophysical logs containing spontaneous potential, resistivity, and conductivity curves. To simplify the presentation of these profiles, only resistivity curves are illustrated.

Note that the Laredo Formation outcrops in a north-south trending band, approximately seven miles in width. Since the formation dips and thickens to the east, wells located in the east will reflect thicker sequences of the formation as compared with wells to the west.

Profile A-A′ runs north-south and indicates that the top of the sand zone begins 300 to 1100 feet below ground surface (bgs). The base of the sand occurs at 550 to 1550 bgs, depending on the location of the log relative to the dip and structure of the formation. Based on relatively high resistivity measurements, three to six separate sand zones occurring in the upper 200 feet of this interval appear to have the greatest capacity to transmit groundwater. These layers are between 5 and 60 feet thick and the logs indicate that interbedding is common within these layers.

In profile B-B′, the top of the sand zone occurs approximately between 100 feet bgs (outcrop) and 900 feet bgs. The base of the sand zone occurs between 400 and 1300 feet. Based on resistivity profiles, the most productive sands appear to occur in the upper 200 feet of this zone. However, this is only true where the upper 200 feet are present and is not the case for well #22 (see **Table A-1**). At test well locations TW-1 and TW-2, the upper sand zone occurs



LEGEND

LOW RESISTIVITY UNIT (SHALE, SILTSTONE)

SCALE: 1" = 7000' HORZ
1" = 400' VERT

0 20-100 ohms

GEOPHYSICAL CONTACT (RESISTIVITY CURVE)

INFERRED CONTACT

TOP/BOTTOM OF INTERVAL CONTAINING THE HIGHEST RESITIVITY UNITS WITHIN UPPER SAND ZONE

APPROXIMATE TOP OF PIEZOMETRIC SURFACE

FIGURE A-2
LAREDO FORMATION
GEOPHYSICAL PROFILE A-A'
AQUIFER STORAGE AND RECOVERY PROJECT
CITY OF LAREDO, TEXAS

18069P02.DGN

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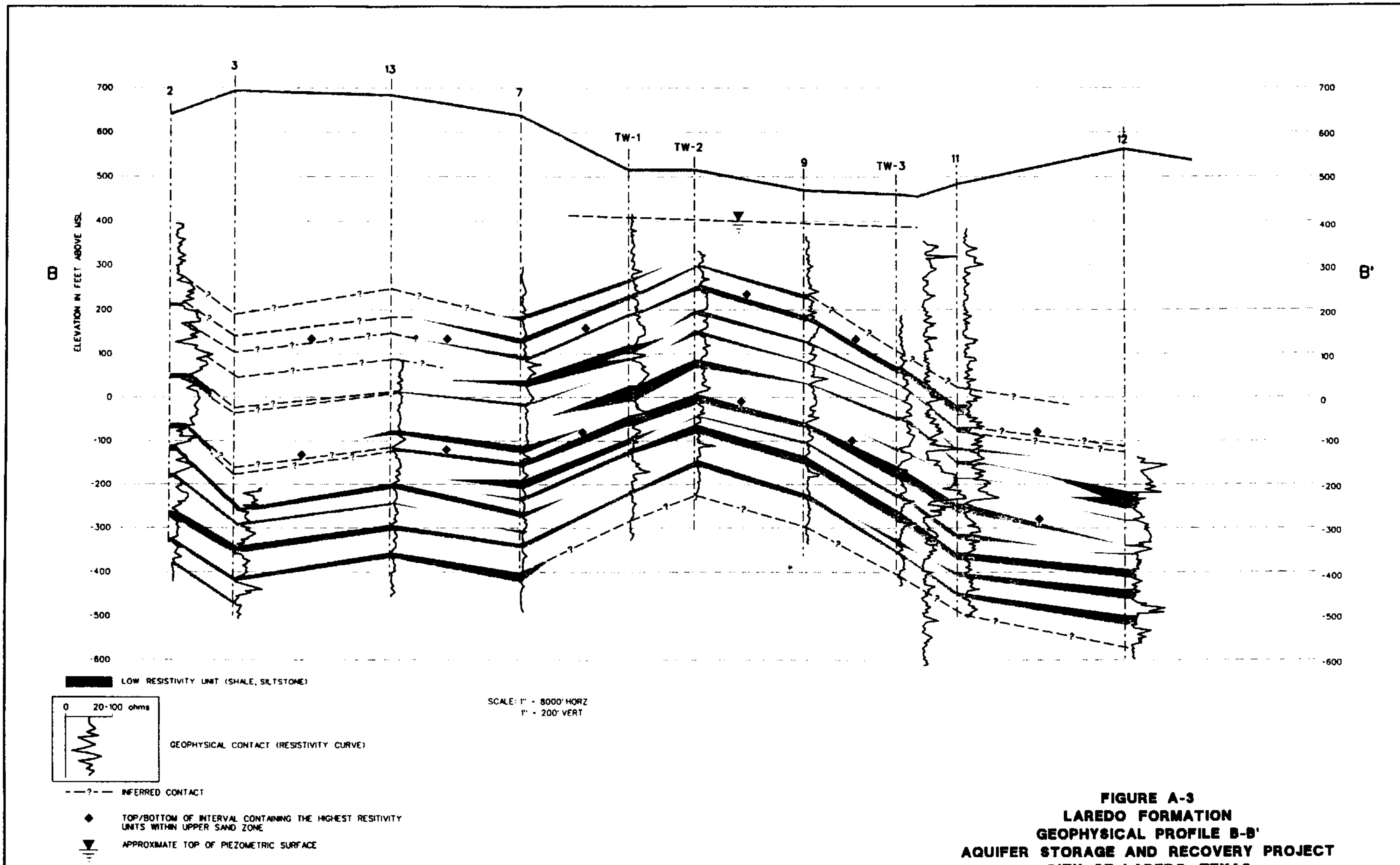


FIGURE A-3
LAREDO FORMATION
GEOPHYSICAL PROFILE B-B'
AQUIFER STORAGE AND RECOVERY PROJECT
CITY OF LAREDO, TEXAS

18069F01.DGN

CH2MHILL

between 330 to 490 and 270 to 420 feet bgs, respectively. However, consistent with findings of the earlier memorandum, specific sand layers do not correlate between all logs. The upper sand zone is present on all of the logs.

A.4 Discussion

West to east (downdip) stratigraphic correlations are generally more difficult to make relative to northeast-southwest correlations along strike, suggesting that individual sand beds may be more continuous along strike. This observation is a likely indication of the environment in which the sediments were deposited and appears consistent with the findings of Ricoy and Brown (1977) who studied the depositional environments of the Laredo/Sparta Formation in South Texas. These authors indicate that in southeast Texas, the depositional environment for the Laredo/Sparta Formation consisted of a coastal barrier- bar sand facies. This facies is associated with a wave-dominated, high-destructive deltaic system, formed by the reworking of channel-mouth bar deposits and redeposition of the sand along strike marginal to the channel mouth. According to Ricoy and Brown, the resultant deposits form arcuate to cuspate sand bodies that were oriented parallel to the current coast line.

The authors indicate that the greatest thickness of net sands (300 feet) within the Laredo Formation occur in a narrow band near the outcrop with a predominant orientation parallel to strike. This band appears to encompass the entire area discussed in this study as well as areas farther east. Outside of this band, the net sand thickness thins considerably downdip as the formation generally becomes finer grained.

A.5 Implications for Drilling Sites

Originally, this information was utilized to evaluate drilling sites that were selected as part of the proposed ASR feasibility assessment. The locations coincided with the location of water towers, treatment plants, and/or pumping stations. At least two of the originally proposed well sites ([6] Northwest Storage Tank and [7] Jefferson Water Treatment Plant) are in areas that do not appear to contain the entire thickness of "net sand" deposits and may not contain any "upper net sand" deposits considered to have the greatest potential for development. Proposed well #1 (Milmo Storage Tank) and #2 (proposed 5 million gallon storage tank) may also occur in areas that may be missing some part of the "upper net sand" zone. Log/well #18 (**Table A-1** and **Figure A-1**) contains approximately 140 feet of net sand but is located about 1 mile downgradient of these proposed well sites. Because of the greater thickness of net upper sands in the northeast areas of the City, it was determined that the best potential for resource development might occur at locations near the Del Mar Storage Tank McPherson Storage Tank, and East Corridor Storage Tank and Booster Station.

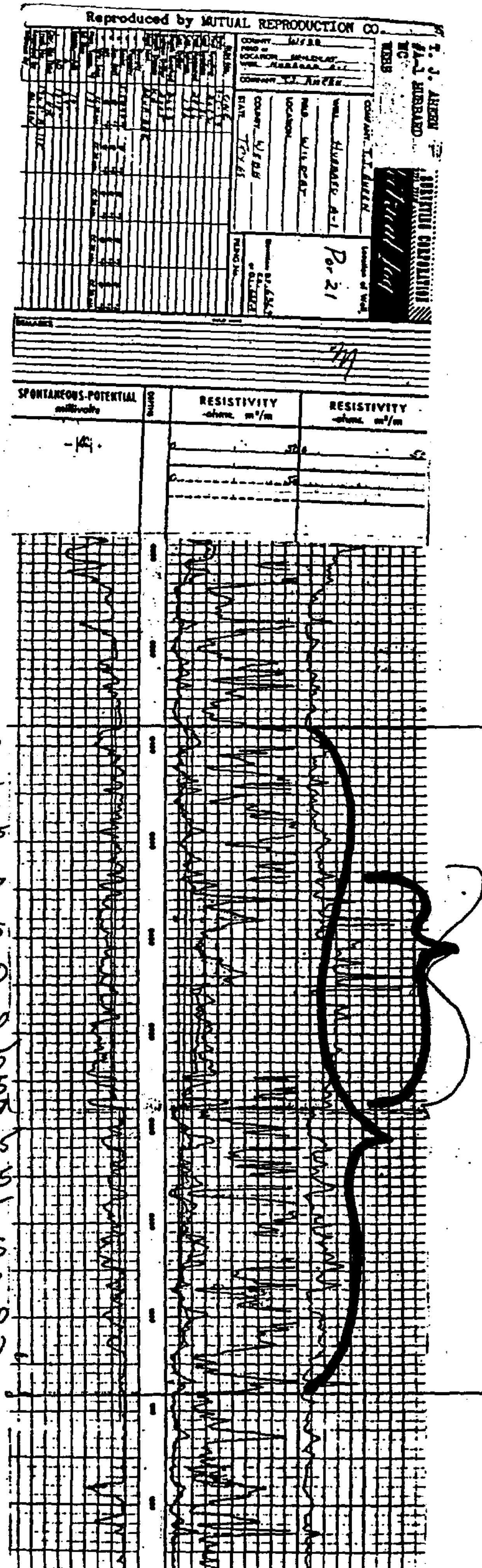
References

Ricoy, J.U. and Brown, L.F., 1977. Depositional Systems in the Sparta Formation (Eocene) Gulf Coast Basin of Texas. Transactions-Gulf Coast Association of Geologic Societies, v XXVII. 17 p.

Attachment A-1
Sites 7 and 12
Geophysical Logs

Type 2 Log

1/7



GROSS
1080
380
700'

Net-upper
159'

Net Total
326'

$\frac{Net}{GROSS} = \frac{326'}{700}$

20
5
5
7
35
30
30
45
5
7
15
25
25
35
7
20
10

Upper Sand Zone
159

Gross Sand Zone

MICHAEL PETROLEUM CORP.
#1 HURD-PEKO-GARCIA UNIT
WC
WEBB

12

Welex

COMPOSITE

DUAL INDUCTION
SPECTRAL DENSIT
DUAL SPACED NEUT
LONG SPACED SON
LOG

COMPANY ____
WELL ____
FIELD ____
COUNTY ____ ST __

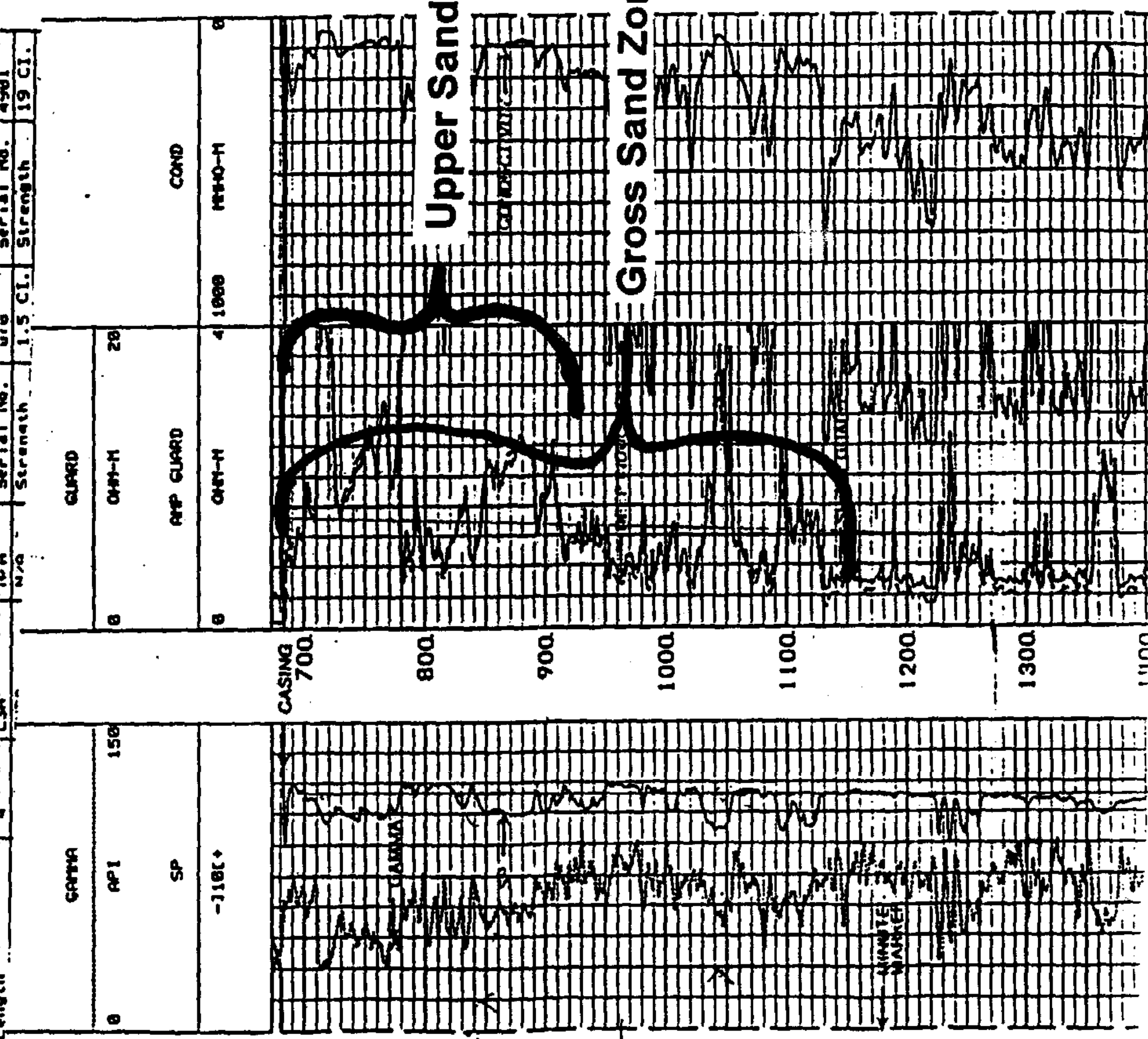
COMPANY MICHAEL PETROLEUM CORP.
WELL HURD-PEKO-GARCIA UNIT NO. 1
FIELD WILDCAT
COUNTY WEBB 04 STATE TX
API NO. N/A 42-479-34751
LOCATION 21200 FNL. 328 FNL OF JOSE MIGUEL DIAZ, PORCION 35, A-546
OTHER SER
DIP
LSA
SEC N/A TWP N/A RGE N/A

PERMANENT DATUM G.L. ELEV. 561.3 ELEV.: K.B / D.F / G.L
LOG MEASURED FROM T.K.B. 18.0FT. ABOVE PERM. DATUM
DRILLING MEASURED FROM T.K.B.

DATE	11/03/88	11/11/88	RRC RECORDS RETENTION
RUN NO.	ONE	TWO	
DEPTH-DRILLER	5593	8020	APR 08 1992
DEPTH-WELEX	5580	8022	
BTM. LOG INTER.	5579	8020	AUSTIN, TEXAS
TOP LOG INTER.	682	5580	
CASING-DRILLER	10.75@700	7.0 @5580	@
CASING-WELEX	682	5580	
BIT SIZE	8.50	6.125	
TYPE FLUID IN HOLE	WATER BASE	OIL BASE	
DENS. : VISC	9.6 135.0	13.5 143.0	
PH : FLUID LOSS	11.5 19.8	N/A IN/A	
SOURCE OF SAMPLE	FLOWLINE	N/A	
RM @ MEAS. TEMP.	2.56 @75	N/A @	@
RMF @ MEAS. TEMP.	1.87 @75	N/A @	@
RMC @ MEAS. TEMP.	3.35 @75	N/A @	@
SOURCE RMF : RMC	MEAS. : MEAS.	N/A :	:
RM @ BHT	1.27 @151	N/A @	@
TIME SINCE CIRC.	4 HOURS	7 HOURS	
TIME ON BOTTOM	8:00 A.M.	10:15 P.M.	
MAX. REC. TEMP.	151 @T.D.	212 @T.D.	@
EQUIP. : LOCATION	5091 : ALICE	2898 : ALICE	:
RECORDED BY	BARRON	STODDARD	
WITNESSED BY	MR. HART	MS. NEAL	MR. RIEBEL

APR 1992 LOG RECORDS

Serial No. | Strength | 1.5 CI. | Serial No. | Strength | 19 CI.



NDE
upper 145
70'
10'
55'
10'
20'
20'
Total Net 145 +40 185'
Gross 1270 700 570 NDE

Appendix B

TWDB Well Survey and Sampling Effort

Texas Water Development Board
Well Schedule

State Well No. 85 20 901 Previous Well No. County Webb 479

River Basin Rio Grande 23 Zone 2 Lat. 27 37 34 Long. 099 37 39 Source of Coord. 1

Owner's Well No. Location 1/4, 1.4, Section, Block, Survey

Owner Laredo Reddy Mix Co. Driller Unknown

Address P.O. Box 116 Laredo, ~~78402~~ 78042 Tenant/Oper. Rogelio Garcia, V.P.

Date Drilled Depth 475 Source of Depth Datum 0 Altitude 521 Source of Alt. Datum M

Aquifer 124LROO Well Type W User

Well Construction Const. Method Casing Material steel S

Completion Screen Material

Lift Data Pump Mfr. Type Subm S No. Stages

Bowls Diam. in. Setting ft. Column Diam. in.

Motor Mfr. Fuel or Power elec. E Horsepower .

Yield Flow GPM Pump GPM Meas., Rept., Est. Date

Performance Test Date Length of Test Production GPM

Static Level ft. Pumping Level ft. Drawdown ft. Sp.Cap. GPM/ft.

~~Quality~~ (Remarks Pumps into 8'x20' Conc. tank.

Water Use Primary Ind. I Secondary Tertiary

Other Data Available Water Level N Water Quality Y Logs Other Data

Water Levels
Date 12 04 1996 Meas. UTM . no MP
Date Meas. .
Date Meas. .

Well was here when LRM bought property.

	Casing or Blank Pipe (C) / Well Screen or Slotted Zone (S) / Open Hole (O)	Diam. (in.)	Setting (feet) From	To
1	C	05		
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Cemented from to

(20 max)

Recorded By D. Coker Date Record Collected or Updated 12 04 1996 Reporting Agency 01

Remarks 1 2 3 4 5 6

Sample AQ-01 Laredo ASR

Aquifer

Well No. 85 20 901

93-0384
2/9/93

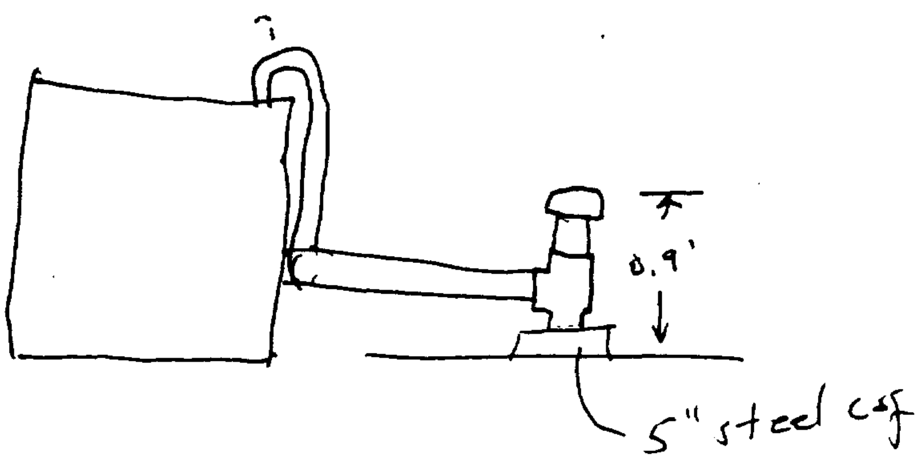
~~photos 1 : 2~~ no photos

LAREDO READY MIX Co.

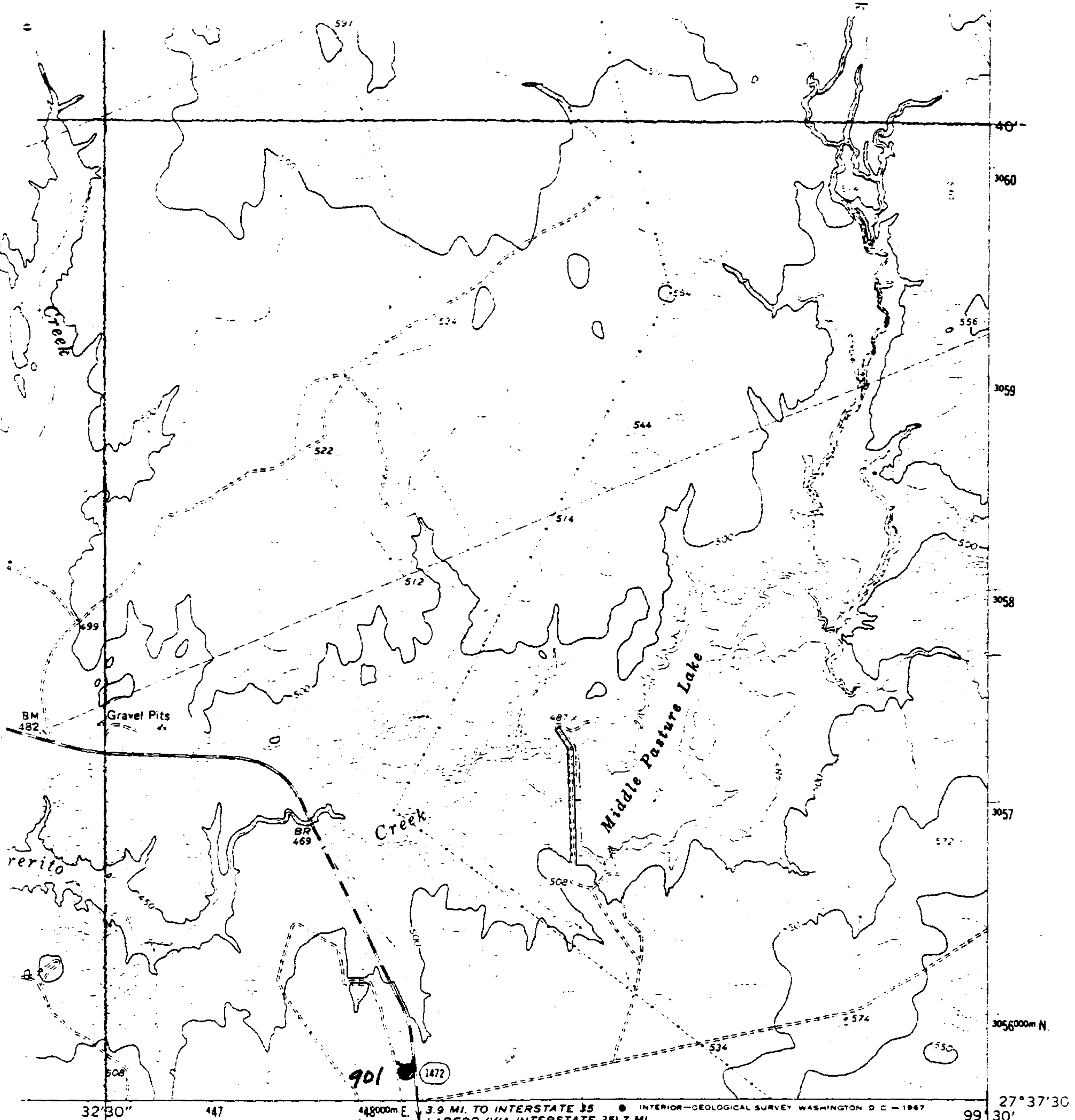
Rogelio Garcia
Vice President

P.O. Box 116
North Mines Rd.
Laredo, Texas 78042

Tel. (210)723-7429
Fax (210)722-4931



85-20-901



ROAD CLASSIFICATION

Medium-duty ▬▬▬ Light-duty ═══

Unimproved dirt ========

State Route

MAP PHOTOINSPECTED

1975

No major culture or drainage changes observed

QUADRANGLE LOCATION

85-20-901

CUERVO CREEK, TEX.

N2737.5—W9930

Water Quality Field Data

27-37-34
99-31-39

SWN: 85-20-901
County: Webb
Aquifer(s): Laredo

Name: Laredo Redi-Mix
Address: Box 116
Laredo, 78042
~~owner's well #~~ Rogelio Garcia

Sample No. AQ-01
Date: 12-4-96
By: D. Coker

	~~Bottle1~~	~~Bottle 2~~	~~Bottle 3~~	~~Bottle 4~~	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
	~~500 ml Anions~~	~~1 liter Cations~~	~~250 ml Nitrate~~	~~1 liter Radioactivity~~	A 1 liter	B 500 ml	C 1 liter	3
		~~2 ml HNO (Nitric)~~	~~0.5 ml H SO (Sulfuric)~~	~~2 ml HNO (Nitric)~~		1 ml HNO_3 ✓		All filtered unless otherwise stipulated

Water Level: UTM LSD
Remark: No MP
Temperature (00010): 27.5 c
Specific Conductance (00094): 2990 umhos/cm
pH (00400): 7.30
Eh (00090): — mv.
Phenol ALK (82244): 0 mg/l
Total ALK (39086): 268 mg/l
Carbonate (00452): ___ meq/l 0 mg/l
Bicarbonate (00453): ___ meq/l 327 mg/l
Total Cations(+): —
Total Anions (-): —
Total Hardness (00900): 390
Dissolved Solids: 1915

Time in: 9:30
Time out: 11:10
Sample time: 10:58
Weather: Lt. rain
well use: Ind, dom
Outside Temp: 65°F
Sampling point: Discharge into 8'x20' Conc. tank (grab)

~~Starting pH~~
~~___ ml. of 0.02N to~~
~~___ ml. of Sample~~
~~Ending pH~~

Time:	10:00	10:05	10:10	10:15	10:22	10:35	ml.	pH	ml.	pH	ml.	pH
pH:	7.61	7.24	7.24	7.25	7.24	7.30	10:45	26.8	10:55	7.30		
Temp:	26.5	26.7	26.8	26.8	26.4	27.3		7.30		27.5		
~~Eh:~~												
Cond.	3050	3000	2960	2950	2950	2970		2990		2990		

other notes:
Pumps on demand.
Pump on 9:58
sample @ 10:58

Texas Water Development Board
Well Schedule

State Well No. 85 28 301 Previous Well No. County Webb 479

River Basin Rio Grande 23 Zone 2 Lat. 27 35 07 Long. 099 30 04 Source of Coord. 7

Owner's Well No. ______ Location ___ 1/4, ___ 1.4, Section ___, Block ___, Survey ___

Owner Severiano Flores Driller Severiano Flores

Address ______ Tenant/Oper. Ms. Saucedo, daughter

Date Drilled 1950's Depth 162 Source of Depth Datum 5 Altitude 438 Source of Alt. Datum m

Aquifer ______ 124LRDO Well Type W User

Well Construction Const. Method ______ Casing Material steel S

Completion ______ Screen Material ______

Lift Data Pump Mfr. ______ Type None W No. Stages ______

Bowls Diam. ______ in. Setting ______ ft. Column Diam. ______ in.

Motor Mfr. ______ Fuel or Power None Horsepower

Yield Flow ______ GPM Pump ______ GPM Meas., Rept., Est. ______ Date ______

Performance Test Date ______ Length of Test ______ Production ______ GPM

Static Level ______ ft. Pumping Level ______ ft. Drawdown ______ ft. Sp.Cap. ______ GPM/ft.

Quality (Remarks was used for domestic, except drinking, too salty

Water Use Primary Abnd U Secondary ______ Tertiary ______

Other Data Available Water Level M Water Quality N Logs Other Data

Water Levels

	Date	Meas.	
Date	12 03 1996	23 . 70	2-01
Date		.	
Date		.	

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

	Diam. (in.)	Setting (feet) From	To
1	C 06		
2	C 05		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

Not used in 30-35 years.

Recorded By D. Coker Date Record Collected or Updated 12 03 1996 (20 max) Reporting Agency 01

Remarks
1 Not used since mid-1960's. Report-
2 ed too salty to drink.
3
4
5
6

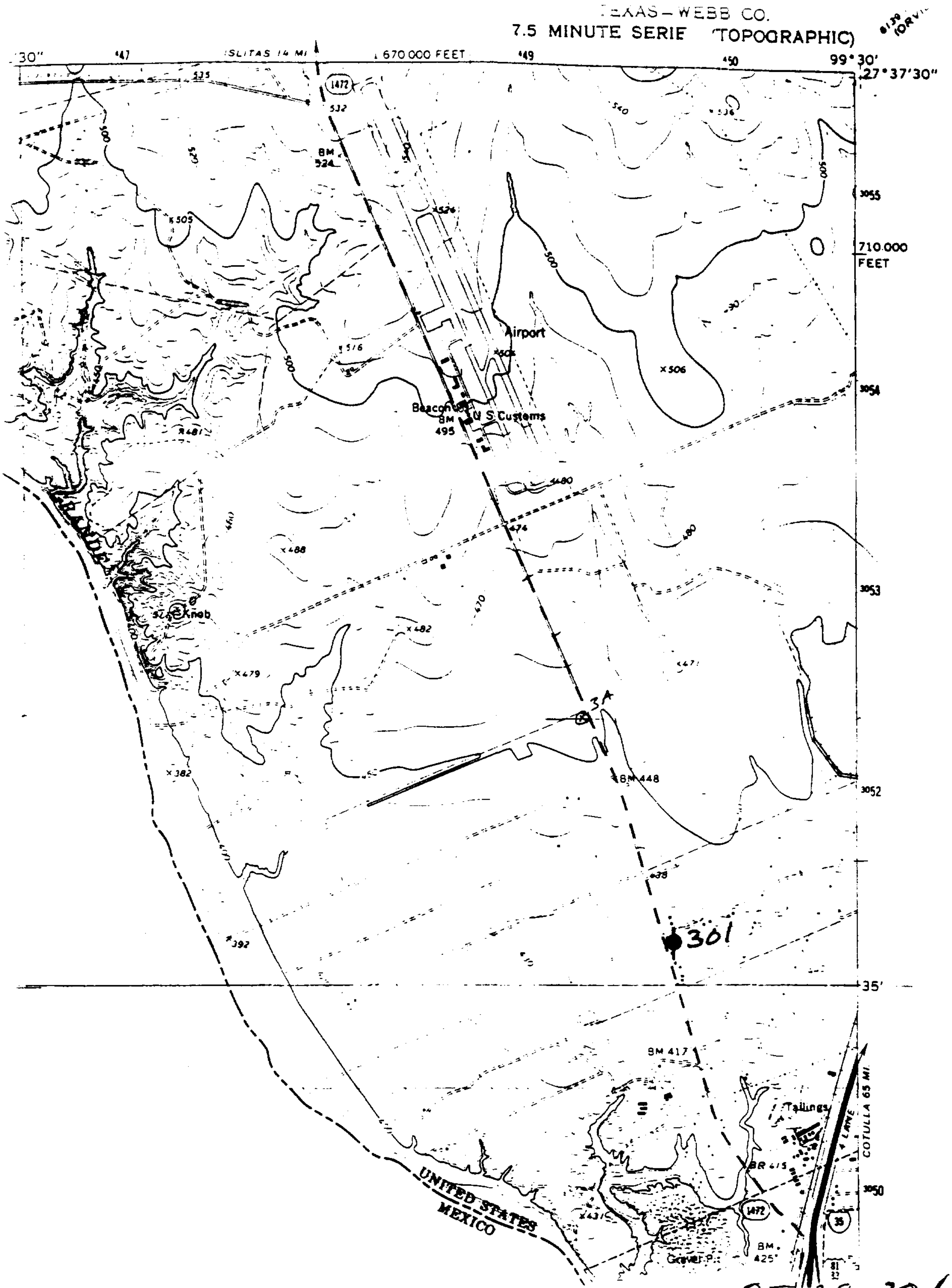
Top of casing, +1.08

Aquifer ______

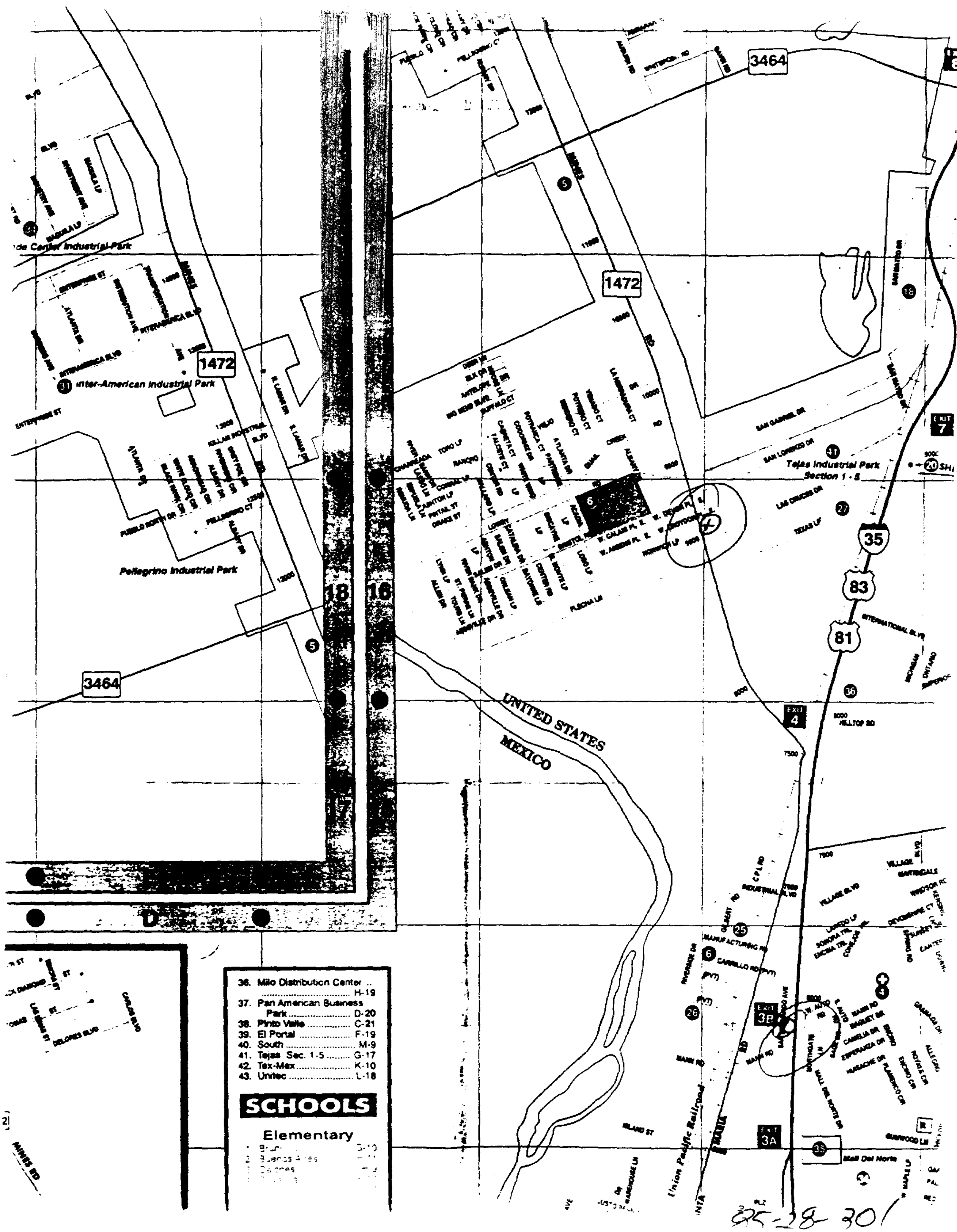
Well No. 8528 30

93-0384

no photos



TEXAS—WEBB CO.
7.5 MINUTE SERIE (TOPOGRAPHIC)
670 000 FEET
99°30'
27°37'30"
710 000 FEET
Airport
Beacon
U S Customs
BM 495
BM 524
BM 448
BM 417
BM 425
Knob
UNITED STATES
MEXICO
Tailings
Gravel P.
COTULLA 65 MI
4 LANE
3055
3054
3053
3052
3050
35'
3A
301


3464
1472
Inter-American Industrial Park
Pellegrino Industrial Park
Tejas Industrial Park
Section 1 - 5
UNITED STATES
MEXICO
35
83
81
EXIT 7
EXIT 4
EXIT 3B
EXIT 3A
SAN GABRIEL DR
SAN LORENZO DR
LAS CRUCES DR
TEXAS LP
INTERNATIONAL BLVD
HILLTOP RD
INDUSTRIAL BLVD
MANUFACTURING RD
CARRILLO RD (PVT)
MANN RD
ISLAND ST
Union Pacific Railroad
Mall Del Norte
VILLAGE BLVD
WINDSOR RD
MINES RD
ATLANTA DR
PUEBLO NORTH DR
PELLEGRINO CT
ENTERPRISE ST
DELORES BLVD
CARLOS BLVD
FLECHA LN
CPL RD
36. Milo Distribution Center ... H-19
37. Pan American Business Park ... D-20
38. Pinto Valle ... C-21
39. El Portal ... F-19
40. South ... M-9
41. Tejas Sec. 1-5 ... G-17
42. Tex-Mex ... K-10
43. Unitec ... L-18
SCHOOLS
Elementary

95-28-301

Texas Water Development Board
Well Schedule

State Well No. 85 28 302 Previous Well No. County webb 479

River Basin 23 Zone 2 Lat. 27 35 43 Long. 099 30 47 Source of Coord. 1 20

Owner's Well No. 10218 FM ~~1427~~ 1472 Location 1/4, 1/4, Section , Block , Survey

formerly Pedro Bustamante, El Caracol Ranch

Owner: Mines Road Dev. Co. Deerfield Subdv. PH 1

Driller: David De La Cruz

Address Tenant/Oper.

Date Drilled 08 04 1966 Depth 210 Source of Depth Datum D Altitude 454 Source of Alt. Datum M

Aquifer Laredo 124LRDO Well Type W User

Well Construction: Const. Method rotary H Casing Material steel S

Completion slotted P Screen Material steel S

Lift Data: Pump Mfr. Type none N No. Stages

Bowls Diam. in. Setting ft. Column Diam. in.

Motor Mfr. Fuel or Power none Horsepower .

Yield Flow GPM Pump GPM Meas., Rept., Est. Date

Performance Test Date 8-66 Length of Test Production 24 GPM

Static Level 150 ft. Pumping Level 192 ft. Drawdown 42 ft. Sp.Cap. GPM/ft.

Quality (Remarks Mr. Pedro Bustamante Jr, : water was good.

Water Use Primary Unused U Secondary Tertiary

Other Data Available: Water Level N Water Quality N Logs D Other Data

Water Levels:

Date 01 20 1997 Meas. 49.80 1-01

Date Meas. .

Date Meas. .

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from 0 to 162

	Diam. (in.)	Setting (feet) From	To
1	C 07	0	172
2	S 07	172	194
3	C 07	194	205
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

(20 max)

Can see well from road, gate across driveway, Beware of Dog sign. No access.

Recorded By D. Coker Date Record Collected or Updated 12 04 1996 Reporting Agency 01

Remarks
1 Reported yield 24 gpm with 42 feet
2 drawdown in 1966
3
4
5
6

P 14-1 192

Aquifer
Well No. 85.28 302

93-0384
2/9/93

no photos

210 - 923 - 7313

31

File or copy with Texas Water Development Board P. O. Box 12386, Capitol Station Austin, Texas 78711	State of **DRILLERS LOG AND WELL DATA REPORT**	For use by TWDB only Well No. 85-28-3-2 Located on map Yes By Date

1) Well Owner: Mr. Pedro Bustamante — 1507 San Bernardo — Laredo — Texas
(Name) (Street or RFD) (City) (State)

2) Land Owner: Mr. Pedro Bustamante — 1507 San Bernardo — Laredo — Texas
(Name) (Street or RFD) (City) (State)

3) Intended use: Industrial ☐ ; Municipal ☐ ; Irrigation ☒ ; Other House use

4) Location of well: County Webb Labor ____ League ____ Abstract No. ____

NW¼ NE¼ SW¼ SE¼ of Section ____ Block No. ____ Survey El Caracol Ranch
(Circle as many as are needed)

6 miles in NW direction
(NE, SW, etc.)

from Laredo
(Town)

Sketch map of well location with distances from two section or survey lines, and to landmarks, roads, and creeks.

DRILLERS LOG OF WELL

Method of drilling: Standard Rig Diameter of hole 8¼ in. Date drilled August 4, 1966

All measurements made from 0 ft. above ground level.

From (ft)	To (ft)	Description and color of formation material	From (ft)	To (ft)	Description and color of formation material
1	3	surface	110	130	salt watersand
3	9	yellow sandstone	130	172	gray sandy shale
9	14	salt watersand	172	194	watersand
14	32	yellow sandstone	194	205	gray shale
32	52	~~xx~~ salt watersand			
52	72	gray sandy shale			
72	92	salt watersand			
92	110	gray sandy shale			

(Use continuation sheets if necessary)

COMPLETION DATA

COMPLETION

Straight wall ☐
Under reamed ☐
Gravel packed ☐
Open hole ☐
Other ____

CASING

Type: Old ☒ New ☐

Cemented from 1 ft. to 130 ft.

Diameter (inches)	Setting from (ft)	Setting to (ft)
7" O.D.	1' above surface	205

SCREEN

Type ____

Perforated ☐ Slotted ☒

Diameter (inches)	Setting from (ft)	Setting to (ft)
	172	194

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

(Signature) David L. De La Cruz (Company Name) Reg. No. 67

Please attach electric log, chemical analysis, and other pertinent information if available.

If well was tested by your company or if you installed the permanent pump please complete the following:

WATER LEVEL AND PUMP DATA

Static water level 50 ft. below surface

Pumping level

feet	hours	gpm
192		24

Pump type ____

Designed pumping rate ____ gpm ☐ gph ☐

Type power unit ____

Horsepower ____

Depth to bowls, cylinder, jet, etc., ____ ft. below pump base

Name of contractor testing well or installing permanent pump if other than your company: ____

85-28-302

Orig.
Pedro Bustamante

Fito Gutierrez
Lone Star

Mines ~~Land~~ Rl. Dev. Co.
Deerfield subdiv. F.I

210 - 725-8884

Not in use -
(K 218 Fm 1472)

(Joe Medina -
722 - 5196 -)
OK

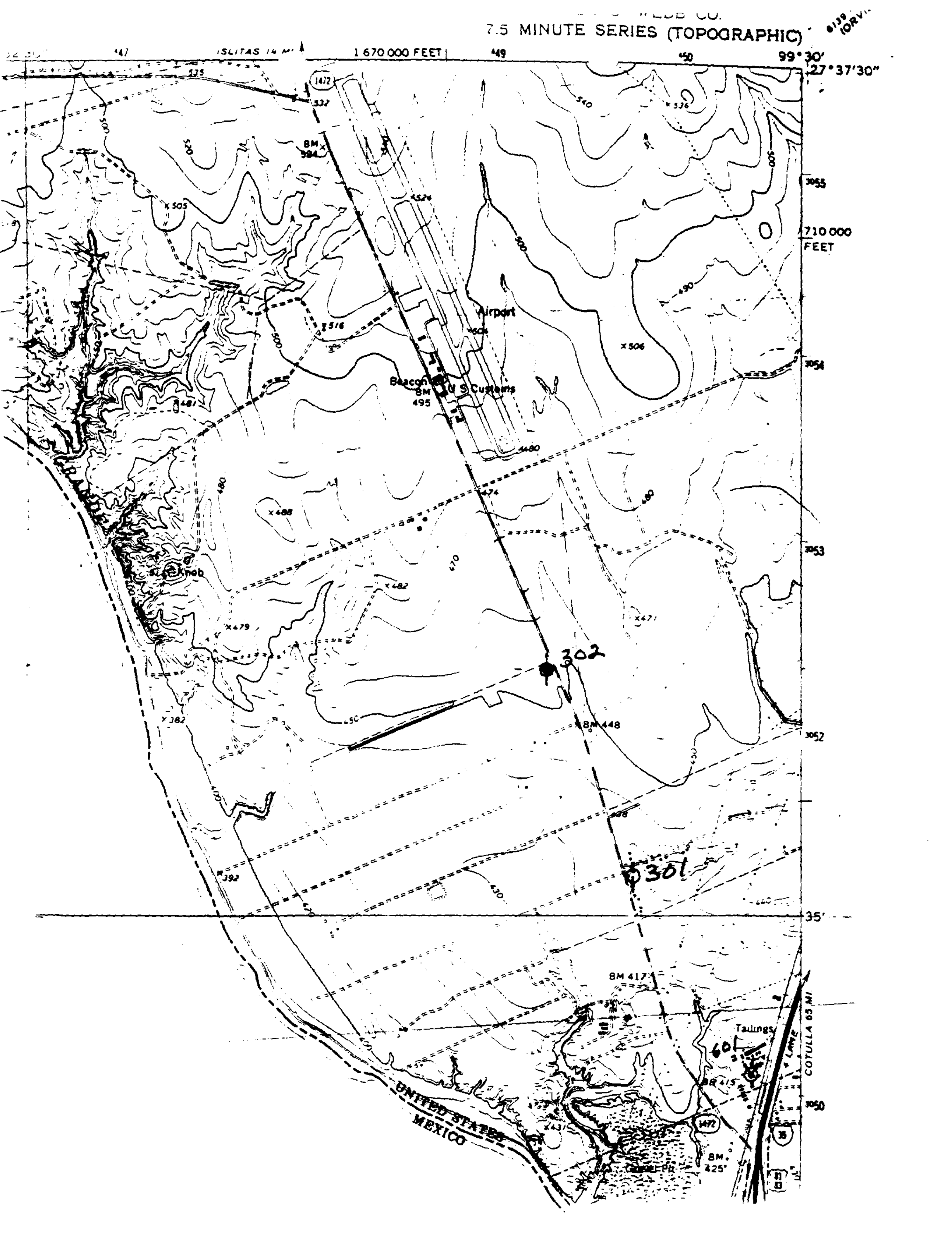
heavy steel
cinder block hse, cannot see from road

Cruz 791-5963
Verlin
Del-Angel

good water mgt by Bustamante

by Palm Tree in Front Yard

2 7 3 5 48 45 43
9 + 30 47 46 47



7.5 MINUTE SERIES (TOPOGRAPHIC)
1 670 000 FEET
99°30′
27°37′30″
710 000 FEET
35′
Airport
Beacon
U S Customs
BM 495
BM 448
BM 417
Tailings
Gravel Pit
UNITED STATES
MEXICO
COTULLA 65 MI
1472
302
301
601

Texas Water Development Board
Well Schedule

State Well No. 85 28 601 Previous Well No. County Webb 479

River Basin Rio Grande 23 Zone 2 Lat. 27 34 32 Long. 099 30 10 Source of Coord. 1

Owner's Well No. #1 Location ___ 1/4, ___ 1.4, Section ___, Block ___, Survey ___

Owner Anzon Inc. Driller Unknown

Address 718 Mines Rd, 78041 Tenant/Oper. Plant Mgr. - Paul Bridges

Date Drilled 1930 Depth 231 Source of Depth Datum D Altitude 425 Source of Alt. Datum M

Aquifer 124KRDO Well Type U User

Well Construction Const. Method drilled Casing Material steel S

Completion Screen Material

Lift Data Pump Mfr. Type subm S No. Stages

Bowls Diam. in. Setting ft. Column Diam. in.

Motor Mfr. Fuel or Power None Horsepower

Yield Flow GPM Pump GPM Meas., Rept., Est. Date 7-

Performance Test Date 7-26-57 Length of Test Production 20 GPM

Static Level ft. Pumping Level ft. Drawdown ft. Sp.Cap. GPM/ft.

Quality (Remarks

Water Use Primary Unused U Secondary Tertiary

Other Data Available Water Level M Water Quality Y Logs Other Data

	Date	Meas.	
Water Levels	11 15 1991	22.38	operator 21?
	12 04 1996	21.45	02-01
	04 19 199?	23.20	1-01

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

		Diam. (in.)	Setting (feet) From	To
1	C	06	0	210
2	C	04	210	231
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Recorded By D. Coker Date Record Collected or Updated 12 04 1996 (20 max) Reporting Agency 01

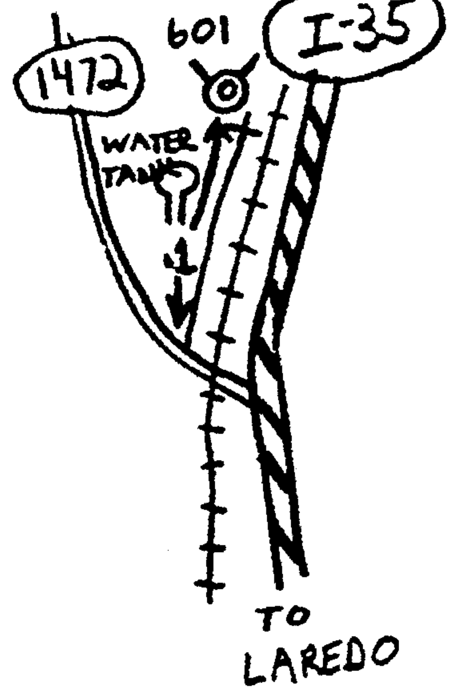
Remarks
1 Owner's well No. 1, ~~Unused.~~
2 Measured yield 20 GPM in 1957.
3
4
5
6

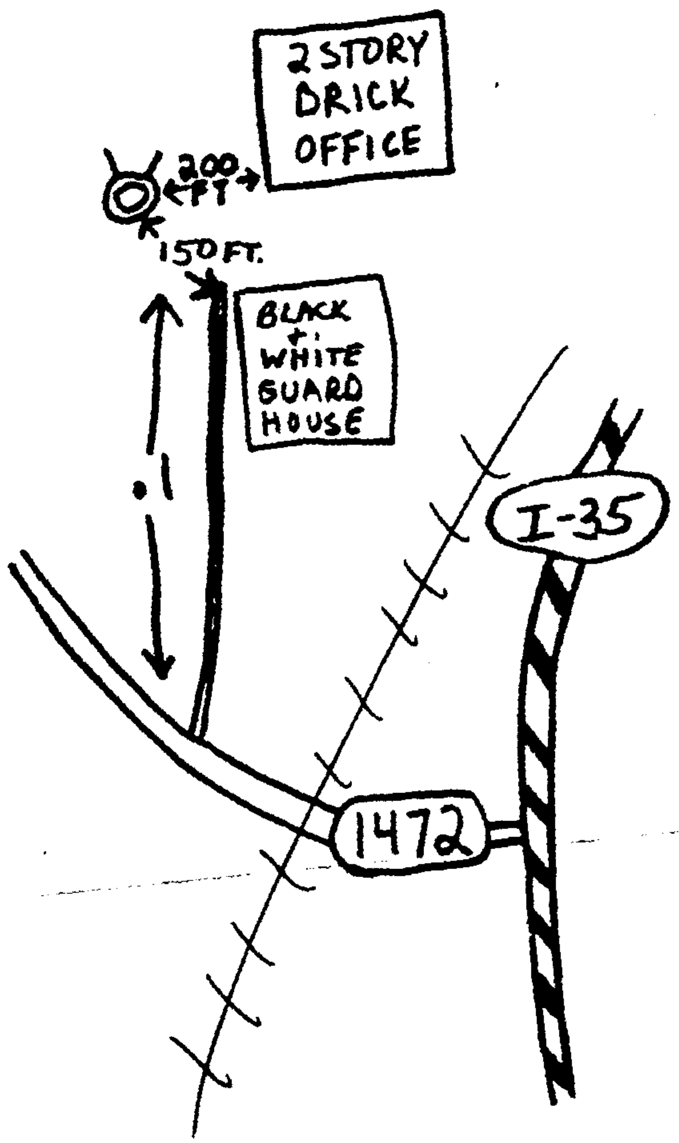
MP. +0.90' Top of Conc.

Aquifer ___
Well No. 8528 601

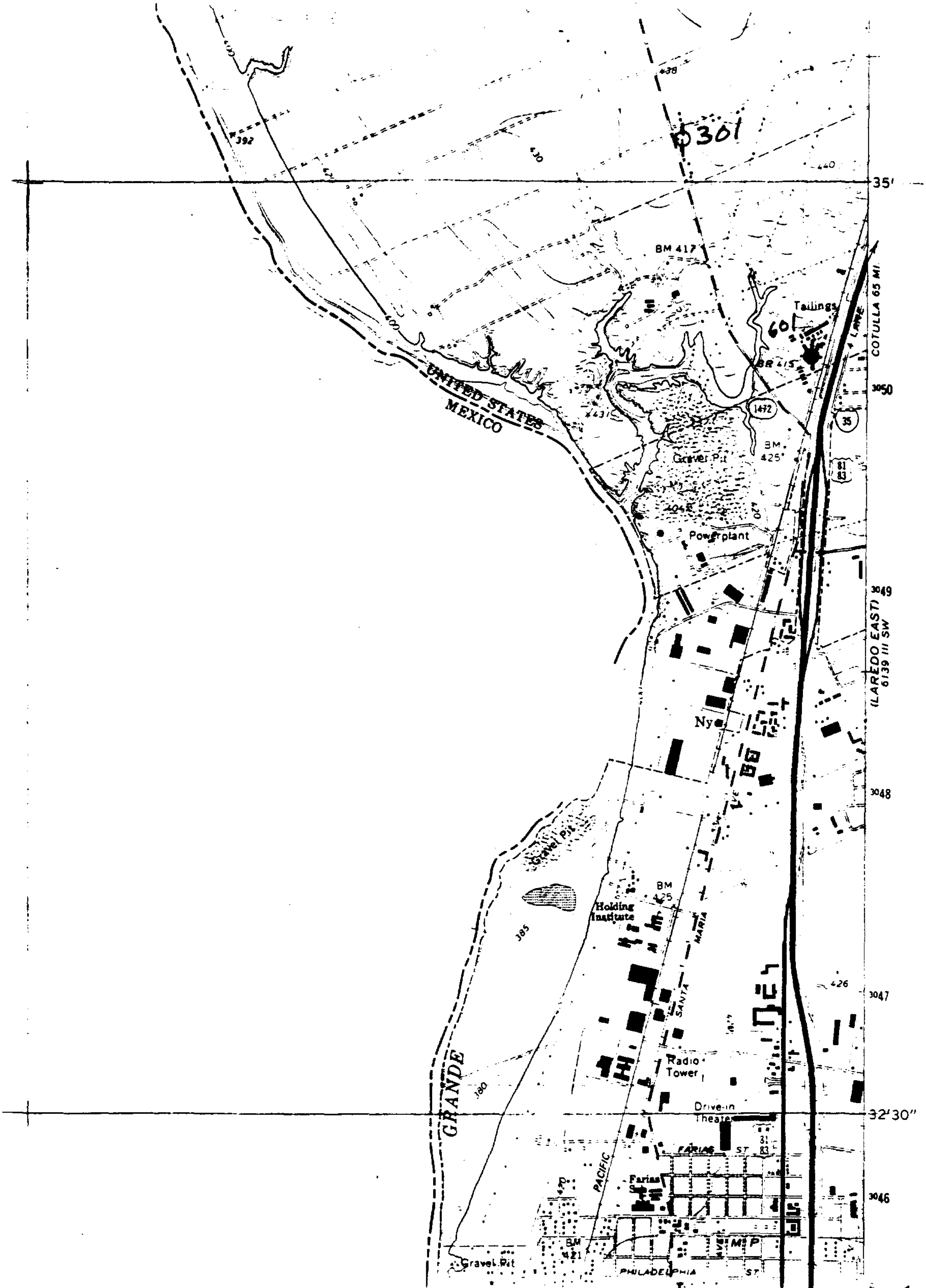
93-0384
2/9/93

no photo


601
I-35
1472
WATER TANK
.1
TO LAREDO


2 STORY BRICK OFFICE
200 FT
150 FT.
BLACK + WHITE GUARD HOUSE
.1
I-35
1472

85-28-601


301
35'
BM 417
Tailings
601
COTULLA 65 MI
BM 415
3050
1472
35
UNITED STATES
MEXICO
BM 425
81
83
Gravel Pit
Powerplant
3049
(LAREDO EAST)
6139 III SW
Nye
3048
Gravel Pit
BM 425
Holding Institute
385
SANTA MARIA
3047
426
GRANDE
Radio Tower
Drive-in Theater
32'30"
FARIAS ST
PACIFIC
Farias
3046
BM 421
Gravel Pit
PHILADELPHIA ST

601

TEXAS WATER DEVELOPMENT BOARD
WELL SCHEDULE

State Well Number - 85 29 102   Previous Well Number -   County - Webb 479
River Basin - Rio Grande - 23   Zone - 2   Latitude - 27 39 52   Longitude - 99 26 35   Source of Coords - 1

Owners Well No. ______ Location ______ 1/4, ______ 1/4, Section ______, Block ______, Survey ______

Owner - Laredo Country Club   Driller - Woods Drilling Co.

Address ______   Tenant/Oper. ______
Date Drilled - 10/04/1993   Depth - 800 ft.   Source of Depth - D   Altitude - 532 ft.   Source of Alt. - M
Aquifer - 124LRDO LAREDO FORMATION   Well Type - W   User -

WELL CONSTRUCTION   Const. Method - HYDRAULIC ROTARY
Casing Material - PVC, FIBERGLASS, OTHER PLASTIC
Screen Material - PCV, FIBERGLASS, OTHER PLASTIC
Completion - PERFORATED OR SLOTTED

LIFT DATA - Pump Mfr. ______ Type - SUBMERSIBLE PUMP   No. Stages ____

Bowls Diam. - ______ in.   Setting - ______ ft. Column Diam. - ______ in.

Motor Mfr. - ______ Fuel or Power - ELECTRIC MOTOR   Horsepower -

YIELD Flow- ______ GPM Pump- ______ GPM Meas.,Rept.,Est- ______ Date- ______

PERFORMANCE TEST Date- ______ Length of Test- ______ Production- ______ GPM

Static Level- ____ ft. Pumping Level- ____ ft. Drawdown- ____ ft. Sp.Cap.- ____ GPM/ft

QUALITY (Remarks- ______

WATER USE Primary- IRRIGATION   Secondary- ______ Tertiary- ______

OTHER DATA AVAILAIBLE   Water Levels- M   Quality- N   Logs- D   Other Data-

WATER LEVELS   Date- 10/04/1993   Measurement- -65.00
Date- / /   Measurement-

Recorded By ______   Date Record Collected or Updated- 11/05/1996

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (
Open Hole (O)
Cemented from ____ to ____

		Diam. (in.)	Setting(feet) From	To
1	C	6	0	440
2	S	6	440	660
3	O	5	660	800
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

Reporting Agency - TEXAS WATER DEVELOPMENT BOARD
REMARKS -
Measured yield 280 GPM with 100 feet drawdown after pumping 2 hours in 1993. Cemented from 0 to 10 and 340 to 440 feet. Pump set at 420 feet.

AQ-06

Aquifer - 124LRDO
Well No. - 85 29 102

Please use black ink.

Confidentiality
Reverse Side

State of Texas
WELL REPORT

Texas Water Well Drillers Board
P.O. Box 13087
Austin, TX 78711-3087
512-371-6299

Owner: Laredo Country Club (Name) ADDRESS 1415 Country Club Dr. Laredo tx 78041 (Street or RFD) (City) (State) (Zip)

LOCATION OF WELL:
County Webb : 0 miles in City limits (NE, SW, etc.) direction from Laredo (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:

Section No. ______ Block No. ______ Township ______ Abstract No. ______ Survey Name ______

Distance and direction from two intersecting section or survey lines ______

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Domestic ☐ Industrial ☐ Monitor ☐ Public Supply ☒ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check): ☐ Driven ☒ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other ______

6) WELL LOG:

Date Drilling:
Started 9-28 1993
Completed 10-4 1993

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
8 1/2	Surface	660'
5 1/2"	660	800'

7) BOREHOLE COMPLETION:
☒ Open Hole ☐ Straight Wall ☐ Underreamed
☐ Gravel Packed ☒ Other Cased To 660
If Gravel Packed give interval . . . from ______ ft. to ______ ft.

From (ft.)	To (ft.)	Description and color of formation material
0	1	Topsoil
1	30	Siltstone yellow
30	440	Sandy shale Gray
440	485	Sand Gray
485	530	Sandy Shale Gray
530	650	Sand Gray White
650	800	Sandy Shale Gray

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	To	Gage Casing Screen
6"	N	SDR-17 PVC Plain	0	440	
6"	N	" " " Perf	440	660	3/8"

9) CEMENTING DATA [Rule 287.44(1)]
Cemented from 440 ft. to 340 ft. No. of Sacks Used 16
10 ft. to 0 ft. No. of Sacks Used 4
Method used Circulation, Plug + Basket
Cemented by Woods Drilling Co

RECEIVED
AUG 04 1994
TEXAS NATURAL RESOURCE
CONSERVATION COMMISSION

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

13) TYPE PUMP:
☐ Turbine ☐ Jet ☒ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., 420' ft.

14) WELL TESTS:
Type Test: ☒ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: 280 gpm with 100 ft. drawdown after 2 hrs.

11) WATER LEVEL:
Static level 65 ft. below land surface Date 10-4-93
Artesian flow None gpm. Date ______

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Good Depth of strata 440-660
Was a chemical analysis made? ☐ Yes ☒ No

12) PACKERS: Type Depth
None

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Woods Drilling Co (Type or print) WELL DRILLER'S LICENSE NO. 2220 WPK

ADDRESS PO 440190 (Street or RFD) Laredo (City) TX (State) 78044 (Zip)

(Signed) Jerry Woods (Licensed Well Driller) (Signed) ______ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. ______ Located on map ______

WC-0199 (Rev. 05-18-90)

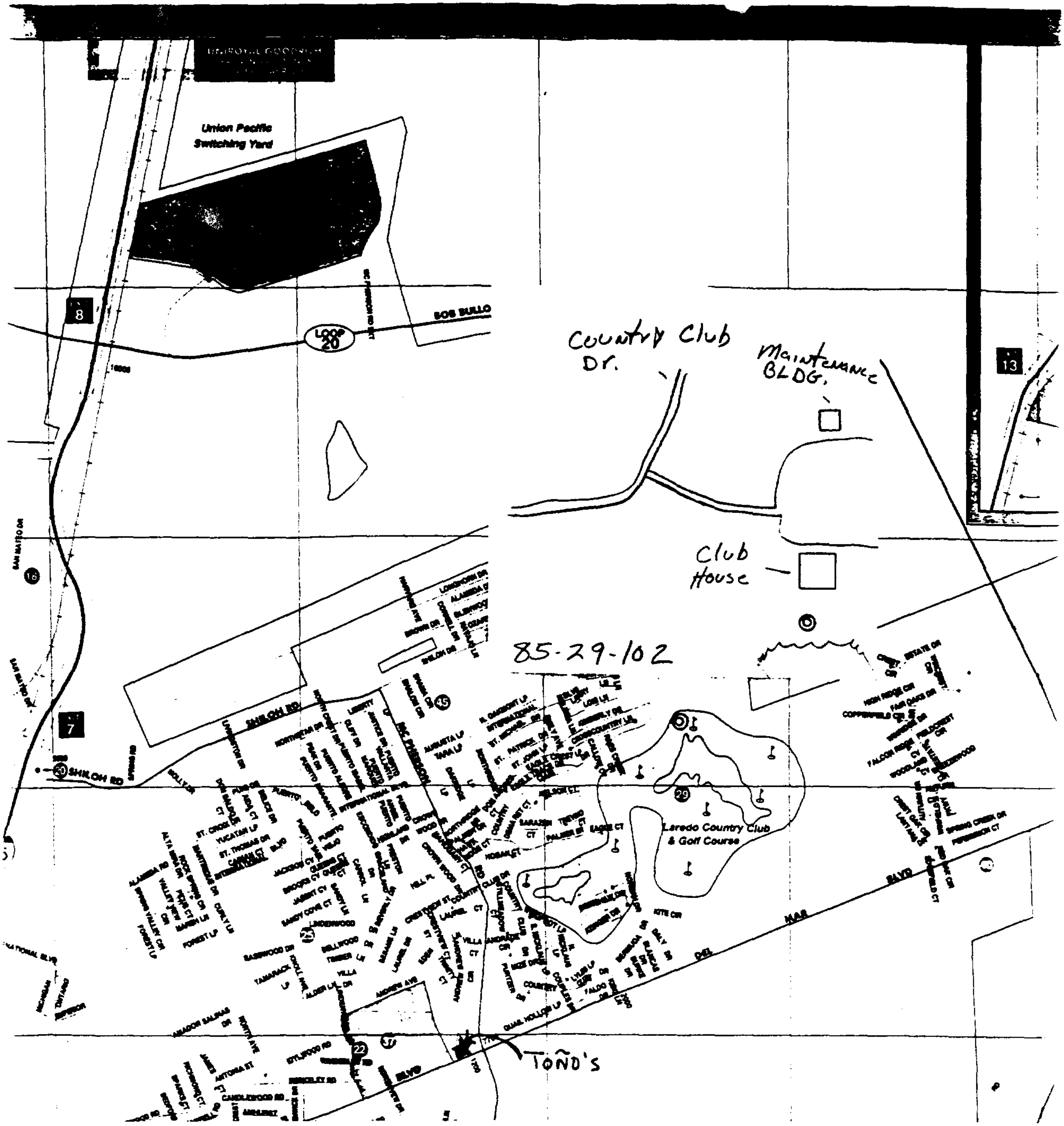
TEXAS WATER COMMISSION COPY

85-29-102

X

102
Country club Dr.
LAREDO INTERNATIONAL AIRPORT
TEXAS
TAMAULIPAS
M A U L I P A S

85-29-102


Union Pacific
Switching Yard
LOOP 20
Country Club Dr.
Maintenance BLDG.
Club House
85-29-102
Laredo Country Club
& Golf Course
SHILOH RD
DEL MAR BLVD
TOÑO'S

85-29-102

Water Quality Field Data

SWN: 85-29-102
County: Webb
Aquifer(s): Laredo

Name: Laredo Country Club
Address: 1415 Country Club Dr.
Laredo, TX
owner's well # 1

Sample No. AQ-06
Date: 12-3-96
By: J. Derton

	Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
	B	A+B (2)						
	500 ml	1 liter	250 ml	1 liter				
	~~Anions~~	~~Cations~~ ANIONS	Nitrate	Radioactivity				3
	Cations 1ml HNO_3	~~2 ml HNO (Nitric)~~	0.5 ml H SO (Sulfuric)	2 ml HNO (Nitric)				All filtered unless otherwise stipulated

Water Level UTM LSD Remark No entry
Temperature (00010) 29.4 c
Specific Conductance (00094) 2830 umhos/cm
pH (00400) 8.59
Eh (00090) ______ mv.
ıenol ALK (82244) 14 mg/l
Total ALK (39086) 220 mg/l
Carbonate (00452) ______ meq/l 16.8 mg/l
Bicarbonate (00453) ______ meq/l 234.3 mg/l
Total Cations(+) U
Total Anions (-) ______
Total Hardness (00900) 10
Dissolved Solids 1410

Time in ______
Time out ______ Sample time 1620
Weather ______ well use IRR.
Outside Temp 71
Sampling point

Starting pH ______
______ ml. of 0.02N to
______ ml. of Sample
Ending pH ______

Time:	1610	1615	1620				ml.	pH	ml.	pH	ml.	pH
pH:	8.58	8.6	8.59									
Temp:	28.4	29.3	29.4									
Eh:												
Cond.	2660	2680	2830									

other notes:
1608 pump ON
well perged 3 times IN 5 mIN ±

Water Quality Field Data

SWN: 8529102
County: Webb
Aquifer(s): Laredo Fm.

Name: Laredo Country Club
Address: 1415 Country Club Dr.
Laredo, TX
owner's well #

Sample No. AQ-06
Date: 12-3-96
By: J. Derton

	Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
	B 500 ml	A 1 liter	C 1 liter	1 liter				3
	1 ml HNO_3 (Nitric)							~~All filtered unless otherwise stipulated~~ Not filtered.

Water Level UTM LSD Remark

Temperature (00010) 29.4 c

Specific Conductance (00094) 2830 umhos/cm

pH (00400) 8.57

Eh (00090) ______ mv.

Phenol ALK (82244) ______ mg/l

Total ALK (39086) ______ mg/l

Carbonate (00452) ______ meq/l ______ mg/l

Bicarbonate (00453) ______ meq/l ______ mg/l

Total Cations(+) ______

Total Anions (-) ______

Total Hardness (00900) ______

Dissolved Solids ______

Time in ______

Time out ______ Sample time 1620

Weather ______ well use IRR

Outside Temp ______

Sampling point Dicharge pipe

Starting pH ______

______ ml. of 0.02N to

______ ml. of Sample

Ending pH ______

Time:	1610	1615	1620			
pH:	8.58	8.6	8.59			
Temp:	28.4	29.3	29.4			
Eh:						
Cond.	2660	2680	2830			

ml.	pH	ml.	pH	ml.	pH

other notes:

1608 pump on

TEXAS WATER DEVELOPMENT BOARD
WELL SCHEDULE

State Well Number - 85 29 203 Previous Well Number - County - Webb 479
River Basin - Rio Grande - 23 Zone - 2 Latitude - 27 35 50 Longitude - 99 25 05 Source of Coords - 1

Owners Well No. ______ Location ______ 1/4, ______ 1/4, Section ______, Block ______, Survey ______

Owner - Enron Oil & Gas Co. Driller - Richardson Water Well Drilling Co.

Address ______ Tenant/Oper. ______
Date Drilled - 01/02/1981 Depth - 483 ft. Source of Depth - D Altitude - 499 ft. Source of Alt. - M
Aquifer - 124LRDO LAREDO FORMATION Well Type - W User -

WELL CONSTRUCTION Const. Method - HYDRAULIC ROTARY Casing Material - STEEL
Completion - PERFORATED OR SLOTTED Screen Material - STEEL

LIFT DATA - Pump Mfr. ______ Type - SUBMERSIBLE PUMP No. Stages ____

Bowls Diam. - ______ in. Setting - ______ ft. Column Diam. - ______ in.

Motor Mfr. - ______ Fuel or Power - ELECTRIC MOTOR Horsepower -

YIELD Flow- ______ GPM Pump- ______ GPM Meas.,Rept.,Est- ______ Date- ______

PERFORMANCE TEST Date- ______ Length of Test- ______ Production- ______ GPM

Static Level- ____ft. Pumping Level- ____ft. Drawdown- ____ft. Sp.Cap.- ____GPM/ft

QUALITY (Remarks- ______

WATER USE Primary- UNUSED Secondary- ______ Tertiary- ______

OTHER DATA AVAILAIBLE Water Levels- M Quality- N Logs- D Other Data-

WATER LEVELS Date- 01/02/1981 Measurement- -90.00
Date- 12/03/1996 Measurement- -71.20

Recorded By J. Denton Date Record Collected or Updated- 12/03/1996

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (
Open Hole (O)
Cemented from ____ to ____

		Diam. (in.)	Setting(feet) From	To
1	C	5	0	189
2	S	5	189	231
3	C	5	231	420
4	S	5	420	483
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

Reporting Agency - TEXAS WATER DEVELOPMENT BOARD
REMARKS -
Unused industrial well. Measured yield 50 GPM in 1981.

mp = Top of Casing +2.4'

Well inoperative at this time.
Well near gas production well #2

Aquifer - 124LRDO
Well No. - 85 29 203

Send original copy by certified mail to Texas Department of Water Resources P. O. Box 13087 Austin, Texas 78711

State of Texas WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

For TDWR use only
Well No. 85-29-2E
Located on map ___
Received: ___

1) OWNER Enron Oil + Gas Co. ~~Amoco Production Co.~~ (Name) Address ~~P. O. Drawer 2188~~ (Street or RFD) ~~Corpus Christi 78403~~ (City) (State) (Zip)

2) LOCATION OF WELL: County Webb 6 miles in N. E. (N.E., S.W., etc.) direction from Laredo (Town)

Killiam & Heard - Amoco Well # B - 1

☐ Legal description:

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

Section No. ___ Block No. ___ Township ___
Abstract No. ___ Survey Name ___
Distance and direction from two intersecting section or survey lines ___

☒ See attached map.

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Domestic ☐ Industrial ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Other ___

5) DRILLING METHOD (Check): ☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other ___

6) WELL LOG:

Date drilled 1/2/81

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
6 3/4	Surface	483

7) BOREHOLE COMPLETION: ☐ Open Hole ☒ Straight Wall ☐ Underreamed ☐ Gravel Packed ☐ Other ___
If Gravel Packed give interval . . . from ___ ft. to ___

From (ft.)	To (ft.)	Description and color of formation material
0	4	Surface Soil
4	15	white Sand & fine gravel
15	20	Rust Shale & gravel
20	42	Rust Shale w/black fine sand
42	72	sandstone w/gravel
72	104	gray shale w/gravel streak
104	124	gray shale
124	145	blue shale w/gravel streak
145	197	blue shale
197	207	blacksand
207	227	black sand
227	248	blue sandy shale
248	268	blue shale w/sandstone
268	351	blue shale
351	371	blue sandy shale
371	391	blue shale
391	444	blue shale sandy
444	454	black sand
454	472	black sand
472	479	hard sand black
479	484	black sand

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	To	Gage Casting Screen
		Set slots from 189' to 231'			
		and from 420' to 483'			

CEMENTING DATA

Cemented from ___ ft. to ___
Method used ___
Cemented by ___ (Company or Individual)

9) WATER LEVEL:
Static level 90 ft. below land surface Date ___
Artesian flow ___ gpm. Date ___

10) PACKERS: Type Depth
Rubber Neopreme 188 & 419

11) TYPE PUMP: ☐ Turbine ☐ Jet ☒ Submersible ☐ Cylinder ☐ Other ___
Depth to pump bowls, cylinder, jet, etc., ___ ft.

12) WELL TESTS: ☐ Type Test: ☐ Pump ☐ Bailer ☒ Jetted ☐ Estimated
Yield: 50 gpm with ___ ft. drawdown after ___ hrs.
with 315' of 2" air line.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☐ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ___ Depth of strata ___
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME Jesse N. Richardson (Type or Print) Water Well Drillers Registration No. 1679

ADDRESS 808 Lincoln (Street or RFD) Alice, Texas 78332 (City) (State) (Zip)

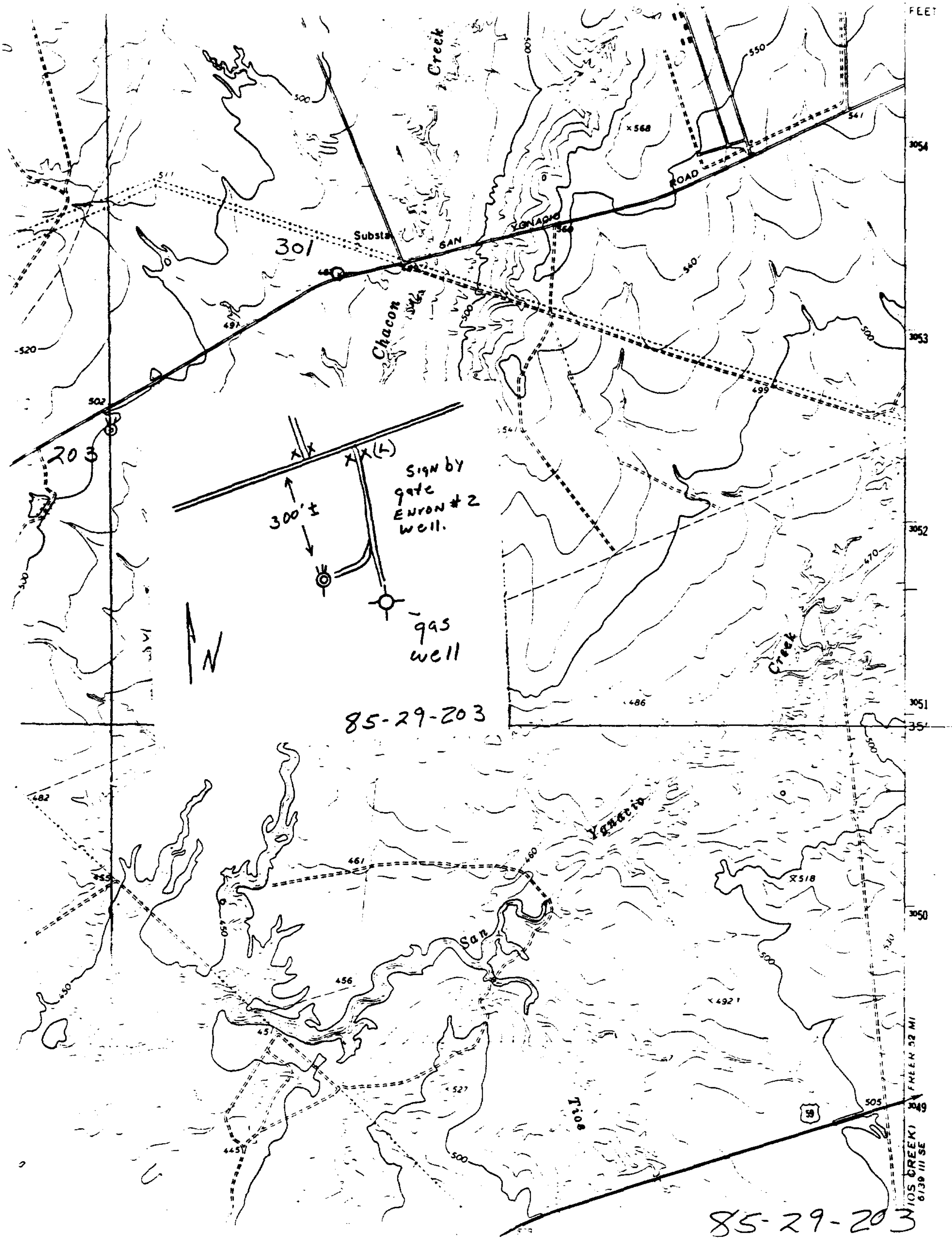
(Signed) Jesse N. Richardson (Water Well Driller) Richardson Water Well drlg. Co., Inc. (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

85-29-203

TDWR-0392 (Rev. 1-12-79)

DEPARTMENT OF WATER RESOURCES COPY



301
203
Substa
SAN YGNACIO ROAD
Creek
Chacon
300'±
Sign by gate Enron #2 well.
X X X X(L)
gas well
N
85-29-203
Yguacio
San
Creek
Tios
59
FEET
3054
3053
3052
3051
3050
3049
35'
TIOS CREEK
6139 III SE

85-29-203

JAN 3 - 1961

GW 1

TEXAS WATER DEVELOPMENT BOARD

WELL SCHEDULE

Aquifer LAREDO

Field No.

Owner's Well No.

State Well No. 85-29-201

County Webb

1. Location: 1/4, 1/4 Sec., Block, Survey
8.9 mi NE of Laredo
2. Owner: Killam Cattle Co. Address:
Tenant: Address:
Driller: Water Well Address:
3. Elevation of LSD is 428 ft. above msl, determined by
4. Drilled: 11-18 1960; Dug, Cable Tool, Rotary,
5. Depth: Rept. ft. Meas. ft.
6. Completion: Open Hole, Straight Wall, Underreamed, Gravel Packed
7. Pump: Mfgr. Type
No. Stages, Bowls Diam. in., Setting ft.
Column Diam. in., Length Tailpipe ft.
8. Motor: Fuel Make & Model HP.
9. Yield: Flow gpm, Pump gpm, Meas., Rept., Est.
10. Performance Test: Date Length of Test Made by
Static Level ft. Pumping Level ft. Drawdown ft.
Production 15 gpm Specific Capacity gpm/ft.
11. Water Level: 21.54 ft. meas. 9-30 1970 below Top of pipe which is 2.5 ft. above surface.
64.15 ft. meas. 2-3 1996 below which is ft. above/below surface.
ft. rept./meas. 19 above/below which is ft. above/below surface.
ft. rept./meas. 19 above/below which is ft. above/below surface.
12. Use: Dom., Stock, Public Supply, Ind., Irr., Waterflooding, Observation, Not Used,
13. Quality: (Remarks on taste, odor, color, etc.)
Temp. 76 °F, Date sampled for analysis 9-30-70 Laboratory TSDH
Temp. °F, Date sampled for analysis Laboratory
Temp. °F, Date sampled for analysis Laboratory
14. Other data available as circled: Driller's Log, Radioactivity Log, Electric Log,
Formation Samples, Pumping Test,
15. Record by: Date 19
Source of Data
16. Remarks:

CASING & BLANK PIPE

Cemented From 4 ft. to 6 ft.

Diam. (in.)	Type	Setting, ft. from	to
7"	Steel		

WELL SCREEN

Screen Openings

Diam. (in.)	Type	Setting, ft. from	to

Depth	Thick
	5
	9
	30
	39
	52
	16

AQ-05

Obs Well

YZ-85-29-301

TWDBE-GW-49

(Sketch)

Water Quality Field Data

SWN: 8529301
County: Webb
Aquifer(s): Laredo FM

Name: Killam Cattle Co.
Address: P.O. Box 499
Laredo, Tx
owner's well #

Sample No. AQ-05
Date: 12-3-96
By: J. Derton

Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
B 500 ml	A 1 liter	C 1 liter	1 liter				3
1 ml HNO3 (Nitric)							~~All filtered unless otherwise stipulated~~ Not filtered.

Water Level 64.15 LSD Remark Static
Temperature (00010) 27.6 c
Specific Conductance (00094) 5050 umhos/cm
pH (00400) 8.34
Eh (00090) ______ mv.
Phenol ALK (82244) 8 mg/l
Total ALK (39086) 280 mg/l
Carbonate (00452) ______ meq/l 9.6 mg/l
Bicarbonate (00453) ______ meq/l 322.2 mg/l
Total Cations(+) ~~U~~
Total Anions (-)
Total Hardness (00900) 30
Dissolved Solids 3100

Time in ______
Time out ______ Sample time 1435
Weather ______ well use Stock.
Outside Temp ______
Sampling point faucet at well

Starting pH ______
______ ml. of 0.02N to
______ ml. of Sample
Ending pH ______

Time:	1405	1410	1420	1425	1430	1435
pH:	8.10	8.17	8.28	8.23	8.33	8.34
Temp:	26.8	26.9	27.0	27.0	27.5	27.6
Eh:						
Cond.	5070	5070	5070	5070	5050	5050

ml.	pH	ml.	pH	ml.	pH

other notes:
pump ON 1400
cloudy at 1420
pumped off at 1430
Estimated yield 8 GPM

Texas Water Development Board
Well Schedule

State Well No. 85 29 401 **Previous Well No.** ______ **County** WEBB 479

River Basin RIO GRANDE 23 **Zone** 2 **Lat.** 27 33 30 **Long.** 99 29 18 **Source of Coord.** 1

Owner's Well No. ______ **Location** ____ 1/4, ____ 1.4, **Section** ____, **Block** ____, **Survey** ____

Owner: JOHN MANN

Driller: WOODS DRILLING

Address 916 Calle Del Norte Laredo 78041 210-726-4771 Tenant/Oper. ______

Date Drilled 10 22 1988 Depth 1000 Source of Depth Datum D Altitude 490 Source of Alt. Datum M

Aquifer ______ Well Type W User ______

Well Construction Const. Method HYDRAULIC ROT. H Casing Material PVC P

Completion OPEN O Screen Material ______

Lift Data Pump Mfr. ______ Type SUBM S No. Stages ______

Bowls Diam. ______ in. Setting ______ ft. Column Diam. ______ in.

Motor Mfr. ______ Fuel or Power ELECTRIC E Horsepower ______

Yield Flow ____ GPM Pump ____ GPM Meas., Rept., Est. ____ Date ____

Performance Test Date 10-22-88 Length of Test 2 HRS Production 30 GPM

Static Level ____ ft. Pumping Level ____ ft. Drawdown 140 ft. Sp.Cap. ____ GPM/ft.

Quality (Remarks ______

Water Use Primary ______ Secondary ______ Tertiary ______

Other Data Available Water Level N Water Quality Y Logs D Other Data ______

Water Levels

Date	Meas.
10 19 1988	95.
12 04 1996	93.1

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from 140 to 240

		Diam. (in.)	Setting (feet) From	To
1	C	5	0	240
2	O	5	240	300
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

(20 max)

Recorded By BIRI Date Record Collected or Updated 04 14 1994 Reporting Agency 01

Remarks 1 2 3 4 5 6

Aquifer ______

Well No. 85-29-401

AQ-07

92-0023
9/9/91

Please ... k ink.
Send orig... copy by certified mail to the Texas Water Commission P.O. Box 13087 Austin, Texas 78711

State of WATER WELL REPORT

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

Texas Water Well Drillers Board P. O. Box 13087 Austin, Texas 78711

1) OWNER A.R.L.A. Farms %John Mann (Name) Address 500 Calle Del Norte Laredo, Tex. 78041 (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL: County Webb 0 miles in City (N.E., S.W., etc.) direction from Laredo (Town)

☐ Legal description:
Section No. ______ Block No. ______ Township ______
Abstract No. ______ Survey Name ______
Distance and direction from two intersecting section or survey lines ______

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☒ See attached map. 00 85 - 37 - 3

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Domestic ☐ Industrial ☐ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ Other ______

5) DRILLING METHOD (Check): ☐ Driven ☒ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☒ Air Rotary ☐ Cable Tool ☐ Other

6) WELL LOG:
Date Drilling:
Started 10-19 1988
Completed 10-22 1988

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
6 3/4	Surface	1000

7) BOREHOLE COMPLETION:
☒ Open Hole ☐ Straight Wall ☐ Underreamed
☐ Gravel Packed ☒ Other Cased to 240'
If Gravel Packed give interval . . . from ______ ft. to ______ ft.

From (ft.)	To (ft.)	Description and color of formation material
0	6	Caliche
6	65	Siltstone Yellow
65	230	Shale Gray
230	280	Sand Gray White
280	1000	Sandy Shale Gray White Red & Green Stks

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
5"	N	PVC Plain	0	240	
		Open 240-300			
		Plug set 300-340			

9) CEMENTING DATA [Rule 319.44(b)]
Cemented from 240 ft. to 140 ft. No. of Sacks Used 9
10 ft. to 0 ft. No. of Sacks Used 4
Method used Basket, Plug & Circulation(Top Gravity)
Cemented by Woods Drilling Co.

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 319.44(c)]
☐ Pitless Adapter Used [Rule 319.44(d)]
☒ Approved Alternative Procedure Used [Rule 319.71]

RECEIVED SEP 19 1989 TEXAS WATER COMMISSION

11) WATER LEVEL:
Static level 95 ft. below land surface Date 10-22-88
Artesian flow None gpm. Date ______

12) PACKERS: Type Depth
None

13) TYPE PUMP:
☐ Turbine ☐ Jet ☒ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., 240' ft.

14) WELL TESTS:
Type Test: ☐ Pump ☐ Bailer ☒ Jetted ☐ Estimated
Yield: 30 gpm with 140 ft. drawdown after 2 hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Fresh Depth of strata 230-280
Was a chemical analysis made? ☐ Yes ☒ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 12 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME [illegible] (Type or Print) Water Well Driller's License No. [illegible] W

ADDRESS P.O.Box 6489 (Street or RFD) [illegible] (City) [illegible] (State) [illegible] (Zip)

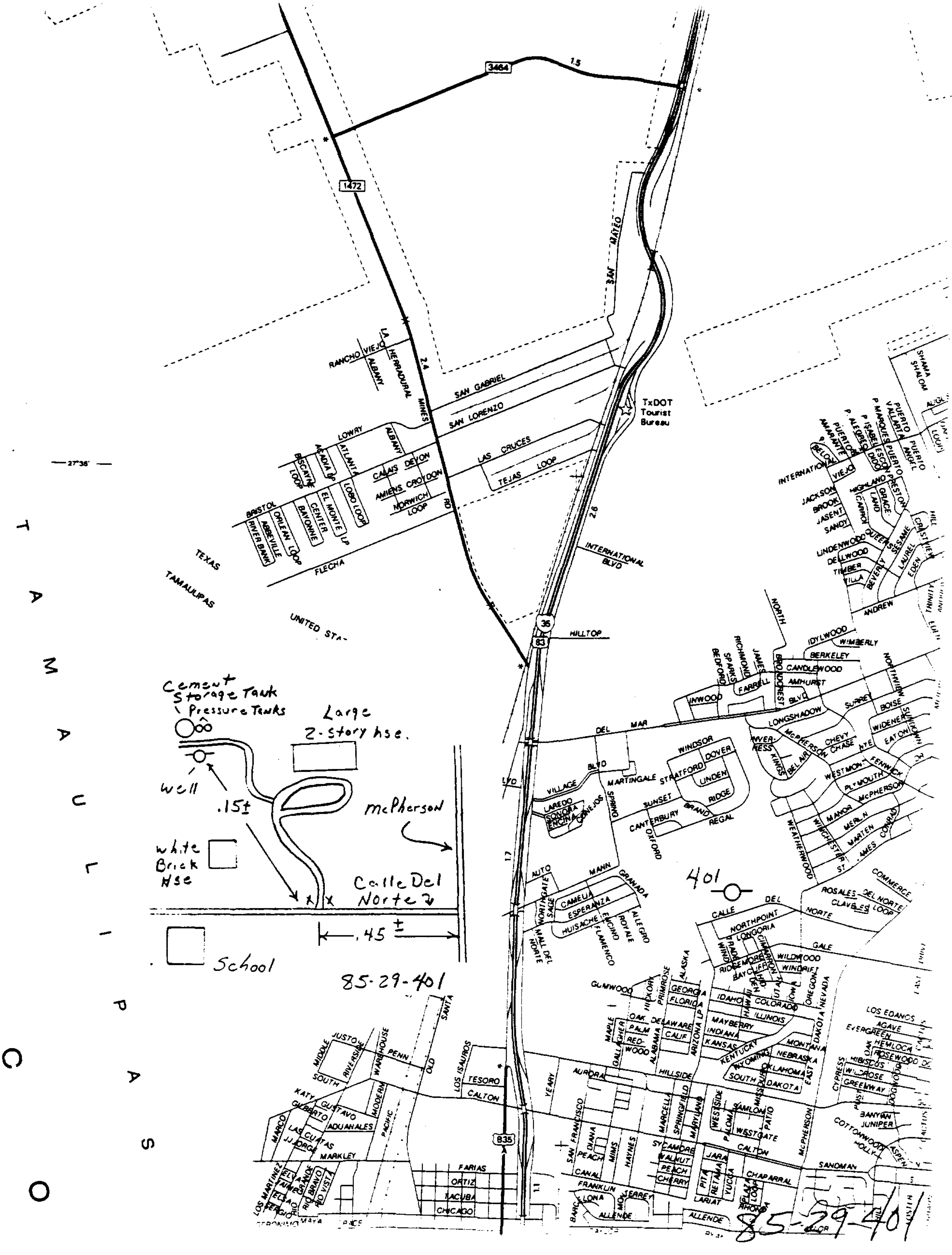
(Signed) Jerry Woods (Licensed Water Well Driller) (Signed) ______ (Registered Driller Trainee)

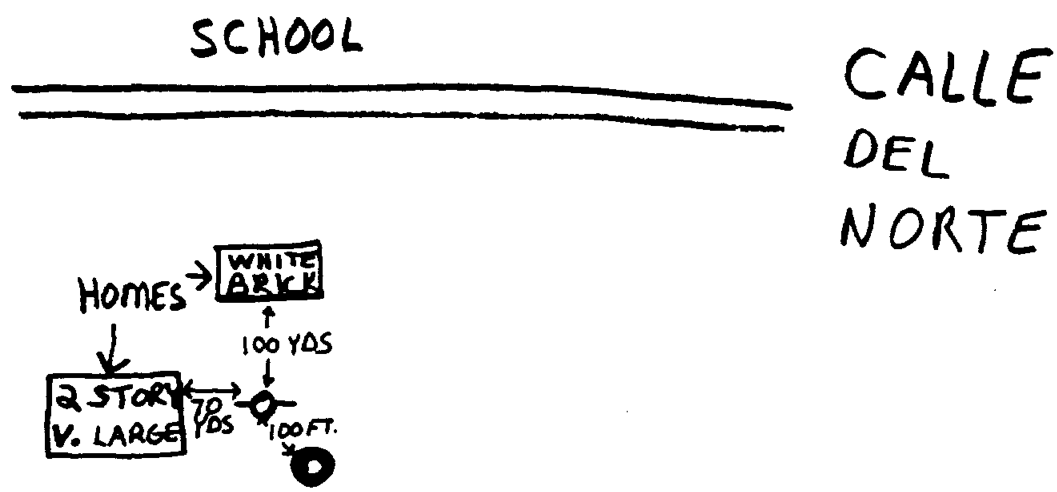
Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only Well No. 85-29-401 Located on map ______

1-0392 (Rev. 06-10-85) TEXAS WATER COMMISSION COPY

85-29-401


Cement Storage Tank
\ Pressure Tanks
well
.15±
Large 2-story hse.
McPherson
white Brick Hse
Calle Del Norte
.45±
School
85-29-401
401
85-29-401
TxDOT Tourist Bureau
TEXAS
TAMAULIPAS
UNITED STA
T A M A U L I P A S
C O
SAN MATEO
SAN GABRIEL
SAN LORENZO
LAS CRUCES
TEJAS LOOP
MINES RD
INTERNATIONAL BLVD
FLECHA
HILLTOP
DEL MAR BLVD
CALLE DEL NORTE
McPHERSON
CALTON
SANDMAN
ALLENDE
3464
1472
35
83
835


SCHOOL
CALLE
DEL
NORTE
WHITE
Homes
100 YDS
2 STORY
V. LARGE
70 YDS
100 FT.

85-29-401

Water Quality Field Data

SWN: 8529401
County: Webb
Aquifer(s): Laredo Fm

Name: John Mann
Address: 956 Calle Del Norte
Laredo, TX
owner's well #

Sample No. AQ-07
Date: 12-4-96
By: J. Derton

	Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples 3
	500 ml	1 liter	1 liter	1 liter				
	1 ml HNO_3 (Nitric)							Not filtered. ~~All filtered unless otherwise stipulated~~

Water Level 93.1 LSD Remark Static
Temperature (00010) 27.3 c
Specific Conductance (00094) 2210 umhos/cm
pH (00400) 8.84
Eh (00090) ______ mv.
Phenol ALK (82244) 24 mg/l
Total ALK (39086) 276 mg/l
Carbonate (00452) ______ meq/l 28.8 mg/l
Bicarbonate (00453) ______ meq/l 278.2 mg/l
Total Cations(+) ______
Total Anions (-) ______
tt
Total Hardness (00900) 4
Dissolved Solids 1320

Time in ______
Time out ______ Sample time 1045
Weather ______ well use Domestic
Outside Temp ______
Sampling point faucet At well

Starting pH ______
______ ml. of 0.02N to
______ ml. of Sample
Ending pH ______

Time:	1025	1030	1035	1040	1045	1050
pH:	8.74	8.81	8.84	8.85	8.85	8.84
Temp:	27.1	27.2	27.3	27.3	27.3	27.3
Eh:						
Cond.	2020	2160	2180	2190	2190	2210

ml.	pH	ml.	pH	ml.	pH

other notes:
pump ON 1022
pL = 173.2'

TEXAS WATER DEVELOPMENT BOARD
WELL SCHEDULE

State Well Number - 85 29 402 Previous Well Number - County - Webb 479
River Basin - Rio Grande - 23 Zone - 2 Latitude - 27 34 53 Longitude - 99 29 27 Source of Coords - 1

Owners Well No. ______ Location ______ 1/4, ______ 1/4, Section ______, Block ______, Survey ______

Owner - Dr. Enrique Benavides Driller - David E. De La Cruz

Address 510 International Blvd, Laredo, TX Tenant/Oper. ______
Date Drilled - 12/11/1975 Depth - 300 ft. Source of Depth - D Altitude - 480 ft. Source of Alt. - M
Aquifer - 124LRDO LAREDO FORMATION Well Type - W User -

WELL CONSTRUCTION Const. Method - CABLE-TOOL Casing Material - STEEL
Completion - PERFORATED OR SLOTTED Screen Material - STEEL

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (
Open Hole (O)
Cemented from ______ to ______

		Diam. (in.)	Setting (feet) From	To
1	C	7	0	185
2	S	7	185	205
3	C	7	205	230
4	S	7	230	252
5	C	7	252	300
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

LIFT DATA - Pump Mfr. ______ Type - SUBMERSIBLE PUMP No. Stages ______

Bowls Diam. - ______ in. Setting - ______ ft. Column Diam. - ______ in.

Motor Mfr. - ______ Fuel or Power - ELECTRIC MOTOR Horsepower -

YIELD Flow- ______ GPM Pump- ______ GPM Meas.,Rept.,Est- ______ Date- ______

PERFORMANCE TEST Date- ______ Length of Test- ______ Production- ______ GPM

Static Level- ______ ft. Pumping Level- ______ ft. Drawdown- ______ ft. Sp.Cap.- ______ GPM/ft

QUALITY (Remarks- ______

WATER USE Primary- UNUSED Secondary- ______ Tertiary- ______

OTHER DATA AVAILAIBLE Water Levels- M Quality- N Logs- D Other Data-

WATER LEVELS Date- 12/11/1975 Measurement- -76.00
Date- / / Measurement-

Recorded By J. Derton Date Record Collected or Updated- 12/05/1996

Reporting Agency - TEXAS WATER DEVELOPMENT BOARD
REMARKS -
Unused domestic well. Measured yield 25 GPM with 125 feet drawdown in 1975. Cemented from 0 to 180 and 259 to 270 feet.

UTM - Tape will not fall free.

pump inoperative

Aquifer - 124LRDO
Well No. - 85 29 402

4

Send original copy by certified mail to the Texas Water Development Board P. O. Box 13087 Austin, Texas 78711

State of Texas

WATER WELL REPORT

For TWDB use only
Well No. 85-29-
Located on map
Received: 7

1) OWNER:
Person having well drilled: Mr. [illegible] Mann (Name) Address: 721 Linden [illegible] Laredo, Texas (Street or RFD) (City) (State)

Landowner: " " " (Name) Address: " " (Street or RFD) (City) (State)

2) LOCATION OF WELL:
County: Webb, 4 miles in [illegible] direction from Laredo (N.E., S.W., etc.) (Town)

Locate by sketch map showing landmarks, roads, creeks, hiway number, etc.* — North

(Use reverse side if necessary)

or Give legal location with distances and directions from adjacent sections or survey lines.
Labor ______ League ______
Block ______ Survey ______
Abstract No. ______
(NW¼ NE¼ SW¼ SE¼) of Section ______

3) TYPE OF WORK (Check): New Well X Deepening Reconditioning Plugging

4) PROPOSED USE (Check): Domestic Industrial Municipal Irrigation Test Well Other X

5) TYPE OF WELL (Check): Rotary Driven Dug Cable X Jetted Bored

6) WELL LOG:
Diameter of hole [illegible] in. Depth drilled 3[illegible] ft. Depth of completed well 300 ft. Date drilled [illegible]

All measurements made from 0 ft. above ground level.

From (ft.)	To (ft.)	Description and color of formation material
1	2	gravel
2	35	yellow sand stone
35	126	gray sandy shale
126	136	water sand
136	160	gray sandy shale
160	170	water sand
170	185	gray sandy shale
185	205	water sand
205	230	gray sandy shale
230	252	water sand
252	275	gray sandy shale
275	296	water sand
296	300	gray clay

(Use reverse side if necessary)

9) Casing:
Type: Old X New Steel X Plastic Other
Cemented from surface 259 ft. to [illegible]

Diameter (inches)	Setting From (ft.)	To (ft.)	Gage
7 O.D.	1 ft. above surface	2?7	

10) SCREEN:
Type ______
Perforated Slotted X

Diameter (inches)	Setting From (ft.)	To (ft.)	Slot Size
7 O.D.	1?5	2?5	
	2?0	2?4	

7) COMPLETION (Check):
Straight wall Gravel packed Other
Under reamed Open Hole

8) WATER LEVEL:
Static level 7? ft. below land surface Date [illegible]
Artesian pressure ______ lbs. per square inch Date ______
Depth to pump bowls, cylinder, jet, etc., ______ ft. below land surface.

11) WELL TESTS:
Was a pump test made? Yes No If yes, by whom?
Yield: ______ gpm with ______ ft. drawdown after ______ hrs.
Bailer test [illegible] gpm with 1?? ft. drawdown after ______
Artesian flow ______ gpm
Temperature of water ______

12) WATER QUALITY:
Was a chemical analysis made? Yes X No
Did any strata contain undesirable water? Yes No X
Type of water? [illegible] depth of strata [illegible]

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME [illegible] (Type or Print) Water Well Drillers Registration No. [illegible]7

ADDRESS [illegible] Laredo (Street or RFD) (City) Tex. (State)

(Signed) [signature] (Water Well Driller) [illegible] (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

85-29-402

*Additional instructions on reverse side.

TWDB-WD-4

File ori. . wi.
Texas Water Development Board
P. O. Box 13087
Austin, Texas 78711

State of Texas
WATER WELL
COMPLETION AND PLUGGING REPORT

For TWDB use only
Well No. RS-29-4E
Form GW 33 received ______
Form GW 54 received ______

1) Well Owner: Mr. Jess E. Mann — 721 Lindenwood — Laredo — Texas
(Name — Street or RFD — City — State)

2) Landowner: ______ (Name — Street or RFD — City — State)

3) Intended Use: Industrial ☐; Municipal ☐; Irrigation ☐; Domestic ☐; Stock ☐; Other x

4) Location Of Well: County Webb Labor ______ League ______ Abstract No. ______

NW¼ NE¼ SW¼ SE¼ of Section ______ Block No. ______ Survey ______
(Circle as many as known)

4 miles in N direction from Laredo (Town). Use reverse side to sketch map of well location showing distances from adjacent section or survey lines, or to landmarks, roads, and creeks.

COMPLETION AND PLUGGING DATA

5) Driller David E. De La Cruz Registration Number 67 Address 2310 Laredo

6) Party Completing Or Plugging Well same Registration Number 67 Address " "

7) Drilled 12 / 11 / 1975; Dug ☐; Cable Tool ☒; Rotary ☐; Other ______ Owners Well Number 1

8) Diameter Of Hole 8⅝ inches, from 1 to 300 feet, and ______ inches, from ______ to ______ feet; Total depth 300 feet.

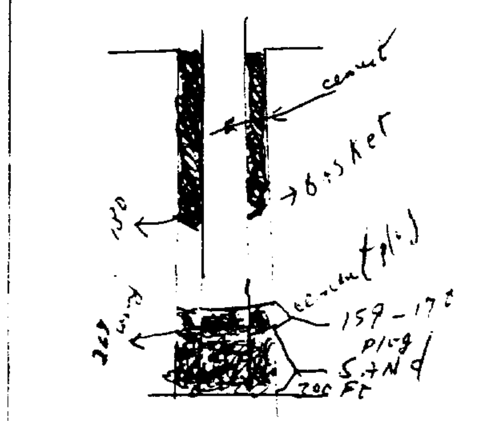
9) Casing and Cement:

Diameter (inches)	Set in Well From (feet)	Set in Well To (feet)	Left in Well From (feet)	Left in Well To (feet)	Cement Baskets or Packers, Depth (feet)	Cement From (feet)	Cement To (feet)
7	[illegible]				cement Baskets 130	surface	130
	surface	247					
					plug 159-170	159	170

10) Well Log: All measurements made from x feet above ground level.

From (ft.)	To (ft.)	Description and color of formation material
1	2	gravel
2	35	yellow sand stone
35	128	gray sandy shale
128	136	water sand
136	160	gray sandy shale
160	170	water sand
170	185	gray sandy shale
185	205	water sand
205	230	gray sandy shale
230	252	water sand
252	275	gray sandy shale
275	29[illegible]	water sand
29[illegible]	300	shale 9 (.r.:)

11) Sketch Of Well: Show method of completion and/or plugging including all casing and cemented intervals.



12) Fresh Water-Bearing Zone(s): Depth in feet to top of 185, Thickness 20 feet.

13) Undesirable Water-Bearing Zone(s): Depth in feet to top of 128, Thickness 8 feet.

14) Static Water Level(s) 78 feet below land surface. Was the water level measured after penetrating the first water-bearing zone ☐, or after drilling to total depth ☐? Check applicable box(s).

15) Describe in detail the type, volume and manner of placement of all cement. Indicate depth to top of cement behind each casing string. Describe and give percent of all cement additives: 130 [illegible] water

16) Was undesirable water exclusion or retention or plugging program checked for adequacy? ______
If so describe method(s) used. [illegible] 130 [illegible] cement [illegible] 159 170

17) Attach electrical, gamma ray or other mechanical log(s), water analyses, and other pertinent data if available.

VALIDATION

18) We, the party performing the undesirable water exclusion ☐ retention ☐ plugging ☐ (Check applicable box) operations, [signature] and the landowner or party having well drilled, deepened or otherwise altered, ______ certify that the undesirable water exclusion or retention or plugging operations were performed in the manner described above.

TWDBE GW 55

Send Original Copy by
Certified Mail to the
Texas Water Development Board
P. O. Box 12386
Austin, Texas 78711

State of Tex

REPORT OF

UNDESIRABLE WATER

For T.W.D.B. use only:
Well No. 85-29-4E
Received:
Form GW 7
Form GW 8
Form GW 9

I. To be completed by water well driller. (Type or Print)

1. Water Well Driller: David A. La Cruz
Company Name:
Address: 2312 Li aria Laredo Texas
(Street or RFD) (City) (State)

2. Landowner: Mr. Juan T. Mann
Address: 721 Lindenwood Laredo Texas
(Street or RFD) (City) (State)

3. Person Having Well Drilled: Same
Address:
(Street or RFD) (City) (State)

4. Location of Well: County Webb Labor
League Abstract No.
NW¼, NE¼, SW¼, SE¼ of Section Block
Survey
4 miles in N direction.
(NE, SW, etc.)
from Laredo
(Town)

5. Date Well Drilled: 12/11/75

6. Has a Water Well Report (Form GW 7) relating to this well been forwarded to the Texas Water Development Board? Yes x No Date 1/11/7-
If No, please submit Water Well Report with this form.

7. I do hereby certify that in drilling, deepening, or otherwise altering the above described well, water injurious to vegetation, to land, or to fresh water has been encountered and the landowner or person having the well drilled has been informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.

Date 1/4/76

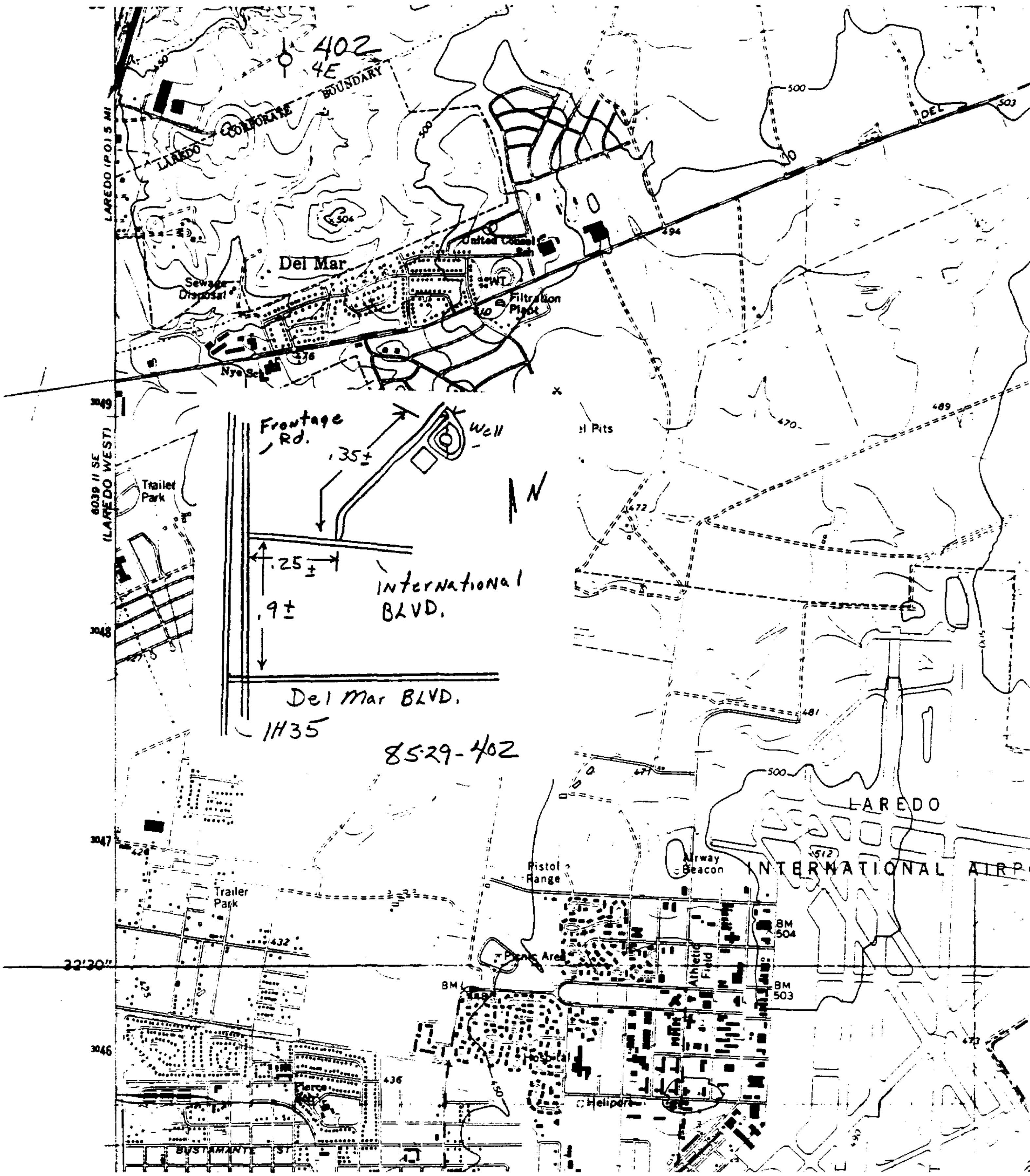
Reg. No. 67 (Signed) David A. La Cruz
(Water Well Driller)

II. To be completed by landowner or person having well drilled.

1. I do hereby certify that I have been informed that the above described well encountered water injurious to vegetation, to land or to fresh water and that the well must be completed or plugged in such a manner as to avoid injury or pollution.

Date (Signed)
(Landowner or person having well drilled)

TDBE-GW-54



402
4E
LAREDO CORPORATE BOUNDARY
LAREDO (P.O. 1.5 MI)
Del Mar
Sewage Disposal
United Consol Sch
Filtration Plant
Nye Sch
Frontage Rd.
Well
.35±
.25±
.9±
International BLVD.
Del Mar BLVD.
IH35
85-29-402
N
Trailer Park
6039 II SE (LAREDO WEST)
Pits
LAREDO
INTERNATIONAL AIRPO
Airway Beacon
Pistol Range
Trailer Park
BM 504
BM 503
Athletic Field
Picnic Area
Hospital
Heliport
Pierce
BUSTAMANTE ST
500
470
489
481
494
503

85-29-402

TEXAS WATER DEVELOPMENT BOARD
WELL SCHEDULE

State Well Number - 85 29 706 Previous Well Number - County - Webb 479
River Basin - Rio Grande - 23 Zone - 2 Latitude - 27 31 41 Longitude - 99 28 55 Source of Coords - 1

Owners Well No. ______ Location ______ 1/4, ______ 1/4, Section ______, Block ______, Survey ______

Owner - Catholic Cemetary Driller - David E. De La Cruz

Address P.O. Box 2366, Laredo, TX Tenant/Oper. ______
Date Drilled - 12/08/1965 Depth - 236 ft. Source of Depth - D Altitude - 464 ft. Source of Alt. - M
Aquifer - 124LRDO LAREDO FORMATION Well Type - W User -

WELL CONSTRUCTION Const. Method - HYDRAULIC ROTARY; Completion - PERFORATED OR SLOTTED
Casing Material - STEEL
Screen Material - STEEL

LIFT DATA - Pump Mfr. ______ Type - SUBMERSIBLE PUMP No. Stages ______

Bowls Diam. - ______ in. Setting - ______ ft. Column Diam. - ______ in.

Motor Mfr. - ______ Fuel or Power - ELECTRIC MOTOR Horsepower -

YIELD Flow- ______ GPM Pump- ______ GPM Meas.,Rept.,Est- ______ Date- ______

PERFORMANCE TEST Date- ______ Length of Test- ______ Production- ______ GPM

Static Level- ______ ft. Pumping Level- ______ ft. Drawdown- ______ ft. Sp.Cap.- ______ GPM/ft

QUALITY (Remarks- ______

WATER USE Primary- IRRIGATION Secondary- ______ Tertiary- ______

OTHER DATA AVAILAIBLE Water Levels- M Quality- Y Logs- D Other Data-

WATER LEVELS Date- 12/08/1965 Measurement- -76.00
Date- 12/04/1996 Measurement- -80.50 steel tape

Recorded By J. Derton Date Record Collected or Updated- 12/04/1996

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (
Open Hole (O)
Cemented from ______ to ______

		Diam. (in.)	Setting (feet) From	To
1	C	7	0	175
2	S	7	175	195
3	C	7	195	212
4	S	7	212	232
5	C	7	232	235
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

Reporting Agency - TEXAS WATER DEVELOPMENT BOARD
REMARKS -
Owner's #1 well. Measured yield 25 GPM with 64 feet drawdown in 1965. Cemented from 0 to 175 feet.

mp = Top of Casing + 0.7'

Unable to insert E-line.
Well pumps into ground storage tank (cement).

AQ-08

Aquifer - 124LRDO
Well No. - 85 29 706

29-7

File original copy w
Texas Water Development Board
P. O. Box 12386, Capitol Station
Austin, Texas 78711

State of Texas

DRILLERS LOG AND WELL DATA REPORT

For use by TWDB only
Well No.
Located on map
By ____ Date ____
Map no.

1) Well Owner: Catholic Cementery 1219 Saunders Laredo Texas
Name / Street or RFD / City / State

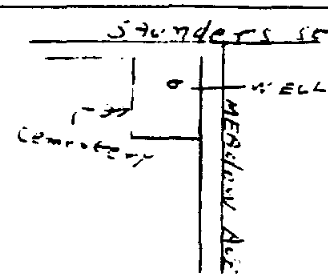
2) Land Owner: Catholic Cementery 1219 Saunders Laredo Texas
Name / Street or RFD / City / State

3) Intended use: Industrial ☐ Municipal ☐ Irrigation ☒ Other ____

4) Location of well: County Webb Labor ____ League ____ Abstract No. ____

NW¼ NE¼ SW¼ SE¼ of Section ____ Block No. ____ Survey ____
(Circle as many as are known)

____ miles in ____ direction
from Laredo Texas
Town



Sketch map of well location with distances from two section or survey lines, and to landmarks, roads, and creeks.

DRILLERS LOG OF WELL

Method of drilling: Standard rig Diameter of hole 8 ½ in. Date drilled 12/ 3/ 55

All measurements made from 0 ft. above ground level.

From (ft)	To (ft)	Description and color of formation material	From (ft)	To (ft)	Description and color of formation material
1	3	Surface	195	212	Gray sandy shale
3	15	Yellow rock	212	232	Water sand
15	26	Gray clay	232	236	Gray clay
26	36	Water sand			
36	162	Gray sandy shale			
162	171	Wet sand (humid)			
171	175	Gray clay			
175	195	water sand			

(Use continuation sheets if necessary)

COMPLETION DATA

COMPLETION

Straight wall ☐
Under reamed ☐
Gravel packed ☐
Open hole ☐
Other ____

CASING

Type: Old ☒ New ☐
Cemented from 1 ft. to 175 ft.

Diameter (inches)	Setting from (ft)	Setting to (ft)
7" O.D	1' above surface	235

SCREEN

Type ____
Perforated ☐ Slotted ☒

Diameter (inches)	Setting from (ft)	Setting to (ft)
	175	195
	212	232

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

(Signature) David De La Cruz Reg. No. 67
Company Name

Please attach electric log, chemical analysis, and other pertinent information if available.

If well was tested by your company or if you installed the permanent pump please complete the following:

WATER LEVEL AND PUMP DATA

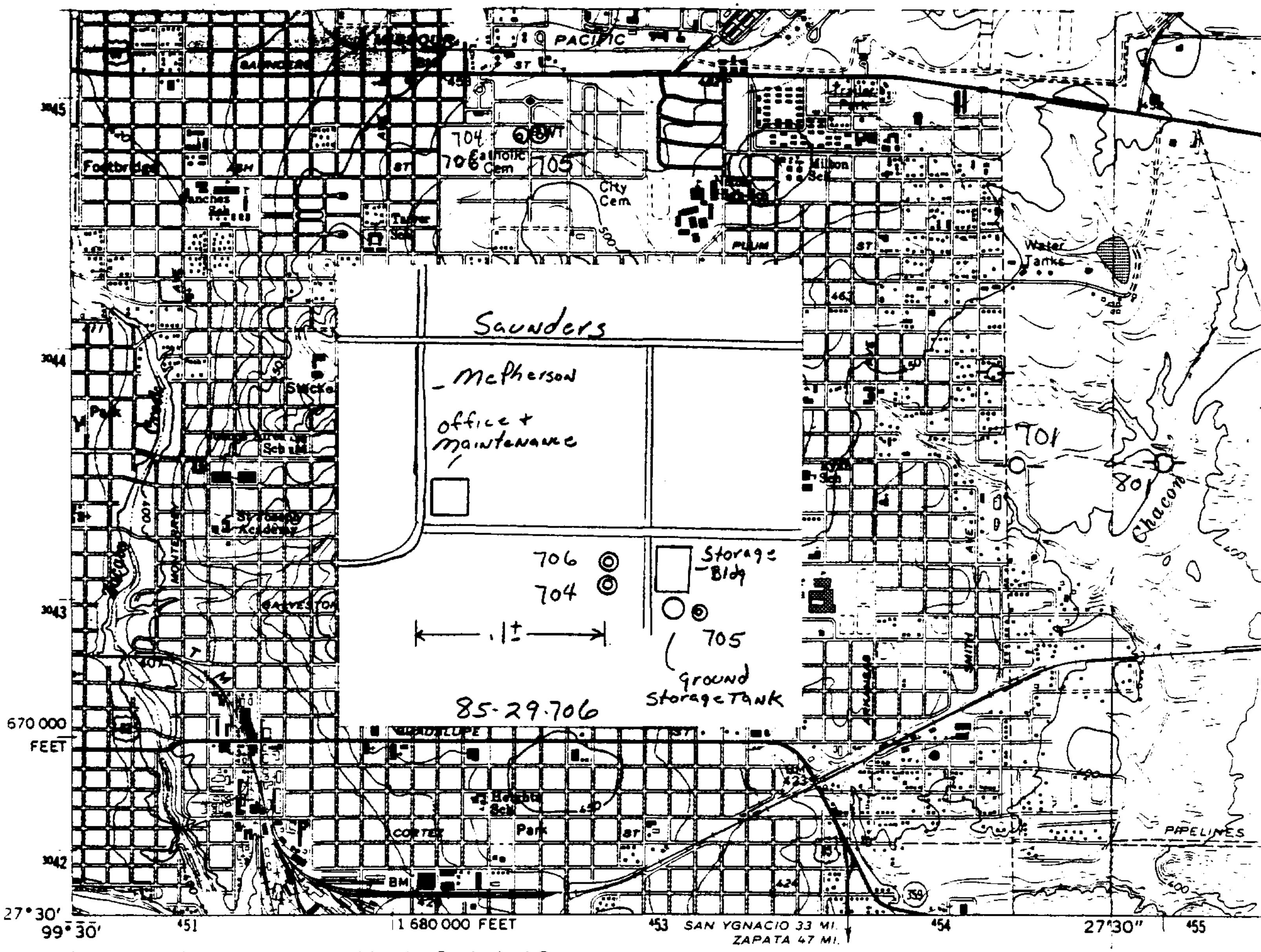
Static water level 76 ft. below surface

Pumping level feet	hours	gpm
140		25

Pump type ____
Designed pumping rate ____ gpm ☐ gph ☐
Type power unit ____
Horsepower ____
Depth to bowls, cylinder, jet, etc., ____ ft. below pump base

Name of contractor testing well or installing permanent pump if other than your company: ____

85-29-706



Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

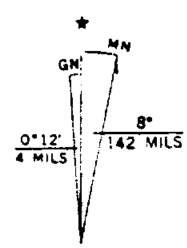
Topography by photogrammetric methods from aerial photographs taken 1964. Field checked 1965

Polyconic projection. 10,000-foot grid based on Texas coordinate system, south zone
1000-meter Universal Transverse Mercator grid ticks, zone 14, shown in blue. 1927 North American Datum
To place on the predicted North American Datum 1983 move the projection lines 27 meters south and 32 meters east as shown by dashed corner ticks

Red tint indicates area in which only landmark buildings are shown

Fine red dashed lines indicate selected fence lines

Areas covered by dashed light-blue pattern are subject to controlled inundation



UTM GRID AND 1980 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Revisions shown in purple compiled from aerial photographs taken 1975 and other source data
This information not field checked. Map edited 1980

Purple tint indicates extension of urban areas

FOR

85-29-706

Water Quality Field Data

SWN: 85-29-706
County: Webb
Aquifer(s): Laredo FM

Name: Catholic Cementary
Address: PO BOX 2366
Laredo, TX
owner's well # 1

Sample No. AQ-08
Date: 12-4-96
By: J. Derton

Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples 3
500 ml	1 liter	1 liter	1 liter				
1 ml HNO_3 (Nitric)							Not filtered. ~~All filtered unless otherwise stipulated~~

Water Level 80.50 LSD Remark Static
Temperature (00010) 27.0 c
Specific Conductance (00094) 2340 umhos/cm
pH (00400) 8.70
Eh (00090) ______ mv.
henol ALK (82244) 20 mg/l
Total ALK (39086) 340 mg/l
Carbonate (00452) ______ meq/l 24 mg/l
Bicarbonate (00453) ______ meq/l 366 mg/l
Total Cations(+) ______
Total Anions (-) ______
Total Hardness (00900) 9
Dissolved Solids 1333

Time in ______
Time out ______ Sample time 1355
Weather ______ well use IRR
Outside Temp ______
Sampling point. Discharge of well.

Starting pH ______
______ ml. of 0.02N to
______ ml. of Sample
Ending pH ______

Time:	1317	1325	1330	1335	1345	1352	ml.	pH	ml.	pH	ml.	pH
pH:	8.56	8.49	8.59	8.67	8.70	8.70						
Temp:	26.0	26.3	26.8	27.0	27.0	27.0						
Eh:												
Cond.	2600	2670	2600	2460	2370	2340						

other notes:
pump ON 1317

TEXAS WATER DEVELOPMENT BOARD
WELL SCHEDULE

State Well Number - 85 29 707 Previous Well Number - County - Webb 479
River Basin - Rio Grande - 23 Zone - 2 Latitude - 27 28 30 Longitude - 99 27 46 Source of Coords - 1

Owners Well No. ______ Location ______ 1/4, ______ 1/4, Section ______, Block ______, Survey ______

Owner - Fausto Bermudez Driller - Woods Drilling Co.

Address 3220 Stewart, Laredo, TX 78041 Tenant/Oper. ______
Date Drilled - 06/24/1984 Depth - 260 ft. Source of Depth - D Altitude - 465 ft. Source of Alt. - M
Aquifer - 124LRDO LAREDO FORMATION Well Type - W User -

WELL CONSTRUCTION Const. Method - AIR ROTARY
Casing Material - PVC, FIBERGLASS, OTHER PLASTIC
Completion - PERFORATED OR SLOTTED
Screen Material - PCV, FIBERGLASS, OTHER PLASTIC

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (
Open Hole (O)
Cemented from ______ to ______

		Diam. (in.)	Setting (feet) From	To
1	C	5	0	200
2	S	5	200	260
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

LIFT DATA - Pump Mfr. ______ Type - SUBMERSIBLE PUMP No. Stages ______

Bowls Diam. - ______ in. Setting - ______ ft. Column Diam. - ______ in.

Motor Mfr. - ______ Fuel or Power - ELECTRIC MOTOR Horsepower -

YIELD Flow- ______ GPM Pump- ______ GPM Meas.,Rept.,Est- ______ Date- ______

PERFORMANCE TEST Date- ______ Length of Test- ______ Production- ______ GPM

Static Level- ______ ft. Pumping Level- ______ ft. Drawdown- ______ ft. Sp.Cap.- ______ GPM/ft

QUALITY (Remarks- ______

WATER USE Primary- DOMESTIC Secondary- ______ Tertiary- ______

OTHER DATA AVAILAIBLE Water Levels- M Quality- N Logs- D Other Data-

WATER LEVELS Date- 06/26/1984 Measurement- -52.00
Date- / / Measurement-

Recorded By J. Derton Date Record Collected or Updated- 12/05/1996

Reporting Agency - TEXAS WATER DEVELOPMENT BOARD
REMARKS -
Measured yield 30 GPM with 115 feet drawdown after pumping 3 hours in 1984. Cemented from 0 to 30 feet. Pump set at 231 feet.

Did not visit this well.
unable to contact owner.

Aquifer - 124LRDO
Well No. - 85 29 707

Please use black
Send original copy by certified mail to the Texas Department of Water Resources
P. O. Box 13087
Austin, Texas 78711

State of Texas
WATER WELL REPORT
ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*

Texas Water Well Drillers Board
P. O. Box 13087
Austin, Texas 78711

1) OWNER Fausto Bermudez (Name) Address 3220 Stewart (Street or RFD) Laredo, (City) Texas (State) 78041 (Zip)

2) LOCATION OF WELL: County Webb Well located on east city limits lineat dead end. miles in (N.E., S.W., etc.) direction from Laredo (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. ______ Block No. ______ Township ______
Abstract No. ______ Survey Name ______
Distance and direction from two intersecting section or survey lines ______
XX See attached map. 85-29-70

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Domestic ☐ Industrial ☐ Public Supply ☒ Irrigation ☐ Test Well ☐ Other

5) DRILLING METHOD (Check): ☐ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored ☒ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other

6) WELL LOG:

Date drilled 6/25/84

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
6 3/4	Surface	260

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☐ Gravel Packed ☒ Other Cased to bottom 260'
If Gravel Packed give interval . . . from ______ ft. to ______ ft.

From (ft.)	To (ft.)	Description and color of formation material	
0	4	Topsoil	Brown ~~yellow~~
4	25	Siltstone	yellow
25	205	Sandy shale	gray
205	256	Sand	gray
256	260	Shale	gray

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
5"	new	P.V.C. plain	0	200	
5"	new	P.V.C. perf.	200	260	¼"

9) CEMENTING DATA [Rule 319.44(b)]
Cemented from 30 ft. to Surface ft.
______ ft. to ______ ft.
Method used Basket & Gravity
Cemented by Woods Drilling Co.

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 319.44(c)]
☐ Pitless Adapter Used [Rule 319.44(d)]
☐ Approved Alternative Procedure Used [Rule 319.71]

11) WATER LEVEL:
Static level 52 ft. below land surface Date 6/26/84
Artesian flow none gpm. Date ______

RECEIVED
JUL 10 1984
DEPT. OF WATER RESOURCES

12) PACKERS: Type Depth
none

13) TYPE PUMP:
☐ Turbine ☐ Jet ☒ Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., 231 ft.

14) WELL TESTS:
Type Test: ☒ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: 30 gpm with 115 ft. drawdown after 3 hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☐ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Light salt Depth of strata 205-256
Was a chemical analysis made? ☐ Yes ☒ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 12 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Woods Drilling Co. (Type or Print) Water Well Driller's License No. 2220

ADDRESS P.O. 6489 (Street or RFD) Laredo, (City) Texas (State) 78042 (Zip)

(Signed) Jerry Woods (Licensed Water Well Driller) (Signed) ______ (Registered Driller Trainee)

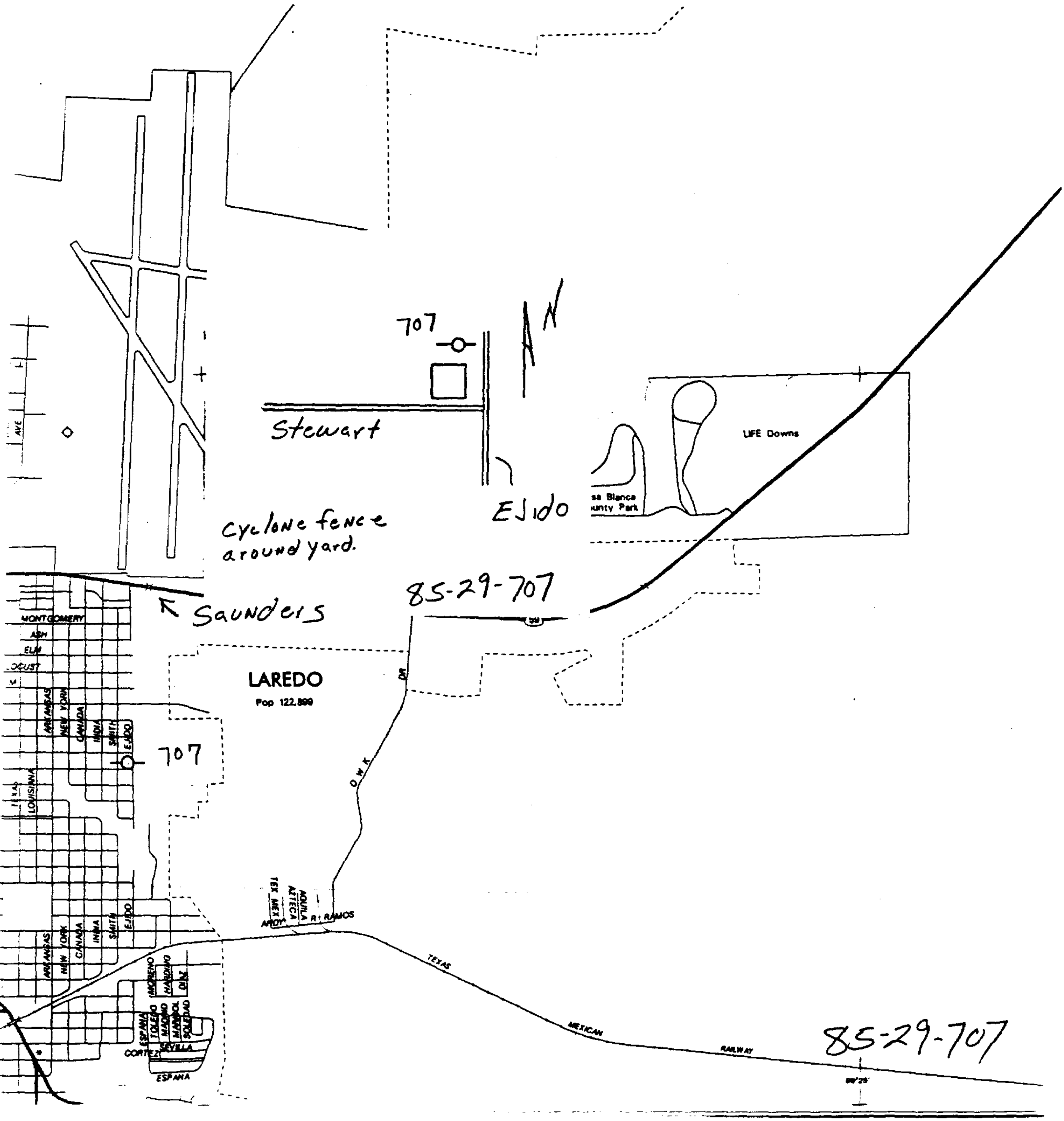
85-29-707

For TDWR use only
Well No. 85-29-70
Located on map WOMM

Please attach electric log, chemical analysis, and other pertinent information, if available.

DEPARTMENT OF WATER RESOURCES COPY

TDWR-0392 (12/29/83)



707
Stewart
Ejido
cyclone fence around yard.
Saunders
85-29-707
LIFE Downs
sa Blanca
ounty Park
MONTGOMERY
ASH
ELM
LOCUST
AVE
LAREDO
Pop 122,899
ARKANSAS
NEW YORK
CANADA
INDIA
SMITH
EJIDO
707
LOUISIANA
O W K
DR
TEX MEX
AZTECA
AQUILA
R RAMOS
MORENO
MARIANO
DIAZ
ESPANA
TOLEDO
MADRID
MARISOL
SOLEDAD
SEVILLA
CORTEZ
TEXAS
MEXICAN
RAILWAY
85-29-707

Texas Water Development Board
Well Schedule

State Well No. 85 29708 Previous Well No. County webb 479

River Basin Rio Grande 23 Zone 2 Lat. 27 30 16 Long. 099 28 33 Source of Coord. 1

Owner's Well No. ______ Location ______ 1/4, ______ 1/4, Section ______, Block ______, Survey ______

* NW Corner Malinche & Market st,

Owner Maria Luisa Trevino Driller Unknown

Address 900 N. Malinche, Laredo, 78041 Tenant/Oper. 722-4228

Date Drilled old Depth 200 Source of Depth Datum M Altitude 440 Source of Alt. Datum m

Aquifer ______ 124LRDO Well Type W User

Well Construction Const. Method ______ Casing Material steel S

Completion ______ Screen Material ______

Lift Data Pump Mfr. ______ Type Subm S No. Stages ______

Bowls Diam. ______ in. Setting ______ ft. Column Diam. ______ in.

Motor Mfr. ______ Fuel or Power elec. E Horsepower .

Yield Flow ______ GPM Pump ______ GPM Meas., Rept., Est. ______ Date ______

Performance Test Date ______ Length of Test ______ Production ______ GPM

Static Level ______ ft. Pumping Level ______ ft. Drawdown ______ ft. Sp.Cap. ______ GPM/ft.

Quality (Remarks Was old Wm; used for yard water, wash

Water Use Primary Dom H Secondary ______ Tertiary ______

Other Data Available Water Level m Water Quality Y Logs Other Data

Water Levels

Date	Meas.	
12 04 1996	32.92	1-01
	.	
	.	

*well in in Apt. 906, under planter

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

		Diam. (in.)	Setting (feet) From	To
1	C	07		
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

(20 max)

Recorded By D. Coker Date Record Collected or Updated 12 04 1996 Reporting Agency 01

Remarks
1
2
3
4
5
6

sample 99-02

mp. +1.10'
Elec. line hole

Aquifer ______
Well No. 8529708

93-0384
2/9/93

~~photos 3, 4, 5~~

Laredo ASR Project
12-2-96

AQ-02 | 12-4-96 | Mrs. Trevino

	13:00	13:10	13:15	13:20
ph	7.47	7.56	7.57	7.60
Temp	22.6	24.5	25.2	25.7
SC	7270	7330	7330	7380

13:25	13:35	13:45	13:55	14:00
7.56	7.58	7.58	7.59	7.57
25.9	25.6	25.3	25.6	25.3
7330	7310	7200 before	7110	7100

Faucet on ditch, @ PT, 10' from well $\boxed{\text{sample}}$
... to manifold ... salty
... rust ...
UT ... pump by E...

Wasold Wm

Previous sample 7-17-79

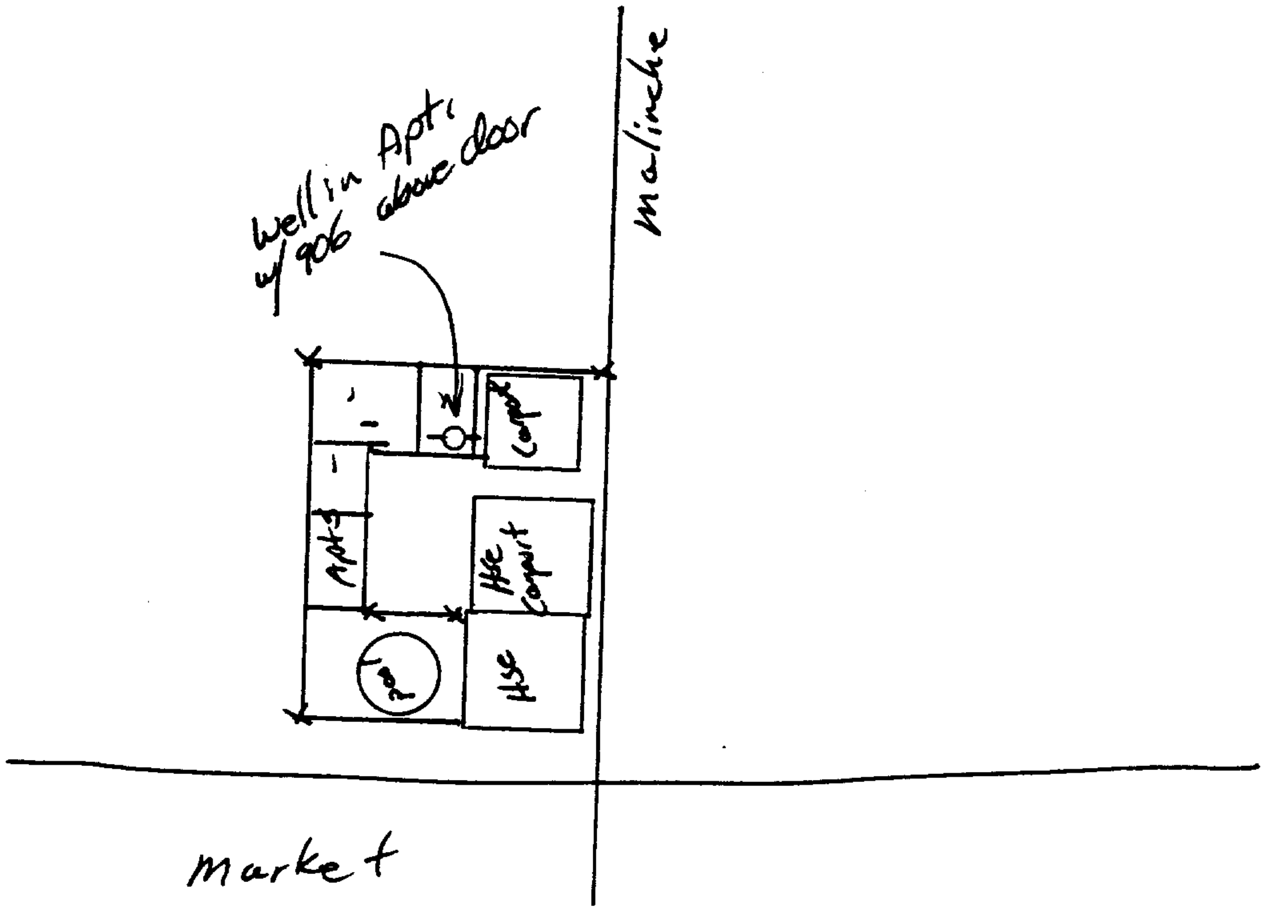
2116 mg/l TDS
835 SO4
373 Cl

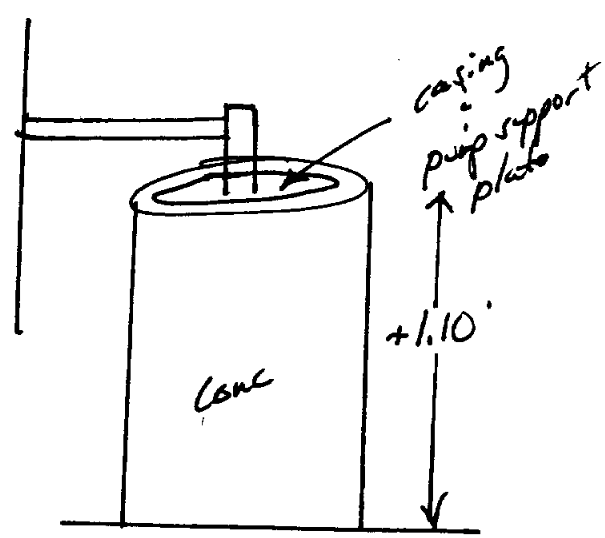
ph 8.0
8.5 Cal
12 mg

Pollution Control Lab
S. Ar
7-17-79

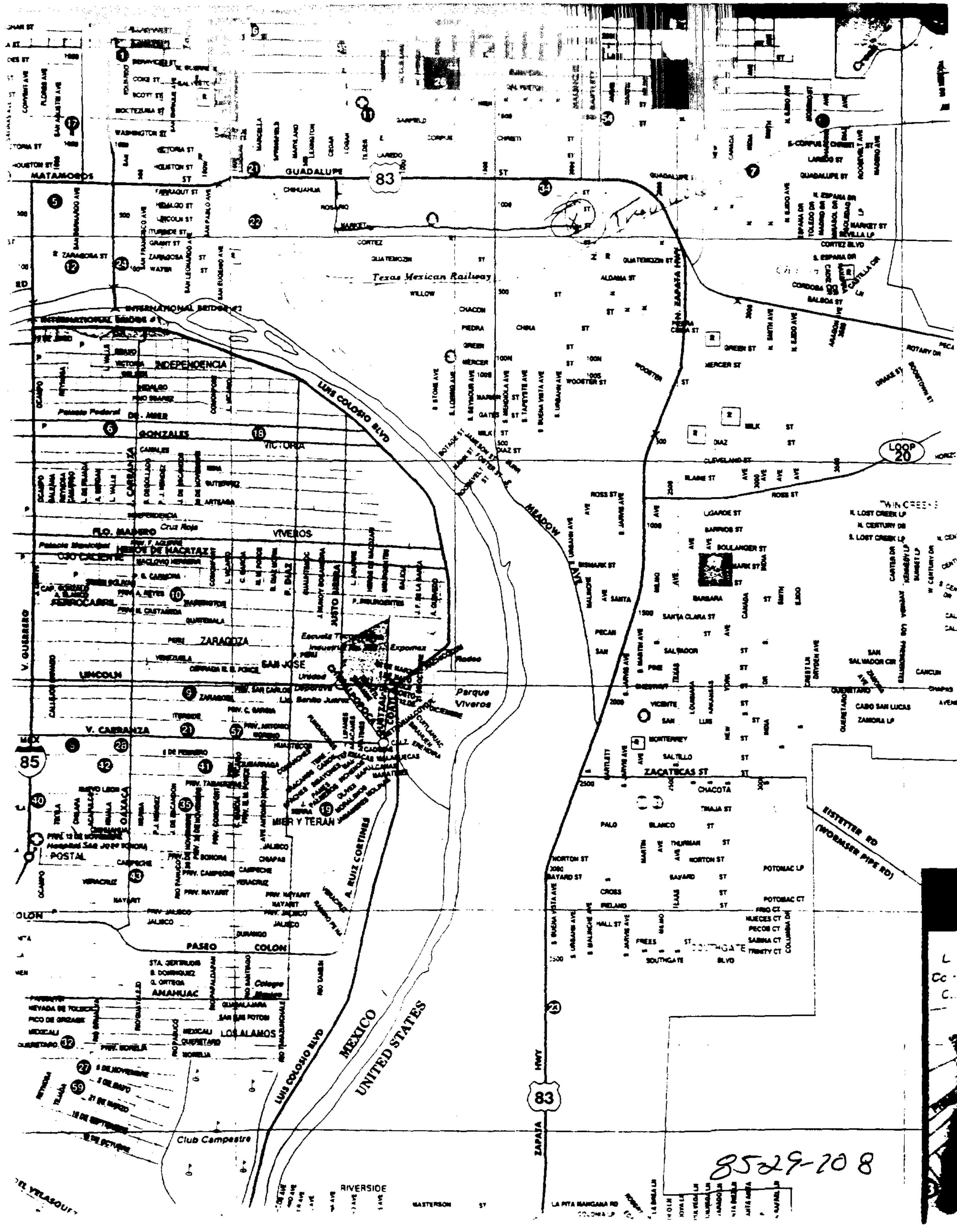
From Mrs Trevino

85-29-708

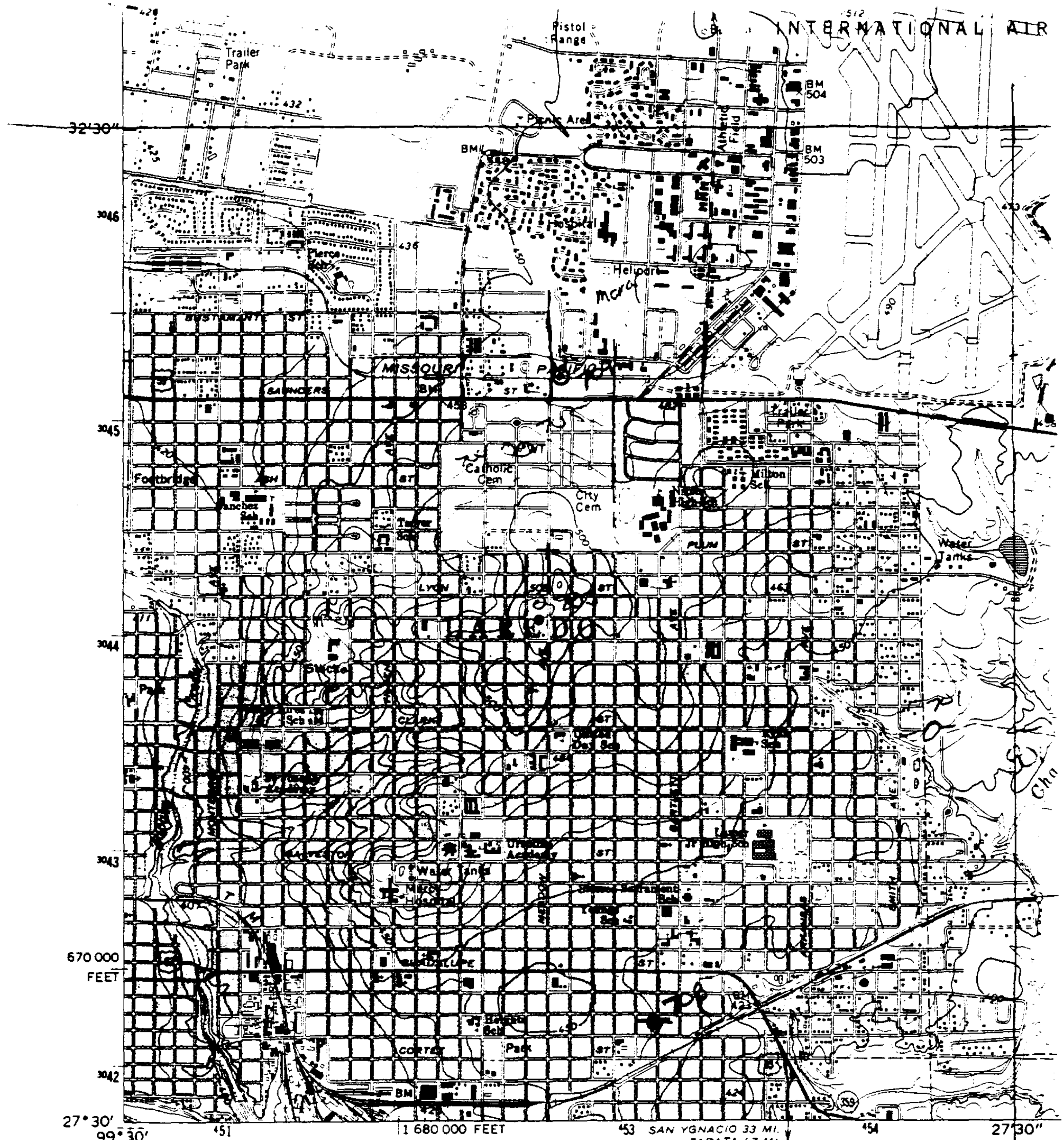

Well in Apts
w/ 906 above door
Malinche
Comp't
Apts
Hse Comp't
Hse
Pool
Market


casing
&
pump support
plate
+1.10'
Conc

85-29-708


MATAMOROS
GUADALUPE
83
CHIHUAHUA
ROSARIO
MARKET
CORTEZ
GUATEMOZIN
Texas Mexican Railway
WILLOW
CHACON
PIEDRA
CHINA
GREEN
MERCER
WOOSTER
INTERNATIONAL BRIDGE #2
INTERNATIONAL BRIDGE #1
INDEPENDENCIA
HIDALGO
DR. MIER
GONZALES
VICTORIA
LUIS COLOSIO BLVD
MEADOW
ZAPATA HWY
LOOP 20
ROSS ST
CLEVELAND ST
DIAZ
MILK
FLO. MADERO
VIVEROS
Cruz Roja
HEROES DE NACATAZ
OJO CALIENTE
FERROCARRIL
ZARAGOZA
SAN JOSE
LINCOLN
V. CARRANZA
Parque Viveros
Rodeo
Expomex
V. GUERRERO
85
SANTA CLARA ST
SALTILLO
MONTERREY
ZACATECAS ST
CHACOTA
EISTETTER RD
(WORMSER PIPE RD)
MIER Y TERAN
A. RUIZ CORTINES
POSTAL
VERACRUZ
NAYARIT
JALISCO
COLON
PASEO
ANAHUAC
LOS ALAMOS
MEXICO
UNITED STATES
SOUTHGATE BLVD
ZAPATA HWY
Club Campestre
RIVERSIDE
MASTERSON
TWIN CREEKS

8529-208

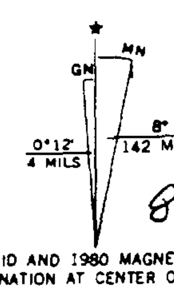


Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1964. Field checked 1965

Polyconic projection. 10,000-foot grid based on Texas coordinate system, south zone
1000-meter Universal Transverse Mercator grid ticks, zone 14, shown in blue. 1927 North American Datum
To place on the predicted North American Datum 1983 move the projection lines 27 meters south and 32 meters east as shown by dashed corner ticks



UTM GRID AND 1980 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

85-29-708

Water Quality Field Data

SWN: 85-29-708
County: Webb
Aquifer(s): Laredo

Name: M.L. Trevino
Address: 900 N. Malinche
Laredo, 78041
owner's well #

Sample No. AQ-02
Date: 12-4-96
By: D. Coker

	Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
	~~500 ml Anions~~	~~1 liter Cations~~	~~250 ml Nitrate~~	~~1 liter Radioactivity~~	A 1 liter	B 500ml	C 1 liter	3
		~~2 ml HNO (Nitric)~~	~~0.5 ml H SO (Sulfuric)~~	~~2 ml HNO (Nitric)~~		1ml HNO3		All filtered unless other-wise stipulated

Water Level 32.92 LSD
Remark
Temperature (00010) 25.3 c
Specific Conductance (00094) 7110 umhos/cm
pH (00400) 7.59
Eh (00090) mv.
Phenol ALK (82244) 18 mg/l
Total ALK (39086) 244 mg/l
Carbonate (00452) meq/l 21.6 mg/l
Bicarbonate (00453) meq/l 253.8 mg/l
Total Cations(+) tt
Total Anions (-)
Total Hardness (00900) 325
Dissolved Solids 4860

Time in 12:35
Time out
Sample time 1405
Weather lt. rain
well use yard
Outside Temp 67°F
Sampling point
12:55 Pump On

~~Starting pH~~
~~ml. of 0.02N to~~
~~ml. of Sample~~
~~Ending pH~~

Time:	1300	1310	1315	1320	1325	1335	ml.	pH	ml.	pH	ml.	pH
pH:	7.47	7.56	7.57	7.60	7.56	7.58	1345	7.58	1355	7.59	1400	7.59
Temp:	22.6	24.5	25.2	25.7	25.9	25.6		25.3		25.6		25.8
Eh:												
Cond.	7270	7330	7330	7340	7330	7310		7200		7110		7110

other notes:
yard, washing out
old wm, "salty" taste
From faucet on disch pipe
10' from well before P. tank

Texas Water Development Board
Well Schedule

State Well No. 85 29 709 Previous Well No. County Webb 479

River Basin Rio Grande 23 Zone 2 Lat. 27 31 55 Long. 099 28 49 Source of Coord. 1

Owner's Well No. Location 1/4, 1.4, Section , Block , Survey

Owner Mercy Hospital Driller Woods Drilling Co.

Address Tenant/Oper.

Date Drilled 11 23 1996 Depth 440 Source of Depth Datum Altitude 463 Source of Alt. Datum M

Aquifer Laredo 124LRDO Well Type W User

Well Construction Const. Method Casing Material

Completion 3/8" drilled P Screen Material

Lift Data Pump Mfr. Type Subm S No. Stages

Bowls Diam. in. Setting 315 ft. Column Diam. in.

Motor Mfr. Fuel or Power elec E Horsepower 15.00

Yield Flow GPM Pump 180 GPM Meas. Rep. Est. Date 11/96

Performance Test Date 1-21-97 Length of Test 1 hr Production 163 GPM

Static Level 71.7 ft. Pumping Level 226.0 ft. Drawdown 154 ft. Sp.Cap. 1.05 GPM/ft.

Quality (Remarks "good" water Conductivity = 2080

Water Use Primary Ind Irr N Secondary Irr. I Tertiary

Other Data Available Water Level M Water Quality Y Logs Other Data

Casing or Blank Pipe (C) / Well Screen or Slotted Zone (S) / Open Hole (O) / Cemented from __ to __	Diam. (in.)	Setting (feet) From	To
1	C 10	0	
2	C 06	0	200
3	S 06	200	420
4	C 06	420	440
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

Water Levels

Date	Meas.	
11 08 1996	91.00	27-07
01 21 1997	71.63	1-01
	.	

AQ-12 1-21-97

Recorded By D. Coker Date Record Collected or Updated 12 05 1996 (20 max) Reporting Agency 01

Remarks
1 Measured yield 163 GPM with 154
2 feet drawdown after pumping 1 hour
3 in 1997.
4
5
6

Aquifer

Well No. 85 29 70

93-0384

Water Quality Field Data
Laredo ASR

SWN: 85-29-709
County: Webb
Aquifer(s): Laredo

Name: Mercy Hosp.
Address: c/o Mejia Engineering Co.
1202 Houston St., Ste 200
~~owner's well #~~ Laredo, TX 78040

Sample No. AQ-12
Date: 1-21-97
By: D. Coker

	Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
	B 500 ml	A 1 liter	C 1 liter					
	1ml HNO3 (Nitric) ✓	✓	✓					Not Filtered

Water Level 71.63 LSD   Remark sun

Temperature (00010) 27.2 c

Specific Conductance (00094) ______ umhos/cm

pH (00400) 8.72

Eh (00090) — mv.

Phenol ALK (82244) — mg/l

Total ALK (39086) — mg/l

Carbonate (00452) ______ meq/l ______ mg/l

Bicarbonate (00453) ______ meq/l ______ mg/l

Total Cations(+)
Total Anions (-) Bal.

Total Hardness (00900) 11

Dissolved Solids 2,660

Std 4.0 = 4.00
7.00 = 7.03

Time in 8:06
Time out 11:04   Sample time 9:30
Weather overcast   well use Ind
Outside Temp 60°F   Pumping 8:41
Sampling point End of Disch. @ pond

Starting pH ______
______ ml. of 0.02N to
______ ml. of Sample
Ending pH ______

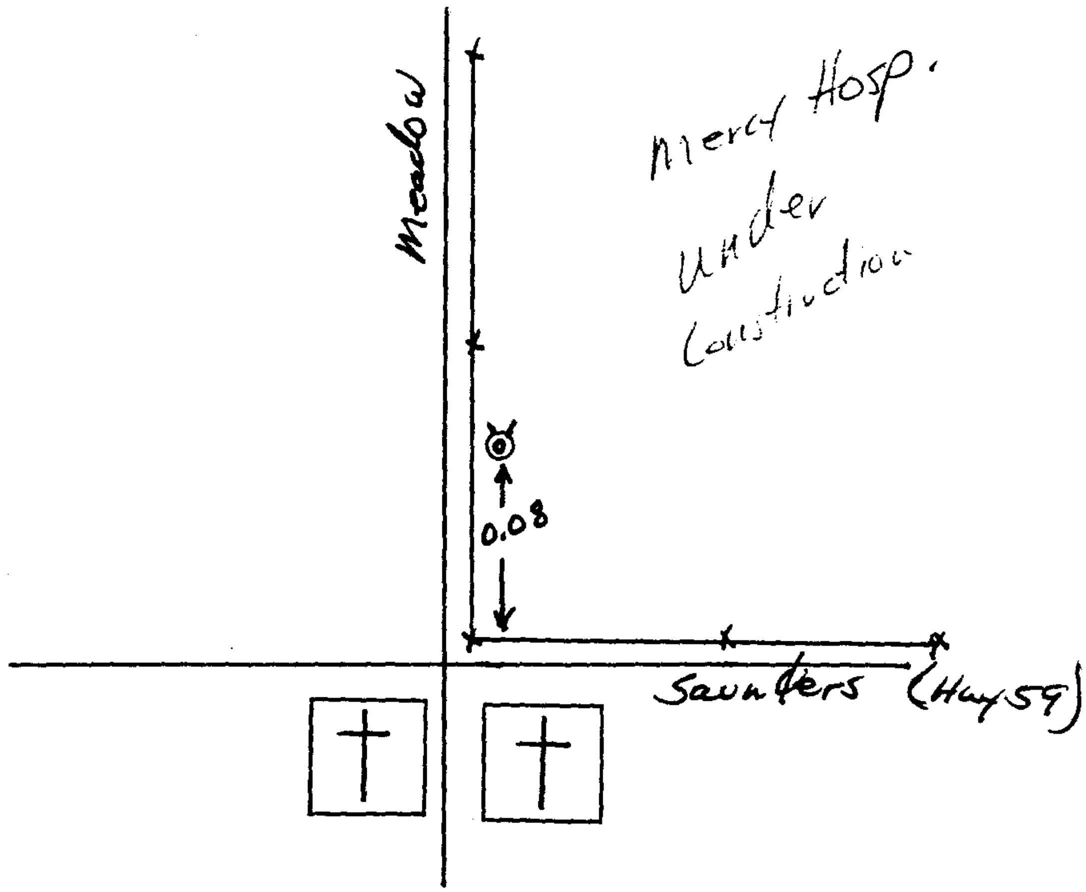
Time:	9:10	9:23	9:28	9:30		
pH:	8.49	8.70	8.72			
Temp:	27.1	27.1	27.2	sample		
Eh:	—	—	—			
Cond.:	2070	2080	2080			

ml.	pH	ml.	pH	ml.	pH

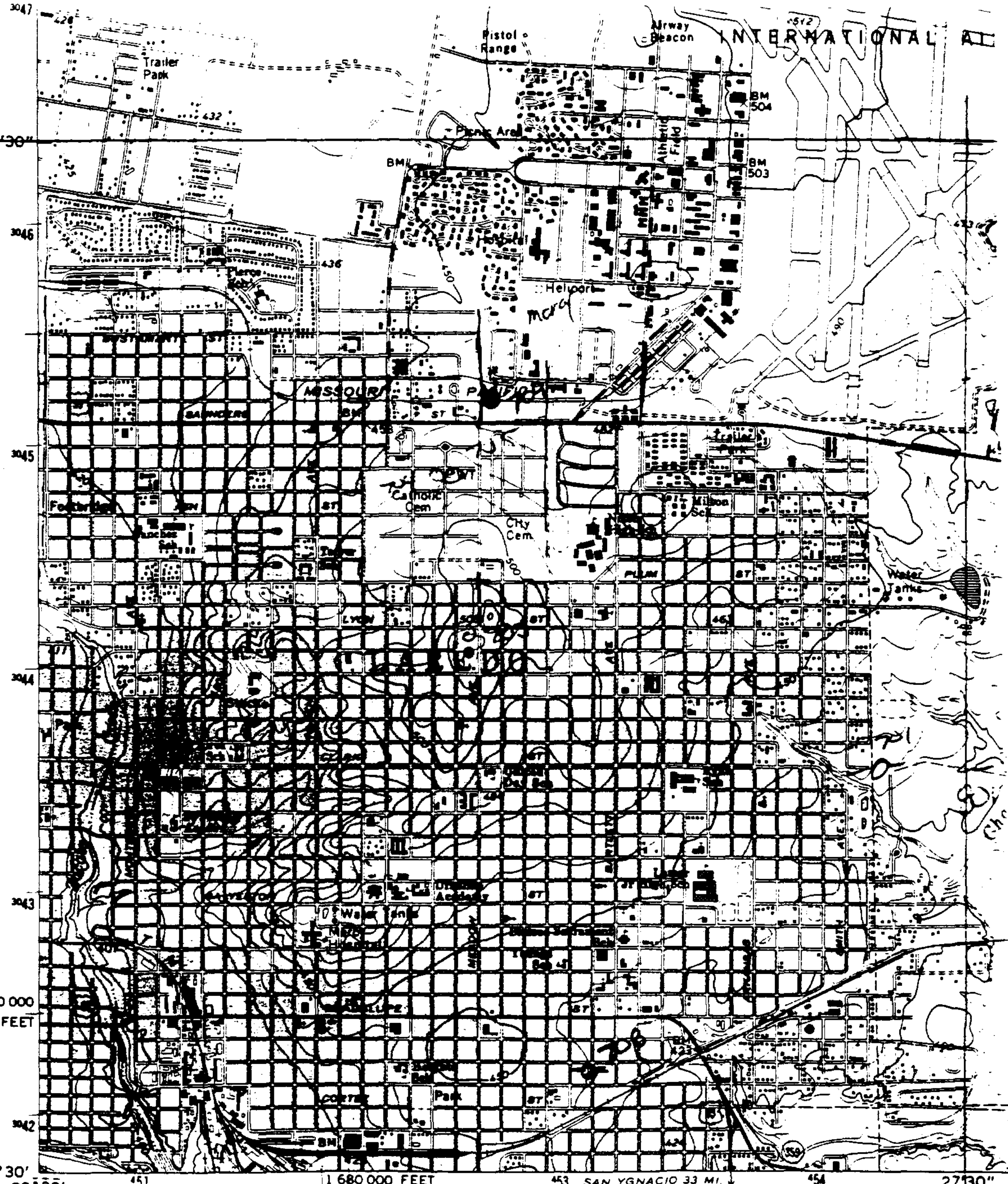
other notes:

440
71
369' of 6" = 1.53 gal/ft =
564.6 gal = 1 volume × 3 =
1694 gal

pumped 41 min @ 175 GPM = 7175 Gallons =



85-29-709

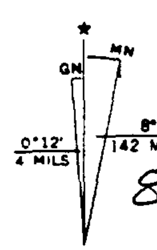


Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

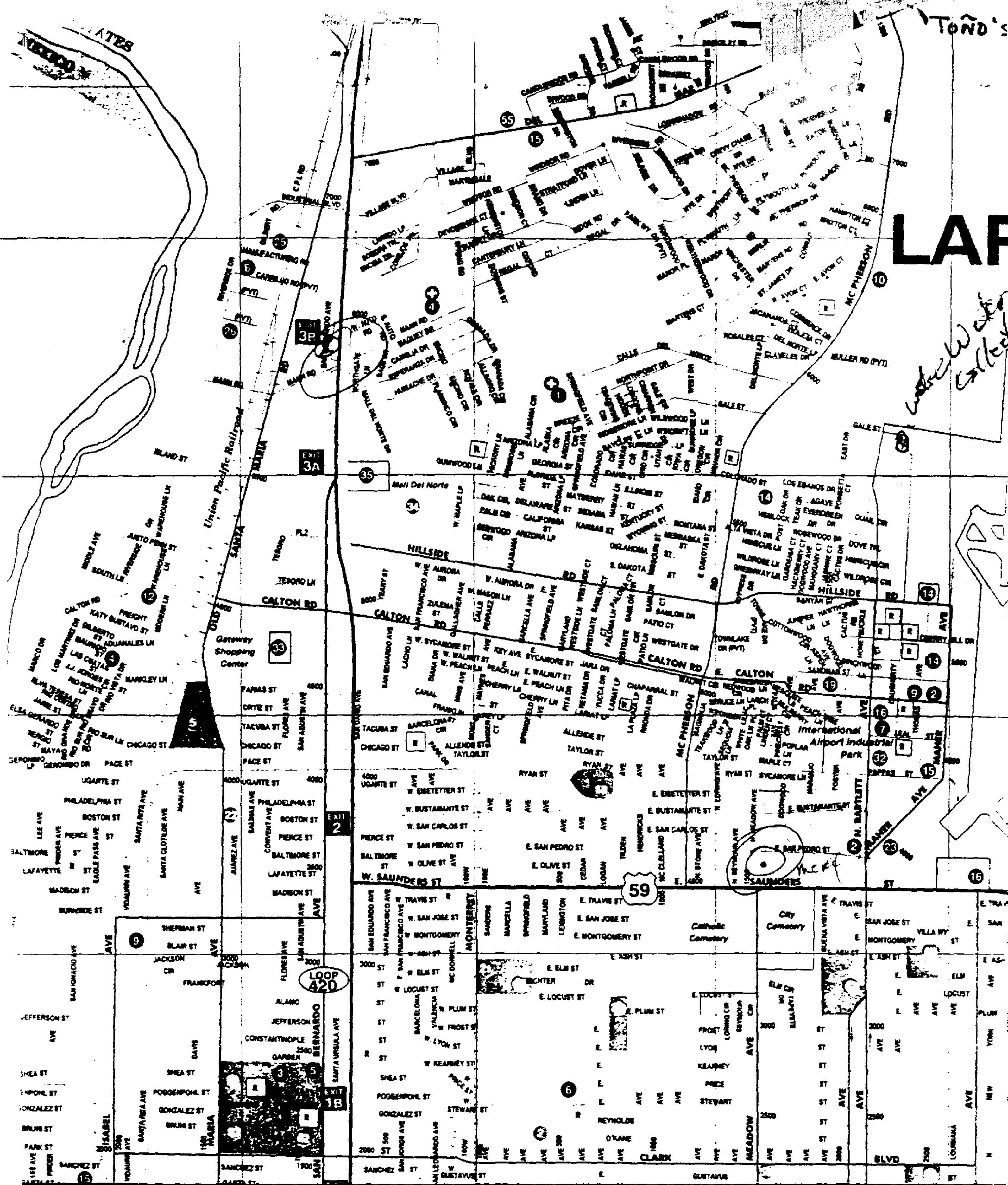
Topography by photogrammetric methods from aerial photographs taken 1964. Field checked 1965

Polyconic projection. 10,000-foot grid based on Texas coordinate system, south zone
1000-meter Universal Transverse Mercator grid ticks, zone 14, shown in blue. 1927 North American Datum
To place on the predicted North American Datum 1983 move the projection lines 27 meters south and 32 meters east as shown by dashed corner ticks



85-29-709

UTM GRID AND 1980 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET


TOÑO'S
LAF
Union Pacific Railroad
SANTA MARIA
HILLSIDE RD
CALTON RD
E. CALTON RD
MC PHERSON
W. SAUNDERS ST
SAUNDERS
59
LOOP 420
EXIT 3B
EXIT 3A
EXIT 2
EXIT 1B
Mall Del Norte
Gateway Shopping Center
International Airport Industrial Park
Catholic Cemetery
City Cemetery
CLARK
BLVD
SAN BERNARDO
MEADOW

1

Date 1-21-97

County : Webb Observation well no. ______

Location: Mercy Hospital Pumped well no. 85-29-709

TD 440' PS 315' Precision Flowmeter

Average Q ______ gpm r = ______ ft. r^2 = ______ mp +1.70'

Time	Elapsed Time	WL from mp	DD	Yield						
8:48A		73.4								static w/E-Line
8:49										Pump On
8:52	3	201.7	128.3							
8:55	6	211.1	137.7	184						
8:57	8	213.8	140.4	177						
9:00	11	216.7	143.3							
9:01	12			177						
9:21	32	224.1	150.7							
9:36	47	226.55	153.15	171						Sampled @ 9:30 ph=8.72, SC=2080, T=27.2
9:43	54	227.35	153.95	166						
9:49	60	227.72	154.32	163						Pump off
9:51	62	145	71.6							
9:52	63	127.6	54.2							
9:53	64	115	41.6							
9:54	65	108.4	35							
9:55	66	104.55	31.15							
9:57	68	99.9	26.5							
9:58	69	98.15	24.75							
9:59	70	96.85	23.45							
10:00	71	95.52	22.12							
10:01	72	94.30	20.9							
10:03	74	92.55	19.15							
10:05	76	91.33	17.93							
10:07	78	90.1	16.7							

85-29-709

(2)

1-21-97

County : Webb
Location: Mercy Hospital

Observation well no. ______
Pumped well no. 85-29-709

Average Q ______ gpm r = ______ ft. r^2 = ______

Time	Elapsed Time	WL from MP	DD	Yield						
10:09A	80	89.25	15.85							
10:15	86	86.83	13.43							
10:20	91	85.55	12.15							
10:26	97	84.30	10.9							
10:30	101	83.60	10.2							
10:40	111	82.30	8.9							
10:50	121	81.33	7.93							
15:50	421	75.55	2.15							

1 HR Spec. Cap. = 163/154 = 1.05 gpm/ft

Sampling TD = 440
WL = 71

369' of 6" = 1.53 gal/ft
369 X 1.53 = 564.6 gal. = 1 well volume
564.6 x 3 = 1694 gal = 3 well volumes
1694 gal / 184 gpm = 9.2 min.
1694 gal / 163 gpm = 10.3 min.
Sampled @ 9:30 after pumping 41 min
@ ± 175 GPM = 7175 Gal. or 12.7 well volumes

Witnessed by Rodriguez,
Woods,
Coker

85-29-709

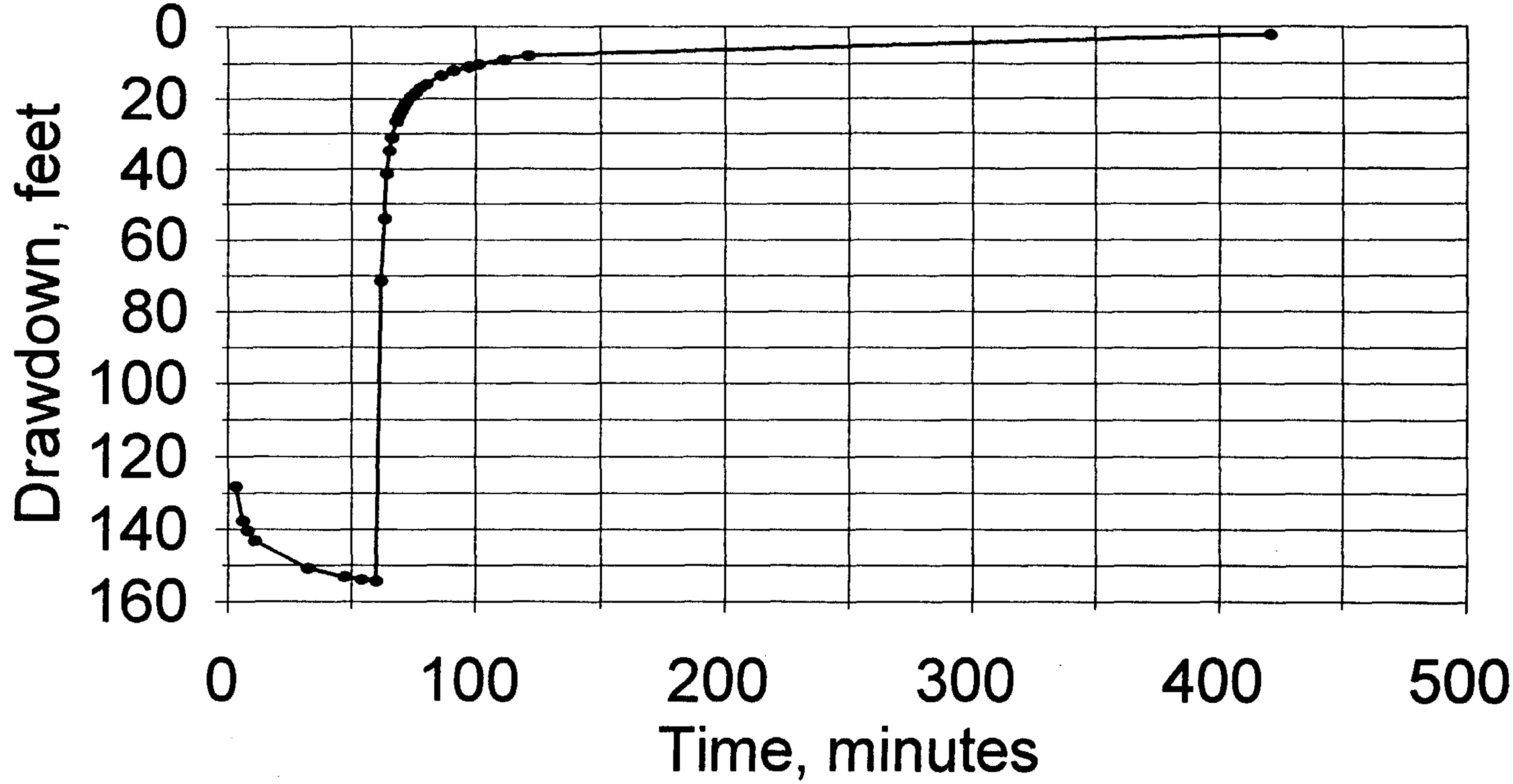
Mercy Hospital Well
Webb, 85-29-709

Time	DD	Yield	
3	128.3		
6	137.7	184	
8	140.4	177	
11	143.3		
32	150.7		
47	153.15	171	
54	153.95	166	
60	154.32	163	Pump off
62	71.6		
63	54.2		
64	41.6		
65	35		
66	31.15		
68	26.5		
69	24.75		
70	23.45		
71	22.12		
72	20.9		
74	19.15		
76	17.93		
78	16.7		
80	15.85		
86	13.43		
91	12.15		
97	10.9		
101	10.2		
111	8.9		
121	7.93		
421	2.15		

85-29-709

Mercy Hospital

85-29-709



85-29-709

Texas Water Development Board
Well Schedule

State Well No. 85 29 804 Previous Well No. ______ County Webb 479

River Basin Rio Grande 23 Zone 2 Lat. 27 31 47 Long. 099 26 28 Source of Coord. 7

Owner's Well No. ______ Location ____ 1/4, ____ 1.4, Section ____, Block ____, Survey ____

Owner c/o David Polston Driller Woods Drilling Co.

Address 1503 Sarazen Court, Laredo 78045 (717-5811, FX 5818) Tenant/Oper. Rick

Date Drilled 01 28 1987 Depth 585 Source of Depth Datum D Altitude 410 Source of Alt. Datum M

Aquifer ______ 124CRDO Well Type W User ______

Well Construction Const. Method Air Rotary A Casing Material steel/PVC P

Completion perf. Gravel Pac P Screen Material ______

Lift Data Pump Mfr. Franklin Type Sub. S No. Stages ______

Bowls Diam. ______ in. Setting 500 (Rick) ft. Column Diam. 2 3/4 in.

Motor Mfr. Franklin Fuel or Power elec. E Horsepower 40.00

Yield Flow ______ GPM Pump 230 GPM Meas., Rept., Est. ______ Date 1-23-97

Performance Test Date 2/87 Length of Test 12 hrs Production 300 GPM

Static Level 12 ft. Pumping Level —— ft. Drawdown 480 ft. Sp.Cap. —— GPM/ft.

Quality (Remarks) In use temporarily; Cond = 4020

Water Use Primary Ind. I Secondary ______ Tertiary ______

Other Data Available Water Level M Water Quality Y Logs D Other Data ______

Water Levels	Date	Meas.	
Date	01 23 1997	27.79	1-01
Date	12 05 1996	32.8	2-01
Date	02 05 1987	12.	7-07

Laredo ASR AQ-13

	Casing or Blank Pipe (C) / Well Screen or Slotted Zone (S) / Open Hole (O)	Diam. (in.)	Setting (feet) From	To
1	C	10	0	20
2	C	06	0	396
3	S	06	396	585
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Open Hole (O) 0-20'
Cemented from 120 to 356'

(20 max)

Recorded By D. Coker Date Record Collected or Updated 01 23 1997 Reporting Agency 01

Remarks
1 Measured yield 230 GPM in 1997.
2 Reported yield 300 GPM w/ 480
3 feet drawdown after pumping 12
4 hours in 1997.
5
6

MP +1.0' Top of PSP

no photos

Aquifer ______

Well No. 85.29.804

93-0384
2/9/93

[illegible] Texas 78711 ATTENTION OWNER: Confidentiality Privilege Notice on [illegible]rse Side Austin, Texas 78711

OWNER Double D Enterprizes (Name) Address North Gateyade Suite 392 Bldg (Street or RFD) Laredo Tex (City) (State) (Zip)

LOCATION OF WELL:
County Webb — 0 miles in City (N.E., S.W., etc.) direction from Laredo (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description:
Section No. ______ Block No. ______ Township ______
Abstract No. ______ Survey Name ______
Distance and direction from two intersecting section or survey lines ______

☒ See attached map.

3) TYPE OF WORK (Check): ☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☒ Domestic ☐ Industrial ☐ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☒ Other Rig Supply

5) DRILLING METHOD (Check): ☐ Driven ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☒ Air Rotary ☐ Cable Tool ☐ Other ______

6) WELL LOG:
Date Drilling:
Started 1/28 1982
Completed 2/3 1982

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
7 7/8	Surface	585

7) BOREHOLE COMPLETION:
☐ Open Hole ☐ Straight Wall ☐ Underreamed
☐ Gravel Packed ☒ Other Cased to 585
If Gravel Packed give interval ... from ______ ft. to ______ ft.

From (ft.)	To (ft.)	Description and color of formation material
0	10	Top Soil
10	15	Sandy Clay Tan
15	19	Gravel
19	385	Shale Clay Sandy Strks Gray
385	490	Sand Gray White
490	515	Sand Dirty Strks Gray
515	585	Sand Gray White

(Use reverse side if necessary)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	To	Gage Casting Screen
6"	New	Sch 40 Plain	0	396	
6"	"	" Perf	396	585	[illegible]

9) CEMENTING DATA [Rule 319.44(b)]
Cemented from 396 ft. to 120 ft. No. of Sacks Used 77
20 ft. to 0 ft. No. of Sacks Used 4
Method used Circulation Plug & Basket
Cemented by Woods Drilling Co.

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 319.44(c)]
☐ Pitless Adapter Used [Rule 319.44(d)]
☒ Approved Alternative Procedure Used [Rule 319.71]

11) WATER LEVEL:
Static level 12 ft. below land surface Date 2/5/82
Artesian flow None gpm. Date ______

12) PACKERS: Type Depth
None

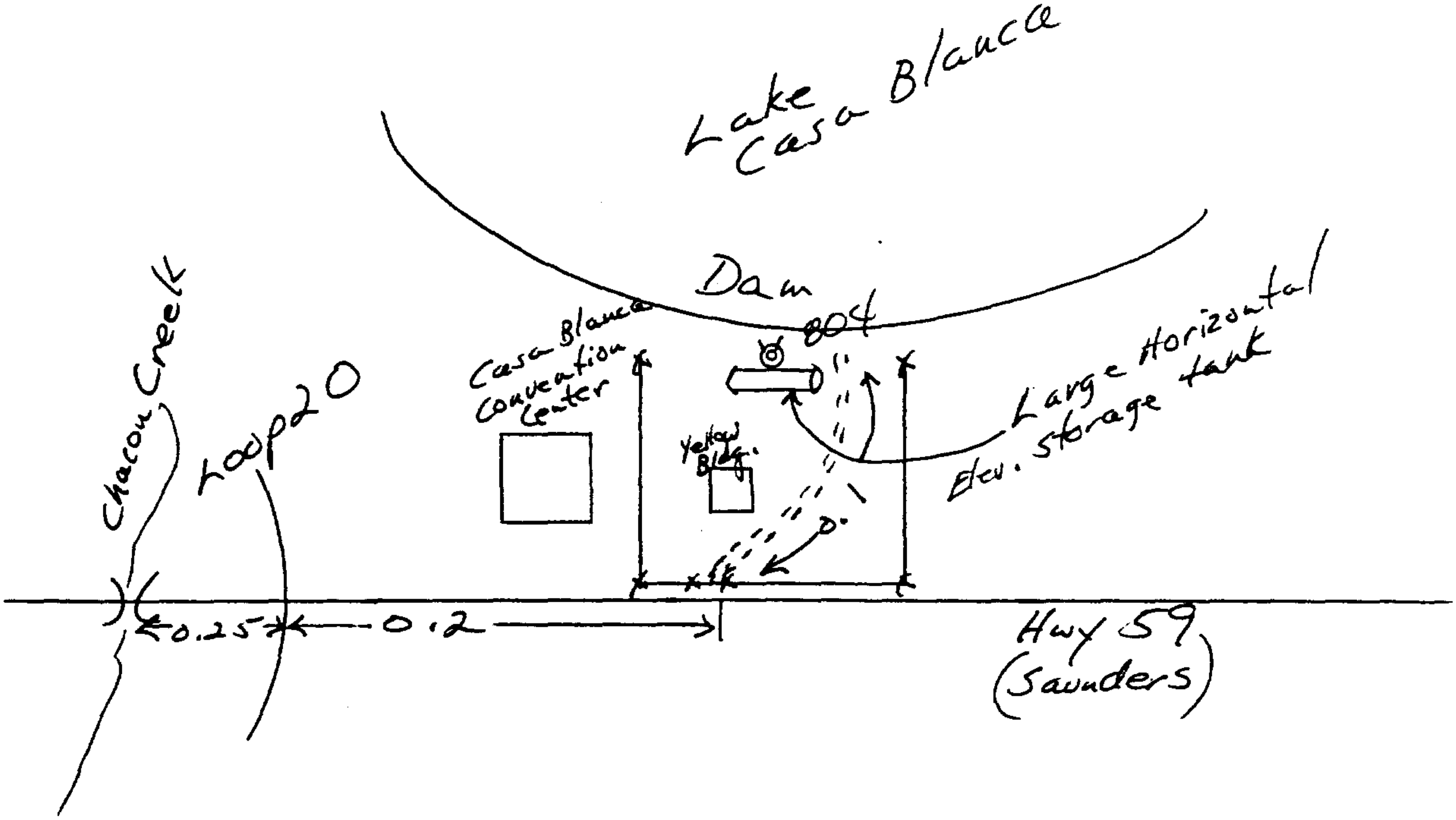
13) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other None yet
Depth to pump bowls, cylinder, jet, etc., ______ ft.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Fresh Depth of strata Strks 400'-580
Was a chemical analysis made? ☒ Yes ☐ No

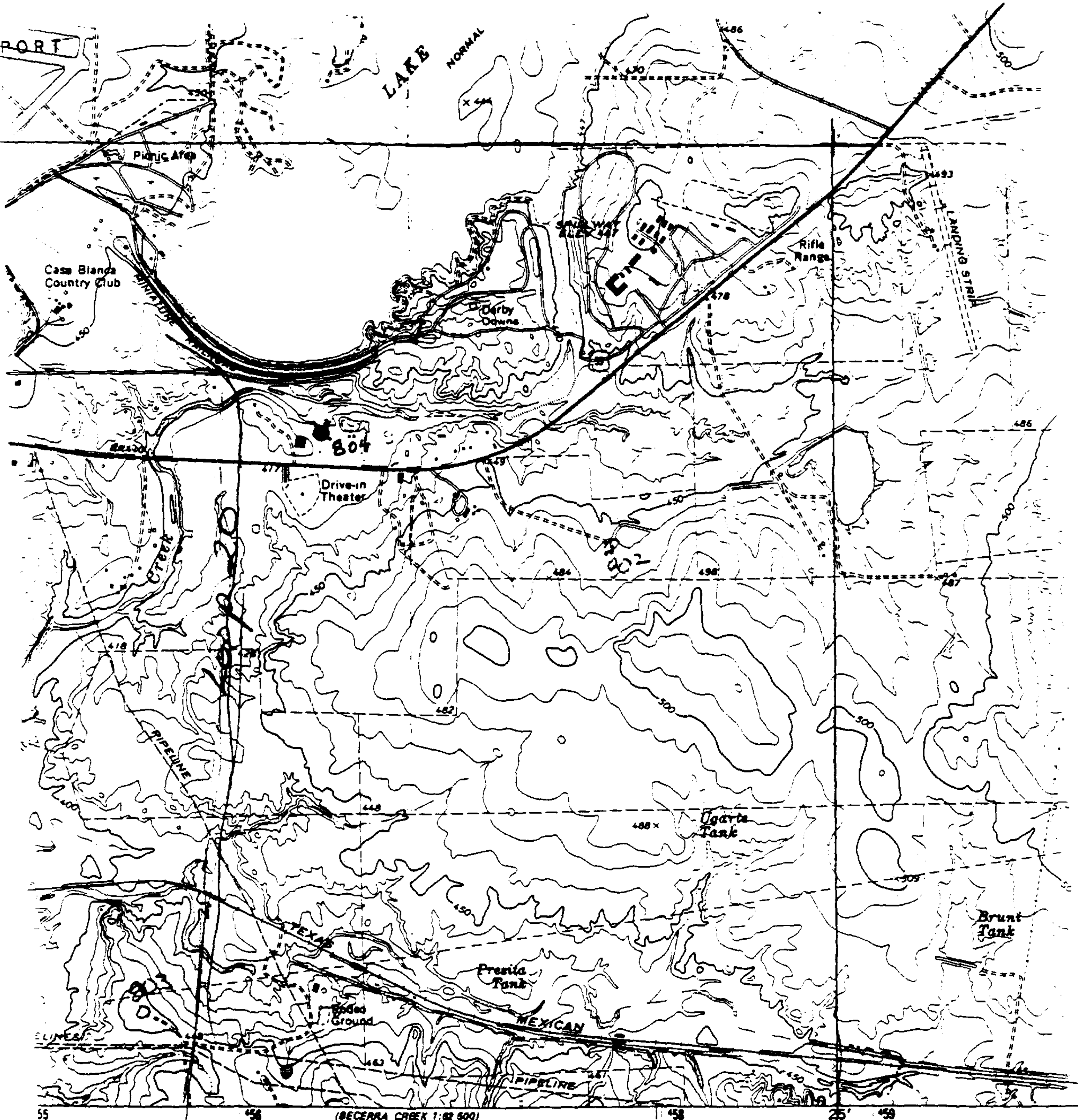
14) WELL TESTS:
Type Test: ☐ Pump ☐ Bailer ☒ Jetted ☐ Estimated
Yield: 300+ gpm with 480 ft. drawdown after 12 hrs.

85-29-804

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my


Lake Casa Blanca
Dam
804
Casa Blanca Convention Center
Yellow Bldg.
Large Horizontal Elev. storage tank
0.1
Chacon Creek
Loop 20
0.25
0.2
Hwy 59 (Saunders)

85-29-804



SCALE 1:24 000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

85-29-804

QUADRANGLE L

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY

County : Webb

Location: Lake Casa Blanca

Observation well no. ______

Pumped well no. 85-29-804

Average Q ______ gpm r= ______ ft. r^2= ______ MP +1.00'

Time	Elapsed Time	WL from MP	Yield						Remarks
9:10		28.65							
9:14			+250						Pump On
									Flow meter "pegged"
		WTM							E-Line will not go past 70'
9:26			235						
9:43			230						
9:55									Cond = 4060 Temp = 28.6 °C
10:00			230						
10:05									Cond = 4030 Temp = 28.9
10:11			230						C = 4020 T = 28.9
10:15									C = 4020 T = 28.9
10:20									Sample (AQ-12)
10:22			228						
10:23									Pump off
10:32		75.85							
10:35		70.54							
10:38		66.16							
10:40		63.37							
10:43		60.28							
10:47		57.20							
10:50		55.60							
10:55		52.54							
11:00		50.45							
11:05		48.66							
11:10		47.20							

85-29-804

Water Quality Field Data
Laredo ASR

SWN: 85-29-804
County: Webb
Aquifer(s): Laredo ? Carrizo ?

Name: c/o David Polston
Address: 1503 Sureen Court
Laredo, TX 78045
owner's well #

Sample No. AG-13
Date: 1-23-97
By: D. Coker

	Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
	B 500 ml	A 1 liter	C 1 liter					3
	1ml HNO3 (Nitric)							Not Filtered

Water Level 27.65 LSD Remark 9.10
Temperature (00010) 28.9 c
Specific Conductance (00094) 4020 umhos/cm
pH (00400) * —
Eh (00090) — mv.
Phenol ALK (82244) ____ mg/l
Total ALK (39086) ____ mg/l
Carbonate (00452) ____ meq/l ____ mg/l
Bicarbonate (00453) ____ meq/l ____ mg/l
Total Cations(+) Unbalanced
Total Anions (-)
Total Hardness (00900) 8
Dissolved Solids 1825

Time in 9:00 Yield 230 GPM Starting pH —
Time out 11:15 Sample time 10:20 — ml. of 0.02N to
Weather overcast well use Ind. ? — ml. of Sample
Outside Temp ____ Pump On 9:14 Ending pH —
Sampling point End of 400' black plastic pipe

Time:	9:55	10:05	10:11	10:15	10:22		ml.	pH	ml.	pH	ml.	pH
pH: *	—	—	—	—	—							
Temp:	28.4	28.9	28.9	28.9	—							
Eh: Yield	—	—	230	—	228							
Cond.	4060	4030	4020	4020	—							

28.65 1.00
27.65
28.79
1.00
27.79

other notes:
* ph meter will not calibrate.

02
09
96

City of Laredo
Water Utilities Department
Water Treatment Plant

Physical-Chemical and Bacteriological Test Results

Date collected: 9-27-96 Date tested: 9-27-96

Sample origin: 5300 Hwy 59 - Poston Well Water

Analysis requested by: Gerardo Pinzon

	Poston Well	JEFF #1 RESULTS	MCL	
Phenolphthalein Alkalinity	29		NL	mg/L
Total Alkalinity	410		NL	mg/L
pH	8.7		NL	
Hardness	8		NL	mg/L
Calcium	2		NL	mg/L
Magnesium	6			mg/L
Sulfate	297			mg/L
Chloride	208			mg/L
Turbidity	0.11			NTU'S
Conductivity				UHOM'S
Temperature	80	26.6		

Total Coliform		/100ml	(Y/N)
Fecal Coliform		/100ml	(Y/N)
Heterotrophic		col/100ml	

Comments: Sample had a slight trace of Total Chlorine. Chlorine residual not reported.

Aracli Gomez
Lab. Technician

[signature]
Supervisor

REV 01/9!

Webb 85-29-804

Post-it® Fax Note 7671	Date 2-20-97 # of pages 2
To Brent Kristen	From Jesus Robles
Co./Dept.	Co.
Phone #	Phone #
Fax # (210) 791-7496	Fax # (210) 795-2622

City of Laredo
Water Utilities Dept.
Division of microbiological and
Chemical Analytical Laboratories
Water Treatment Plant
2519 Jefferson St.
Chain of custody form

Analysis requested by: Gerardo Pinzon
Date and time requested: Date: 9-27-96 Time: 11:00 A.M./P.M.
Physical address: 4002 Bartlett
City of Laredo County of Webb State of Texas
Telephone: 795-2600
Signature:

Collector or custodian of sample collected: Felipe Elizondo
Physical address: 619 Reynolds
City of Laredo County of Webb State of Texas
Telephone: 795-2630
Signature: Felipe Elizondo

Physical address of point of collection 5300 Hwy 59 Poston Well Water
City of Laredo County of Webb State of Texas
Date and time of collection: Date: 9-27-96 Time: 10:30 A.M./P.M.
Sample identification or log number 148

Type of system:	Public system:	Water Source:
____Public	____Distribution	____River
____Individual	____Raw	____Lake
____School	____Check	✓ Well
____Dairy	____Construction	____Well Depth
____Bottled Water	✓ Special	Cl2 Res. ____

Source of transfer to laboratory Unit 13135
Person delivering sample to laboratory Felipe Elizondo
Date and time of delivery: Date: 9-27-96 Time: 11:00 A.M./P.M.
Person receiving sample at laboratory Araceli Gomez

Condition of the sample on receipt: ✓ Of satisfactory condition.

Unsuitable for analysis:
____Form incomplete. (see encircled item.)
____Sample too old. Sample not received within 30 hrs of collection.
____Excessive chlorine present in sample.
____Broken in shipment.
____Date discrepancy.
____Quantity too great to permit agitation.
____Quantity insufficient for analysis. (100 ml. minimum)
____Bottle not provided by this laboratory.
____Only one sample per time and point of collection required.
____Heavy non-coliform bacteria/silt present, possible obscuring and compromising test. Please resubmit.

Other: ____

REV 01/95

webb 85-29-804

Texas Water Development Board
Well Schedule

State Well No. 85 37 204 Previous Well No. 8537301 County Webb 479

River Basin Rio Grande 23 Zone 2 Lat. 27 28 24 Long. 099 25 10 Source of Coord. 1

Owner's Well No. Tordillo Ranch Location ____ 1/4, ____ 1.4, Section ____, Block ____, Survey ____

Owner Rafael Garcia Driller Rene Gutierrez

Address 2601 E. Plum Laredo, 78043 Tenant/Oper. 210) 722-2505

Date Drilled 1959 Depth 230 Source of Depth Datum M Altitude 535 Source of Alt. Datum M

Aquifer Laredo Fm. 124LRDO Well Type W User

Well Construction Const. Method Rotary H Casing Material iron I

Completion open hole X Screen Material

Lift Data Pump Mfr. ____ Type Subm S No. Stages ____

Bowls Diam. ____ in. Setting ____ ft. Column Diam. ____ in.

Motor Mfr. ____ Fuel or Power elec E Horsepower

Yield Flow ____ GPM Pump ____ GPM Meas., Rept., Est. ____ Date ____

Performance Test Date ____ Length of Test ____ Production ____ GPM

Static Level ____ ft. Pumping Level ____ ft. Drawdown ____ ft. Sp.Cap. ____ GPM/ft.

Quality (Remarks AQ-14 sample

Water Use Primary stock S Secondary ____ Tertiary ____

Other Data Available Water Level M Water Quality Y Logs D Other Data

Water Levels

Date	Meas.
07 26 1961	125.5
01 30 1997	117.59

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (S)
Open Hole (O)
Cemented from ___ to ___

	Diam. (in.)	Setting (feet) From	To
1	C 07	0	170
2	O	170	230
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

(20 max)

City of Laredo ASR project
for D. Coker

Recorded By Brent Christian Date Record Collected or Updated 01 30 1997

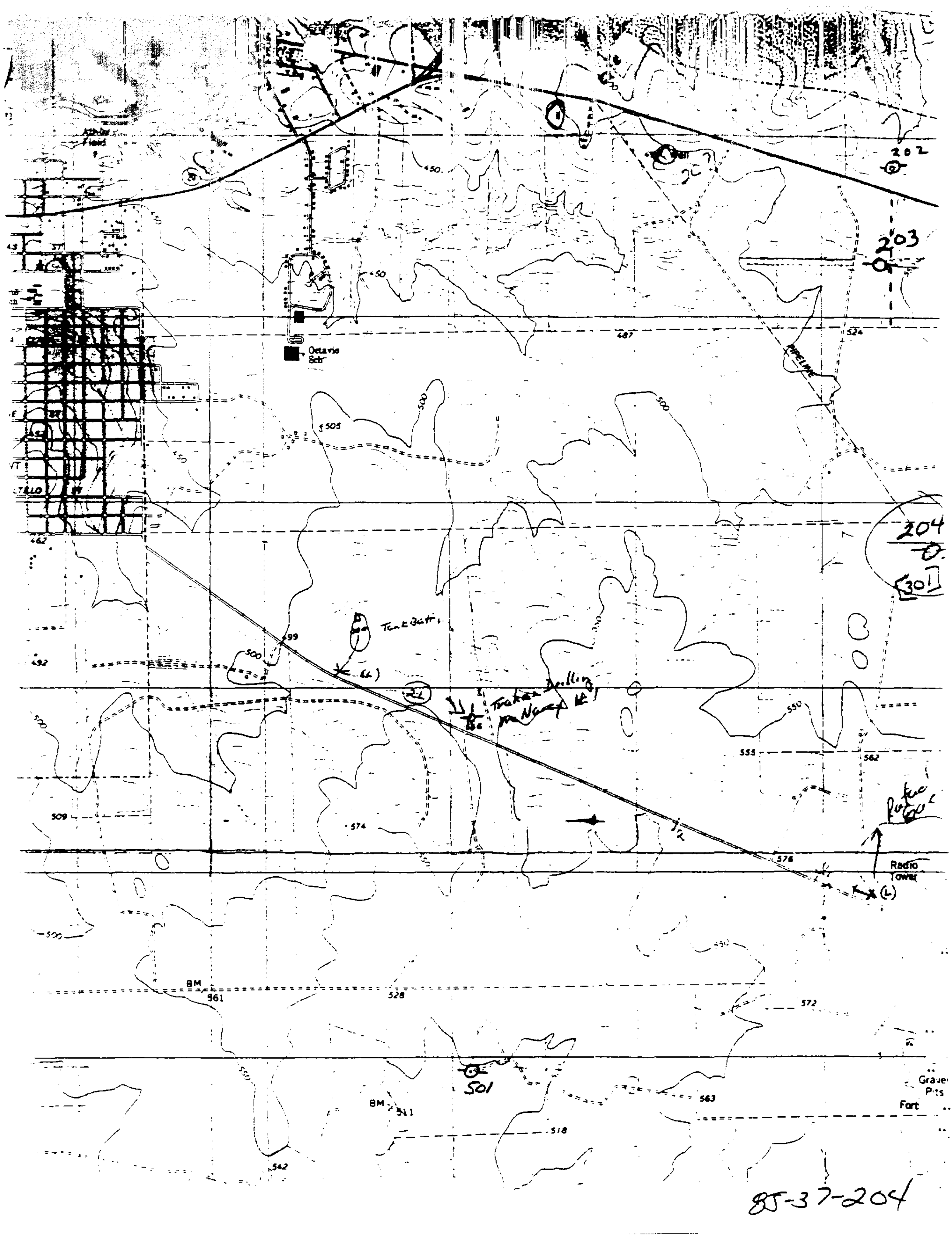
Reporting Agency

Remarks
1 Previously numbered 85-37-301.
2
3
4
5
6

AQ-14

Aquifer ____
Well No. 85 37 204

93-0384
2/9/93



Atholl Field
202
203
Octavio Schl
487
524
PIPELINE
505
500
450
462
492
499
204
301
Tank Batt.
(L)
Trakas Drilling
509
574
555
562
576
Radio Tower
BM
561
528
572
501
BM 511
563
518
542
Gravel Pits
Fort
BJ-37-204

Water Quality Field Data

Laredo ASR

SWN: 85-37-~~501~~ 204

County: Webb

Aquifer(s):

Name: Mr. Rafael Garcia

Address: 2601 E. Plum, Laredo 78043

owner's well # Tordillo Ranch well

Sample No. AQ-14

Date: 01-30-97

By: Brent Christian, City of Laredo

	Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
	B	A	C					
	500 ml	1 liter	1 liter					
	1 ml HNO_3 (Nitric)							Not Filtered

Water Level 117.59 LSD **Remark**

Temperature (00010) 15.6 c

Specific Conductance (00094) TDS 2.73 umhos/cm

pH (00400) 7.7

Eh (00090) mv.

Phenol ALK (82244) mg/l

Total ALK (39086) mg/l

Carbonate (00452) meq/l mg/l

Bicarbonate (00453) meq/l mg/l

Total Cations(+) Balanced

Total Anions (-)

Total Hardness (00900) 166

Dissolved Solids 1825

Time in 14:47 pump on

Time out 16:05 **Sample time** 15:55

Weather Clear 70° **well use** cattle

Outside Temp 70°

Sampling point Spigot by pump, close to tank

Starting pH 8.03

_____ **ml. of 0.02N to**

_____ **ml. of Sample**

Ending pH

Time:	14:52	15:01	15:10	15:20	15:31	15:45
pH:	8.03	7.94	8.01	7.98	7.75	7.80
Temp:	16.7	15.6	14.2	15.8	14.7	16.3
Eh: D.O.				1.88		
Cond. TDS	2.67	2.66	2.7	2.74	2.70	2.77

ml.	pH	ml.	pH	ml.	pH
	Time				
	15:55				
	pH				
	7.73				
	Temp				
	15.6				
	Con				
	2.73				

other notes:

Pump cycled off, low water 15:04, back on 15:08

GPS PDOP=2.99

Pumps ≈ 5 gpm

TEXAS WATER DEVELOPMENT BOARD
WELL SCHEDULE

State Well Number - 85 37 404 Previous Well Number - County - Webb 479
River Basin - Rio Grande - 23 Zone - 2 Latitude - 27 25 15 Longitude - 99 28 36 Source of Coords - 1

Owners Well No. ______ Location ______ 1/4, ______ 1/4, Section ______, Block ______, Survey ______

Owner - John Minne Driller - Rene Gutierrez

Address ______ Tenant/Oper. ______
Date Drilled - / / Depth - 250 ft. Source of Depth - M Altitude - 465 ft. Source of Alt. - M
Aquifer - 124LRDO LAREDO FORMATION Well Type - W User -

WELL CONSTRUCTION Const. Method - HYDRAULIC ROTARY Casing Material - WROUGHT IRON
Screen Material - WROUGHT IRON
Completion - PERFORATED OR SLOTTED

LIFT DATA - Pump Mfr. ______ Type - SUBMERSIBLE PUMP No. Stages ______

Bowls Diam. - ______ in. Setting - ______ ft. Column Diam. - ______ in.

Motor Mfr. - ______ Fuel or Power - ELECTRIC MOTOR Horsepower -

YIELD Flow- ______ GPM Pump- ______ GPM Meas.,Rept.,Est- ______ Date- ______

PERFORMANCE TEST Date- ______ Length of Test- ______ Production- ______ GPM

Static Level- ______ ft. Pumping Level- ______ ft. Drawdown- ______ ft. Sp.Cap.- ______ GPM/ft

QUALITY (Remarks- ______

WATER USE Primary- DOMESTIC Secondary- STOCK Tertiary- ______

OTHER DATA AVAILAIBLE Water Levels- M Quality- Y Logs- Other Data-

WATER LEVELS Date- 12/05/1996 Measurement- -100.70
Date- 12/05/1996 Measurement- -143.70 pumping level

Recorded By S. Moore Date Record Collected or Updated- 07/27/1961

Reporting Agency - TEXAS WATER DEVELOPMENT BOARD
REMARKS -

M.P. + 0.50
Hole in steel plate

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (
Open Hole (O)
Cemented from ______ to ______

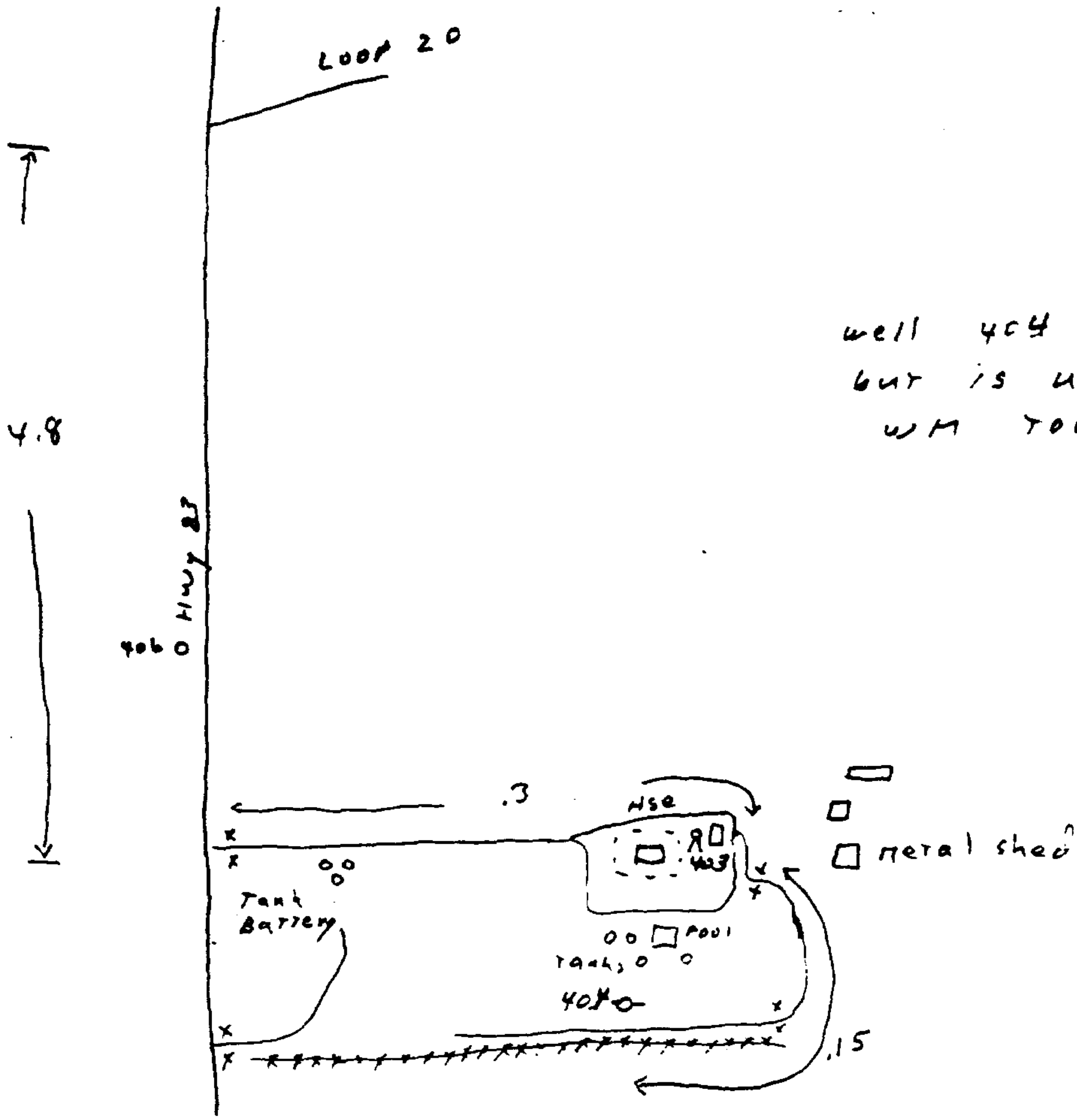
	Diam. (in.)	Setting (feet) From	To
1	C 7		
2	S 7		
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			

AQ-03

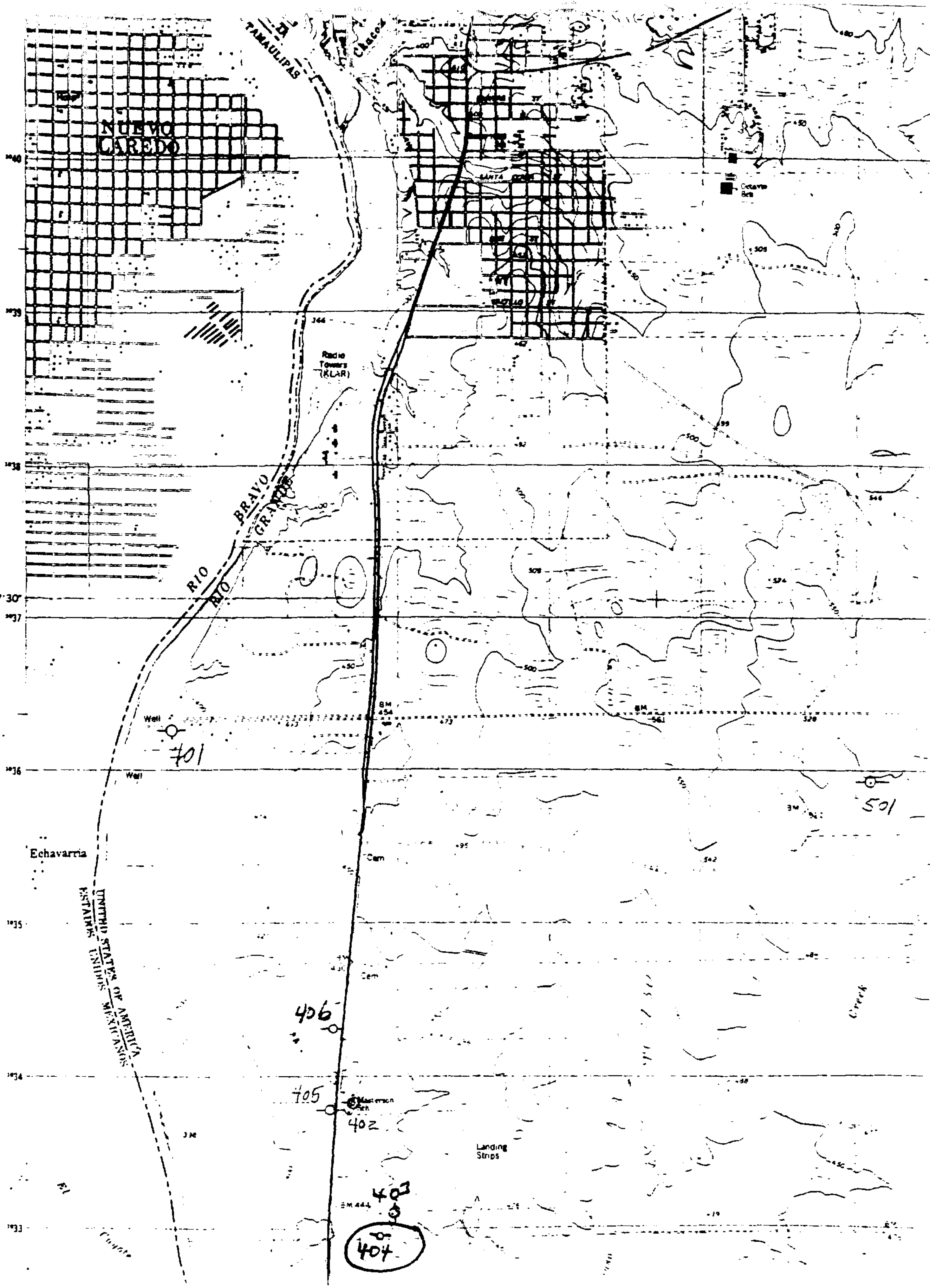
Aquifer - 124LRDO
Well No. - 85 37 404

pictures
4, 5, 6

well 404 has - sub
but is under old
WM tower



85 37 404



NUEVO LAREDO
TAMAULIPAS
Chacon
Radio Towers (KLAR)
RIO BRAVO
RIO GRANDE
27°30'
Well
701
Well
501
Echavarria
UNITED STATES OF AMERICA
ESTADOS UNIDOS MEXICANOS
Cem
Cem
406
405
Masterson Sch
402
Landing Strips
403
404
Creek
El Coyote
Octavio Bda
BM

Water Quality Field Data

SWN: 85 37 404
County: Webb 479
Aquifer(s):

Name: John Minne
Address: 5709 Springfield
Laredo, Texas 78041
owner's well #

Sample No. AQ - 03
Date: 12-5-96
By: S. MOORE

	Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
	~~500 ml Anions~~	~~1 liter Cations~~	~~250 ml Nitrate~~	~~1 liter Radioactivity~~	A 1 Liter	B 500 ML	C 1 Liter	
		~~2 ml HNO (Nitric)~~	~~0.5 ml H SO (Sulfuric)~~	~~2 ml HNO (Nitric)~~		1 mL Nitric		All filtered unless otherwise stipulated

Water Level 100.70 LSD Remark
Temperature (00010) 27.4 c
Specific Conductance (00094) 3190 umhos/cm
pH (00400) 7.3
Eh (00090) mv.
Phenol ALK (82244) 8 mg/l
Total ALK (39086) 328 mg/l
Carbonate (00452) meq/l 9.6 mg/l
Bicarbonate (00453) meq/l 380.8 mg/l
Total Cations(+)
Total Anions (-)
Total Hardness (00900) 325
Dissolved Solids 2110

Time in 9:30 AM Pump on 10 AM
Time out
Sample time 11:40
Weather Cloudy - Cool
well use Dom - Stock
Outside Temp 14° C
Sampling point

Starting pH
ml. of 0.02N to
ml. of Sample
Ending pH

Time:	10:15	10:30	10:45	11:00	11:15	11:30	ml.	pH	ml.	pH	ml.	pH
pH:	6.87	6.87	7.25	7.25	7.30	7.30						
Temp:	27.3	27.2	27.2	27.4	27.4	27.4						
Eh:												
Cond.	3.18	3.17	3.18	3.18	3.18	3.18						

mS/cm

other notes:

Water Level	
10:15	125.50
10:30	132.15
10:45	137.80
11:00	141.00
11:15	143.20
11:30	143.70

OI' TEXAS WATER DEVELOPMENT BOARD
WELL SCHEDULE

l Number - 85 37 406 Previous Well Number - County - Webb 479
in - Rio Grande - 23 Zone - 2 Latitude - 27 25 58 Longitude - 99 28 47 Source of Coords - 1

ell No. ______ Location ______ 1/4, ______ 1/4, Section ______, Block ______, Survey ______

Owner - Ramond Whiteside Driller - David De La Cruz

Tenant/Oper. Zapata Lease Service
lled - 04/01/1975 Depth - 330 ft. Source of Depth - D Altitude - 425 ft. Source of Alt. - M
- 124LRDO LAREDO FORMATION Well Type - W User -
Const. Casing
TION Method - CABLE-TOOL Material - STEEL
Screen
Completion - PERFORATED OR SLOTTED Material - STEEL

A - Pump Mfr. ______ Type - SUBMERSIBLE PUMP No. Stages ____

am. - ______ in. Setting - ______ ft. Column Diam. - ______ in.

r. - ______ Fuel or Power - ELECTRIC MOTOR Horsepower -

low- ______ GPM Pump- ______ GPM Meas.,Rept.,Est- ______ Date- ______

NCE TEST Date- ______ Length of Test- ______ Production- ______ GPM

evel- ____ ft. Pumping Level- ____ ft. Drawdown- ____ ft. Sp.Cap.- ____ GPM/ft

Remarks- ______

Primary- DOMESTIC Secondary- ______ Tertiary- ______

A AVAILAIBLE Water Levels- C Quality- Y Logs- D Other Data-

ELS Date- 04/01/1975 Measurement- -79.00
Date- 12/03/1996 Measurement- -116.40 pumping level

By S. Moore Date Record Collected or Updated- 12/03/1996

Casing or Blank Pipe (C)
Well Screen or Slotted Zone (
Open Hole (O)
Cemented from ____ to ____

		Diam. (in.)	Setting(feet) From	To
1	C	7	0	118
2	S	7	118	130
3	C	7	130	180
4	S	7	180	205
5	C	7	205	305
6	S	7	305	325
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

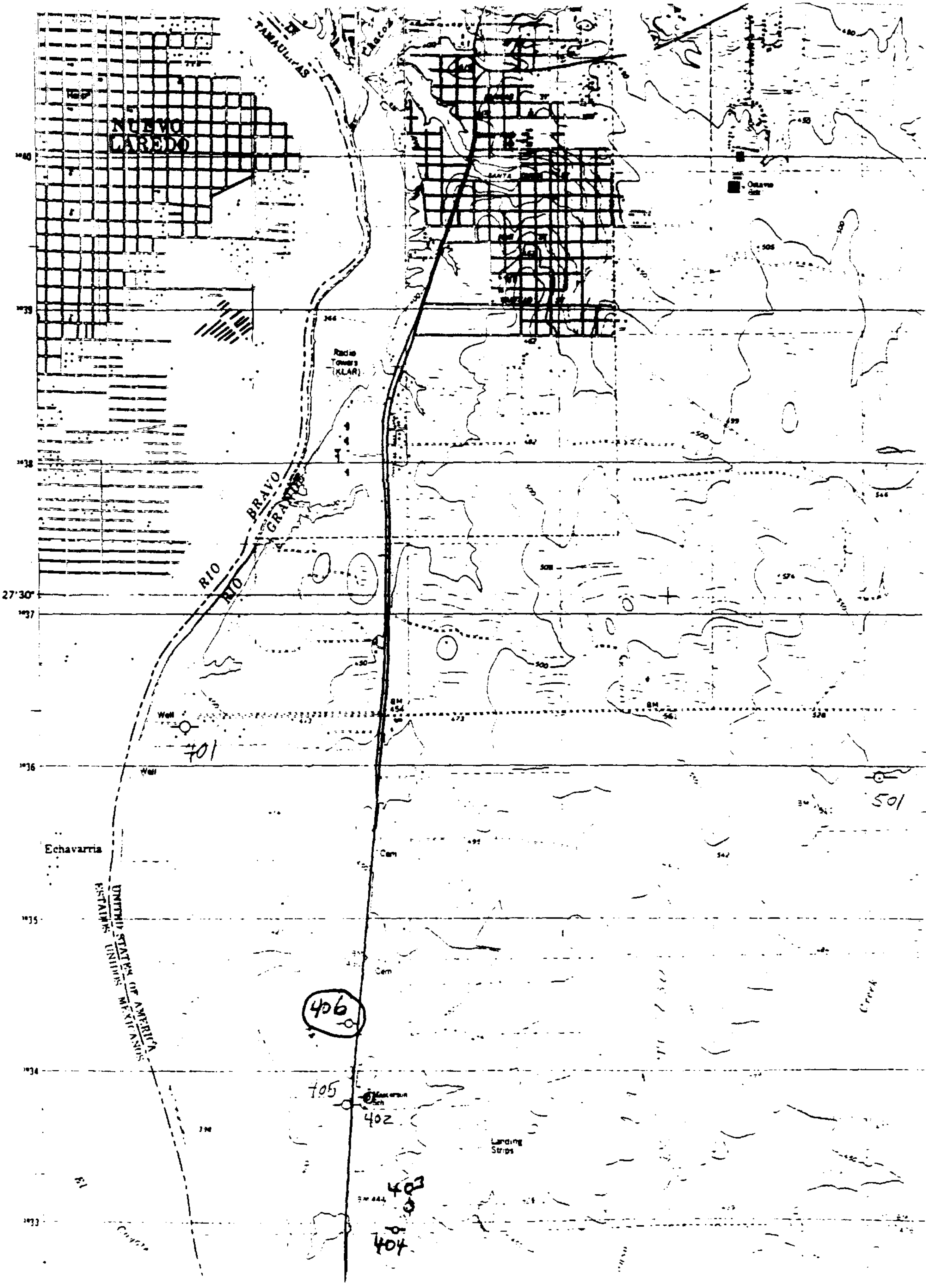
Agency - TEXAS WATER DEVELOPMENT BOARD

ition well. Measured yield 25
h 176 feet drawdown in 1975.
d from 0 to 110 feet.

M.P. + 1.00
Hole in
steel plate

AQ-04

Aquifer - 124LRDO
Well No. - 85 37 406



NUEVO LAREDO
TAMAULIPAS
Radio Towers (KLAR)
RIO BRAVO
RIO GRANDE
27°30"
Well
701
Well
501
Echavarria
Cem
UNITED STATES OF AMERICA
ESTADOS UNIDOS MEXICANOS
Cem
406
405
402
Landing Strips
403
404
Creek

Water Quality Field Data

SWN: 85-37-406
County: webb 479
Aquifer(s): Laredo

Name: Zapata Lease Service, Inc
Address: P.O. Box 1067
Zapata, Texas 78076
owner's well #

Sample No. AQ 04
Date: 12-3-96
By: S. Moore

Bottle1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Total SUB-Samples
				4A	4C	4B	
~~500 ml Anions~~	~~1 liter Cations~~	~~250 ml Nitrate~~	~~1 liter Radioactivity~~	1 Liter	1 Liter	500 Ml	
	2 ml HNO (Nitric)	0.5 ml H SO (Sulfuric)	2 ml HNO (Nitric)			1 Ml Nitric	All filtered unless otherwise stipulated

Water Level 81.80 LSD Remark
Temperature (00010) 27.3 c
Specific Conductance (00094) 4540 umhos/cm
pH (00400) 7.18
Eh (00090) mv.
Phenol ALK (82244) 0 mg/l
Total ALK (39086) 352 mg/l
Carbonate (00452) meq/l 0 mg/l
Bicarbonate (00453) meq/l 429.6 mg/l
Total Cations(+)
Total Anions (-)
Total Hardness (00900) 545
Dissolved Solids 3450

Time in NOON
Time out 4:30 PM Sample time 3:50 PM
Weather Cloudy - Cool well use
Outside Temp
Sampling point Top of well Head

Starting pH
ml. of 0.02N to
ml. of Sample
Ending pH

Time:	2:10	2:20	2:30	2:45	3:15	3:45	ml.	pH	ml.	pH	ml.	pH
pH:	7.07	7.07	7.22	7.22	7.21	7.18						
Temp:	27.3	27.3	27.3	27.3	27.3	27.3						
Eh:												
Cond.	4.52	4.52	4.53	4.53	4.54	4.54						

mS/cm

other notes:

Pump on 1:50
WL 2:10 110.50
2:20 113.70
2:30 114.60
2:45 115.50
3:15 115.75
3:45 116.40

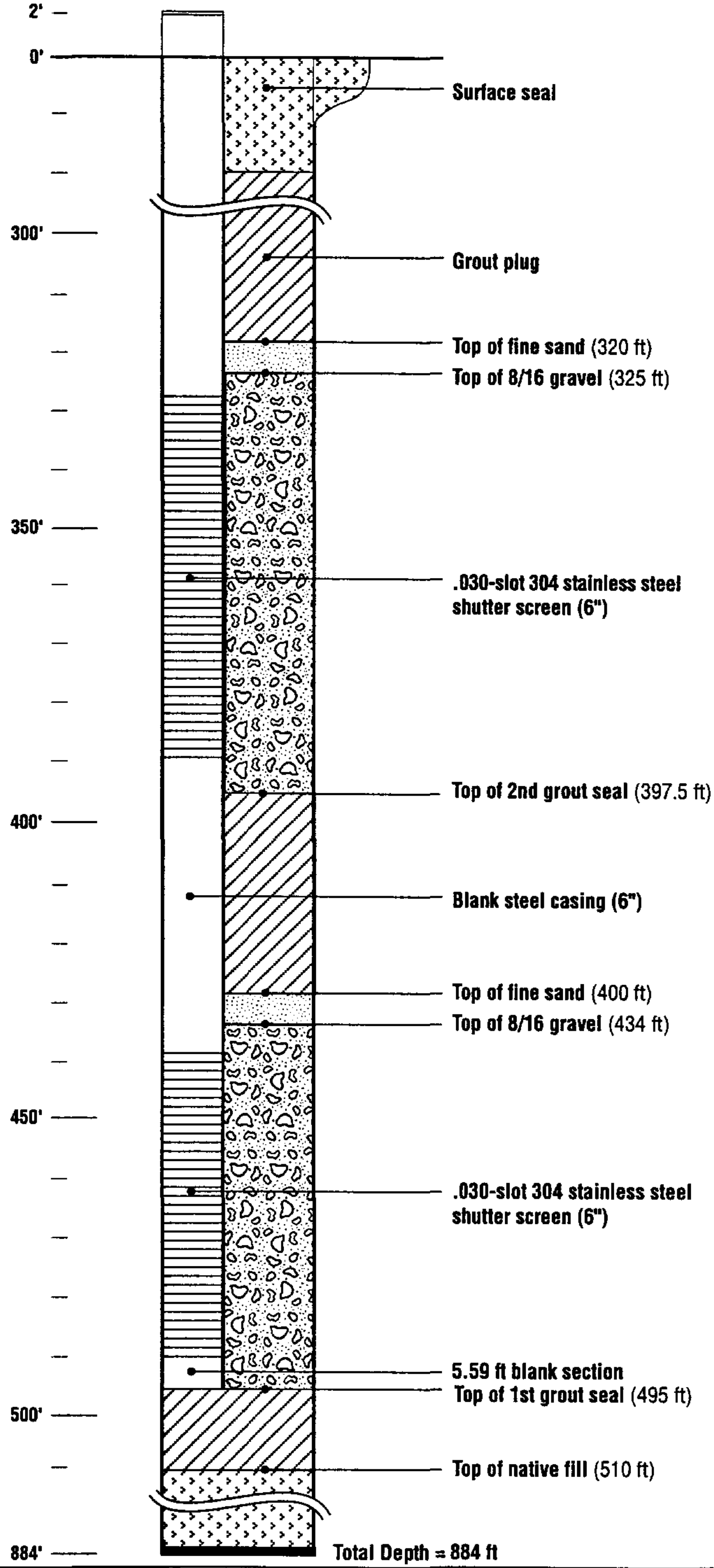
Appendix C

Boring Logs, Rock Core Logs, and Well Completion Diagrams

CH2MHILL

PROJECT NAME / LOCATION	PROJECT #	BORING #	DRILLING CONTRACTOR
City of Laredo ASR Feasibility Study McPherson	118069.J0.ZZ	TW-1	Texas Water Development Board

WELL CONSTRUCTION DIAGRAM	SUPERVISED BY	DEPTH TO WATER	DATE
	B. Christian City of Laredo	135.14 ft	2/5/97



NOTES:

6" well casing diameter
10 5/8" hole diameter

At 357 ft gravel pack bridges. Only 2 bags gravel added between 357 and 346 ft:
likely borehole collapse in this interval.

Well completed 2/3/97

NOT TO SCALE

Send original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER City of Laredo (Name) ADDRESS P.O. Box 2950 (Street or RFD) Laredo (City) Texas (State) 78044 (Zip)

2) ADDRESS OF WELL:
County Webb McPherson (Street, RFD or other) Laredo (City) Texas (State) 78044 (Zip) GRID # 85-29-1

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering ☒ Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) LAT 27°35.321 Long 099 28 588 N

6) WELL LOG:
Date Drilling:
Started 1-7 1997
Completed 2-7 1997

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
14-3/4	Surface	40
10-5/8	40	525
7-7/8	525	886

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary ☒ Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	10	White Caliche
10	50	Yellow shale
50	308	Blue & gray shale
308	469	Gray Sandstone
469	473	Hard white rock
473	493	Gray sandstone
493	886	Blue-gray shale

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☒ Gravel Packed ☐ Other
If Gravel Packed give interval ... from 320 430 ft. to 395 & 495 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
6-5/8	n	Steel casing	0	330	
6-5/8	n	Stainless Steel scrn	330	390	.030
6-5/8	n	Steel Casing	390	440	
6-5/8	n	Stainless steel scrn	440	490	.030
6-5/8	n	Steel Casing	490	495	

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 395 ft. to 320 430 ft. No. of sacks used 120 8
495 ft. to 525 ft. No. of sacks used 14
Method used Tremmie pipe
Cemented by T.W.D.B. & Halliburton
Distance to septic system field lines or other concentrated contamination 200 ft.
Method of verification of above distance Estimated

10) SURFACE COMPLETION
☒ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 137 ft. below land surface Date 2-5-97
Artesian flow _____ gpm. Date _____

12) PACKERS: Type Depth
None

13) TYPE PUMP:
☐ Turbine ☐ Jet ☒ Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., 358 ft.

14) WELL TESTS:
Type test: ☒ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: 75 gpm with 140 ft. drawdown after 8 hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Texas Water Development Board (Type or print) WELL DRILLER'S LICENSE NO. 2327 WI

ADDRESS 1700 Hydro Drive (Street or RFD) Austin (City) Texas (State) 78728-7725 (Zip)

(Signed) Alan D. Dashin (Licensed Well Driller) (Signed) Lonnie Carr (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) White - TNRCC Yellow - DRILLER Pink - WELL OWNER

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET
118069.J0.ZZ	TW-1	SHEET 1 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION McPherson Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 7 7/8" bit (6 1/8" start)

WATER LEVEL AND DATE START 1-7-97 FINISH 1-13-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0'	10	1	—	—	**CLAY (CL)**, yellowish orange with dark yellow orange staining 15-25% fine gravel, mostly quartz, clear, light brown and dark gray	
	20	2	—	—	**CLAY (CL)**, with gravel as above, fragments of gypsum	
25'	30	3	—	—	**CLAY (CL)**, as above, with yellowish gray mottling, some silty nodules with fragments of oyster shell chert and gypsum	Driller hit hard "ledge", bit wants to kick off to side
	40	4	—	—	**CLAY (CL)**, as above, increased fragments of shell and chipped chert, decreasing gravel content (5-10%)	32-37 ft: very rough drilling
	50	5	—	—	**CLAY (CL)**, dark gray with yellowish orange silty nodules, some ??? fragments (claystone/siltstone), "shaley", fragments of gypsum and some oyster shell	Stop 1-7-97 to install 40 ft surface casing Start 1-8-97
50'	60	6	—	—	**CLAY SHALE**, dark gray, soft, friable	
	70	7	—	—	**SHALE/CLAYSTONE**, dark gray, fine grained, soft, fissile	
75'	80	8	—	—	**SHALE**, as above and **SANDSTONE**, light steel gray, very fine quartz sand, soft, ~0.5 ft thick	76 ft: very rough quartz sandstone layer ~0.5 ft thick
	90	9	—	—	**SHALE** and **SANDSTONE**, interbedded in layers 0.5 to ~1.0 ft thick, as above **SANDSTONE** at 90'	
	100	10	—	—	**SHALE**, as above from ~90.5 ft	Sandstone layer at 90 ft (0.5 ft thick) Sandstone decreasing
100'	110	11	—	—	**SHALE/CLAYSTONE**, as above, no distinct sandstone intervals	
	120	12	—	—	**SHALE/CLAYSTONE**, as above	
125'	130	13	—	—	**SHALE/CLAYSTONE**, as above	
	140	14	—	—	Interbedded **SHALE** and **SANDSTONE**, as above, fragments of gypsum	Rough drilling at 135+ ft
150'	150	15	—	—	**SHALE** and **SANDSTONE**, as above, some mica and shelly material	Rough drilling at 140+ ft

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.J0.ZZ	TW-1	SHEET 2 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION McPherson Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 7 7/8" bit (6 1/8" start)

WATER LEVEL AND DATE START 1-7-97 FINISH 1-13-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
150'	160	16	—	—	**SHALE**, dark gray, soft, fissile, fine grained layer of oyster? shell at 156 ft, very hard, white and gray crushed shelly material, shiny fragments from shell interior	Hard drilling at 156 ft, ground shell fragments and mica?
	170	17	—	—	**SHALE**, as above, no oyster shell	
175'	180	18	—	—	**SHALE**, as above	
	190	19	—	—	**SHALE**, as above	
	200	20	—	—	**SHALE**, as above	
200'	210	21	—	—	**SHALE**, as above	Stop drilling 1-8-97
	220	22	—	—	**SHALE**, as above	
225'	230	23	—	—	**SHALE**, as above, with numerous thin layers of **SANDSTONE**, steel gray, soft, very fine grain, quartz (mostly sandstone recovered)	
	240	24	—	—	**SHALE**, as above	
	250	25	—	—	**SHALE**, as above	
250'	260	26	—	—	**SHALE**, as above	
	270	27	—	—	**SHALE**, as above	
275'	280	28	—	—	**SHALE**, as above	
	290	29	—	—	**SHALE**, as above	
300'	300	30	—	—	**SHALE**, as above	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.J0.ZZ	TW-1	SHEET 3 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION McPherson Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 7 7/8" bit (6 1/8" start)

WATER LEVEL AND DATE START 1-7-97 FINISH 1-13-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
300'	310	31	—	—	**SHALE,** dark gray, fine grained (silt and clay), soft, fissile, trace of very fine sand	OVM- 0 ppm
	320	32	—	—	**SHALE,** as above	320 ft: Top of 20/40 sand pack
325'	330	33	—	—	**SHALE,** as above	
	340	34	—	—	**SHALE,** as above	
	350	35	—	—	**SHALE,** as above	
350'	360	36	—	—	**SHALE,** as above, becoming sandier, less clay, trace of yellow orange fragments of agate, siltsone and cabonite type material	
	370	37	—	—	**SANDY SHALE/SANDSTONE,** dark gray, very fine grained sand and silt, soft, fissile, decreased clay, yellow orange fragments as above	
375'	380	38	—	—	**SANDY SHALE,** as above	
	390	39	—	—	**SHALE,** with less sand	
	400	40	—	—	**SHALE,** as above, fine grained, soft, fissile, clayey	397.5 ft: Top of grout seal and top of blank casing
400'	410	41	—	—	**SHALE,** as above, sandier in zones	
	420	42	—	—	**SHALE,** as above, thin sandy layers, some sandstone fragments	Slightly harder at ~418 ft
425'	430	43	—	—	**SHALE,** as above	
	440	44	—	—	**SHALE,** as above	435 ft: Top of sand pack
	450	45	—	—	**SHALE,** as above, and **SANDSTONE**, steel blue gray, very fine grained, quartz, harder than shales	Drilling much rougher at 442-444 ft, sandstone 445 ft: Top of lower screen
450'						

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.J0.ZZ	TW-1	SHEET 4 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION McPherson Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 7 7/8" bit (6 1/8" start)

WATER LEVEL AND DATE START 1-7-97 FINISH 1-13-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
450'	460	46	—	—	**SHALE**, dark gray, slightly harder, has black sand?, slightly coarser, in shale, shale is overall less fissile	Rougher slower drilling overall
	470	47	—	—	**SHALE**, as above 469 ft: **SANDSTONE**, light gray with black speckles, hard, very fine sand, well sorted, quartz with caliche cement	469 ft: Hit hard sandstone, only drilled 1 ft in 30 minutes
475'	480	48	—	—	**SHALE** and **SANDSTONE**, as above	475 ft: Out of sandstone
	490	49	—	—	**SHALE**, as above, fine grained and clayey, little to no sand/sandstone	
	500	50	—	—	**SHALE**, as above, few thin stringers of sandstone	495 ft: Top of sump
500'	510	51	—	—	**SHALE**, as above	500 ft: Top of bottom plug Stop 1-10-97
	520	52	—	—	**SHALE**, as above	Intermittent rough drilling in sandstone <0.5 ft thick
525'	530	53	—	—	**SHALE**, as above	
	540	54	—	—	**SHALE**, as above	
	550	55	—	—	**SHALE**, as above	
550'	560	56	—	—	**SHALE**, as above	
	570	57	—	—	**SHALE**, as above, more clay, slightly lighter in color even when wet, softer	Shale softer and more clayey
575'	580	58	—	—	**SHALE**, as above	
	590	59	—	—	**SHALE**, as above	
600'	600	60	—	—	**SHALE**, as above	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.J0.ZZ	TW-1	SHEET 5 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION McPherson Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 7 7/8" bit (6 1/8" start)

WATER LEVEL AND DATE START 1-7-97 FINISH 1-13-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
600'	610	61	—	—	**SHALE,** dark gray, fine grained, fissile, mostly clayey, occasional stringers of thin, very fine grained sandstone	
	620	62	—	—	**SHALE,** as above, thin white shelly layer	
625'	630	63	—	—	**SHALE,** as above, no shell	
	640	64	—	—	**SHALE,** as above	
	650	65	—	—	**SHALE,** as above	
650'	660	66	—	—	**SHALE,** as above	
	670	67	—	—	**SHALE,** as above	
675'	680	68	—	—	**SHALE,** lighter gray, 15-20% white shelly material, oyster? possibly tan limestone, some brown shelly material also, nodules of yellowish orange silt	
	690	69	—	—	**SHALE,** as above, more sand size grains, but not in layers	
	700	70	—	—	**SHALE,** as above	
700'	710	71	—	—	**SHALE,** light gray, soft, clayey, ~5-10% fine black sand, not in layers, just sandy shale, trace of shelly material and tan and yellow orange silt nodules	Soft- drilling much faster
	720	72	—	—	**SHALE,** as above	
725'	730	73	—	—	**SHALE,** as above	
	740	74	—	—	**SHALE,** as above, less sand, only trace of shelly material, soft and clayey, nodules of yellow orange silt	
750'	750	75	—	—	**SHALE,** as above	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.J0.ZZ	TW-1	SHEET 6 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION McPherson Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

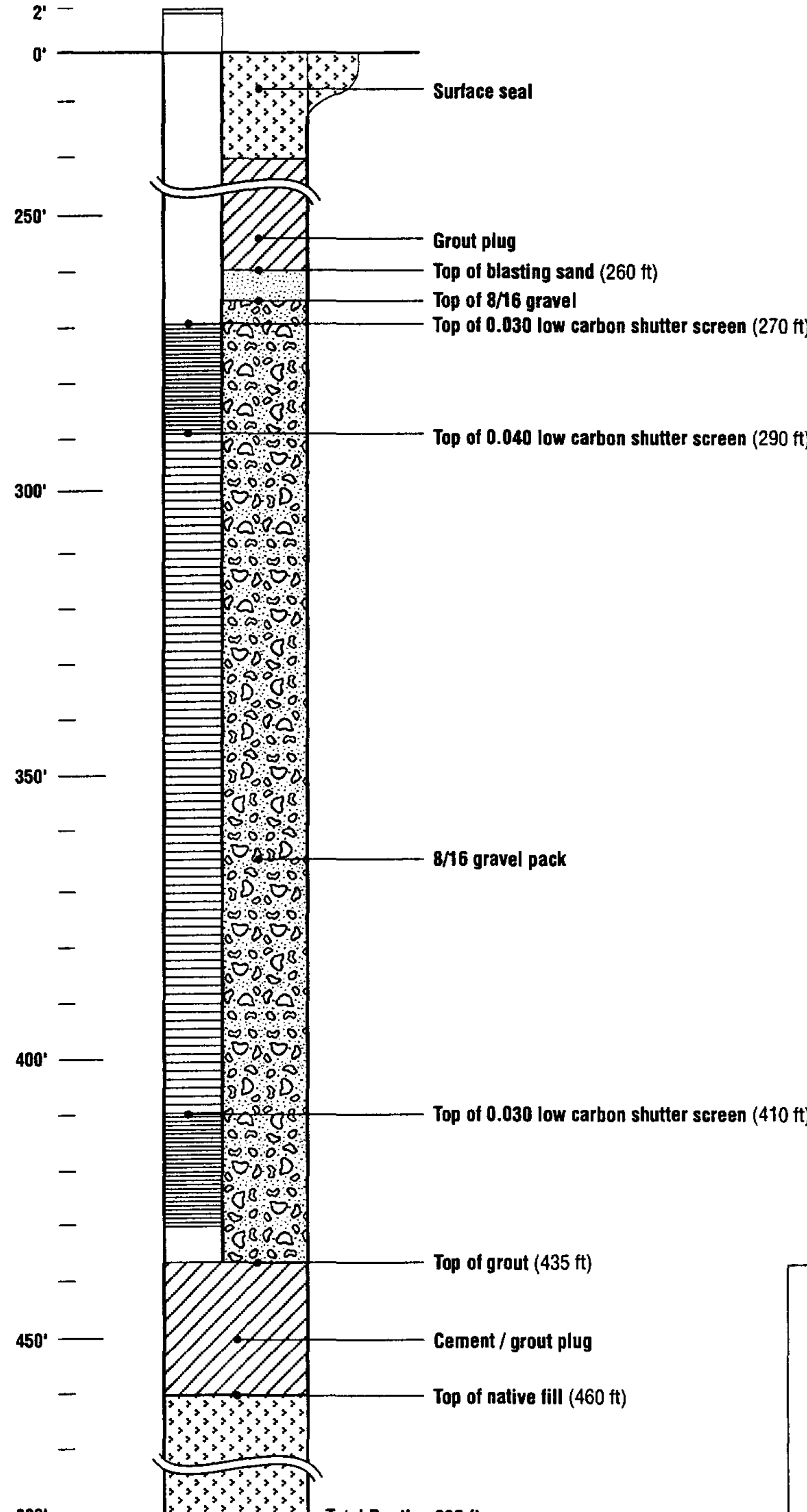
DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 7 7/8" bit (6 1/8" start)

WATER LEVEL AND DATE START 1-7-97 FINISH 1-13-97 LOGGER L. McAllister/B. Christian

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
750'	760	76	—	—	**SHALE,** light gray, fine grained, clayey, trace of sand and shell fragments, some orange brown silty nodules	Stop 1-12-97
	770	77	—	—	**SHALE,** light gray, fine grained	
775'	780	78	—	—	**SHALE,** darker gray, some light gray silt	
	790	79	—	—	**SHALE,** light gray, silty	
	800	80	—	—	**SHALE,** as above, less silt	
800'	810	81	—	—	**SHALE,** dark gray, some light gray silt	
	820	82	—	—	**SHALE,** as above, trace silt, some orange-brown silty nodules	
825'	830	83	—	—	**SHALE,** light grained, fine grained, trace of sand	
	840	84	—	—	**SHALE,** dark gray, some fine grained light gray silty sand	
	850	85	—	—	**SHALE,** as above	
850'	860	86	—	—	**SHALE,** dark gray	
	870	87	—	—	**SHALE,** as above	
875'	880	88	—	—	**SHALE,** as above	
					Total Depth 884.5	
900'						

PROJECT NAME / LOCATION	PROJECT #	BORING #	DRILLING CONTRACTOR
City of Laredo ASR Feasibility Study Del Mar Storage Tank	118069.J0.ZZ	TW-2	Texas Water Development Board

WELL CONSTRUCTION DIAGRAM	SUPERVISED BY	DEPTH TO WATER	DATE
	B. Christian / City of Laredo	117.0 ft	3/7/97



NOTES:

6" well casing diameter
10 5/8" hole diameter

Well completed 3/6/97

NOT TO SCALE

Send original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER City of Laredo (Name) ADDRESS P.O. Box 2950 (Street or RFD) Laredo (City) TX (State) 78044 (Zip)

2) ADDRESS OF WELL: County WEBB DelMar Street (Street, RFD or other) Laredo (City) Texas (State) 78044 (Zip) GRID # 85-29-4

3) TYPE OF WORK (Check): [X] New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering [X] Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) Lat 27° 34.289' Lon 099° 28.887 N

6) WELL LOG:
Date Drilling:
Started 2-10- 19 97
Completed ______ 19 ___

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
14-3/4	Surface	20
10-5/8	20	450
7-7/8	450	800

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary [X] Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	20	Yellow Caliche
20	40	Yellow Caliche & Blue Shale
40	110	Blue Shale & Gypsum streaks
110	196	Blue Shale & hard streaks
196	290	Gray Shale & sandstone streaks
290	440	Gray Sandstone
440	800	Blue & Gray Shale & hard streaks

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed [X] Gravel Packed ☐ Other
If Gravel Packed give interval ... from 260 ft. to 429 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
6-5/8	n	Steel casing	0	269	
6-5/8	n	Shutter screen	269	289	.030
6-5/8	n	Shutter screen	289	409	.040
6-5/8	n	Shutter screen	409	429	.030

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 260 ft. No. of sacks used 102
429 ft. to 450 ft. No. of sacks used 14
Method used Tremmie pipe
Cemented by T.W.D.B & Halliburton
Distance to septic system field lines or other concentrated contamination 150 ft.
Method of verification of above distance Estimated

10) SURFACE COMPLETION
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 130 ft. below land surface Date 3-9-97
Artesian flow ______ gpm. Date ______

12) PACKERS: Type Depth
None

13) TYPE PUMP:
☐ Turbine ☐ Jet [X] Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., 350 ft.

14) WELL TESTS:
Type test: [X] Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: 65 gpm with 71 ft. drawdown after 8 hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Texas Water Development Board T.W.D.B. (Type or print) WELL DRILLER'S LICENSE NO. 2327 WI

ADDRESS 1700 Hydro Drive (Street or RFD) Austin (City) Texas (State) 78728-7725 (Zip)

(Signed) [signature] (Licensed Well Driller) (Signed) [signature] (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) *White - TNRCC Yellow - DRILLER Pink - WELL OWNER*

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-2	SHEET 1 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION Del Mar Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary

WATER LEVEL AND DATE START 2-9-97 FINISH 2-20-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0'	10	1	—	—	**SILT/SILTSTONE (ML)**, yellowish orange, trace of fine sand, highly gypsuforous (selnite)	OVM- 0 ppm
	20	2	—	—	**SILT (ML)**, as above	
25'	30	3	—	—	**SILT (ML)**, as above	
	40	4	—	—	**SILT (ML)**, as above with **CLAY (CL)**	
	50	5	—	—	**CLAY (CL)**, yellowish orange and greenish gray, less gypsum, trace of silt to very fine sand	
50'	60	6	—	—	**CLAY (CL)**, light olive gray, trace silt	
	70	7	—	—	**CLAYSTONE / SILTSTONE**, light olive gray, friable	
75'	80	8	—	—	**SHALE**, light olive gray, fine grained, fissile, silty with trace of shell material	
	90	9	—	—	**SHALE**, as above, 10-15% oyster shell, trace of very fine sand and gypsum	
	100	10	—	—	**SHALE / SANDSTONE**, fine grained sand, blue-gray color, fissile, 10-15% oyster shell	
100'	110	11	—	—	**SHALE / SANDSTONE**, light olive gray, fine grained, fissile, less shell	
	120	12	—	—	**SHALE**, as above, decreasing fine sand	
125'	130	13	—	—	**SHALE**, as above	
	140	14	—	—	**SHALE**, as above, increasing clay	
150'	150	15	—	—	**SHALE**, as above, some very fine sand/sandstone	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-2	SHEET 2 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION Del Mar Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary

WATER LEVEL AND DATE START 2-9-97 FINISH 2-20-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
150'	160	16	—	—	**SHALE,** as above	
	170	17	—	—	**SHALE,** as above	
175'	180	18	—	—	**SHALE,** as above, increasing clay	
	190	19	—	—	**CLAYEY SHALE,** light olive gray, less fissile, more fine grained and soft	
200'	200	20	—	—	**CLAYEY SHALE,** as above, trace of sand, very fine	
	210	21	—	—	**SHALE,** light olive gray, fine grained, fissile, trace sand	
	220	22	—	—	**SHALE,** as above	
225'	230	23	—	—	**SHALE,** as above, little to no sand	
	240	24	—	—	**SHALE,** as above	
250'	250	25	—	—	**SHALE,** as above, gyp???	
	260	26	—	—	**SHALE,** as above, with increasing clay, light gray color	
	270	27	—	—	**SHALE/CLAY,** light gray, soft, more fine grained, less fissile, some very fine sand	
275'	280	28	—	—	**SHALE/CLAY,** as above	
	290	29	—	—	**SHALE/CLAY,** as above	
300'	300	30	—	—	**SHALE/CLAY,** as above	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-2	SHEET 3 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION Del Mar Storage Tank
ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)
DRILLING METHOD AND EQUIPMENT Failing Mud Rotary
WATER LEVEL AND DATE START 2-9-97 FINISH 2-20-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
300'	310	31	—	—	**SHALE/CLAY,** as above	
	320	32	—	—	**SHALE/CLAY,** as above	
325'	330	33	—	—	**SHALE/CLAY,** as above	
	340	34	—	—	**SHALE/CLAY,** as above	
	350	35	—	—	**SHALE/CLAY,** as above	
350'	360	36	—	—	**CLAY (CL),** light olive gray, very fine grained, soft, plastic, less shelly texture	
	370	37	—	—	**CLAY (CL),** as above	
375'	380	38	—	—	**CLAY (CL),** as above	
	390	39	—	—	**CLAY (CL),** as above	
	400	40	—	—	**CLAY (CL),** as above	
400'	410	41	—	—	**CLAY/MUD/MUDSTONE,** light gray, very fine grained, soft, little to no texture	
	420	42	—	—	**CLAY/MUD/MUDSTONE,** as above	
425'	430	43	—	—	**CLAY/MUD/MUDSTONE,** as above	
	440	44	—	—	**CLAY/MUD/MUDSTONE,** as above	
	450	45	—	—	**CLAY/MUD/MUDSTONE,** as above	
450'						

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-2	SHEET 4 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION Del Mar Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary

WATER LEVEL AND DATE START 2-9-97 FINISH 2-20-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
450'	460	46	—	—	**CLAY/SANDSTONE**, with traces of harder material, less shaley texture	
	470	47	—	—	**CLAY/SANDSTONE**, as above	
475'	480	48	—	—	**CLAY/SANDSTONE**, as above	
	490	49	—	—	**CLAY/SANDSTONE**, as above	
	500	50	—	—	**CLAY/SANDSTONE**, as above	
500'	510	51	—	—	**CLAY/SANDSTONE**, as above	
	520	52	—	—	**CLAY/SANDSTONE**, as above	
525'	530	53	—	—	**CLAYEY SHALE**, gray, very fine grained, less fissile, more pulverized	
	540	54	—	—	**CLAYEY SHALE**, as above	
	550	55	—	—	**CLAYEY SHALE**, as above	
550'	560	56	—	—	**CLAYEY SHALE**, as above, trace of sandy zones	
	570	57	—	—	**CLAYEY SHALE**, as above	
575'	580	58	—	—	**CLAYEY SHALE**, as above	
	590	59	—	—	**CLAY**, as above, becoming slightly shaley, very fine, no sand	
600'	600	60	—	—	**CLAY**, as above	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-2	SHEET 5 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION Del Mar Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary

WATER LEVEL AND DATE START 2-9-97 FINISH 2-20-97 LOGGER L. McAllister

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
600'						
	610					
	620				**SHALE,** light gray, fine texture, siltier than above, some oyster shell fragments	
625'	630				**SHALE,** as above	
	640				**SHALE,** as above	
650'	650				**SHALE,** as above	
	660				**SHALE,** as above	
	670				**SHALE,** as above	
675'	680				**SHALE,** as above with trace of **SAND/SANDSTONE**	
	690				**SHALE,** as above	
700'	700				**SHALE,** as above, slightly sandier	
	710				**SHALE,** with trace of fine sand	
	720				**SHALE,** as above	
725'	730				**SHALE,** more clay, little to no sand	
	740				**CLAYEY SHALE,** fine grained, no sand	
750'	750					

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-2	SHEET 6 OF 6

SOIL BORING LOG

PROJECT Laredo ASR LOCATION Del Mar Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary

WATER LEVEL AND DATE START 2-9-97 FINISH 2-20-97 LOGGER L. McAllister

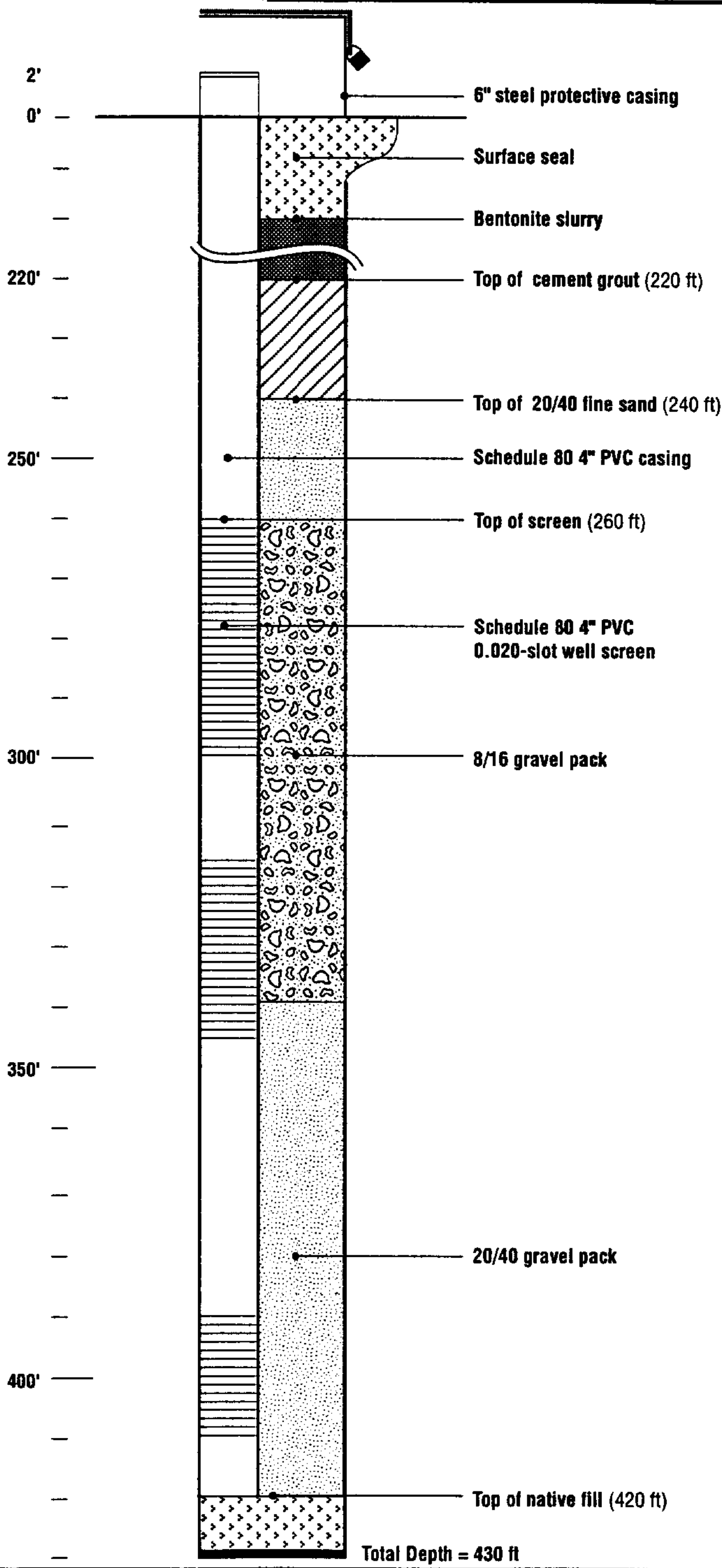
DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
750'	760				**CLAYEY SHALE**, as above	
	770				**CLAYEY SHALE**, as above	
775'	780				**CLAYEY SHALE**, as above, trace of fine sand	
	790				**CLAYEY SHALE**, as above	
	800				**CLAYEY SHALE**, as above	
800'					**END OF BORING**	
825'						
700'						
725'						
750'						

CH2MHILL

PROJECT NAME / LOCATION	PROJECT #	BORING #	DRILLING CONTRACTOR
City of Laredo ASR Feasibility Study Del Mar Storage Tank	118069.J0.ZZ	TW-2A	Texas Water Development Board

WELL CONSTRUCTION DIAGRAM

SUPERVISED BY	DEPTH TO WATER	DATE
B. Christian City of Laredo	121.94 ft	7/28/97



NOTES:

4" well casing diameter
9 7/8" hole diameter

Well completed 7/25/97

NOT TO SCALE

Send original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER City of Laredo (Name) ADDRESS PO Box 2950 (Street or RFD) Laredo Texas (City) 78044 (State) (Zip)

2) ADDRESS OF WELL:
County Webb Del Mar (Street, RFD or other) Laredo, TX (City) (State) (Zip) GRID #

3) TYPE OF WORK (Check):
[X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [ ] Monitor [ ] Environmental Soil Boring [ ] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [X] Testwell
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

6)

5) WELL LOG:
Date Drilling:
Started 7-8-97 19
Completed 7-28-97 19

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
9-7/8	Surface	420

7) DRILLING METHOD (Check): [ ] Driven [ ] Air Rotary [X] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [ ] Other

From (ft.)	To (ft.)	Description and color of formation material
0	40	Orange caliche & gravel
40	250	Blue gray shale & hard streaks
250	254	Graywhite limestone
254	330	Blue gray hard shale & sandstone
330	345	Sandstone & blue gray
345	410	Blue gray shale & sandstone
410	420	Bluegray shale

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): [ ] Open Hole [ ] Straight Wall [ ] Underreamed [X] Gravel Packed [ ] Other
If Gravel Packed give interval ... from 240 ft. to 420 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4	n	PVC casing	-2	260	
4	n	PVC screen	260	300	.020
4	n	PVC blank	300	315	
4	n	PVC screen	315	345	.020
4	n	PVC blank	345	390	
4	n	PVC screen	390	410	.020

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 240 ft. to 260 ft. No. of sacks used 6
0' ft. to 15' ft. No. of sacks used 5
Method used Trimmie pipe
Cemented by T.W.D.B.
Distance to septic system field lines or other concentrated contamination 300 ft.
Method of verification of above distance

10) SURFACE COMPLETION
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[ ] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(b)]
[ ] Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 135 ft. below land surface Date 7-27-97
Artesian flow gpm. Date

12) PACKERS: Type Depth
NONE

13) TYPE PUMP:
[ ] Turbine [ ] Jet [X] Submersible [ ] Cylinder
[ ] Other
Depth to pump bowls, cylinder, jet, etc., 252 ft.

14) WELL TESTS:
Type test: [X] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield: 60 gpm with 180 ft. drawdown after 8 hrs.

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? [ ] Yes [ ] No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Texas Water Development Board (Type or print) WELL DRILLER'S LICENSE NO. 2327WI

ADDRESS 1700 Hydro Drive (Street or RFD) Austin (City) Texas (State) 78728 (Zip)

(Signed) [signature] (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 06-21-96) *White - TNRCC* *Yellow - DRILLER* *Pink - WELL OWNER*

CH2MHILL

PROJECT NUMBER	BORING NUMBER
118069.J0.ZZ	TW-2A SHEET 1 OF 3

SOIL BORING LOG

PROJECT Laredo ASR   LOCATION Del Mar Storage Tank

ELEVATION   DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 7 7/8" - 9 7/8" bit

WATER LEVEL AND DATE   START 7-9-97   FINISH 7-15-97   LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0'	10				**SILT WITH SAND**, 20-40% very fine sand, orange brown selenite gypsum fragments, trace caliche	Samples obtained via mud logging at 10 ft intervals
	20				**SILT WITH SAND**, same as above, trace shell fragments	7 7/8" pilot hole 9-6 mud weight
25'	30				**SILT WITH SAND**, same as above, trace gray clay	30 second viscosity
	40				**SILTSTONE AND CLAYSTONE**, dark gray, stiff	
	50				**SILTSTONE AND CLAYSTONE**, same as above, siltstone	
50'	60				**CLAYSTONE**, dark gray, trace fine sandstone quartz and dark minerals (mafics or glauconite)	
	70				**CLAYSTONE**, same as above, increased gypsum	
75'	80				**SILTSTONE**, medium gray	
	90				**SILTSTONE**, with very fine sandstone, gray to light gray friable sandstone	Hard streak at 86-89 ft
	100				**SANDSTONE**, very fine, light gray, no HCL reaction	
100'	110				**SILTSTONE**, soft, trace qypsum, light to medium gray	
	120				**SILTSTONE**, same as above	
125'	130				**SILTSTONE**, same as above	
	140				**SANDSTONE**, very hard, very fine, 80% quartz, 20% dark minerals, moderate reaction with HCL suggests calcite cement	Hard streak at 130-132, 137-142, 148-150 ft probably
150'	150				**SILTSTONE AND CLAYSTONE**, trace sand	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.J0.ZZ	—TW-2A	SHEET 2 OF 3

SOIL BORING LOG

PROJECT Laredo ASR LOCATION Del Mar Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 7 7/8" - 9 7/8" bit

WATER LEVEL AND DATE START 7-9-97 FINISH 7-15-97 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
150'	160				**SILTSTONE AND CLAYSTONE,** same as above	
	170				**CLAYSTONE,** clay dominant, trace sandstone	
175'	180				**SILTSTONE,** trace claystone, dark gray	
	190				**SILTSTONE,** same as above, with sandstone, siltstone reacts with HCL	Hard streak at 182-184 ft
	200				**SILTSTONE,** same as above, mostly friable sandstone to very hard	
200'	210				**CLAYSTONE,** with siltstone alternating	
	220				**CLAYSTONE,** same as above	
225'	230				**SILT TO SILTSTONE,** gray, soft	
	240				**SILTSTONE**	
	250				**SILTSTONE,** same as above, trace coarse siltstone, no HCL reaction	
250'	258.50				**SANDSTONE,** very fine, hard, reacts with HCL, trace selenite	Hard streak at 250-254 ft
	270				See rock core logs C-1, C-2, C-3	Begin rock coring 7/11/97
275'	280					
	290					
300'	300					

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.J0.ZZ	TW-2A	SHEET 3 OF

SOIL BORING LOG

PROJECT Laredo ASR LOCATION Del Mar Storage Tank

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 7 7/8" - 9 7/8" bit

WATER LEVEL AND DATE START 7-9-97 FINISH 7-15-97 LOGGER P. Van Noort

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
300'	315				See rock core logs 2,3	
325'	330				**SANDSTONE AND SILTSTONE CUTTINGS** (likely carryover from coring)	
350'	350				See rock core log 4	
	355				See rock core log 5	
375'	380				**CLAYSTONE,** soft, dark gray **SILTSTONE,** dark gray, hard	
400'	400				See rock core log 6	
	420				See rock core log 7	
425'	430				**SILTSTONE,** dark gray, trace sand	
					END OF BORING AT 430 FT	Reamed hole to 9 7/8", set 4" PVC well, 0.020-slot at 200-300, 315-345, 390-410 ft

CH2MHILL

PROJECT NUMBER	BORING NUMBER
118069.K0	TW-2A - Core C-1 SHEET 1 OF 1

ASR ROCK CORE LOG

PROJECT : Laredo ASR **LOCATION :** TW-2A @ Del Mar Treatment Plant

ELEVATION : NA **DRILLING CONTRACTOR :** TWDB

DRILLING METHOD AND EQUIPMENT USED : Failing Mud Rotary - 6" core barrel x 20', 7 7/8" pilot hole

SAMPLE RUN C-1 **START:** 7/10/97 **END:** 7/10/97 **LOGGER :** Peter van Noort

DEPTH INTERVAL 258.5-275.5' **LENGTH RECOVERY:** 15.33' **PERCENT RECOVERY:** 90.2%

DEPTH	COLOR	LITHOLOGY and DISCONTINUITIES	COMMENTS
		ROCK TYPE, MINERALOGY, WEATHERING, HARDNESS AND ROCK MASS CHARACTERISTICS (BEDDING) ; FAULTS, ORIENTATION, INFILLING MATERIAL, THICKNESS, SURFACE STAINING	SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC
258.5 - 268.9	Light to medium gray	Siltstone, dark green specs. on outside of core are probably glauconite. Light color laminations react with HCL, hard laminated (< 1mm), alternatiing light and medium gray wavy laminations; thin (1 mm or <) laminations of claystone and organic detritus trace fossils across entire core, including gastropods, & mollusks. Pitting across some fossiliferous zones.	See visual log for coring rates, fractures and secondary features.
		@ 263, begin sandy Siltstone, light and dark colored minerals, secondary glauconite in lenticular zones, trace selenite gypsum (clear platy min)Laminated, decreasing laminations and less wavy, hard	
		@266.2 along drill break, Sandstone lamination, very fine sand, same at breaks occurring at 267.3, @ 267.7-267.9, same with claystone lamination, dark gray brown, 1mm or less in thickness. ,	
268.9 - 273.9	Alt. medium gray to light gray	Sandstone, very fine, 70-80% qtz, 20-30% dark minerals, massive to laminated with siltstone, Heavy mineral lag deposits along thin laminations.	
		Fracture Summary: 259, 260.4, 262.3, 261.75, 263.3, 264.1, 264.4, 264.7, 264.8, 265.5, 266.2, 266.5, 266.7, 267.35, 267.7, 267.9, 268.55, 268.9, 269.5, 269.9, 270.6, 271.05, 271.4, 272.1, 272.4, 272.8, 273.1, 273.4, 273.9 Fractures generally occur along lithologic changes and are likely created during coring. No staining observed to suggest secondary porosity.	

CH2MHILL

PROJECT NUMBER	BORING NUMBER
118069.KO	TW-2A Core C-2 SHEET 1 OF 1

ASR ROCK CORE LOG

PROJECT : Laredo ASR **LOCATION :** TW-2A @ Del Mar Treatment Plant

ELEVATION : NA **DRILLING CONTRACTOR :** TWDB

DRILLING METHOD AND EQUIPMENT USED : Failing Mud Rotary - 6" core barrel x 20', 7 7/8" pilot hole

SAMPLE RUN C-2 **START:** 7/12/97 **END:** 7/12/97 **LOGGER :** Peter van Noort

DEPTH INTERVAL 275.5-295' **LENGTH RECOVERY:** 18.95 **PERCENT RECOVERY:** 97%

DEPTH	COLOR	LITHOLOGY and DISCONTINUITIES ROCK TYPE, MINERALOGY, WEATHERING, HARDNESS AND ROCK MASS CHARACTERISTICS (BEDDING) ; FAULTS, ORIENTATION, INFILLING MATERIAL, THICKNESS, SURFACE STAINING	COMMENTS SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC
275.5 - 295	Medium to light gray	Sandstone, very fine, well sorted. 80% quartz, glauconite? or mafic minerals?, trace rose and smokey qtz, trace pyrite, jasper, selenite. Laminated with thin, wavy lams <1mm of siltstone. Trace shell fragments, trace lignite in darker laminations. Hard	See visual log for coring rates, fractures, secondary features
		Fracture Summary: 276.5, 277.1, 277.6, 277.9, 279.7, 281.1, 282.3, 283.5, 284, 284.5, 286.1, 286.7, 287.1, 287.5, 287.9, 288.2, 288.55, 288.95, 290, 290.9, 291.8, 292.05, 293.4, 294.1, 294.35. All breaks occur along bedding planes.	

CH2MHILL

PROJECT NUMBER	BORING NUMBER
118069.K0	TW-2A - Core C-3 SHEET 1 OF 1

ASR ROCK CORE LOG

PROJECT : Laredo ASR **LOCATION :** TW-2A @ Del Mar Treatment Plant

ELEVATION : NA **DRILLING CONTRACTOR :** TWDB

DRILLING METHOD AND EQUIPMENT USED : Failing Mud Rotary - 6" core barrel x 20', 7 7/8" pilot hole

SAMPLE RUN C-3 **START:** 7/12/97 **END:** 7/12/97 **LOGGER :** Peter van Noort

DEPTH INTERVAL 295-315' **LENGTH RECOVERY:** 20.5 **PERCENT RECOVERY:** 100%

DEPTH	COLOR	LITHOLOGY and DISCONTINUITIES ROCK TYPE, MINERALOGY, WEATHERING, HARDNESS AND ROCK MASS CHARACTERISTICS (BEDDING) ; FAULTS, ORIENTATION, INFILLING MATERIAL, THICKNESS, SURFACE STAINING	COMMENTS SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC
295 - 300.5	Medium to light gray	Sandstone, very fine, well sorted. 80% quartz, 20% glauconite? or mafic minerals?, trace pyrite, jasper, selenite. Soft to medium hardness. Calcified zone at 297, very hard. Laminated (wavy) with heavy mineral deposits, trace cross bedding, trace laminations of silt. Trace fossil and organic zones @ 298. Organic fragments consisting of wood, leaf material? @300, vuggy zone - pyritic, fossils (oysters?) , dark brown to black, 1-1.5" infilled with sandstone, soft - some secondary minerals.	See visual log for coring rates, fractures, secondary features
300.5 - 312	Dark gray	Siltstone, fine to coarse. medium gray. quartz and dark minerals dominate mineralogy, trace pyrite and selenite. Hard. Strongly laminated, interbedded with 0.01-0.05' lams. of fine sand. Lenticular, boudin structures throughout - 1/4-1", coarse material generally surrounded by finer silt and sand.	
312 - 315		Sandy Siltstone, very fine sand. Medium gray. hard - soft. Wavy laminations, trace clay laminations, trace pyrite.	
		Fracture Summary: 295.2, 296.3, 296.65, 297.1, 297.35, 297.6, 297.9, 298.1, 298.2, 298.5, 299.15, 299.6, 299.95, 300.5, 301.2, 302.25, 302.75, @303.1-305.8 vertical fracture w/ numerous horizontal breaks -drilling induced) 304.15, 304.65, 305.8, 308.15, 309.4, 309.9, 310.6, 311.7, 313.2, 314.5, 314.9, 315.05, 315.55	

CH2MHILL

PROJECT NUMBER	BORING NUMBER
118069.K0	TW-2A - Core C-4 SHEET 1 OF 1

ASR ROCK CORE LOG

PROJECT : Laredo ASR **LOCATION :** TW-2A @ Del Mar Treatment Plant

ELEVATION : NA **DRILLING CONTRACTOR :** TWDB

DRILLING METHOD AND EQUIPMENT USED : Failing Mud Rotary - 6" core barrel x 20', 7 7/8" pilot hole

SAMPLE RUN C-4 **START:** 7/13/97 **END:** 7/13/97 **LOGGER :** Peter van Noort

DEPTH INTERVAL 330-348 **LENGTH RECOVERY:** 3.6 **PERCENT RECOVERY:** 20%

DEPTH	COLOR	LITHOLOGY and DISCONTINUITIES ROCK TYPE, MINERALOGY, WEATHERING, HARDNESS AND ROCK MASS CHARACTERISTICS (BEDDING) ; FAULTS, ORIENTATION, INFILLING MATERIAL, THICKNESS, SURFACE STAINING	COMMENTS SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC
330 - 333.6	Medium to light gray	Sandstone, very fine, silty, well sorted. 70-80% quartz, 20% glauconite? or mafic minerals?, Secondary minerals include trace pyrite, selenite, trace greenish black platy mineral. Soft to medium hardness. Friable on edge.	See visual log for coring rates, fractures, secondary features. Greater down pressure and worn core bit may have contributed to poor recovery.
		Fractures: 330.95, 331.4, 331.65, 332.25, 332.4, 332.95, 333.2, 333.35, 333.5	

CH2MHILL

PROJECT NUMBER	BORING NUMBER
118069.K0	TW-2A - Core C-5 SHEET 1 OF 1

ASR ROCK CORE LOG

PROJECT : Laredo ASR **LOCATION :** TW-2A @ Del Mar Treatment Plant

ELEVATION : NA **DRILLING CONTRACTOR :** TWDB

DRILLING METHOD AND EQUIPMENT USED : Failing Mud Rotary - 6" core barrel x 20', 7 7/8" pilot hole

SAMPLE RUN C-5 **START:** 7/13/97 **END:** 7/13/97 **LOGGER :** Peter van Noort

DEPTH INTERVAL 348 - 355 **LENGTH RECOVERY:** 4.9 **PERCENT RECOVERY:** 70%

DEPTH	COLOR	LITHOLOGY and DISCONTINUITIES ROCK TYPE, MINERALOGY, WEATHERING, HARDNESS AND ROCK MASS CHARACTERISTICS (BEDDING) ; FAULTS, ORIENTATION, INFILLING MATERIAL, THICKNESS, SURFACE STAINING	COMMENTS SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC
348 - 351.8	Light to dark gray	Alternating sandstone and siltstone, interbedded, with minor claystone laminations; .5 - 1.5" layers of sandstone, 1mm - 2" siltstone lames. Trace boudin structures. similar mineralogy. soft to medium hard.	See visual log for coring rates, fractures, secondary features.
351.8 - 352.9	Dark gray	Siltstone to claystone. Sandstone present at 352.5 to end of core. hard. claystone is very finely laminated. unconformable contact at 351.8. Heavily fractured @ laminations-1-3" fragments - too numerous to list, drilling induced. 30-degree low angle fault with offset @ 349.5 with slick-n -sides, 60-degree faults at 352, 352.3, 352.7. Such faults may contribute to breakage within core barrel	

CH2MHILL

PROJECT NUMBER	BORING NUMBER
118069.K0	TW-2A - Core C-6 SHEET 1 OF 1

ASR ROCK CORE LOG

PROJECT : Laredo ASR **LOCATION :** TW-2A @ Del Mar Treatment Plant

ELEVATION : NA **DRILLING CONTRACTOR :** TWDB

DRILLING METHOD AND EQUIPMENT USED : Failing Mud Rotary - 6" core barrel x 20', 7 7/8" pilot hole

SAMPLE RUN C-6 **START:** 7/14/97 **END:** 7/14/97 **LOGGER :** Peter van Noort

DEPTH INTERVAL 380-399 **LENGTH RECOVERY:** 9.55 **PERCENT RECOVERY:** 50%

DEPTH	COLOR	LITHOLOGY and DISCONTINUITIES ROCK TYPE, MINERALOGY, WEATHERING, HARDNESS AND ROCK MASS CHARACTERISTICS (BEDDING) ; FAULTS, ORIENTATION, INFILLING MATERIAL, THICKNESS, SURFACE STAINING	COMMENTS SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC
380 - 385 (actual is 381.55 - see notes)	Light to dark gray	Sandstone, fine to very fine. well sorted. 70-80% qtz, 20% mafics or glauconite. Laminated, trace silt laminations, hard to soft (easy scratch with knife)	See visual log for coring rates, fractures, secondary features. Core logged on 7/15/97.
385 - 391.3	Dark gray	Siltstone, interbedded with fine sandstone, trace claystone laminations, quartz and glauconite, pyrite, selenite. Hard to very hard. some laminations are limy (react with HCl). Boudin structures, evidence of minor claystone laminations; .5 - 1.5" layers of sandstone, 1mm - 2" siltstone lames. Evidence of bioturbation including vertical burrows infilled with light gray, coarser silt and fine sand, surrounded by black to dark green heavy minerals (secondary glauconite?) Trace shell fragments.	Notes: originally recovered 1.5-foot sample. "Fished out" additional 7.3 feet of core. Chose 385 feet as top of "fished" section because top sand is mostly zone to have washed out.
391.3 - 393.3	Medium gray	Sandstone, fine. Well sorted. Similar mineralogy (quartz majority). Massive with trace laminations. hard. Fragments are 2-4" long and fractures show signs of erosion caused during coring (core broke in barrel).	
		Fracture Summary: Heavily fractured @ 380-381.55 (7 fracturess), @385-391.3, 9 fractures (.7 fracts/ft); @391.3-393, 3 fractures (.56 fracts/ft)	

CH2MHILL

PROJECT NUMBER	BORING NUMBER
118069.K0	TW-2A - Core C-7 SHEET 1 OF 1

ASR ROCK CORE LOG

PROJECT : Laredo ASR **LOCATION :** TW-2A @ Del Mar Treatment Plant
ELEVATION : NA **DRILLING CONTRACTOR :** TWDB
DRILLING METHOD AND EQUIPMENT USED : Failing Mud Rotary - 6" core barrel x 20', 7 7/8" pilot hole
SAMPLE RUN C-7 **START:** 7/14/97 **END:** 7/14/97 **LOGGER :** Peter van Noort
DEPTH INTERVAL 399 - 419 **LENGTH RECOVERY:** 18.8 **PERCENT RECOVERY:** 94%

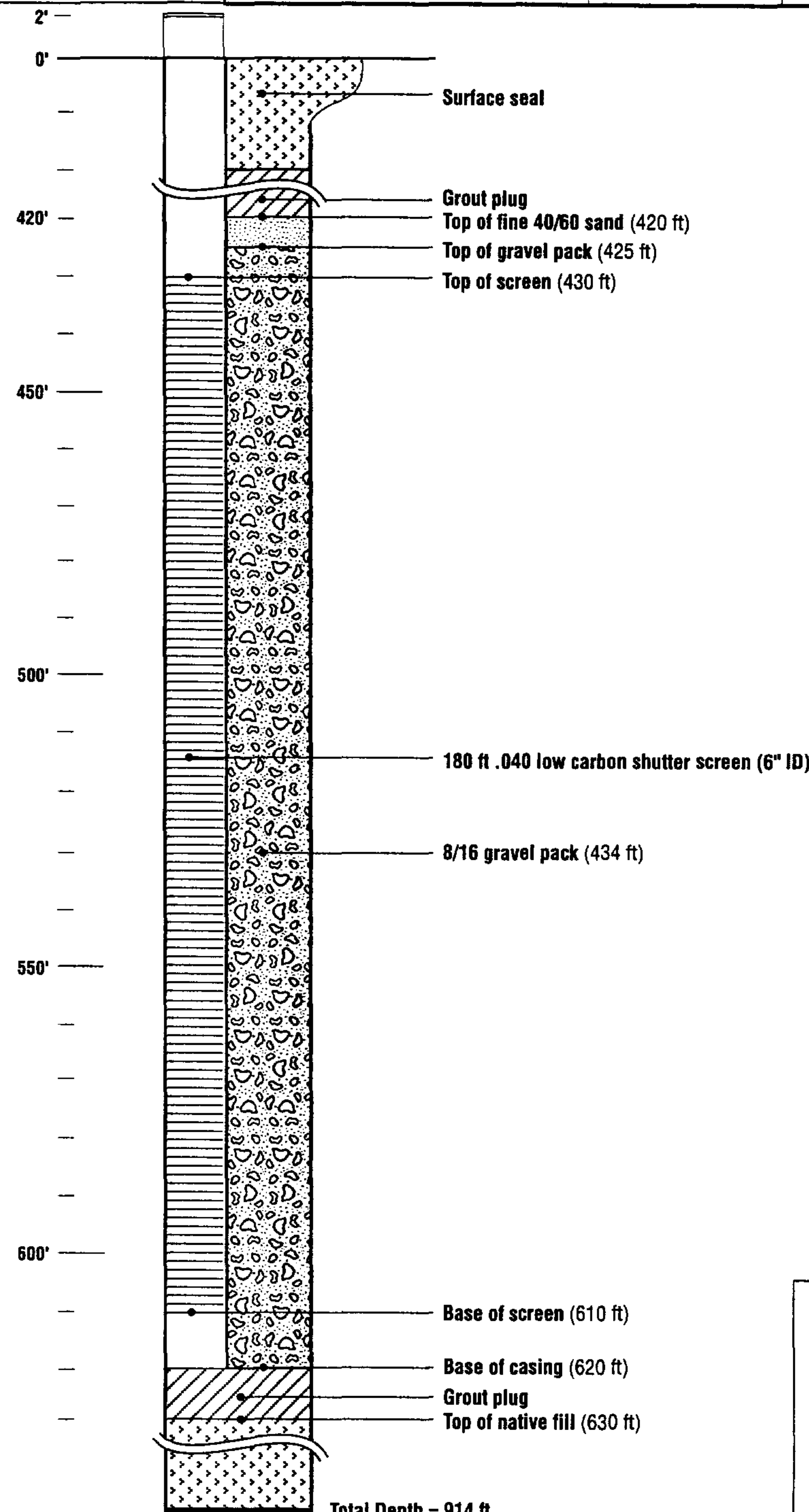
DEPTH	COLOR	LITHOLOGY and DISCONTINUITIES ROCK TYPE, MINERALOGY, WEATHERING, HARDNESS AND ROCK MASS CHARACTERISTICS (BEDDING) ; FAULTS, ORIENTATION, INFILLING MATERIAL, THICKNESS, SURFACE STAINING	COMMENTS SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC
399 - 404.35	Light to dark gray	Sandstone, fine to very fine. well sorted. 70-80% qtz, 20% mafics or glauconite. Laminated, trace silt & clay laminations, soft, trace lignite. Abrupt contact at 404 - very hard sandstone (calcified) - fossiliferous	See visual log for coring rates, fractures, secondary features. Core logged on 7/15/97.
404.35 - 418.8	Dark gray	Siltstone, sandy, massive with wavy laminations of silt and v. fine sandstone, Hard to very hard. boudin structures, trace fossils.	
		Fracture Summary: @399 to 404, 11 fractures/5.35 ft. @404.35-418.8, 6 fractures/14.45 ft	

CH2MHILL

PROJECT NAME / LOCATION	PROJECT #	BORING #	DRILLING CONTRACTOR
City of Laredo ASR Feasibility Study East Corridor Wall	118069.J0.ZZ	TW-3	Texas Water Development Board

WELL CONSTRUCTION DIAGRAM

SUPERVISED BY	DEPTH TO WATER	DATE
B. Christian City of Laredo	72.2 ft	4/8/97



NOTES:

6" well casing diameter
10 5/8" hole diameter

Well completed 4/7/97

NOT TO SCALE

Send original copy by certified return receipt requested mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

ATTENTION OWNER: *Confidentiality Privilege Notice on on reverse side of Well Owner's copy (pink)*

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER City of Laredo (Name) ADDRESS P.O. Box 2950, Laredo, texas 78044 (Street or RFD) (City) (State) (Zip)

2) ADDRESS OF WELL: County Webb E. Corridor Laredo, TX 78044 (Street, RFD or other) (City) (State) (Zip) GRID # 85-29-5

3) TYPE OF WORK (Check): [X] New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering [X] Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5) Lat 27°32.526' Long 099°27.159'

6) WELL LOG:
Date Drilling:
Started 3/20 19 97
Completed 4/15 1997

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
14-3/4	Surface	20
10-5/8	20	630
7-7/8	630	1000

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary [X] Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0'	10'	White Caliche
10'	40'	Gray shale
40	55'	Gypsum streak
55'	435'	Blue-gray shale & hard streak
435'	616'	Gray Sandstone
616'	1000	Gray shale & hard streaks

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed [X] Gravel Packed ☐ Other
If Gravel Packed give interval ... from ______ ft. to ______ ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
6-5/8	n	Steel casing	0	430	
6-5/8	n	Shutter screen	430	610	.040
6-5/8	n	Steel casing	610	615	

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 420 ft. No. of sacks used 134
616 ft. to 630 ft. No. of sacks used 7
Method used Tremmie pipe
Cemented by T.W.D.B. & Halliburton
Distance to septic system field lines or other concentrated contamination 200 ft.
Method of verification of above distance Estimated

13) TYPE PUMP:
☐ Turbine ☐ Jet [X] Submersible ☐ Cylinder
☐ Other
Depth to pump bowls, cylinder, jet, etc., 405 ft.

10) SURFACE COMPLETION
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
☐ Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: [X] Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: 60 gpm with 142 ft. drawdown after 8 hrs.

11) WATER LEVEL:
Static level 73.20 ft. below land surface Date 4-9-97
Artesian flow ______ gpm. Date

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

12) PACKERS: Type Depth
None

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Texas Water Development Board (Type or print) WELL DRILLER'S LICENSE NO. 2327 WI

ADDRESS 1700 Hydro Drive (Street or RFD) Austin (City) Texas (State) 78728-7725 (Zip)

(Signed) Alan D. [signature] (Licensed Well Driller) (Signed) Romeo Cano (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) *White - TNRCC* *Yellow - DRILLER* *Pink - WELL OWNER*

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-3	SHEET 1 OF 4

SOIL BORING LOG

PROJECT Laredo ASR LOCATION North East Corridor

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 10 7/8

WATER LEVEL AND DATE START 3-19-97 FINISH 4-7-97 LOGGER B. Christian

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0'		1			**CLAY**, yellow orange, trace gravel	DRILLER NOTES:
10		2			**CLAY**, dark gray	
20		3			**CLAY**, same as above	
30		4			**SANDSTONE**, light gray, very fine grained	
40		5			**SANDSTONE**, same as above, with some oyster shells	
50'		6			**SANDSTONE**, same as above	
60		7			**SANDSTONE**, gray, very fine grained	68-70 ft: Hard sandstone
70		8			**SHALE**, dark gray	
80		9			**SHALE**, same as above	
90		10			**SHALE**, same as above	93-94 ft: Hard streak
100'		11			**SILT**, gray	
110		12			**SANDSTONE**, light gray	118-123 ft: Hard streak
120		13			**SANDSTONE**, dark gray	
130		14			**SHALE**, dark gray	
140		15			**SHALE**, same as above	
150'		16			**SHALE**, same as above	
160		17			**SHALE**, same as above	163-164 ft: Hard sandstone
170		18			**SANDSTONE**, dark gray	176-179 ft: Hard sandstone
180		19			**SHALE**, dark gray	
190		20			**SANDSTONE**, gray, gypsum mottling	198-200 ft: Gray sandstone
200'		21			**SANDSTONE**, same as above, darker gray	
210		22			**SHALE**, gray	
220		23			**SHALE**, same as above	
230		24			**SHALE**, same as above	
240		25			**SANDSTONE**, gray	242 ft: Hard streak
250'		26			**SANDSTONE**, same as above, darker gray	
260		27			**SANDSTONE**, same as above	
270		28			**SANDSTONE**, same as above	
280		29			**SANDSTONE**, same as above	
290		30			**SANDSTONE**, dark gray, shaley	
300'						

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-3	SHEET 2 OF 4

SOIL BORING LOG

PROJECT Laredo ASR LOCATION North East Corridor

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 10 7/8

WATER LEVEL AND DATE START 3-19-97 FINISH 4-7-97 LOGGER B. Christian

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
300'		31			**SHALE**, dark gray with gypsum mottling	DRILLER NOTES:
310		32			**SHALE**, same as above	
320		33			**SHALE**, same as above	Grouted to surface
330		34			**SANDSTONE**, gray	
340		35			**SANDSTONE**, same as above	
350'		36			**SHALE**, brownish gray	
360		37			**SHALE**, same as above	
370		38			**SHALE**, same as above	
380		93			**SANDSTONE**, gray, inbedded shale with some gypsum 390-420'	
390		40			**SANDSTONE**, same as above	
400'		41			**SANDSTONE**, same as above	400 ft: Top of 20/40 sand
410		42			**SANDSTONE**, same as above	415 ft: Top of 8/10 sand
420		43			**SANDSTONE**, same as above	
430		44			**SHALE**, dark gray	430 ft: Top of 0.040 slot low carbon shutter screen
440		45			**SANDSTONE**, light gray	
450'		46			**SHALE**, dark gray	
460		47			**SHALE**, same as above	
470		48			**SHALE**, same as above	
480		49			**SHALE**, same as above	
490		50			**SHALE**, same as above	
500'		51			**SHALE**, light gray	
510		52			**SHALE**, dark gray	
520		53			**SANDSTONE**, light gray	
530		54			**SANDSTONE**, same as above	
540		55			**SANDSTONE**, same as above	
550'		56			**SANDSTONE**, same as above	
560		57			**SANDSTONE**, same as above	
570		58			**SANDSTONE**, same as above	
580		59			**SHALE**, dark gray	580-605 ft: Sandstone- good drilling
590		60			**SHALE**, same as above	
600'						

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-3	SHEET 3 OF 4

SOIL BORING LOG

PROJECT Laredo ASR LOCATION North East Corridor

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 10 7/8

WATER LEVEL AND DATE START 3-19-97 FINISH 4-7-97 LOGGER B. Christian

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
600'					**SANDSTONE**, light gray	610 ft: Bottom of screen
610					**SANDSTONE**, dark gray	610-615 ft: Blank casing sump
620					**SHALE**, dark gray	615'7" to ~630": Cement plug
630					**SHALE**, same as above	
640					**SHALE**, same as above	
650'					**SHALE**, gray	Native fill
660					**SHALE**, same as above	
670					**SHALE**, same as above	
680					**SHALE**, same as above	
690					**SHALE**, same as above	
700'					**SANDSTONE**, gray	
710					**SANDSTONE**, same as above	
720					**SHALE**, gray	
730					**SHALE**, same as above	
740					**SHALE**, same as above	
750'					**SHALE**, same as above	
760					**SHALE**, same as above	
770					**SHALE**, same as above	
780					**SHALE**, same as above	
790					**SHALE**, same as above	
800'					**SHALE**, same as above	
810					**SHALE**, same as above	
820					**SHALE**, same as above	
830					**SHALE**, same as above	
840					**SHALE**, same as above	
850'					**SHALE**, same as above	
860					**SHALE**, same as above	
870					**SANDSTONE**, light gray	
880					**SANDSTONE**, same as above	
890					**SHALE**, dark gray	
900'						

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
118069.K0.ZZ	TW-3	SHEET 4 OF 4

SOIL BORING LOG

PROJECT Laredo ASR LOCATION North East Corridor

ELEVATION DRILLING CONTRACTOR TWDB (Texas Water Development Board)

DRILLING METHOD AND EQUIPMENT Failing Mud Rotary 10 7/8

WATER LEVEL AND DATE START 3-19-97 FINISH 4-7-97 LOGGER B. Christian

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USGS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
900'					900-1,000 ft: Interbedded **SHALE** and **SANDSTONE**	
910						Native fill
920						
930						
940						
950'						
960						
970						
980						
990						
1000'					**TOTAL DEPTH = 1,001 ft bls**	

Appendix D
Test Well Geophysical Data

Attachment D-1

TW-1: McPherson Storage Tank Site

Resistivity, Spontaneous Potential, Gamma Ray, Temperature

STATE OF TEXAS

TEXAS WATER DEVELOPMENT BOARD

Resistivity Log

WELL: Mc Phereson Street Test Hole (TW-1)   SWN = 85-29-103

OWNER/PROJECT: **City of Laredo / Laredo Aquifer Storage and Recovery Feasibility Investigation**

COUNTY: **Webb**

LOCATION: At City of Laredo, Mc Phereson St. elevated water tank site. Approximately 1 mile N from intersection of Mc Phereson St. and Del Mar Blvd. 1.45 miles fom W line and 2.58 miles from N line of topo map 85-29 (Laredo East) **Lat. 27-35-19N , Long. 099-28-34W**	OTHER LOGS: **Natural Gamma Ray, Fluid Resistivity, Spinner**

Date	1/21/1997	Fluid Level	10 feet
Run No.	1	Type of Fluid in Hole	Natural Mud
Depth Driller	886	Source of Sample	Mud Pit
Depth Logger	885.4	Rm @ Meas. Temp	3.8 Ohms @ 77 degrees F
First Reading	882	Density / pH	9.1 lbs. per gallon / 9.7
Last Reading	64	Viscosity	33 seconds through Marsh funnel
Casing-Driller	10 inches I.D. 0-40		
Casing-Logger	10 inches I.D. 0-40		
Bit Size	7.875 inces		

Recorded By	R. Williams	Elevation above Mean Sea Level	GL = 526	KB= 529
Witnessed By	R. Cano	Log Measured From = ground level		

Remarks: Logged for formation identification and to determine screen setting for well completion. Cased with 6 inch I.D. steel. Screened w stainless steel wire based screen330 - 390 and 440 - 490, TD = 495 feet. **Log curve exhibits indications of potential formation invasion b drilling mud and presence of bedded Anhydrite/Gypsum.**

SPONTANEOUS POTENTIAL	5" =100'	RESISTIVITY 16" & 64" ohms/m2	
(+) 5 milivolts/division (-)	Depth	0	10

STATE OF TEXAS

TEXAS WATER DEVELOPMENT BOARD

Natural Gamma Ray Log

WELL: **Mc Phereson Street Test Hole (TW-1) SWN = 85-29-103**

OWNER/PROJECT: **City of Laredo / Laredo Aquifer Storage and Recovery Feasibility Investigation**

COUNTY: **Webb**

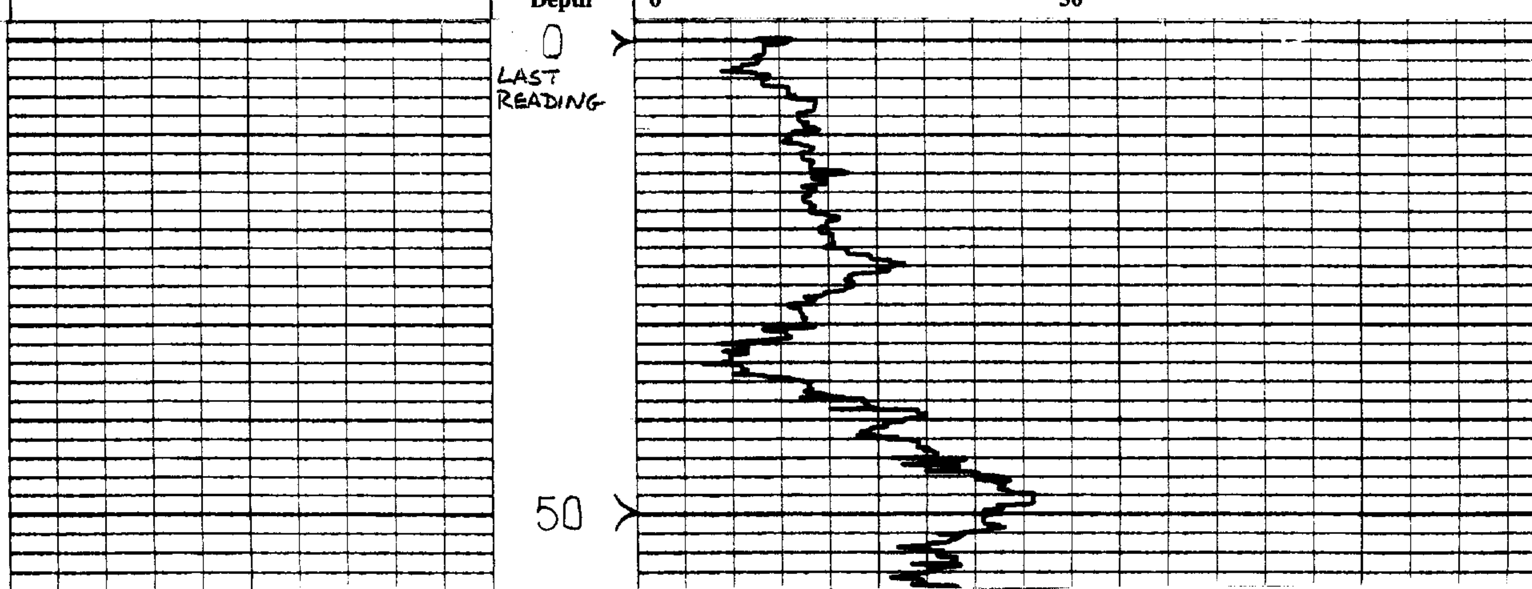
LOCATION: At City of Laredo, Mc Phereson St. elevated water tank site. Approximately 1 mile N from intersection of Mc Phereson St. and Del Mar Blvd. !.45 miles from W line and 2.58 miles from N line of topo map 85-29 (Laredo East) **Lat. 27-35-19N , Long. 099-28-34W**	OTHER LOGS: **Resistivity, Spontaneous Potential, Spinne Fluid Resistivity**

Date	1/21/97	Fluid Level	10 feet
Run No.	1	Type of Fluid in Hole	Natural Mud
Depth Driller	886	Source of Sample	Mud Pit
Depth Logger	885.4	Rm @ Meas. Temp	3.8 ohms @ 77 degrees F
First Reading	874	Density / pH	9.1 lbs per gallon / 9.7
Last Reading	0	Viscosity	33 secs through Marsh funnel
Casing-Driller	10 inch I.D. steel 0-40'		
Casing-Logger	10 inch I.D. steel 0-40'		
Bit Size	7.875 inches		

Recorded By	R. Williams	Elev. above Mean Sen Level	GL = 526	KB= 529
Witnessed By	R. Cano	Log Measured From = ground level		

Remarks: Logged for formation identification and to determine screen setting for well completion. Cased with 6 in. I.D. steel. Screened with stainless steel wire based screen 330 - 390 and 440 - 490. TD = 495 feet. **Log curve indicates evidence of the potential presence bedded Anhydrite/Gypsum.**

	5" =100'	Natural Gamma Radiation (increasing to right)
	Depth	0 50



STATE OF TEXAS

TEXAS WATER DEVELOPMENT BOARD

Spinner (fluid velocity) Log

WELL: **Mc Phereson Street Test Hole (TW-1) SWN = 85-29-103**

OWNER/PROJECT: **City of Laredo / Laredo Aquifer Storage and Recovery Feasibility Investigation**

COUNTY: **Webb**

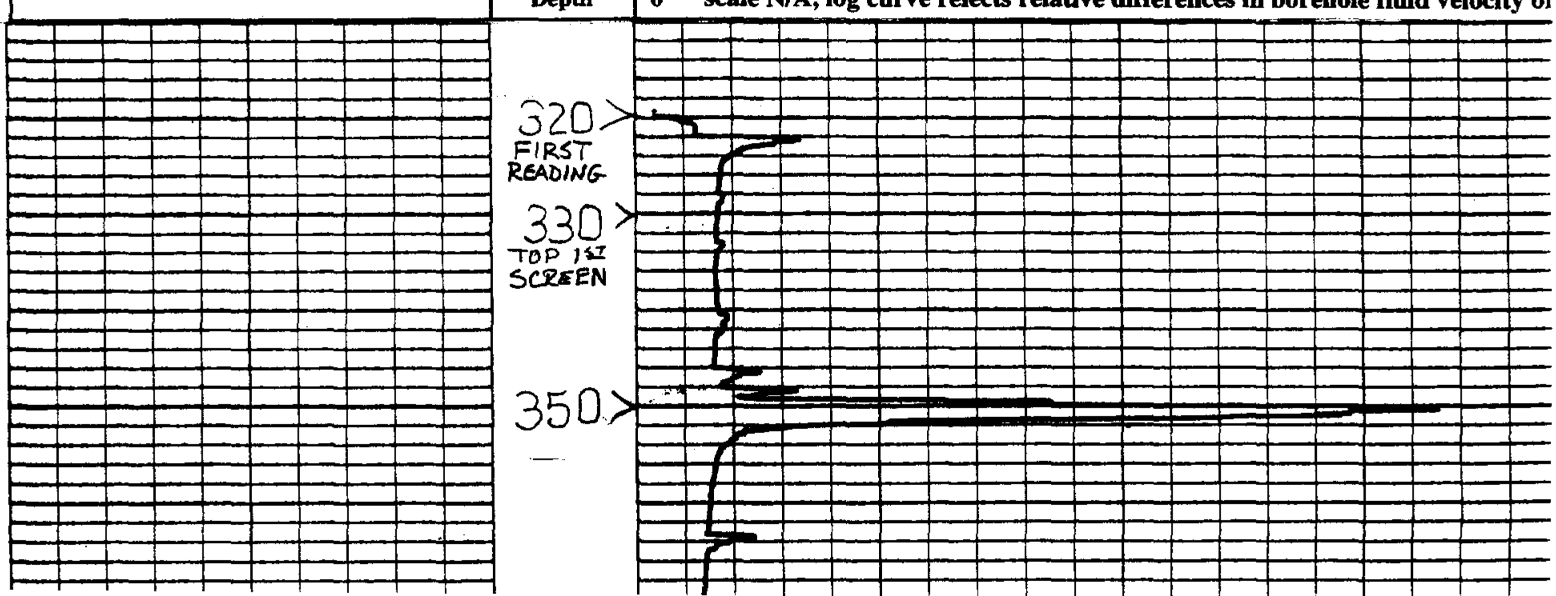
LOCATION: At City of Laredo, Mc Phereson St. elevated water tank site. Approximately 1 mile N from intersection of Mc Phereson St. and Del Mar Blvd. !.45 miles from W line and 2.58 miles from N line of topo map 85-29 (Laredo East)
Lat. 27-35-19N , Long. 099-28-34W

OTHER LOGS: **Resistivity, Spontaneous Potential, Temperature and Fluid Resistivity, Natural Gamma Ray**

Date	4/16/97	Fluid Level	127 feet	
Run No.	2	Type of Fluid in Hole	Water	
Depth Driller	495	Source of Sample	Bore hole	
Depth Logger	495	Rm @ Meas. Temp	5.8 ohms @ 79.52 degrees F	
First Reading	320	Density / pH	N/A	
Last Reading	480	Viscosity	N/A	
Casing-Driller	6 inch I.D. steel 0-330'			
Casing-Logger	6 inch I.D. steel 0-330'			
Bit Size	7.875 inches			
Recorded By	R. Williams	Elev. above Mean Sen Level	GL = 526	KB= 529
Witnessed By	R. Cano	Log Measured From = ground level		

Remarks: Cased with 6 in. I.D. steel. Screened with stainless steel wire based screen 330 - 390 and 440 - 490. **Log curve indicates evidence potential invasion of drilling mud (natural), resulting in aquifer clogging and reflected in erratic fluid velocites. Logged down @20 feet per minute, while pumping @ 31 gallons per minute. Mud slurry filling borehole 486 to T.D.**

	5" =100'	Fluid Velocity (in revolutions per second, increasing to right)
	Depth	0 scale N/A, log curve relects relative differences in borehole fluid velocity o



STATE OF TEXAS

TEXAS WATER DEVELOPMENT BOARD

Spinner (fluid velocity) Log

WELL: **Mc Phereson Street Test Hole (TW-1) SWN = 85-29-103**

OWNER/PROJECT: **City of Laredo / Laredo Aquifer Storage and Recovery Feasibility Investigation**

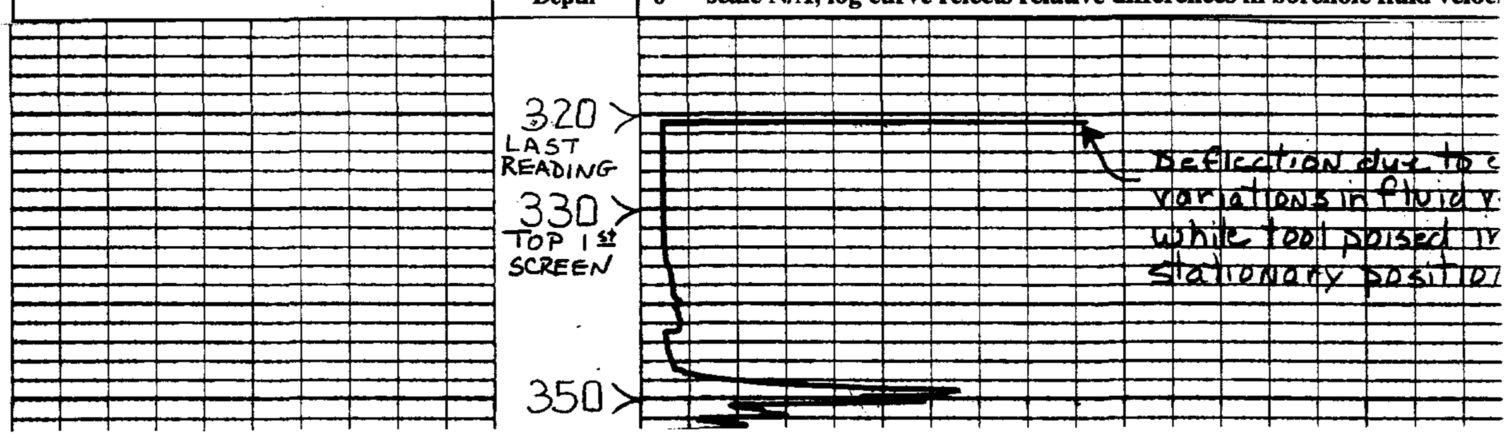
COUNTY: **Webb**

LOCATION: At City of Laredo, Mc Phereson St. elevated water tank site. Approximately 1 mile N from intersection of Mc Phereson St. and Del Mar Blvd. !.45 miles from W line and 2.58 miles from N line of topo map 85-29 (Laredo East) **Lat. 27-35-19N , Long. 099-28-34W**	OTHER LOGS: **Resistivity, Spontaneous Potential, Temperature and Fluid Resistivity, Natural Gamma R**

Date	4/16/97	Fluid Level	127 feet	
Run No.	1	Type of Fluid in Hole	Water	
Depth Driller	495	Source of Sample	Bore hole	
Depth Logger	495	Rm @ Meas. Temp	5.8 ohms @ 79.52 degrees F	
First Reading	480	Density / pH	N/A	
Last Reading	321	Viscosity	N/A	
Casing-Driller	6 inch I.D. steel 0-330'			
Casing-Logger	6 inch I.D. steel 0-330'			
Bit Size	7.875 inches			
Recorded By	R. Williams	Elev. above Mean Sen Level	GL = 526	KB= 529
Witnessed By	R. Cano	Log Measured From = ground level		

Remarks: Cased with 6 in. I.D. steel. Screened with stainless steel wire based screen 330 - 390 and 440 - 490. **Log curve indicates evid potential invasion of drilling mud (natural), resulting in aquifer clogging and reflected in erratic fluid velocites. Logged up @20 f minute, while pumping @ 31 gallons per minute. Mud slurry filling borehole from 486 to T.D.**

	5" =100'	Fluid Velocity (in revolutions per second, increasing to right)
	Depth	0 scale N/A, log curve relects relative differences in borehole fluid veloc



STATE OF TEXAS
TEXAS WATER DEVELOPMENT BOARD

Temperature and Fluid Resistivity Log

ELL: **Mc Phereson Street Test Hole (TW-1) SWN = 85-29-103**
VNER/PROJECT: **City of Laredo / Laredo Aquifer Storage and Recovery Feasibility Investigation**
)UNTY: **Webb**

CATION: At City of Laredo, Mc Phereson St. elevated water ‹ site. Approximately 1 mile N from intersection of Mc Phereson and Del Mar Blvd. !.45 miles from W line and 2.58 miles from N : of topo map 85-29 (Laredo East) **:. 27-35-19N , Long. 099-28-34W**	OTHER LOGS: **Resistivity, Spontaneous Potential, Spinner, Natural Gamma Ray**

e	4/16/97	Fluid Level	127 feet	
ı No.	1	Type of Fluid in Hole	Water	
›th Driller	495	Source of Sample	Bore hole	
›th Logger	495	Rm @ Meas. Temp	5.8 ohms @ 79.52 degrees F	
›t Reading	140	Density / pH	N/A	
t Reading	495	Viscosity	N/A	
ing-Driller	6 inch I.D. steel 0-330'			
ing-Logger	6 inch I.D. steel 0-330'			
Size	7.875 inches			
orded By	R. Williams	Elev. above Mean Sen Level	GL = 526	KB= 529
nessed By	R. Cano	Log Measured From = ground level		

marks: Cased with 6 in. I.D. steel. Screened with stainless steel wire based screen 330 - 390 and 440 - 490. **Log curve indicates evidence of ential invasion of drilling mud (natural), resulting in aquifer clogging**

emperature (in degrees C, up to right)	5" =100'	Fluid Resistivity (in Ohms, increasing to left)
2 deg.C/inch, begin value=26.4	Depth	Scale = 1.2 ohm/division or 5 ohms/inch, End value = 6.6 ohms Begin value = 5.8 ohms
26.4 °C	140 > FIRST READING 150 >	5.8 Ohms

STATE OF TEXAS

TEXAS WATER DEVELOPMENT BOARD

Resistivity Log

WELL: **Del Mar Boulevard Test Hole (TW-2) SWN = 85-29-403**

OWNER/PROJECT: **City of Laredo / Laredo Aquifer Storage and Recovery Feasibility Investigation**

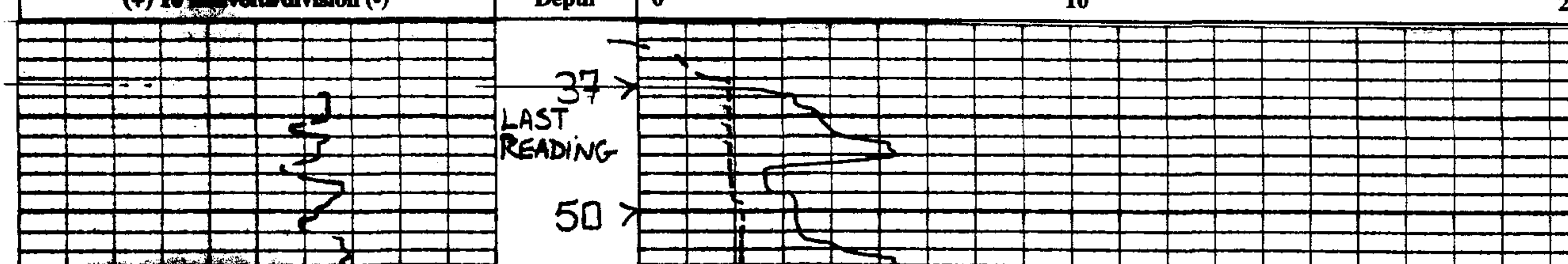
COUNTY: **Webb**

LOCATION: At City of Laredo, Del Mar Blvd. elevated water tank site. Approximately 3 mile E from intersection of I.H. 35 and Del Mar Blvd. !.94 miles from W line and 3.35 miles from N line of topo map 85-29 (Laredo East) **Lat. 27-34-36N , Long. 099-28-55W**	OTHER LOGS: **Natural Gamma Ray, Fluid Resistivity and Temperature**

Date	2/20/97	Fluid Level	10 feet	
Run No.	1	Type of Fluid in Hole	Natural Mud	
Depth Driller	776	Source of Sample	Mud Pit	
Depth Logger	777.5	Rm @ Meas. Temp	3.92 ohms@ 77 degrees F	
First Reading	776	Density / pH	9.4 pounds per gallon / 8.6	
Last Reading	37	Viscosity	34 seconds through marsh funnel	
Casing-Driller	10 inch I.D. steel 0-40'			
Casing-Logger	10 inch I.D. steel 0-36'			
Bit Size	7.875 inches			
Recorded By	R. Williams	Elev. above Mean Sen Level	GL = 500	KB= 503
Witnessed By	R. Cano	Log Measured From = ground level		

Remarks: Logged for formation identification and to determine screen setting for well completion. Screens set at 269 to 429. **Log curve indicates evidence of the potential presence bedded Anhydrite/Gypsum and potential formation invasion by drilling mud.**

Spontaneous Potential	5" =100'	Resistivity 16" & 64" in Ohms/m2
(+) 10 millivolts/division (-)	Depth	0 10 20



STATE OF TEXAS

TEXAS WATER DEVELOPMENT BOARD

Temperature and Fluid Resistivity Log

WELL: **Del Mar Boulevard Test Hole (TW-2) SWN = 85-29-403**

OWNER/PROJECT: **City of Laredo / Laredo Aquifer Storage and Recovery Feasibility Investigation**

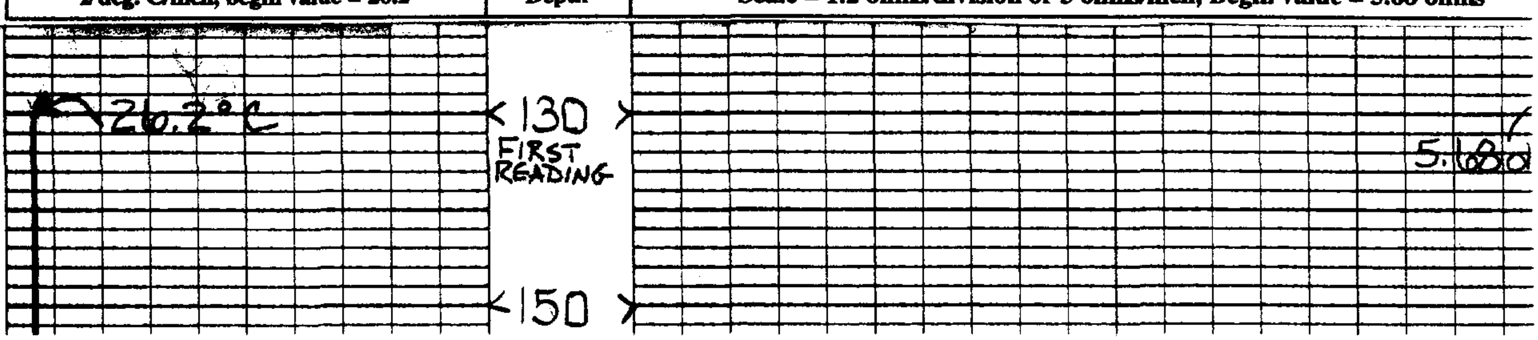
COUNTY: **Webb**

LOCATION: At City of Laredo, Del Mar Blvd. elevated water tank site. Approximately 3 mile E from intersection of I.H. 35 and Del Mar Blvd. !.94 miles from W line and 3.35 miles from N line of topo map 85-29 (Laredo East) **Lat. 27-34-36N , Long. 099-28-55W**	OTHER LOGS: **Natural Gamma Ray, Resistivity and Spontaneous Potential**

Date	4/15/97	Fluid Level	120 feet	
Run No.	1	Type of Fluid in Hole	groundwater	
Depth Driller	429	Source of Sample	N/A	
Depth Logger	429	Rm @ Meas. Temp	N/A	
First Reading	130	Density / pH	N/A	
Last Reading	429	Viscosity	N/A	
Casing-Driller	10 inch I.D. steel 0-40'			
Casing-Logger	10 inch I.D. steel 0-36'			
Bit Size	7.875 inches			
Recorded By	R. Williams	Elev. above Mean Sen Level	GL = 500	KB= 503
Witnessed By	R. Cano	Log Measured From = ground level		

Remarks: Completed with ^inch I.D. steel casing. Non stainless louvered screens set at 269 to 429. **Log curve indicates evidence of potent formation invasion by drilling mud.** Logged down at 2 feet per minute.

Temperature (in degrees C, up to right)	5" =100'	Fluid Resistivity (in Ohms, increasing to left)
2 deg. C/inch, begin value = 26.2	Depth	Scale = 1.2 ohms/division or 5 ohms/inch, Begin value = 5.68 ohms



STATE OF TEXAS

TEXAS WATER DEVELOPMENT BOARD

Natural Gamma Ray Log

WELL: **Del Mar Boulevard Test Hole (TW-2) SWN = 85-29-403**

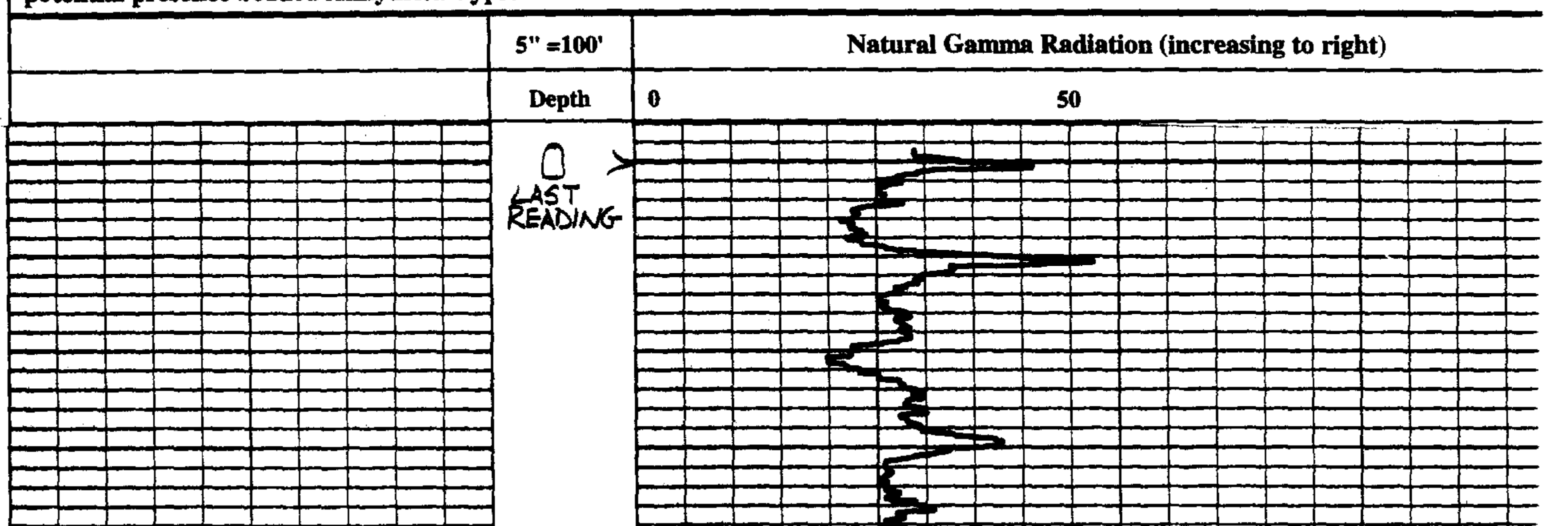
OWNER/PROJECT: **City of Laredo / Laredo Aquifer Storage and Recovery Feasibility Investigation**

COUNTY: **Webb**

LOCATION: At City of Laredo, Del Mar Blvd. elevated water tank site. Approximately 3 mile E from intersection of I.H. 35 and Del Mar Blvd. !.94 miles from W line and 3.35 miles from N line of topo map 85-29 (Laredo East) **Lat. 27-34-36N , Long. 099-28-55W**	OTHER LOGS: **Resistivity, Spontaneous Potential, Fluid Resistivity**

Date	2/20/97	Fluid Level	10 feet	
Run No.	1	Type of Fluid in Hole	Natural Mud	
Depth Driller	776	Source of Sample	Mud Pit	
Depth Logger	775.4	Rm @ Meas. Temp	N/A	
First Reading	766	Density / pH	N/A	
Last Reading	0	Viscosity	N/A	
Casing-Driller	10 inch I.D. steel 0-40'			
Casing-Logger	10 inch I.D. steel 0-40'			
Bit Size	7.875 inches			
Recorded By	R. Williams	Elev. above Mean Sen Level	GL = 500	KB= 503
Witnessed By	R. Cano	Log Measured From = ground level		

Remarks: Logged for formation identification and to determine screen setting for well completion. **Log curve indicates evidence of the potential presence bedded Anhydrite/Gypsum.**



DELMAR TW-2

Century Geophysical Corp.

COMPANY	: TEXAS WATER BOARD			OTHER SERVICES:	
WELL	: DELMAR TW-2				
LOCATION/FIELD	: LAREDO				
COUNTY	: WEBB				
STATE	: TX				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 07/26/97	PERMANENT DATUM	:	ELEVATIONS	
DEPTH DRILLER	: 429	ELEV. PERM. DATUM	:	KB	:
LOG BOTTOM	: 428.30	LOG MEASURED FROM	: TOC	DF	:
LOG TOP	: -2.20	DRL MEASURED FROM	: TOC	GL	:
CASING DRILLER	: 429	LOGGING UNIT	: 9605		
CASING TYPE	: STEEL	FIELD OFFICE	: VEGAS		
CASING THICKNESS	: .25	RECORDED BY	: D.STEWART		
BIT SIZE	: -	BOREHOLE FLUID	: H20	FILE	: ORIGINAL
MAGNETIC DECL.	: -	RM	:	TYPE	: 9041A
MATRIX DENSITY	: -	RM TEMPERATURE	:	LOG	: 2
FLUID DENSITY	: 1.1	MATRIX DELTA T	:	PLOT	: ROGER 27
NEUTRON MATRIX	: LIMESTONE	FLUID DELTA T	:	THRESH	: 10000
REMARKS	:				

-

-

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

GAM(NAT)	RES(FL)
0 API-GR 100	0 OHM-M 3

0

Century GEOPHYSICAL CORP.

DELMAR TW-2 TIME DRIVE

COMPANY	: TEXAS WATER BOARD	OTHER SERVICES:			
WELL	: DELMAR TW-2 TIME DRIVE				
LOCATION/FIELD	: LAREDO				
COUNTY	: WEBB				
STATE	: TX				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 07/26/97	PERMANENT DATUM	:	ELEVATIONS	
DEPTH DRILLER	: 429	ELEV. PERM. DATUM	:	KB	:
LOG BOTTOM	: 279.90	LOG MEASURED FROM	: TOC	DF	:
LOG TOP	: 249.30	DRL MEASURED FROM	: TOC	GL	:
CASING DRILLER	: 429	LOGGING UNIT	: 9605		
CASING TYPE	: STEEL	FIELD OFFICE	: VEGAS		
CASING THICKNESS	: .25	RECORDED BY	: D.STEWART		
BIT SIZE	: -	BOREHOLE FLUID	: H20	FILE	: PROCESSED
MAGNETIC DECL.	: -	RM	:	TYPE	: 9710A
MATRIX DENSITY	: -	RM TEMPERATURE	:	LOG	: 5
FLUID DENSITY	: 1.1	MATRIX DELTA T	:	PLOT	: ROGER 25
NEUTRON MATRIX	: LIMESTONE	FLUID DELTA T	:	THRESH	: 10000

REMARKS :

THIS A TIME DRIVE, TOOL STATIONARY AT ABOUT 280 FT, DEPTH ON LOG IS NOT TRUE DEPTH. STATIONARY LOG FOR 1 MINUTE WHILE WELL PUMPED AT 60 GPM

Century Geophysical Corp.

DELMAR TW-2

COMPANY	: TEXAS WATER BOARD	OTHER SERVICES:			
WELL	: DELMAR TW-2				
LOCATION/FIELD	: LAREDO				
COUNTY	: WEBB				
STATE	: TX				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: *07/26/97*	*PERMANENT DATUM*	:	*ELEVATIONS*	
DEPTH DRILLER	: *429*	*ELEV. PERM. DATUM:*		*KB*	:
LOG BOTTOM	: 427.10	LOG MEASURED FROM:	TOC	DF	:
LOG TOP	: 4.30	DRL MEASURED FROM:	TOC	GL	:
CASING DRILLER	: *429*	*LOGGING UNIT*	: *9605*		
CASING TYPE	: *STEEL*	*FIELD OFFICE*	: *VEGAS*		
CASING THICKNESS	: *.25*	*RECORDED BY*	: D.STEWART		
BIT SIZE	: -	BOREHOLE FLUID	: H2O	FILE	: PROCESSED
MAGNETIC DECL.	: -	RM	:	TYPE	: 9710A
MATRIX DENSITY	: -	RM TEMPERATURE	:	LOG	: 0
FLUID DENSITY	: 1.1	MATRIX DELTA T	:	PLOT	: ROGER 25
NEUTRON MATRIX	: LIMESTONE	FLUID DELTA T	:	THRESH:	10000
REMARKS	:				

Down survey at 30 ft/min static water.

CGC

Century GEOPHYSICAL CORP.

DELMAR TW-2

COMPANY	: TEXAS WATER BOARD			OTHER SERVICES:	
WELL	: DELMAR TW-2				
LOCATION/FIELD	: LAREDO				
COUNTY	: WEBB				
STATE	: TX				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 07/26/97	PERMANENT DATUM	:	ELEVATIONS	
DEPTH DRILLER	: 429	ELEV. PERM. DATUM:		KB	:
LOG BOTTOM	: 427.10	LOG MEASURED FROM:	TOC	DF	:
LOG TOP	: 4.30	DRL MEASURED FROM:	TOC	GL	:
CASING DRILLER	: 429	LOGGING UNIT	: 9605		
CASING TYPE	: STEEL	FIELD OFFICE	: VEGAS		
CASING THICKNESS	: .25	RECORDED BY	: D.STEWART		
BIT SIZE	: -	BOREHOLE FLUID	: H2O	FILE	: PROCESSED
MAGNETIC DECL.	: -	RM	:	TYPE	: 9710A
MATRIX DENSITY	: -	RM TEMPERATURE	:	LOG	: 0
FLUID DENSITY	: 1.1	MATRIX DELTA T	:	PLOT	: ROGER 25
NEUTRON MATRIX	: LIMESTONE	FLUID DELTA T	:	THRESH:	10000
REMARKS	:				

Down survey at 30 ft/min static water.

-

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

Century GEOPHYSICAL CORP.

DELMAR TW-2

COMPANY	: TEXAS WATER BOARD			OTHER SERVICES:	
WELL	: DELMAR TW-2				
LOCATION/FIELD	: LAREDO				
COUNTY	: WEBB				
STATE	: TX				
SECTION	:	TOWNSHIP	:	RANGE	:
DATE	: 07/26/97	PERMANENT DATUM	:	ELEVATIONS	
DEPTH DRILLER	: 429	ELEV. PERM. DATUM	:	KB	:
LOG BOTTOM	: 427.50	LOG MEASURED FROM	: TOC	DF	:
LOG TOP	: 270.10	DRL MEASURED FROM	: TOC	GL	:
CASING DRILLER	: 429	LOGGING UNIT	: 9605		
CASING TYPE	: STEEL	FIELD OFFICE	: VEGAS		
CASING THICKNESS	: .25	RECORDED BY	: D.STEWART		
BIT SIZE	: -	BOREHOLE FLUID	: H20	FILE	: PROCESSED
MAGNETIC DECL.	: -	RM	:	TYPE	: 9710A
MATRIX DENSITY	: -	RM TEMPERATURE	:	LOG	: 4
FLUID DENSITY	: 1.1	MATRIX DELTA T	:	PLOT	: ROGER 26
NEUTRON MATRIX	: LIMESTONE	FLUID DELTA T	:	THRESH	: 10000
REMARKS	:				

Survey run up hole at 30 ft/min while pump running at 60 gal/min.

-

GR - INDUCTION-ELECTRIC LOG

SIGMA DATA

FILING NO.	
	COMPANY CH2M-HILL CO. INC.
	WELL TW-2A
	FIELD
	COUNTY WEBB STATE TEXAS

LOCATION: LAREDO-DEL MAR TW-2A
DEL MAR TREATMENT PLANT

SEC ____ TWP ____ RGE ____

Other Services

Permanent Datum G. L. Elev. N/A
Log Measured from G. L. , ____ Ft. Above Permanent Datum
DRILLING MEASURED FROM G. L.

Elevations:
KB
DF
GL

Date	15 JULY 1997			
Run No.	ONE			
Depth-Driller	440			
Depth-Logger	439			
Bottom Logged Interval	438			
Top Logged Interval	41			
Casing-Driller	@	@	@	@
Casing-Logger				
Bit Size	7 7/8			
Type Fluid in Hole	NATIVE-GEL			
	@	@	@	@
Density / Viscosity	9.2 / 29			
pH / Fluid Loss	7.5 / N/A cc	cc	cc	cc
Source of Sample	MUD PIT			
Rm @ Meas. Temp.	2.7 @ 88 °F	@ °F	@ °F	@ °F
Rmf @ Meas. Temp.	2.3 @ 88 °F	@ °F	@ °F	@ °F
Rmc @ Meas. Temp.	2.8 @ 88 °F	@ °F	@ °F	@ °F
Source of Rmf / Rmc	CALC.			
Rm @ BHT	2.6 @ 90 °F	@ °F	@ °F	@ °F
Time Since Circ.	1HR			
Max. Rec. Temp. Deg. F.	90 °F	°F	°F	°F
Equip. No. / Location	850-09 / PLSN			
Recorded By	DREW			
Witnessed By	MR. VAN NOORT / MR. PRINCETON			

fold here

Scale Changes

Type Log	Depth	Scale Up Hole	Scale Down Hole

Equipment Record

Run	Tool Type	SourceNo	S.O.	Tool No.	Panel No.	Other
ONE	IND-GR			113/101	115/102	C405/ZE

Changes in Mud Type or Additional Samples

Date/Sample No.		
Depth Driller		
Borehole Fluid		
Dens./Viscosity		
pH /Fluid Loss	cc	cc
Source of Sample		
Rm @ Meas. Temp.	@ °F	@ °F
Rmf @Meas. Temp.	@ °F	@ °F
Rmc @Meas. Temp.	@ °F	@ °F
Source Rmf/Rmc		
Rm @ BHT	@ °F	@ °F
Rmf @ BHT	@ °F	@ °F
Rmc @ BHT	@ °F	@ °F

Remarks :

TEXAS WATER DEVELOPEMENT BOARD

SPONTANEOUS POTENTIAL
millivolts

GAMMA RAY
API UNITS

DEPTHS

RESISTIVITY
ohm-meter

CONDUCTIVITY
millimhos/meter

STATE OF TEXAS

TEXAS WATER DEVELOPMENT BOARD

Resistivity Log

WELL: **East Corridor Test Hole (TW-3) SWN = 85-29-501**

OWNER/PROJECT: **City of Laredo / Laredo Aquifer Storage and Recovery Feasibility Investigation**

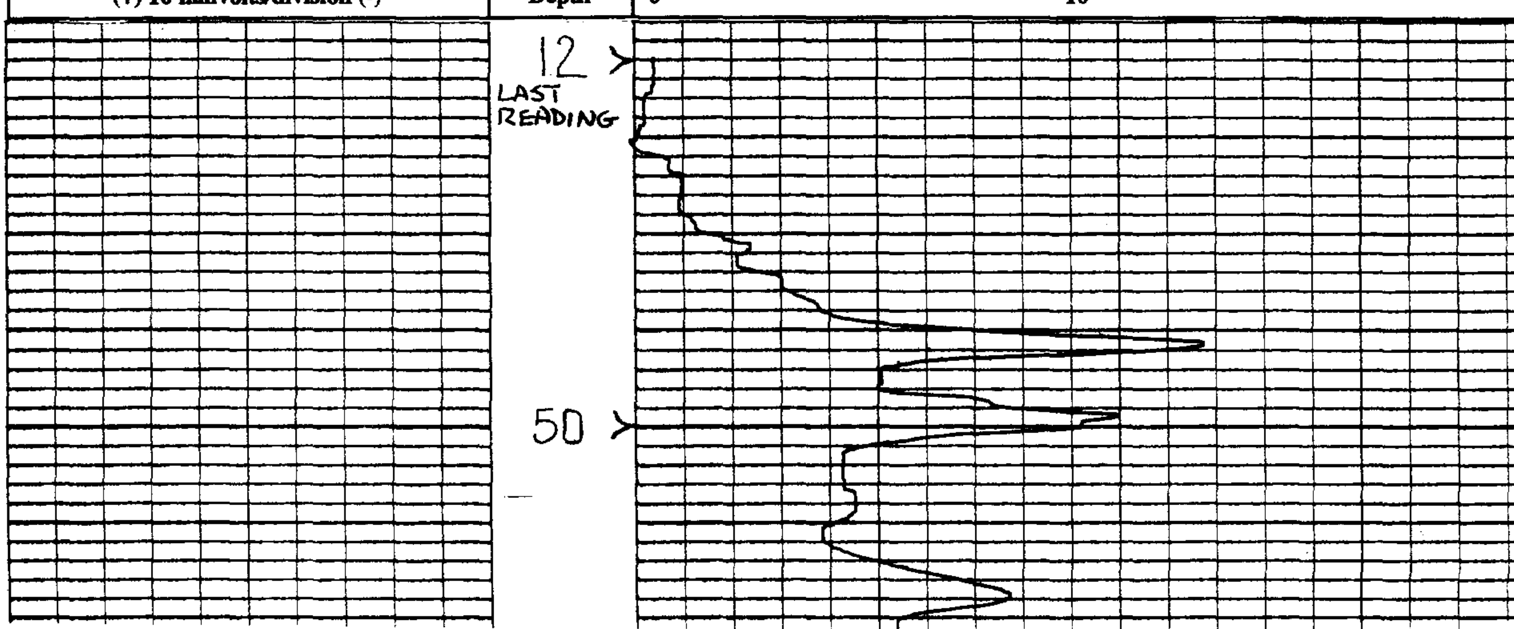
COUNTY: **Webb**

LOCATION: At City of Laredo, East Corridor water tank site, near the location of the new airport terminal on East Corridor Rd. 2.97 miles from W line and 2.90 miles from S line of topo map 85-29 (Laredo East) **Lat. 27-32-31N , Long. 099-27-06W**	OTHER LOGS:

Date	3/25/97	Fluid Level	5 feet	
Run No.	1	Type of Fluid in Hole	Natural Mud	
Depth Driller	1,001	Source of Sample	Mud Pit	
Depth Logger	998	Rm @ Meas. Temp	N/A	
First Reading	996	Density / pH	N/A	
Last Reading	12	Viscosity	N/A	
Casing-Driller	none			
Casing-Logger	none			
Bit Size	7.875 inches, 0 - 860	6.125, 860 - 1,001		
Recorded By	R. Williams	Elev. above Mean Sen Level	GL = 462	KB= 465
Witnessed By	R. Cano	Log Measured From = ground level		

Remarks: Logged for formation identification and to determine screen setting for well completion. Screens set at 430 to 610. **Log curve indicates evidence of the potential presence bedded Anhydrite/Gypsum.** SP and 64" resistivity non-functional due to electrical interferen

Spontaneous Potential	5" =100'	Resistivity 16" & 64" in Ohms/m2
(+) 10 milivolts/division (-)	Depth	0 10



Attachment D-2

TW-2: Del Mar Storage Tank Site

Resistivity, Spontaneous Potential, Gamma Ray, Spinner

Attachment D-3

TW-2A: Del Mar Storage Tank Site

Resistivity, Spontaneous Potential, Gamma Ray

Attachment D-4
TW-3: East Corridor Storage Tank and Booster Station Site
Resistivity

Appendix E
Aquifer Test Curves

Attachment E-1

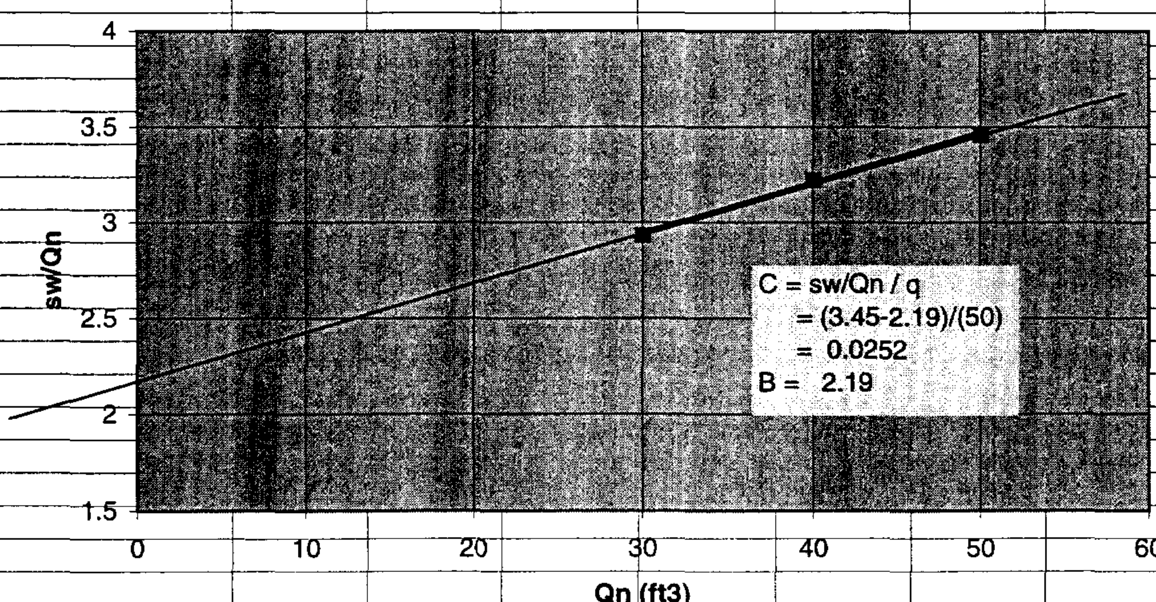
Test Well TW-1

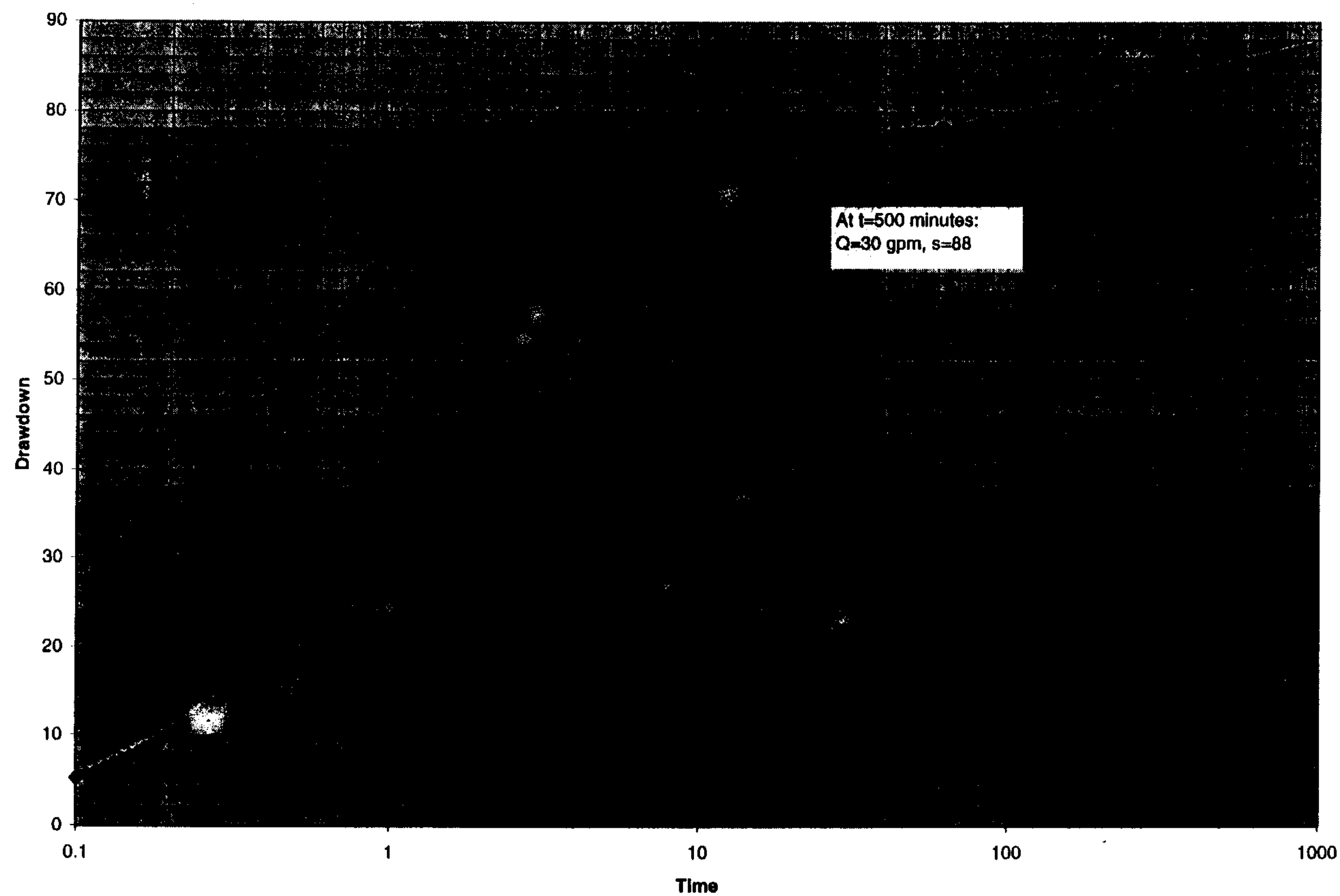
TW-1 Well Loss Determination,
March, 1997

Hantush-Bierschenk Method of Determining Well Losses			
$s = BQ + CQ^2$ where BQ is aquifer loss (laminar term), CQ^2 is well loss (turbulent term)			
Lp = percentage head loss attributable to laminar flow			
$Lp = BQ/(BQ + CQ^2)$			
Q=	50		
B =	2.19		(From graph)
C =	0.0252		(From graph)
Lp =	63.48%		
CQ^2=	36.52%		

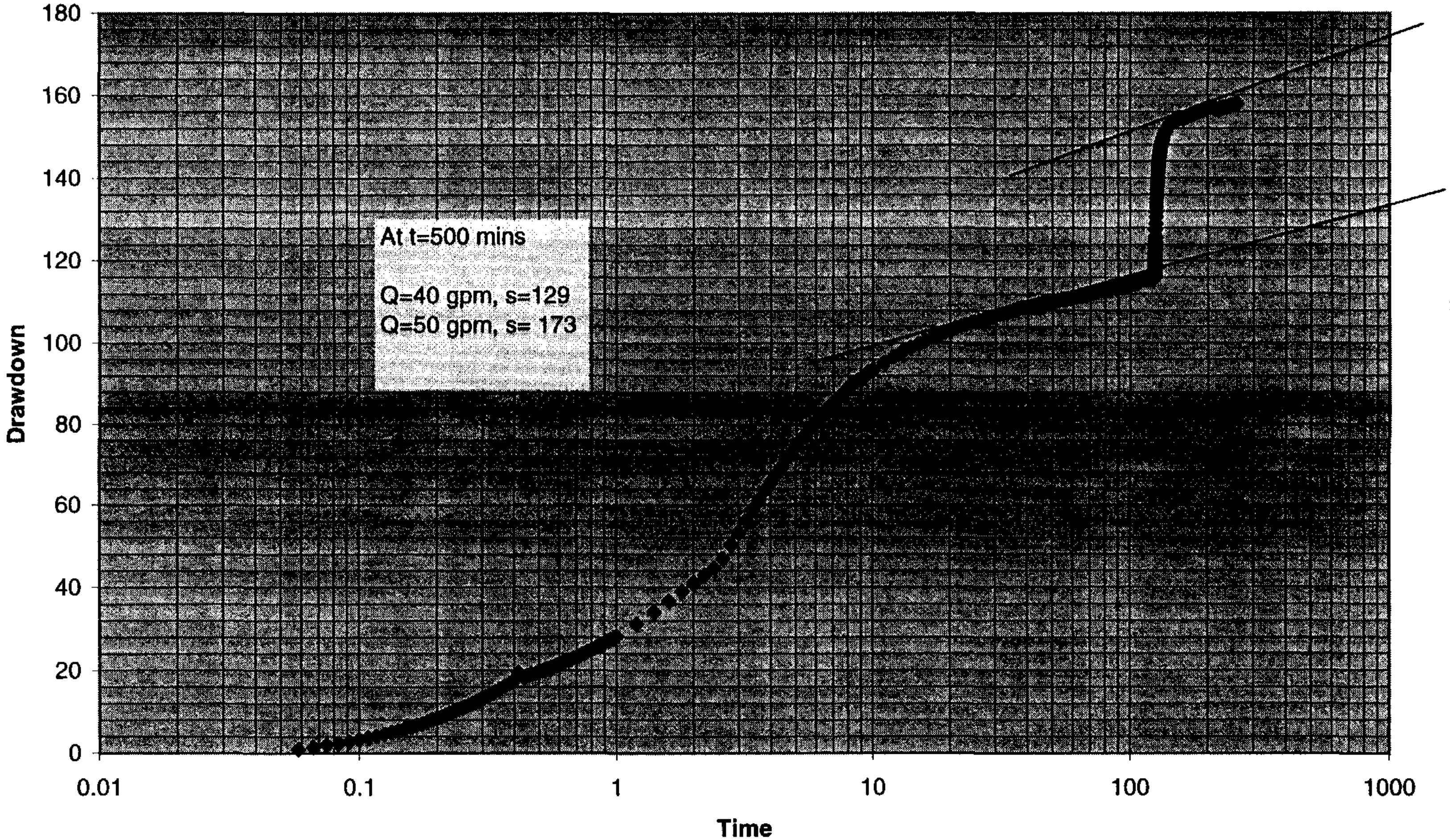
Q	s/Q	Q/s	s
30	**2.933333**	0.340909	88
40	**3.225**	0.310078	129
50	**3.46**	0.289017	173

TW-1 March, 1997 Step Test
Determination of Parameters B & C





TW-1 Step Test, March, 1997
30 GPM



TW-1 Step Test, March, 1997
40 - 50 GPM

Attachment E-2

Test Wells TW-2/TW-2A

TW-2 Well Loss Determination -
Pre-development
March, 1997

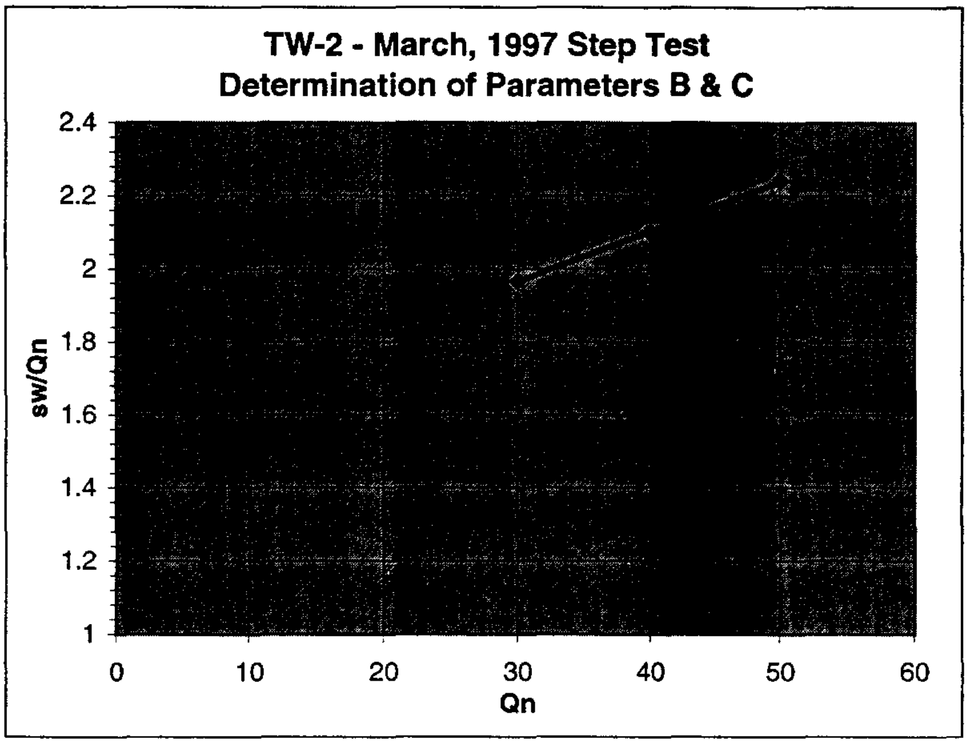
Hantush-Bierschenk Method of Determining Well Losses

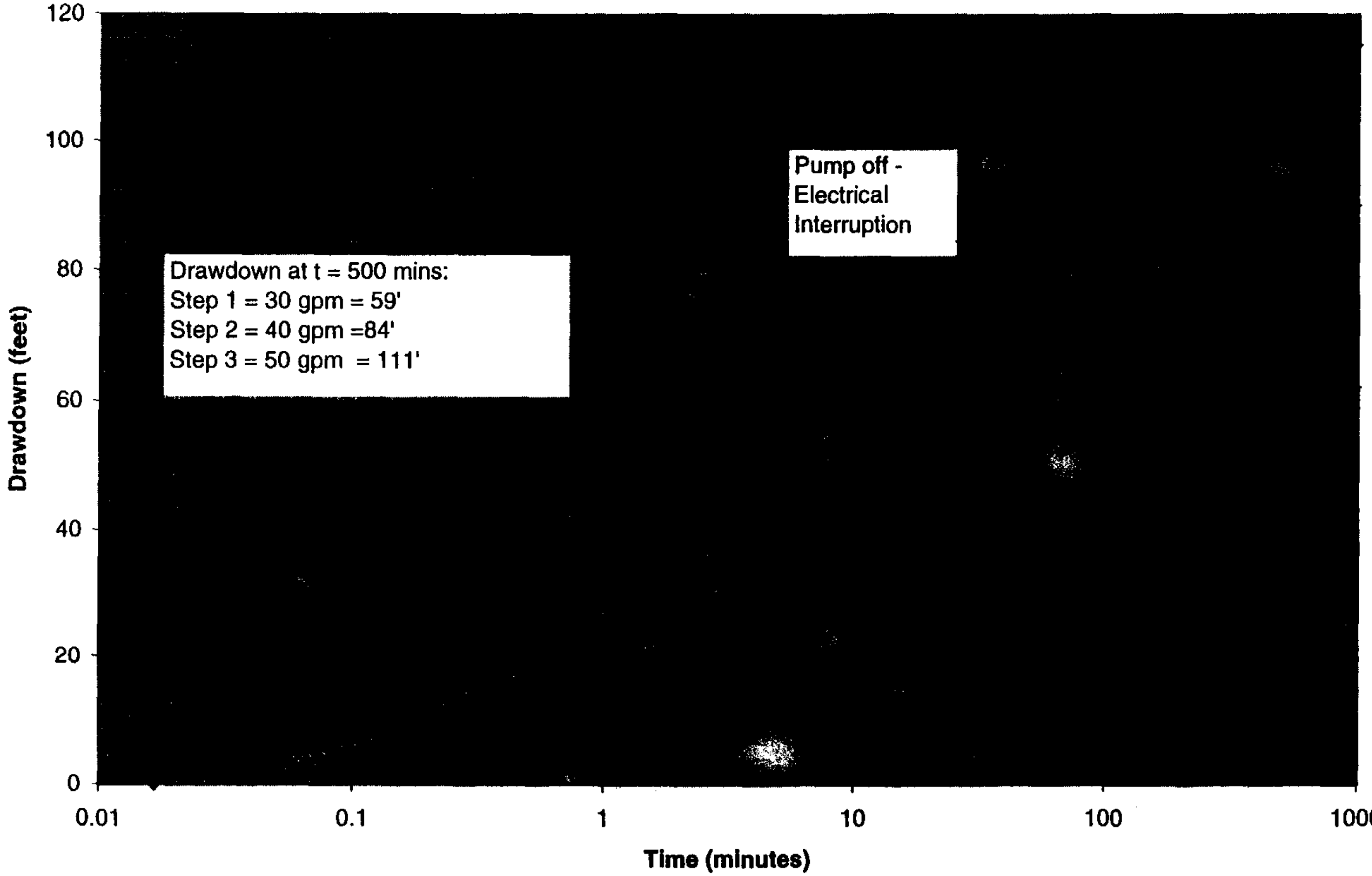
$s = BQ + CQ^2$ where BQ is aquifer loss (laminar term), CQ^2 is well loss (turbulent term)

Lp = percentage head loss attributable to laminar flow

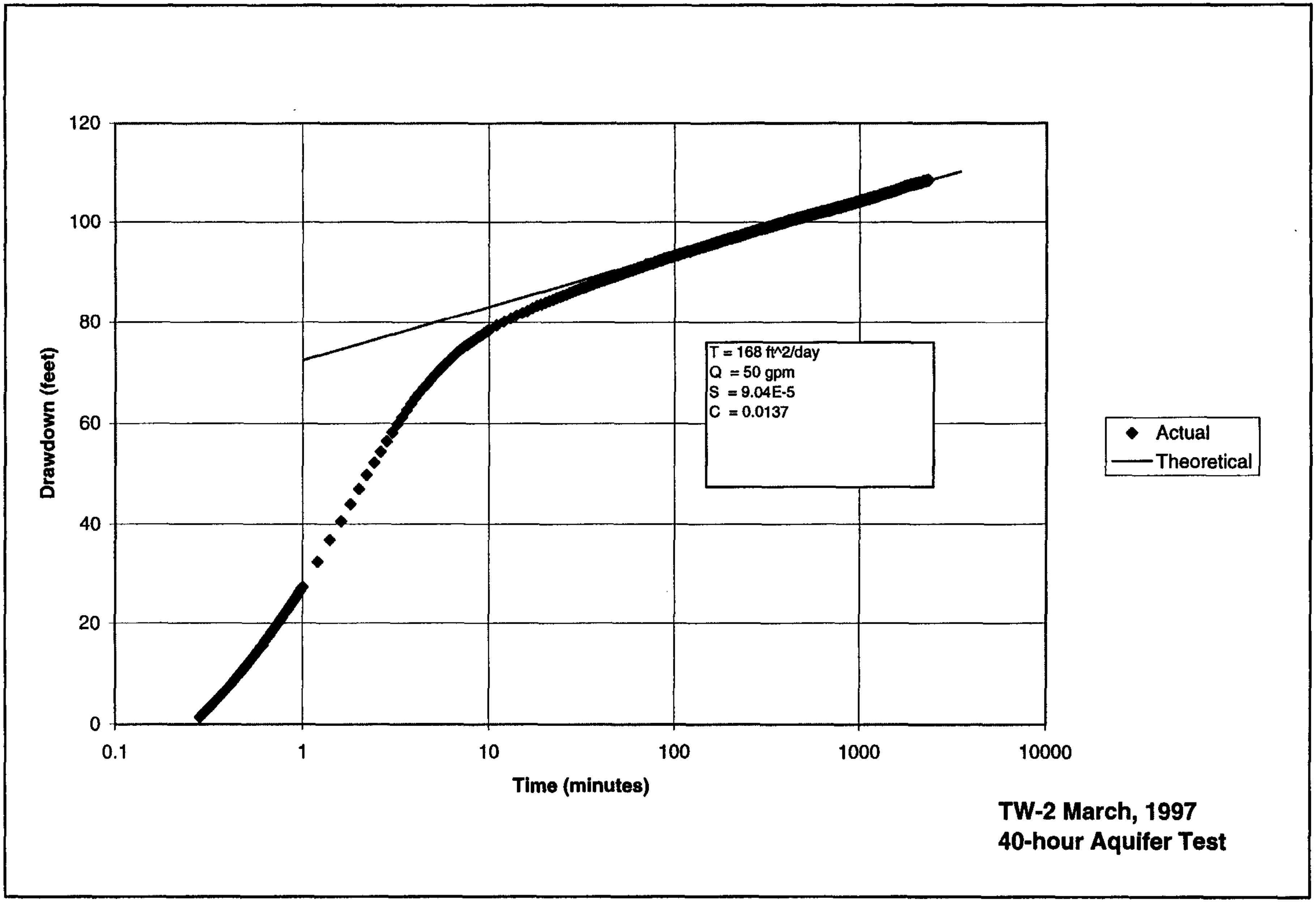
$Lp = BQ/(BQ + CQ^2)$

Q=	50.0000					
B =	1.5556 (From graph)					
C=	**0.0137** (From graph)					
Lp =	**69.48%**					
CQ2=	34.1667					
Q	**s/Q**	s	**Q/s**	**B**	**C=**	**0.013667**
30	**1.966667**	59	0.508475	1.556667		
40	**2.1**	84	0.47619	1.553333		
50	**2.24**	112	0.446429	1.556667		





TW-2 Step Test
March, 1997, Pre-Redevelopment


120
100
80
60
40
20
0
Drawdown (feet)
0.1
1
10
100
1000
10000
Time (minutes)
T = 168 ft^2/day
Q = 50 gpm
S = 9.04E-5
C = 0.0137
Actual
Theoretical
TW-2 March, 1997
40-hour Aquifer Test

TW-2 Well Loss Determination
Post-Redevelopment

Hantush-Bierschenk Method of Determining Well Losses

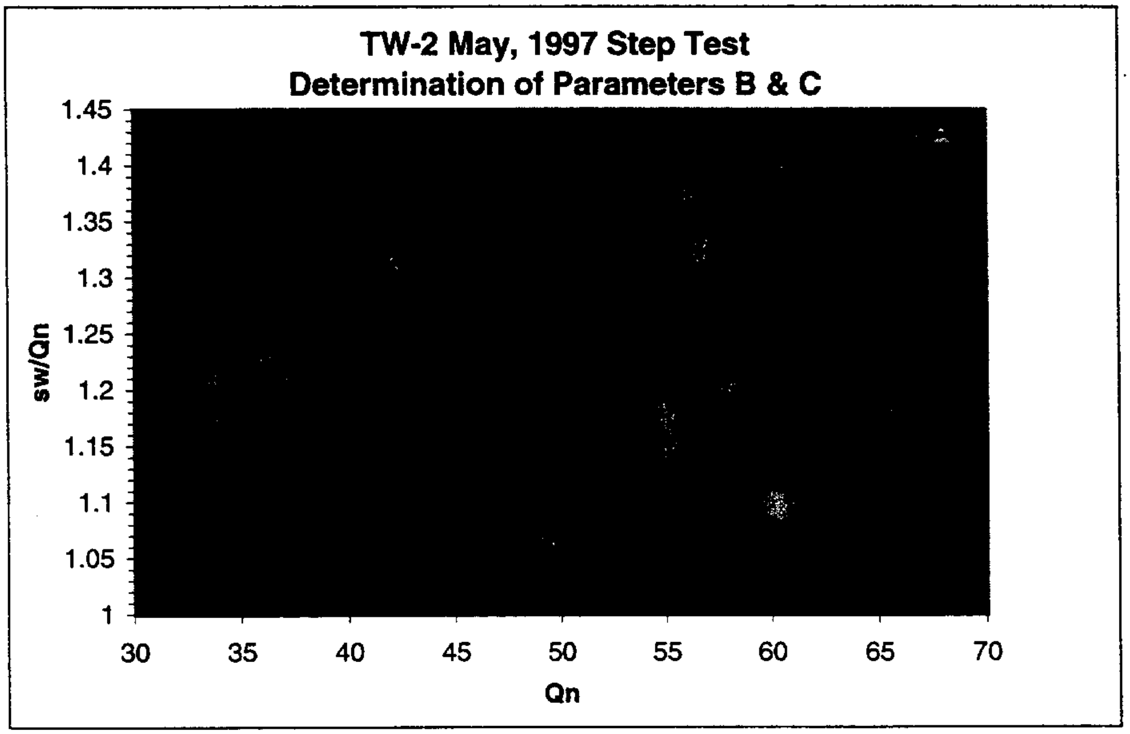
$s = BQ + CQ^2$ where BQ is aquifer loss (laminar term), CQ^2 is well loss (turbulent term)

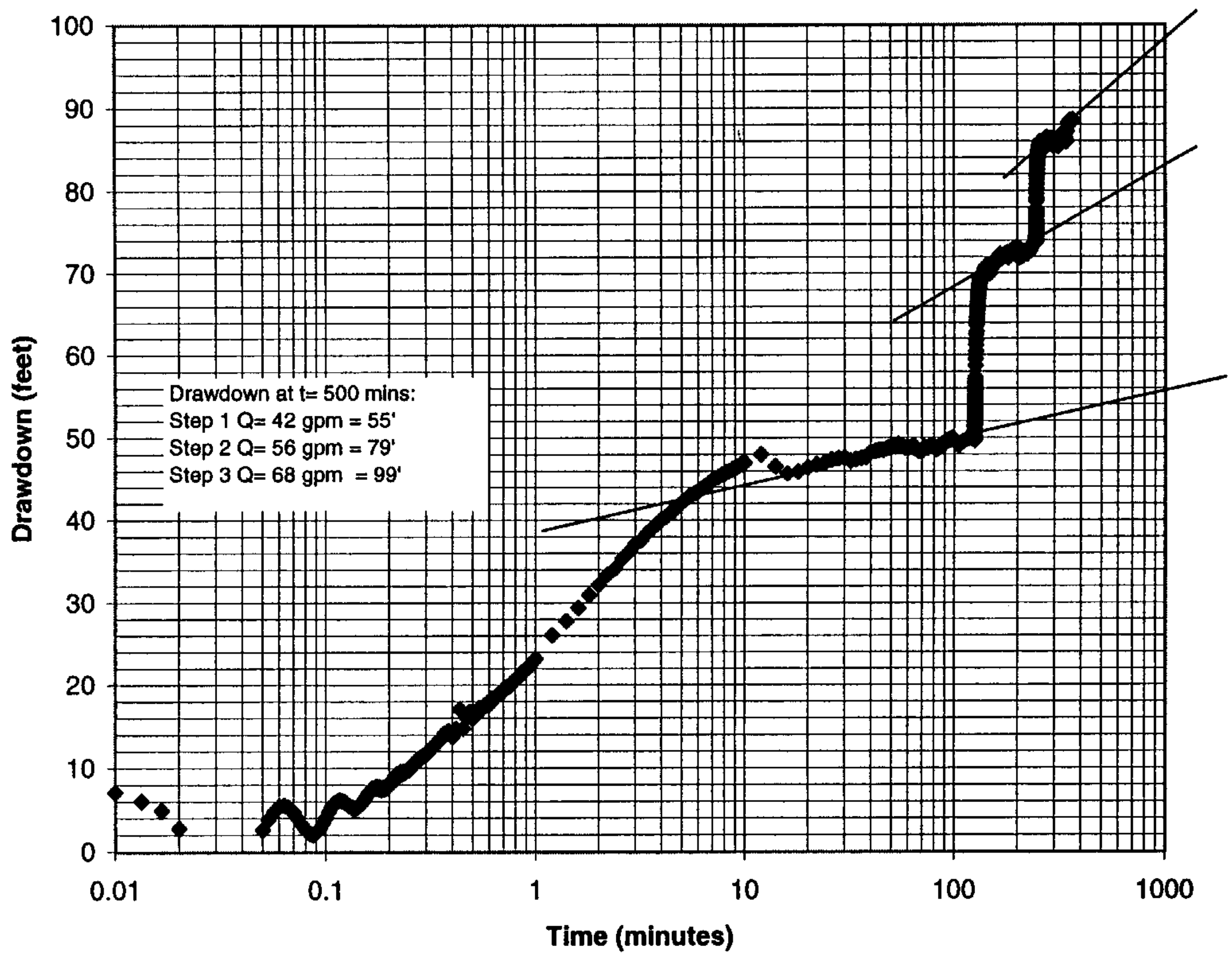
Lp = percentage head loss attributable to laminar flow

$Lp = BQ/(BQ + CQ^2)$

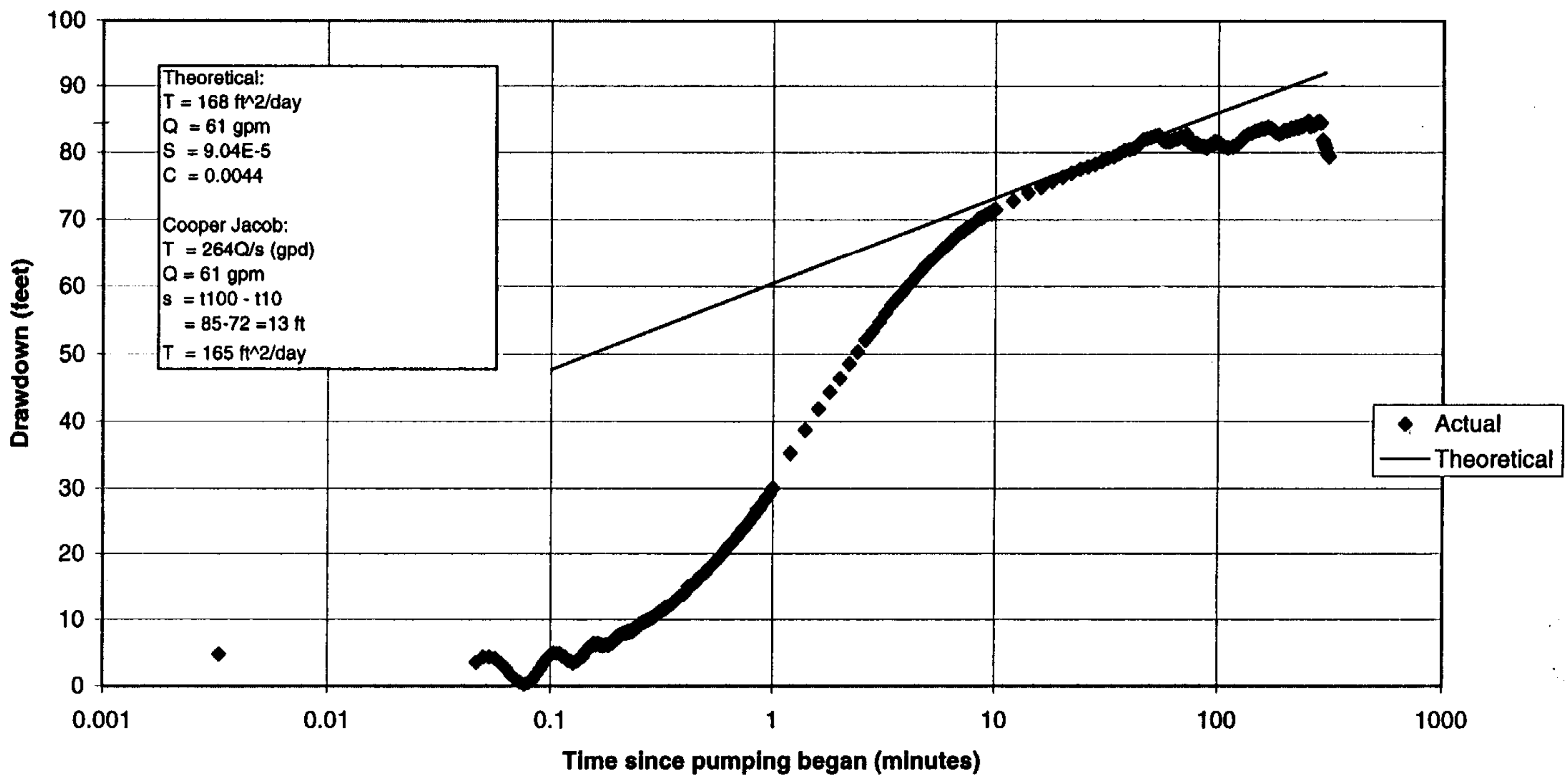
Q=	50.0000	
B =	1.1273	(From graph)
C=	**0.0044**	(From graph)
Lp =	**83.65%**	
CQ2=	11.0159	

Q (gpm)	s (after 500 mins)	s/Q	Calc Q/s	B	C=	0.004406
42	55.1	1.311905	0.76225	1.126837		
56	77	1.375	0.727273	1.128243		
68	97	1.426471	0.701031	1.126837		

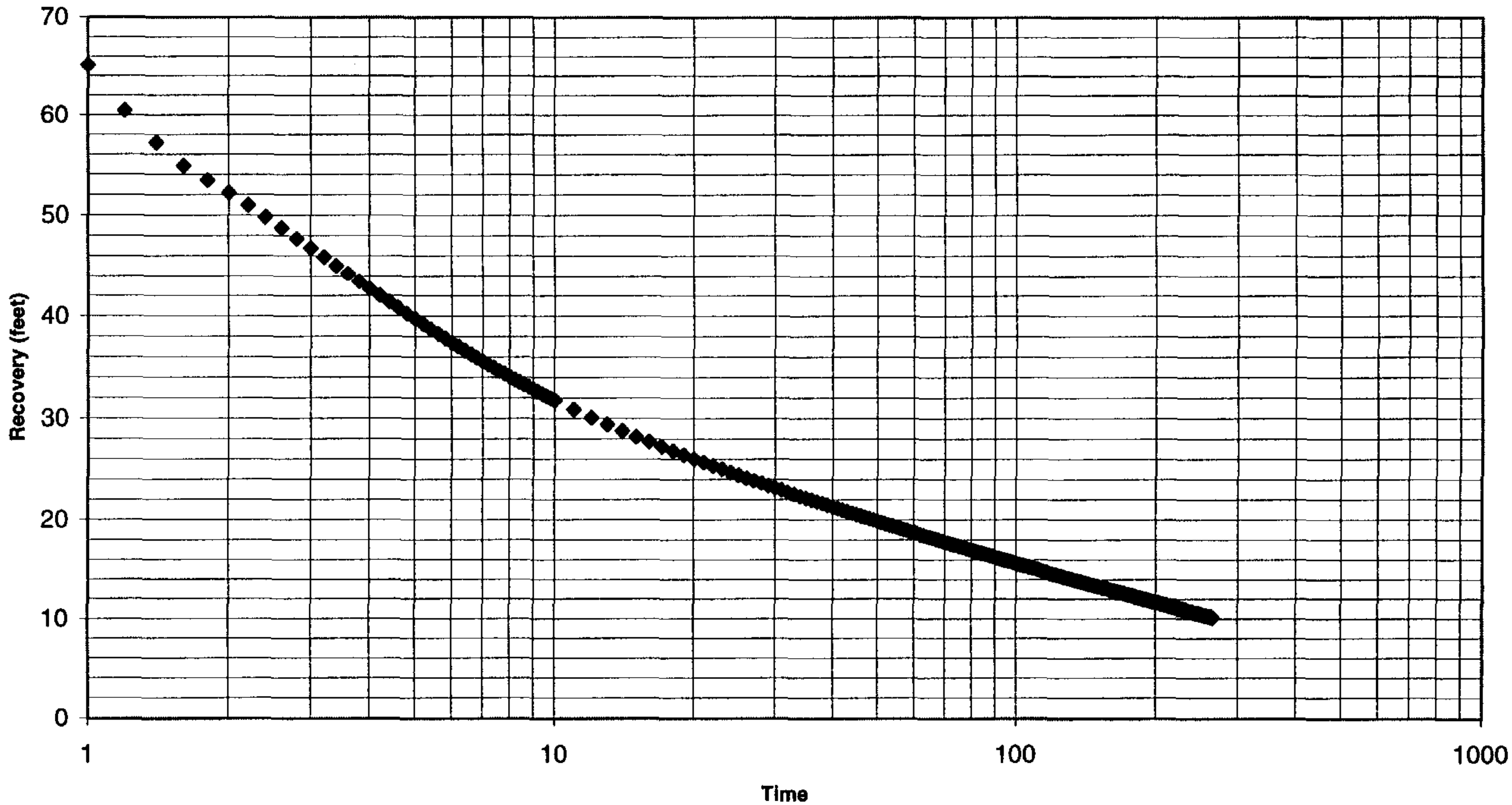




TW-2 May, 1997
Post-Redevelopment Step Test



TW-2 May, 1997
5-hour Aquifer Test



TW-2 Recovery Plot, March, 1997

Figure E- (Recovery)

Attachment E-3
Test Well TW-3

TW-3 Well Loss Determination -
Pre-redevelopment

Hantush-Bierschenk Method of Determining Well Losses

$s = BQ + CQ^2$ where BQ is aquifer loss (laminar term), CQ^2 is well loss (turbulent term)

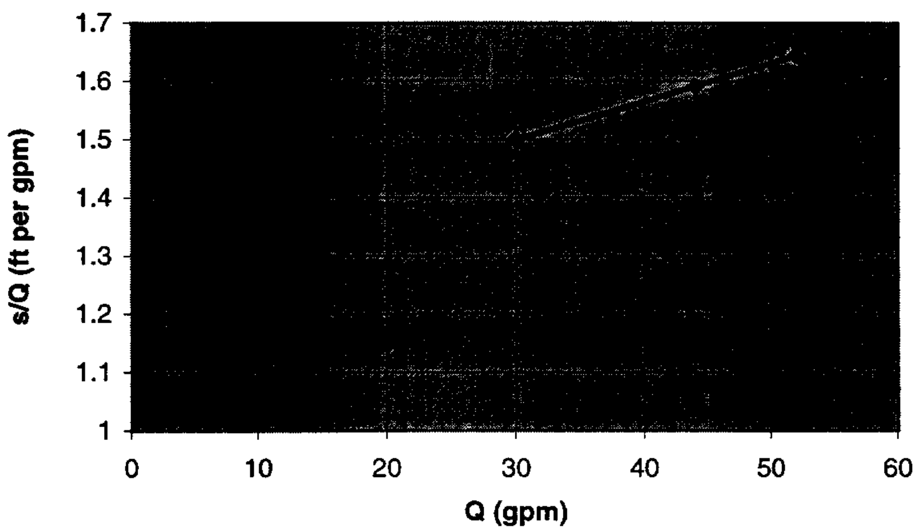
Lp = percentage head loss attributable to laminar flow

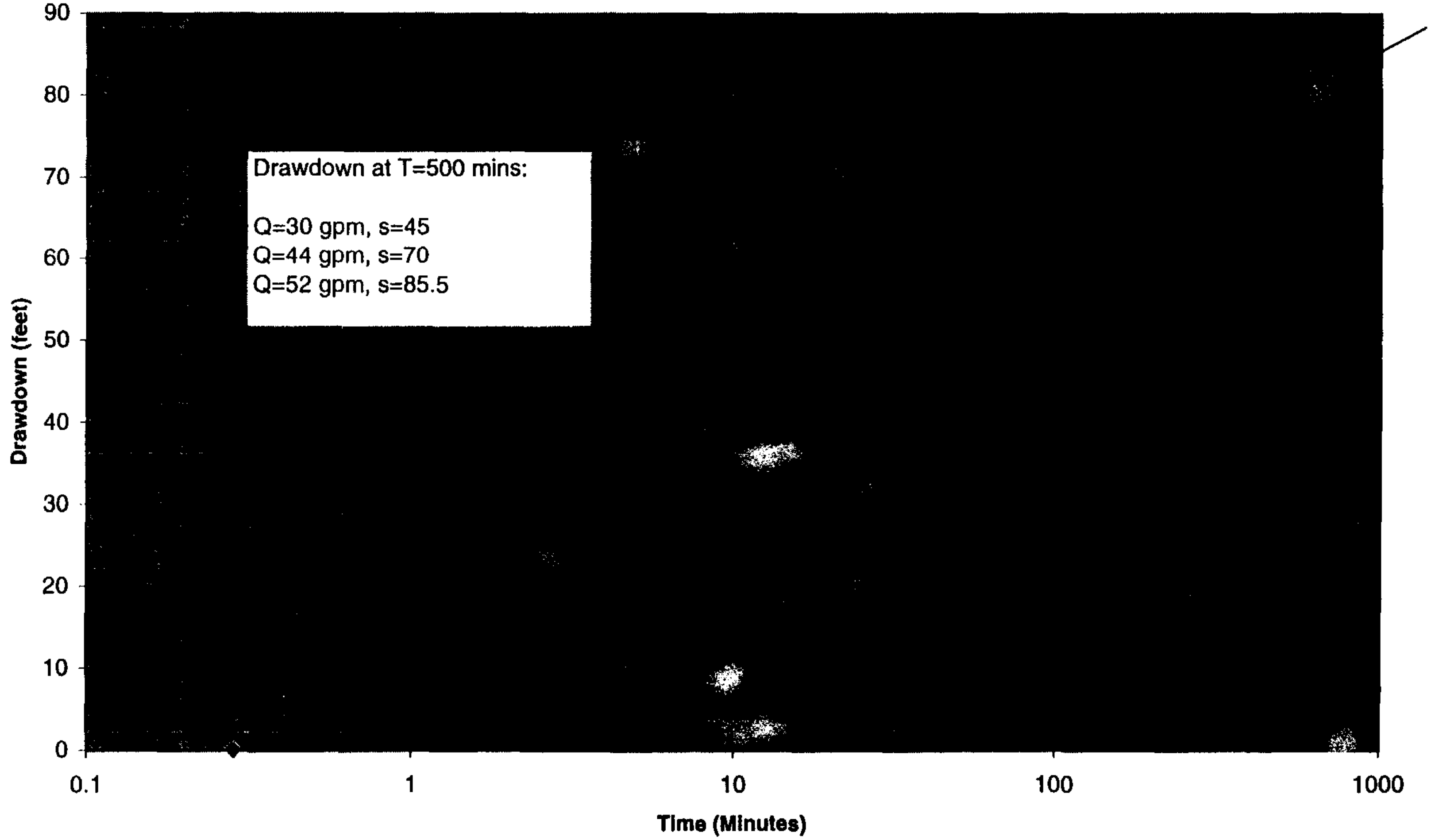
$Lp= BQ/(BQ + CQ^2)$

Q=	50.0000	
B =	1.3030	(From graph)
C=	**0.0066**	(From graph)
Lp =	**79.90%**	
CQ2=	16.3899	

Q (gpm)	Q/s	s	s/Q	B	C=	0.006556
30	0.66666667	45	**1.5**	1.303321678		
44	0.62857143	70	**1.590909**	1.302447552		
52	0.60818713	85.5	**1.644231**	1.303321678		

TW-3 - April, 1997 Step Test #1
Determination of Parameters B & C

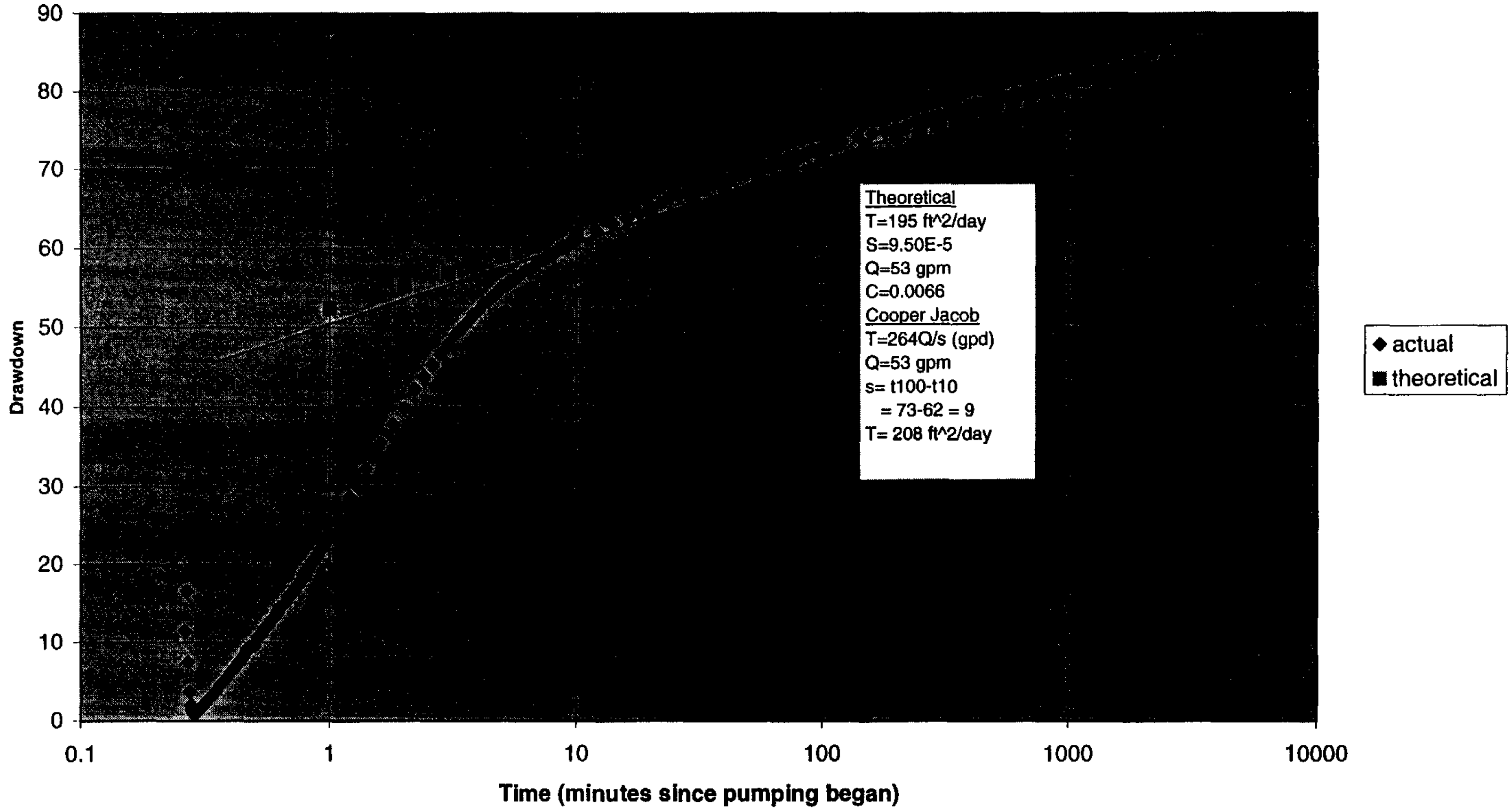




TW-3 Step Test
April 12, 1997 Pre-redevelompment

Figure E-_ Step Test Graph (2)

TW3REV-fnl.xls5/15/98



TW-3 Pump Test Results
April, 1997

TW-3 Well Loss Determination - Post-redevelopment

Hantush-Bierschenk Method of Determining Well Losses

$s = BQ + CQ^2$ where BQ is aquifer loss (laminar term), CQ^2 is well loss (turbulent term)

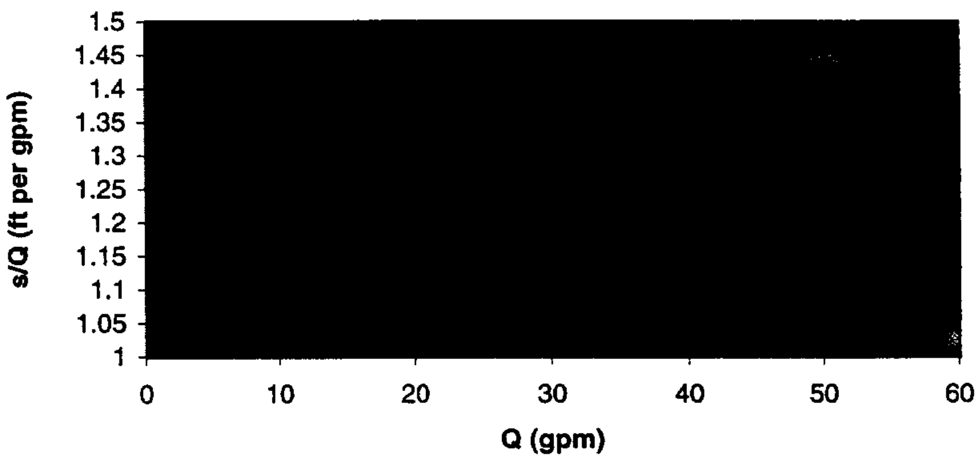
Lp = percentage head loss attributable to laminar flow

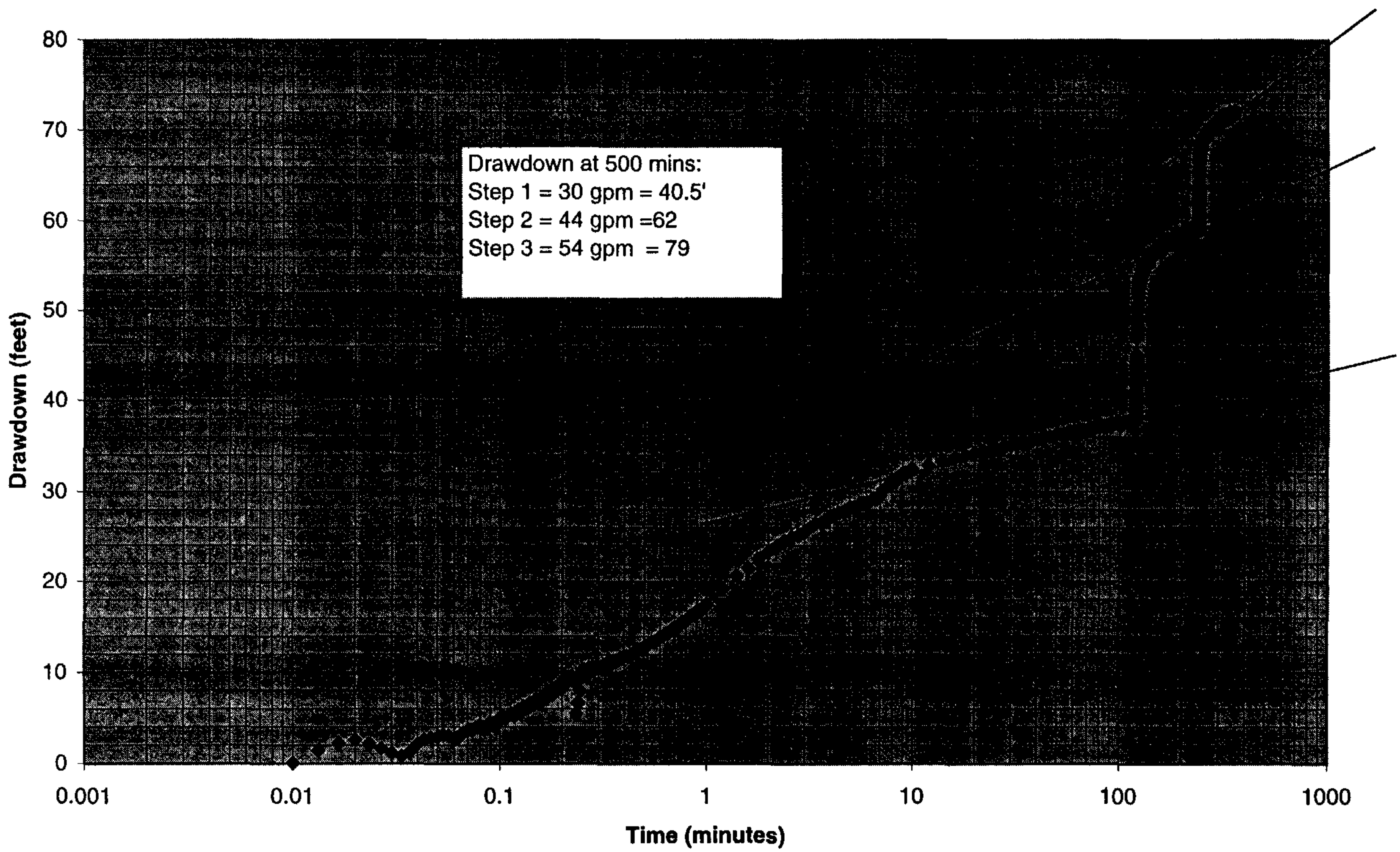
$Lp = BQ/(BQ + CQ^2)$

Q=	50	
B =	1.2065	(From graph)
C=	**0.0047**	(From graph)
Lp =	**83.68%**	
CQ2=	11.77	

Q (gpm)	Q/s	s	**s/Q**	**B**	**c=**	**0.004707**
30	0.74074074	40.5	**1.35**	1.208796296		
44	0.70967742	62	**1.409091**	1.201992144		
54	0.6835443	79	**1.462963**	1.208796296		

TW-3 - May, 1997 Post Re-development Step Test
Determination of Parameters B & C





TW-3 Step Test
May,1997 Post- Redevelopment

Appendix F
Laboratory Reports

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	85-20-901	LAB ID	AQ-01
DATE SAMPLED	12/04/96	DATE RECEIVED	12/04/96
TIME SAMPLED	10:58	TIME RECEIVED	p.m.

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2,105		µS/cm	12/05/96	hm
SM 2540 C	Total Dissolved Solids	2,065		mg/L	12/05/96	hm
SM 2540 H+B	pH	7.47		S.U.	12/04/96	hm
SM 2320 B	Total Alkalinity as CaCO3	268		mg/L	12/10/96	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	ND		mg/L	12/10/96	hm
SM 2320 B	Carbonate as CaCO3	ND	Calculated	mg/l		
SM 2320 B	Bicarbonates as CaCO3	268	Calculated	mg/L		
SM 2340 B	Hardness as CaCO3	389		mg/L	12/20/96	hm
EPA 300.7	Calcium	88	0.02	mg/L	12/20/96	jcm
EPA 300.0	Magnesium	41	0.02		12/20/96	jcm
EPA 300.0	Bromide	0.924	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrate	0.490	0.002	mg/L	12/05/96	jcm
EPA 300.0	Sulfate	876	0.02	mg/L	12/05/96	jcm
EPA 300.0	Chloride	315	0.02	mg/L	12/05/96	jcm
EPA 300.0	Flouride	2.629	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	12/05/96	jcm
EPA 300.0	Ortho-Phosphate	ND	0.003	mg/L	12/05/96	jcm
EPA 300.7	Lithium	0.117	0.01	mg/L	12/20/96	jcm
EPA 300.7	Sodium	422	0.03	mg/L	12/20/96	jcm
EPA 300.7	Potassium	7.096	0.01	mg/L	12/20/96	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	12/20/96	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	85-29-7	LAB ID	AQ-02
DATE SAMPLED	12/04/96	DATE RECEIVED	12/04/96
TIME SAMPLED	14:05	TIME RECEIVED	p.m.

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	4,772		µS/cm	12/05/96	hm
SM 2540 C	Total Dissolved Solids	5,163		mg/L	12/05/96	hm
SM 2540 H+B	pH	7.84		S.U.	12/04/96	hm
SM 2320 B	Total Alkalinity as CaCO3	244		mg/L	12/10/96	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	18		mg/L	12/10/96	hm
SM 2320 B	Carbonate as CaCO3	36	Calculated	mg/l		
SM 2320 B	Bicarbonates as CaCO3	208	Calculated	mg/L		
SM 2340 B	Hardness as CaCO3	323		mg/L	12/20/96	hm
EPA 300.7	Calcium	83	0.02	mg/L	12/20/96	jcm
EPA 300.0	Magnesium	28	0.02		12/20/96	jcm
EPA 300.0	Bromide	1.74	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	12/05/96	jcm
EPA 300.0	Sulfate	2,830	0.02	mg/L	12/05/96	jcm
EPA 300.0	Chloride	743	0.02	mg/L	12/05/96	jcm
EPA 300.0	Flouride	5.841	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	12/05/96	jcm
EPA 300.0	Ortho-Phosphate	ND	0.003	mg/L	12/05/96	jcm
EPA 300.7	Lithium	0.073	0.01	mg/L	12/20/96	jcm
EPA 300.7	Sodium	982	0.03	mg/L	12/20/96	jcm
EPA 300.7	Potassium	39.00	0.01	mg/L	12/20/96	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	12/20/96	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	85-37-403	LAB ID	AQ-03
DATE SAMPLED	12/05/96	DATE RECEIVED	12/05/96
TIME SAMPLED	11:40	TIME RECEIVED	p.m.

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2,160		µS/cm	12/05/96	hm
SM 2540 C	Total Dissolved Solids	2,243		mg/L	12/05/96	hm
SM 2540 H+B	pH	7.38		S.U.	12/04/96	hm
SM 2320 B	Total Alkalinity as CaCO3	328		mg/L	12/10/96	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	8		mg/L	12/10/96	hm
SM 2320 B	Carbonate as CaCO3	16	Calculated	mg/l		
SM 2320 B	Bicarbonates as CaCO3	312	Calculated	mg/L		
SM 2340 B	Hardness as CaCO3	322		mg/L	12/20/96	hm
EPA 300.7	Calcium	76	0.02	mg/L	12/20/96	jcm
EPA 300.0	Magnesium	32	0.02		12/20/96	jcm
EPA 300.0	Bromide	0.64	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	12/05/96	jcm
EPA 300.0	Sulfate	1,027	0.02	mg/L	12/05/96	jcm
EPA 300.0	Chloride	243	0.02	mg/L	12/05/96	jcm
EPA 300.0	Flouride	3.23	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	12/05/96	jcm
EPA 300.0	Ortho-Phosphate	ND	0.003	mg/L	12/05/96	jcm
EPA 300.7	Lithium	0.09	0.01	mg/L	12/20/96	jcm
EPA 300.7	Sodium	521	0.03	mg/L	12/20/96	jcm
EPA 300.7	Potassium	5.52	0.01	mg/L	12/20/96	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	12/20/96	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	85-37-405	LAB ID	AQ-04
DATE SAMPLED	12/03/96	DATE RECEIVED	12/04/96
TIME SAMPLED	15:50	TIME RECEIVED	a.m.

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	3,044		µS/cm	12/05/96	hm
SM 2540 C	Total Dissolved Solids	3,410		mg/L	12/05/96	hm
SM 2540 H+B	pH	7.43		S.U.	12/04/96	hm
SM 2320 B	Total Alkalinity as CaCO3	352		mg/L	12/10/96	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	ND		mg/L	12/10/96	hm
SM 2320 B	Carbonate as CaCO3	ND	Calculated	mg/l		
SM 2320 B	Bicarbonates as CaCO3	352	Calculated	mg/L		
SM 2340 B	Hardness as CaCO3	271		mg/L	12/20/96	hm
EPA 300.7	Calcium	107	0.02	mg/L	12/20/96	jcm
EPA 300.0	Magnesium	67	0.02		12/20/96	jcm
EPA 300.0	Bromide	1.03	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	12/05/96	jcm
EPA 300.0	Sulfate	1,801	0.02	mg/L	12/05/96	jcm
EPA 300.0	Chloride	356	0.02	mg/L	12/05/96	jcm
EPA 300.0	Flouride	4.6	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	12/05/96	jcm
EPA 300.0	Ortho-Phosphate	ND	0.003	mg/L	12/05/96	jcm
EPA 300.7	Lithium	0.14	0.01	mg/L	12/20/96	jcm
EPA 300.7	Sodium	892	0.03	mg/L	12/20/96	jcm
EPA 300.7	Potassium	7.56	0.01	mg/L	12/20/96	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	12/20/96	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	85-29-301	LAB ID	AQ-05
DATE SAMPLED	12/03/96	DATE RECEIVED	12/04/96
TIME SAMPLED	14:35	TIME RECEIVED	a.m.

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	3,362		µS/cm	12/05/96	hm
SM 2540 C	Total Dissolved Solids	3,465		mg/L	12/05/96	hm
SM 2540 H+B	pH	8.7		S.U.	12/04/96	hm
SM 2320 B	Total Alkalinity as CaCO3	280		mg/L	12/10/96	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	8		mg/L	12/10/96	hm
SM 2320 B	Carbonate as CaCO3	16	Calculated	mg/l		
SM 2320 B	Bicarbonates as CaCO3	264	Calculated	mg/L		
SM 2340 B	Hardness as CaCO3	103		mg/L	12/20/96	hm
EPA 300.7	Calcium	10	0.02	mg/L	12/20/96	jcm
EPA 300.0	Magnesium	1.00	0.02		12/20/96	jcm
EPA 300.0	Bromide	1.08	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	12/05/96	jcm
EPA 300.0	Sulfate	1,855	0.02	mg/L	12/05/96	jcm
EPA 300.0	Chloride	358	0.02	mg/L	12/05/96	jcm
EPA 300.0	Flouride	4.62	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	12/05/96	jcm
EPA 300.0	Ortho-Phosphate	ND	0.003	mg/L	12/05/96	jcm
EPA 300.7	Lithium	0.10	0.01	mg/L	12/20/96	jcm
EPA 300.7	Sodium	695	0.03	mg/L	12/20/96	jcm
EPA 300.7	Potassium	1.63	0.01	mg/L	12/20/96	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	12/20/96	jcm

LABORATORY RESULTS

PROJECT: ASR

SAMPLE ID	85-2~~0~~9-102	LAB ID	AQ-06
DATE SAMPLED	12/03/96	DATE RECEIVED	12/04/96
TIME SAMPLED	16:20	TIME RECEIVED	a.m.

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	1,890		µS/cm	12/05/96	hm
SM 2540 C	Total Dissolved Solids	1,785		mg/L	12/05/96	hm
SM 2540 H+B	pH	8.92		S.U.	12/04/96	hm
SM 2320 B	Total Alkalinity as CaCO3	220		mg/L	12/10/96	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	14		mg/L	12/10/96	hm
SM 2320 B	Carbonate as CaCO3	28	Calculated	mg/l		
SM 2320 B	Bicarbonates as CaCO3	192	Calculated	mg/L		
SM 2340 B	Hardness as CaCO3	2.20		mg/L	12/20/96	hm
EPA 300.7	Calcium	3.19	0.02	mg/L	12/20/96	jcm
EPA 300.0	Magnesium	0.31	0.02		12/20/96	jcm
EPA 300.0	Bromide	1.11	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	12/05/96	jcm
EPA 300.0	Sulfate	521	0.02	mg/L	12/05/96	jcm
EPA 300.0	Chloride	397	0.02	mg/L	12/05/96	jcm
EPA 300.0	Flouride	2.35	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	12/05/96	jcm
EPA 300.0	Ortho-Phosphate	ND	0.003	mg/L	12/05/96	jcm
EPA 300.7	Lithium	0.03	0.01	mg/L	12/20/96	jcm
EPA 300.7	Sodium	349	0.03	mg/L	12/20/96	jcm
EPA 300.7	Potassium	0.90	0.01	mg/L	12/20/96	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	12/20/96	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	85-29-401	LAB ID	AQ-07
DATE SAMPLED	12/04/96	DATE RECEIVED	12/04/96
TIME SAMPLED	10:45	TIME RECEIVED	p.m.

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	1,465		µS/cm	12/05/96	hm
SM 2540 C	Total Dissolved Solids	1,318		mg/L	12/05/96	hm
SM 2540 H+B	pH	8.85		S.U.	12/04/96	hm
SM 2320 B	Total Alkalinity as CaCO3	276		mg/L	12/10/96	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	24		mg/L	12/10/96	hm
SM 2320 B	Carbonate as CaCO3	48	Calculated	mg/l		
SM 2320 B	Bicarbonates as CaCO3	228	Calculated	mg/L		
SM 2340 B	Hardness as CaCO3	24		mg/L	12/20/96	hm
EPA 300.7	Calcium	1.69	0.02	mg/L	12/20/96	jcm
EPA 300.0	Magnesium	0.16	0.02		12/20/96	jcm
EPA 300.0	Bromide	0.78	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	12/05/96	jcm
EPA 300.0	Sulfate	329	0.02	mg/L	12/05/96	jcm
EPA 300.0	Chloride	378	0.02	mg/L	12/05/96	jcm
EPA 300.0	Flouride	0.83	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	12/05/96	jcm
EPA 300.0	Ortho-Phosphate	ND	0.003	mg/L	12/05/96	jcm
EPA 300.7	Lithium	0.02	0.01	mg/L	12/20/96	jcm
EPA 300.7	Sodium	445	0.03	mg/L	12/20/96	jcm
EPA 300.7	Potassium	0.67	0.01	mg/L	12/20/96	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	12/20/96	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	85-20-706	LAB ID	AQ-08
DATE SAMPLED	12/04/96	DATE RECEIVED	12/04/96
TIME SAMPLED	13:55	TIME RECEIVED	p.m.

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	1,546		µS/cm	12/05/96	hm
SM 2540 C	Total Dissolved Solids	1,420		mg/L	12/05/96	hm
SM 2540 H+B	pH	8.74		S.U.	12/04/96	hm
SM 2320 B	Total Alkalinity as CaCO3	340		mg/L	12/10/96	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	20		mg/L	12/10/96	hm
SM 2320 B	Carbonate as CaCO3	40	Calculated	mg/l		
SM 2320 B	Bicarbonates as CaCO3	300	Calculated	mg/L		
SM 2340 B	Hardness as CaCO3	9.23		mg/L	12/20/96	hm
EPA 300.7	Calcium	2.22	0.02	mg/L	12/20/96	jcm
EPA 300.0	Magnesium	0.90	0.02		12/20/96	jcm
EPA 300.0	Bromide	0.74	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	12/05/96	jcm
EPA 300.0	Sulfate	341	0.02	mg/L	12/05/96	jcm
EPA 300.0	Chloride	271	0.02	mg/L	12/05/96	jcm
EPA 300.0	Flouride	0.87	0.01	mg/L	12/05/96	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	12/05/96	jcm
EPA 300.0	Ortho-Phosphate	ND	0.003	mg/L	12/05/96	jcm
EPA 300.7	Lithium	0.02	0.01	mg/L	12/20/96	jcm
EPA 300.7	Sodium	512	0.03	mg/L	12/20/96	jcm
EPA 300.7	Potassium	1.28	0.01	mg/L	12/20/96	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	12/20/96	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	85-29-709	LAB ID	AQ-12
DATE SAMPLED	01/21/97	DATE RECEIVED	01/21/97
TIME SAMPLED	09:30	TIME RECEIVED	12:26

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	1366		µS/cm	01/23/97	pa
SM 2540 C	Total Dissolved Solids	1080		mg/L	01/23/97	jcm
SM 2540 H+B	pH	8.48		S.U.	01/23/97	pa
SM 2320 B	Total Alkalinity as CaCO3	325		mg/L	01/23/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	35		mg/L	01/23/97	hm
	Carbonate as CaCO3	42	Calculated	mg/l	02/07/97	am
	Bicarbonates as CaCO3	311	Calculated	mg/L	02/07/97	am
SM 2340 B	Hardness as CaCO3	11		mg/L	01/23/97	am
SM 4110 B	Calcium	NA		mg/L		hm
EPA 300.7	Calcium	2.4	0.02	mg/L	01/25/97	jcm
EPA 300.0	Magnesium	0.6	0.02	mg/L	01/25/97	jcm
EPA 300.0	Bromide	ND	0.01	mg/L	01/24/97	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	02/07/97	jcm
EPA 300.0	Sulfate	472	0.02	mg/L	02/07/97	jcm
SM 4110 B	Chlorides	NA		mg/L		pa
EPA 300.0	Chlorides	278	0.02	mg/L	02/07/97	jcm
EPA 300.0	Flouride	0.7	0.01	mg/L	02/07/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	02/07/97	jcm
EPA 300.0	Phosphate	ND	0.003	mg/L	02/07/97	jcm
EPA 300.7	Lithium	0.06	0.01	mg/L	01/25/97	jcm
EPA 300.7	Sodium	473	0.03	mg/L	01/25/97	jcm
EPA 300.7	Potassium	1.5	0.01	mg/L	01/25/97	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	01/25/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	85-29-804	LAB ID	AQ-13
DATE SAMPLED	01/21/97	DATE RECEIVED	01/21/97
TIME SAMPLED	10:20	TIME RECEIVED	12:26

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2732		µS/cm	01/23/97	pa
SM 2540 C	Total Dissolved Solids	2200		mg/L	01/23/97	jcm
SM 2540 H+B	pH	8.13		S.U.	01/23/97	pa
SM 2320 B	Total Alkalinity as CaCO3	970		mg/L	01/23/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	20		mg/L	01/23/97	hm
	Carbonate as CaCO3	24	Calculated	mg/l	02/07/97	am
	Bicarbonates as CaCO3	1134	Calculated	mg/L	02/07/97	am
SM 2340 B	Hardness as CaCO3	10.3		mg/L	01/23/97	am
SM 4110 B	Calcium	NA		mg/L		hm
EPA 300.7	Calcium	2.5	0.02	mg/L	01/25/97	jcm
EPA 300.0	Magnesium	1.3	0.02	mg/L	01/25/97	jcm
EPA 300.0	Bromide	1.3	0.01	mg/L	01/24/97	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	02/07/97	jcm
EPA 300.0	Sulfate	629	0.02	mg/L	02/07/97	jcm
SM 4110 B	Chlorides	NA		mg/L		pa
EPA 300.0	Chlorides	482	0.02	mg/L	02/07/97	jcm
EPA 300.0	Flouride	1.7	0.01	mg/L	02/07/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	02/07/97	jcm
EPA 300.0	Phosphate	ND	0.003	mg/L	02/07/97	jcm
EPA 300.7	Lithium	0.11	0.01	mg/L	01/25/97	jcm
EPA 300.7	Sodium	956	0.03	mg/L	01/25/97	jcm
EPA 300.7	Potassium	2.1	0.01	mg/L	01/25/97	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	01/25/97	jcm

CITY OF LAREDO, WATER UTILITIES LAB SERVICES

PROJECT: ASR

DATE: Mar. 11,1998

Sample ID: AQ-14
Date Sampled: 1/30/97
Time Sampled: 16:30

Lab ID: AQ-14
Date Received: 1/30/97
Time Received: 16:20

TEST METHOD	PARAMETER	SAMPLE RESULT	UNITS	DATE	TECH
SM 2510B	Conductivity	2001	us/cm	1/31/97	JCM
SM 2540C	Total Dissolved Solids	1654	mg/L	1/30/97	HM
SM 2540 H+B	pH	7.48	S.U.	1/31/97	HM
SM 2320 B	Total Alkalinity	500	mg/L	1/31/97	HM
SM 2320 B	Phenolphthalein Alkalinity	ND	mg/L	1/31/97	HM
SM 2320 B	Carbonate	0	mg/L	CALC.	
SM 2320 B	Bicarbonate	500	mg/L	CALC.	
SM 2320 B	Hardness	164	mg/L	1/31/97	PA
EPA 300.7	Calcium	36.7	mg/L	2/1/97	JCM
EPA 300.0	Magnesium	17.8	mg/L	1/31/97	PA
EPA 300.0	Bromide	5.1	mg/L	1/31/97	JCM
EPA 300.0	Nitrate	ND	mg/L	1/31/97	JCM
EPA 300.0	Sulfate	540	mg/L	1/31/97	JCM
EPA 300.0	Chloride	280	mg/L	1/31/97	JCM
EPA 300.0	Flouride	1.913	mg/L	1/31/97	JCM
EPA 300.0	Nitrite	ND	mg/L	1/31/97	JCM
EPA 300.0	Ortho-Phosphate	NA	mg/L	1/31/97	JCM
EPA 300.7	Lithium	0.182	mg/L	1/31/97	JCM
EPA 300.7	Potassium	6.257	mg/L	1/31/97	JCM
AM 4500 MH3	Ammonia Nitrogen	ND	mg/L	1/31/97	JCM

City of Laredo, Water Utilities Department
Water Pollution Control Laboratory Services

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-14	LAB ID	AQ-14
DATE SAMPLED	01/30/97	DATE RECEIVED	01/30/97
TIME SAMPLED	15:45	TIME RECEIVED	16:30

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2,001		µS/cm	01/31/97	hm
SM 7540 C	Total Dissolved Solids	1.654		mg/L	01/31/97	hm
SM 2540 H+B	pH	7.48		S.U.	01/31/97	hm
SM 2320 B	Total Alkalinity as CaCO3	500		mg/L	01/31/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	ND		mg/L	01/31/97	hm
	Carbonate ion	0	Calculated	mg/l	02/07/97	am
	Bicarbonate ion	610	Calculated	mg/L	02/07/97	am
SM 2340 B	Hardness as CaCO3	165		mg/L	01/31/97	hm
EPA 300.7	Calcium	37	0.02	mg/L	02/02/97	jcm
EPA 300.0	Magnesium	18	0.02	mg/L	02/02/97	jcm
EPA 300.0	Bromide	5.1	0.01	mg/L	01/31/97	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	01/31/97	jcm
EPA 300.0	Sulfate	541	0.02	mg/L	01/31/97	jcm
EPA 300.0	Chlorides	280	0.02	mg/L	01/31/97	jcm
EPA 300.0	Flouride	1.9	0.01	mg/L	01/31/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	01/31/97	jcm
EPA 300.0	o-Phosphate	ND	0.003	mg/L	01/31/97	jcm
EPA 300.7	Lithium	0.2	0.01	mg/L	02/02/97	jcm
EPA 300.7	Sodium	639	0.03	mg/L	02/02/97	jcm
EPA 300.7	Potassium	6.3	0.01	mg/L	02/02/97	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	02/02/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-15	LAB ID	AQ-15
DATE SAMPLED	02/06/97	DATE RECEIVED	02/06/97
TIME SAMPLED	1230	TIME RECEIVED	1250

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2890		µS/cm	02/10/97	pa
SM 2540 C	Total Dissolved Solids	1752		mg/L	02/20/97	jcm
SM 2540 H+B	pH	8.95		S.U.	02/06/96	pa
SM 2320 B	Total Alkalinity as CaCO3	185		mg/L	02/07/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	27		mg/L	02/07/97	hm
	Carbonate as CaCO3	54	Calculated	mg/l	02/20/97	am
	Bicarbonates as CaCO3	131	Calculated	mg/L	02/20/97	am
SM 2340 B	Hardness as CaCO3	21		mg/L	02/20/97	am
SM 4110 B	Calcium	8		mg/L	02/07/97	hm
EPA 300.7	Calcium	7.61	0.02	mg/L	02/07/97	jcm
EPA 300.0	Magnesium	0.194	0.02	mg/L	02/13/97	jcm
EPA 300.0	Bromide	1.29	0.01	mg/L	02/07/97	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	02/07/97	jcm
EPA 300.0	Sulfate	616	0.02	mg/L	02/07/97	jcm
SM 4110 B	Chlorides	450		mg/L	02/07/97	pa
EPA 300.0	Chlorides	469	0.02	mg/L	02/07/97	jcm
EPA 300.0	Flouride	2.40	0.01	mg/L	02/07/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	02/07/97	jcm
EPA 300.0	Phosphate	ND	0.003	mg/L	02/07/97	jcm
EPA 300.7	Lithium	0.06	0.01	mg/L	02/13/97	jcm
EPA 300.7	Sodium	736	0.03	mg/L	02/13/97	jcm
EPA 300.7	Potassium	2.36	0.01	mg/L	02/13/97	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	02/13/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-16	LAB ID	AQ-16
DATE SAMPLED	02/06/97	DATE RECEIVED	02/07/97
TIME SAMPLED	1935	TIME RECEIVED	0910

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2880		µS/cm	02/10/97	PA
SM 2540 C	Total Dissolved Solids	1282		mg/L	02/20/97	HM
SM 2540 H+B	pH	9.0		S.U.	02/06/96	PA
SM 2320 B	Total Alkalinity as CaCO3	184		mg/L	02/07/97	HM
SM 2320 B	Phenolphthalein Alk as CaCO3	20		mg/L	02/07/97	HM
	Carbonate as CaCO3	40	Calculated	mg/l	02/20/97	AM
	Bicarbonates as CaCO3	144	Calculated	mg/L	02/20/97	AM
SM 2340 B	Hardness as CaCO3	20		mg/L	02/20/97	AM
SM 4110 B	Calcium as CaCO3	8.22		mg/L	02/07/97	HM
EPA 300.7	Calcium	6.72	0.02	mg/L	02/07/97	JCM
EPA 300.0	Magnesium	0.308	0.02	mg/L	02/14/97	JCM
EPA 300.0	Bromide	1.15	0.01	mg/L	02/07/97	JCM
EPA 300.0	Nitrate	ND	0.002	mg/L	02/07/97	JCM
EPA 300.0	Sulfate	593	0.02	mg/L	02/07/97	JCM
SM 4110 B	Chlorides	455		mg/L	02/07/97	PA
EPA 300.0	Chlorides	481	0.02	mg/L	02/07/97	JCM
EPA 300.0	Flouride	2.20	0.01	mg/L	02/07/97	JCM
EPA 300.0	Nitrite	ND	0.004	mg/L	02/07/97	JCM
EPA 300.0	Phosphate	ND	0.003	mg/L	02/07/97	JCM
EPA 300.7	Lithium	ND	0.01	mg/L	02/14/97	JCM
EPA 300.7	Sodium	739	0.03	mg/L	02/14/97	JCM
EPA 300.7	Potassium	1.98	0.01	mg/L	02/14/97	JCM
EPA 300.7	Ammonium	ND	0.03	mg/L	02/14/97	JCM

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-17	LAB ID	AQ-17
DATE SAMPLED	02/06/97	DATE RECEIVED	02/07/97
TIME SAMPLED	2359	TIME RECEIVED	0910

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2900		µS/cm	02/10/97	pa
SM 2540 C	Total Dissolved Solids	1224		mg/L	02/10/97	jcm
SM 2540 H+B	pH	8.79		S.U.	02/10/96	pa
SM 2320 B	Total Alkalinity as CaCO3	180		mg/L	02/07/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	18		mg/L	02/07/97	hm
	Carbonate as CaCO3	36	Calculated	mg/l	02/20/97	am
	Bicarbonates as CaCO3	144	Calculated	mg/L	02/20/97	am
SM 2340 B	Hardness as CaCO3	19		mg/L	02/20/97	hm
SM 4110 B	Calcium as CaCO3	8		mg/L	02/07/97	hm
EPA 300.7	Calcium	6.2	0.02	mg/L	02/14/97	jcm
EPA 300.0	Magnesium	0.38	0.02	mg/L	02/14/97	jcm
EPA 300.0	Bromide	1.17	0.01	mg/L	02/07/97	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	02/07/97	jcm
EPA 300.0	Sulfate	609	0.02	mg/L	02/07/97	JCM
SM 4110 B	Chlorides	445		mg/L	02/07/97	pa
EPA 300.0	Chlorides	426	0.02	mg/L	02/07/97	jcm
EPA 300.0	Flouride	2.22	0.01	mg/L	02/07/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	02/07/97	jcm
EPA 300.0	Phosphate	ND	0.003	mg/L	02/07/97	jcm
EPA 300.7	Lithium	ND	0.01	mg/L	02/14/97	jcm
EPA 300.7	Sodium	718	0.03	mg/L	02/14/97	jcm
EPA 300.7	Potassium	1.76	0.01	mg/L	02/14/97	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	02/14/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-18	LAB ID	AQ-18
DATE SAMPLED	02/07/97	DATE RECEIVED	02/07/97
TIME SAMPLED	0825	TIME RECEIVED	0910

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2900		µS/cm	02/10/97	pa
SM 2540 C	Total Dissolved Solids	1204		mg/L	02/10/97	jcm
SM 2540 H+B	pH	8.83		S.U.	02/10/96	pa
SM 2320 B	Total Alkalinity as CaCO3	181		mg/L	02/07/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	18		mg/L	02/07/97	hm
	Carbonate as CaCO3	36	Calculated	mg/l	02/20/97	am
	Bicarbonates as CaCO3	145	Calculated	mg/L	02/20/97	am
SM 2340 B	Hardness as CaCO3	18		mg/L	02/07/97	hm
SM 4110 B	Calcium as CaCO3	8		mg/L	02/12/97	hm
EPA 300.7	Calcium	5.74	0.02	mg/L	02/14/97	jcm
EPA 300.0	Magnesium	0.47	0.02	mg/L	02/14/97	jcm
EPA 300.0	Bromide	1.24	0.01	mg/L	02/07/97	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	02/07/97	jcm
EPA 300.0	Sulfate	605	0.02	mg/L	02/07/97	jcm
SM 4110 B	Chlorides	445		mg/L	02/11/97	hm
EPA 300.0	Chlorides	413	0.02	mg/L	02/07/97	jcm
EPA 300.0	Flouride	2.26	0.01	mg/L	02/07/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	02/07/97	jcm
EPA 300.0	Phosphate	ND	0.003	mg/L	02/07/97	jcm
EPA 300.7	Lithium	ND	0.01	mg/L	02/14/97	jcm
EPA 300.7	Sodium	712	0.03	mg/L	02/14/97	jcm
EPA 300.7	Potassium	1.65	0.01	mg/L	02/14/97	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	02/14/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-19	LAB ID	AQ-19
DATE SAMPLED	02/07/97	DATE RECEIVED	02/07/97
TIME SAMPLED	1145	TIME RECEIVED	1443

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2900		µS/cm	02/10/97	pa
SM 2540 C	Total Dissolved Solids	1240		mg/L	02/10/97	jcm
SM 2540 H+B	pH	8.82		S.U.	02/10/96	pa
SM 2320 B	Total Alkalinity as CaCO3	180		mg/L	02/10/97	pa
SM 2320 B	Phenolphthalein Alk as CaCO3	25		mg/L	02/10/97	pa
	Carbonate as CaCO3	50	Calculated	mg/l	02/20/97	am
	Bicarbonates as CaCO3	130	Calculated	mg/L	02/20/97	am
SM 2340 B	Hardness as CaCO3	NA[1]		mg/L		
SM 4110 B	Calcium as CaCO3	8.02		mg/L	02/11/97	pa
EPA 300.7	Calcium	5.71	0.02	mg/L	02/14/97	jcm
EPA 300.0	Magnesium	0.524	0.02	mg/L	02/14/97	jcm
EPA 300.0	Bromide	1.13	0.01	mg/L	02/11/97	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	02/11/97	jcm
EPA 300.0	Sulfate	614	0.02	mg/L	02/11/97	jcm
SM 4110 B	Chlorides	445		mg/L	02/11/97	hm
EPA 300.0	Chlorides	549	0.02	mg/L	02/11/97	jcm
EPA 300.0	Flouride	2.2	0.01	mg/L	02/11/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	02/11/97	jcm
EPA 300.0	Phosphate	ND	0.003	mg/L	02/11/97	jcm
EPA 300.7	Lithium	ND	0.01	mg/L	02/14/97	jcm
EPA 300.7	Sodium	715	0.03	mg/L	02/14/97	jcm
EPA 300.7	Potassium	1.67	0.01	mg/L	02/14/97	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	02/14/97	jcm

1 Note: Due to loss of sample, hardness as $CaCO_3$ was not measured

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-20	LAB ID	AQ-20
DATE SAMPLED	02/07/97	DATE RECEIVED	02/07/97
TIME SAMPLED	1355	TIME RECEIVED	1443

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2910		µS/cm	02/10/97	jcm
SM 2540 C	Total Dissolved Solids	1300		mg/L	02/10/97	jcm
SM 2540 H+B	pH	8.88		S.U.	02/10/96	pa
SM 2320 B	Total Alkalinity as CaCO3	182		mg/L	02/10/97	pa
SM 2320 B	Phenolphthalein Alk as CaCO3	15		mg/L	02/10/97	pa
	Carbonate as CaCO3	30	Calculated	mg/l	02/20/97	am
	Bicarbonates as CaCO3	146	Calculated	mg/L	02/20/97	am
SM 2340 B	Hardness as CaCO3	17		mg/L		
SM 4110 B	Calcium as CaCO3	8.01		mg/L	02/11/97	pa
EPA 300.7	Calcium	5.48	0.02	mg/L	02/14/97	jcm
EPA 300.0	Magnesium	0.871	0.02	mg/L	02/14/97	jcm
EPA 300.0	Bromide	1.230	0.01	mg/L	02/11/97	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	02/11/97	jcm
EPA 300.0	Sulfate	593	0.02	mg/L	02/11/97	jcm
SM 4110 B	Chlorides	482		mg/L	02/11/97	hm
EPA 300.0	Chlorides	549	0.02	mg/L	02/11/97	jcm
EPA 300.0	Flouride	2.34	0.01	mg/L	02/11/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	02/11/97	jcm
EPA 300.0	Phosphate	ND	0.003	mg/L	02/11/97	jcm
EPA 300.7	Lithium	ND	0.01	mg/L	02/14/97	jcm
EPA 300.7	Sodium	703	0.03	mg/L	02/14/97	jcm
EPA 300.7	Potassium	1.7	0.01	mg/L	02/14/97	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	02/14/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID AQ-21
DATE SAMPLED 02/08/97
TIME SAMPLED 0810

LAB ID AQ-21
DATE RECEIVED 02/10/97
TIME RECEIVED 1336

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2930		µS/cm	02/10/97	jcm
SM 2540 C	Total Dissolved Solids	1764		mg/L	02/20/97	hm
SM 2540 H+B	pH	8.58		S.U.	02/11/96	hm
SM 2320 B	Total Alkalinity as CaCO3	182		mg/L	02/11/96	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	16		mg/L	02/11/96	hm
	Carbonate as CaCO3	32	Calculated	mg/l	02/20/97	am
	Bicarbonates as CaCO3	150	Calculated	mg/L	02/20/97	am
SM 2340 B	Hardness as CaCO3	17		mg/L	02/11/97	hm
SM 4110 B	Calcium as CaCO3	6.4		mg/L	02/11/97	hm
EPA 300.7	Calcium	5.1	0.02	mg/L	02/14/97	jcm
EPA 300.0	Magnesium	0.59	0.02	mg/L	02/14/97	jcm
EPA 300.0	Bromide	1.27	0.01	mg/L	02/11/97	jcm
EPA 300.0	Nitrate	ND	0.002	mg/L	02/11/97	jcm
EPA 300.0	Sulfate	631	0.02	mg/L	02/11/97	jcm
SM 4110 B	Chlorides	445		mg/L	02/11/97	hm
EPA 300.0	Chlorides	489	0.02	mg/L	02/11/97	jcm
EPA 300.0	Flouride	2.3	0.01	mg/L	02/11/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	02/11/97	jcm
EPA 300.0	Phosphate	ND	0.003	mg/L	02/11/97	jcm
EPA 300.7	Lithium	ND	0.01	mg/L	02/14/97	jcm
EPA 300.7	Sodium	708	0.03	mg/L	02/14/97	jcm
EPA 300.7	Potassium	1.54	0.01	mg/L	02/14/97	jcm
EPA 300.7	Ammonium	ND	0.03	mg/L	02/14/97	jcm

CORE LAB

CORE LABORATORIES

Q U A L I T Y   C O N T R O L   R E S U L T S

Job Number: 970777 | Date: 03/19/97

CUSTOMER: City of Laredo | PROJECT: | ATTN: Adrian Montemayor

Test Method........: EPA 200.7 | Batch..............: 13705 | Analyst...: gcc
Method Description.: Metals Analysis (ICAP) | Reporting Limit...: 1
Parameter..........: Calcium (Ca) | Units..............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
CCV		M0057	5.06900		5.00		101.4	% REC	03/18/97 1345
CCB			0.01328						03/18/97 1409
MB		200.7	0.00327						03/18/97 1419
MD	970609-11		134.87251			137.61285	2.0	RPD	03/18/97 1431
CCV		M0057	5.18075		5.00		103.6	% REC	03/18/97 1512
CCV		M0057	5.04632		5.00		100.9	% REC	03/18/97 1515
CCB			0.00202						03/18/97 1537
MD	970742-1		16.85875			17.87253	5.8	RPD	03/18/97 1618
MS	970742-1	M3520	18.83610		1.00	17.87253	96.4	% REC	03/18/97 1622
CCB			-0.03261						03/18/97 1653
MD	970777-2		6.72875			7.07161	5.0	RPD	03/18/97 1731
CCV		M0057	5.06387		5.00		101.3	% REC	03/18/97 1741
CCV		M0057	4.95749		5.00		99.1	% REC	03/18/97 1748
CCB			0.08768						03/18/97 1759
SB		M3520B	2.09682		2.00		104.8	% REC	03/18/97 1834
SB		M3520B	2.12781		2.00		106.4	% REC	03/18/97 1837
CCV		M0057	4.80400		5.00		96.1	% REC	03/18/97 1841
CCB			0.08842						03/18/97 1844

Test Method........: EPA 200.7 | Batch..............: 13705 | Analyst...: gcc
Method Description.: Metals Analysis (ICAP) | Reporting Limit...: 0.05
Parameter..........: Magnesium (Mg) | Units..............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
ICV		M0058	1.04205		1.00		104.2	% REC	03/18/97 1135
ICV		M0058	1.02569		1.00		102.6	% REC	03/18/97 1316
CCV		M0057	4.96994		5.00		99.4	% REC	03/18/97 1345
CCB			-0.02002						03/18/97 1409
MB		200.7	-0.01962						03/18/97 1419
LCS		M3520	0.90811		1.00		90.8	% REC	03/18/97 1423
MD	970609-11		28.23038			28.75441	1.8	RPD	03/18/97 1431
CCV		M0057	5.24851		5.00		105.0	% REC	03/18/97 1512
CCV		M0057	5.09570		5.00		101.9	% REC	03/18/97 1515
CCB			0.00945						03/18/97 1537
MD	970742-1		1.38717			1.51960	9.1	RPD	03/18/97 1618
MS	970742-1	M3520	2.48500		1.00	1.51960	96.5	% REC	03/18/97 1622
CCV		M0057	5.23119		5.00		104.6	% REC	03/18/97 1638
CCB			0.01797						03/18/97 1653
MD	970777-2		1.35786			1.38133	1.7	RPD	03/18/97 1731
MS	970777-2	M3520	2.24087		1.00	1.38133	86.0	% REC	03/18/97 1734
CCV		M0057	5.16107		5.00		103.2	% REC	03/18/97 1741
CCV		M0057	5.05152		5.00		101.0	% REC	03/18/97 1748
CCB			0.01257						03/18/97 1759
SB		M3520B	1.95416		2.00		97.7	% REC	03/18/97 1834
SB		M3520B	1.99820		2.00		99.9	% REC	03/18/97 1837
CCV		M0057	4.88429		5.00		97.7	% REC	03/18/97 1841
CCB			0.01051						03/18/97 1844

CORE LAB

CORE LABORATORIES

QUALITY CONTROL RESULTS

Job Number: 970777 — Date: 03/19/97

CUSTOMER: City of Laredo — PROJECT: — ATTN: Adrian Montemayor

Test Method........: EPA 200.7 — Batch.............: 13705 — Analyst...: gcc
Method Description.: Metals Analysis (ICAP) — Reporting Limit...: 1
Parameter..........: Potassium (K) — Units.............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
ICV		M0054	10.01218		10.00		100.1	% REC	03/18/97 1325
CCV		M0057	4.89646		5.00		97.9	% REC	03/18/97 1345
CCB			-0.08526						03/18/97 1409
MB		200.7	-0.41412						03/18/97 1419
MD	970609-11		38.95249			39.15956	0.5	RPD	03/18/97 1431
CCV		M0057	4.82798		5.00		96.6	% REC	03/18/97 1515
CCB			0.98623						03/18/97 1537
MD	970742-1		2.23623			1.68578	0.55045	ABS Diff.	03/18/97 1618
CCB			0.26376						03/18/97 1653
MD	970777-2		1.60550			1.84633	0.24083	ABS Diff.	03/18/97 1731
CCV		M0057	4.87385		5.00		97.5	% REC	03/18/97 1741
CCV		M0057	4.77064		5.00		95.4	% REC	03/18/97 1748
CCB			0.66513						03/18/97 1759
MD	970777-2		1.19266			1.84633	0.21789	ABS Diff.	03/18/97 1808
SB		M3520B	2.27064		2.00		113.5	% REC	03/18/97 1834
SB		M3520B	1.97247		2.00		98.6	% REC	03/18/97 1837
CCV		M0057	4.82798		5.00		96.6	% REC	03/18/97 1841
CCB			0.94036						03/18/97 1844

Test Method........: EPA 200.7 — Batch.............: 13705 — Analyst...: gcc
Method Description.: Metals Analysis (ICAP) — Reporting Limit...: 1.0
Parameter..........: Sodium (Na) — Units.............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
ICV		M0054	1.04679		1.00		104.7	% REC	03/18/97 1325
CCV		M0057	4.89359		5.00		97.9	% REC	03/18/97 1345
CCB			-0.00269						03/18/97 1409
MB		200.7	-0.00636						03/18/97 1419
LCS		M3520	0.88389		1.00		88.4	% REC	03/18/97 1423
MD	970609-11		1187.96557			1213.57971	2.1	RPD	03/18/97 1431
CCV		M0057	5.18924		5.00		103.8	% REC	03/18/97 1512
CCV		M0057	5.09991		5.00		102.0	% REC	03/18/97 1515
CCB			0.03030						03/18/97 1537
CCB			0.01745						03/18/97 1653
MD	970777-2		560.91516			581.17779	3.5	RPD	03/18/97 1731
CCV		M0057	5.07068		5.00		101.4	% REC	03/18/97 1748
CCB			0.22447						03/18/97 1759
SB		M3520B	2.43716		2.00		121.9	% REC	03/18/97 1834
SB		M3520B	2.54854		2.00		127.4	% REC	03/18/97 1837
CCV		M0057	4.87327		5.00		97.5	% REC	03/18/97 1841
CCB			0.30614						03/18/97 1844

QUALITY ASSURANCE METHODS

REFERENCES AND NOTES

Report Date: 03/19/97

(1) EPA 600/4-79-020, Methods for Chemical Analysis of Water and Wastes, March 1983
(2) EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1990 and July 1992 Update
(3) Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1995
(4) Federal Register, July 1, 1992 (40 CFR Part 136)
(5) EPA 600/2-78-054, Field and Laboratory Methods Applicable to Overburdens and Minesoils
(6) Methods of Soil Analysis, American Society of Agronomy, Agronomy No. 9, 1965
(7) ASTM, Section 11 Water and Environmental Technology, Volume 11.01 Water (1), 1991
(8) ASTM, Section 5, Petroleum Products, Lubricants, and Fossil Fuels, Volume 05.05, Gaseous Fuels, Coal, and Coke

Comments:
Data in the QA report may differ from final results due to digestion and/or dilution of sample into analytical ranges. The "Time Analyzed" in the QA report refers to the start time of the analytical batch which may not reflect the actual time of each analysis. The "Date Analyzed" is the actual date of analysis. Results for soil and sludge samples are reported on a wet weight basis (i.e. not corrected for percent moisture) unless otherwise indicated.

NC = Not Calculable Due to Value(s) lower than the Detection Limit.

Quality Control acceptance criteria are method dependent.

All data reported on sample "as received" unless noted.

Sample IDs with a "-00" at the end indicate a blank spike or blank spike duplicate associated with the numbered sample.

BLANK QC SAMPLE IDENTIFICATION

MB	Method Blank
ICB	Initial Calibration Blank
CCB	Continuing Calibration Blank

SPIKE QC SAMPLE IDENTIFICATION

MS	Method (Matrix) Blank
MSD	Method (Matrix) Spike Duplicate
PDS	Post Digestion Spike
SB	Spiked Blank
SBD	Spiked Blank Duplicate

REFERENCE STANDARD QC SAMPLE IDENTIFICATION

LCS	Laboratory Control Standard
RS	Reference Standard
ICV	Initial Calibration Verification Standard
CCV	Continuing Calibration Verification Standard
ISA/ISB	ICP Interface Check Sample
ICL	Initial Calibration/Laboratory Control Sample
DSC	Distilled Standard Check

CORE LAB

CORE LABORATORIES

QUALITY ASSURANCE METHODS

REFERENCES AND NOTES

Report Date: 03/19/97

DUPLICATE QC SAMPLE IDENTIFICATION

MD	Method (Matrix) Duplicate
ED	Extraction Duplicate
DD	Digestion Duplicate
PDD	Post Digestion Duplicate

Analyses performed by a subcontract laboratory are indicated on the analytical and/or quality control reports under "technician" using the following codes:

SUBCONTRACT LABORATORY	CODE
Core Laboratories - Anaheim, CA	* an
Core Laboratories - Aurora, CO	* au
Core Laboratories - Casper, WY	* ca
Core Laboratories - Edison, NJ	* ed
Core Laboratories - Houston (Env.), TX	* he
Core Laboratories - Houston (Pet.), TX	* hp
Core Laboratories - Indianapolis, IN	* in
Core Laboratories - Lake Charles, LA	* lc
Core Laboratories - Long Beach, CA	* lb
Core Laboratories - Tampa, FL	* tp
Core Laboratories - Valparaiso, IN	* vp
Other Subcontract Laboratories	* xx
Pollution Control Srv. - San Antonio, TX	* pc
Client Provided data	* cp

EXPLANATION OF DATA FLAGS

B - This flag is used to indicate that an analyte is present in the method blank as well as in the sample. It indicates that the client should consider this when evaluating the results.

D - This flag indicates that surrogates were diluted out of calibration range and cannot be quantified.

E - Indicates that a sample result is an estimate because the concentration exceeded the calibration range of the instrument.

I - Used to indicate matrix interference.

J - Indicates that a value is an estimate. It is used when a compound is determined to be present based on the mass spectral data, but at a concentration less than the practical quantitation limit of the method. This flag is also used when estimating the concentration of a tentatively identified compound.

X - Indicates that a surrogatge recovery is outside the specified quality control limits.

Y - Used to identify a spike or spike duplicate recovery and spike duplicate is outside the specified quality control limits.

* - Indicates a relative percent difference for a duplicate analysis is outside the specified quality control limits.

^ - Used to indicate that a standard is outside specified quality control limits.

CORE LAB

CORE LABORATORIES

ANALYTICAL REPORT

JOB NUMBER: 970777

Prepared For:

City of Laredo
P. O. Box 2950
Laredo, TX 78044

Attention: Adrian Montemayor

Date: 03/19/97

Signature

Name: Chip Meador

Title: Regional Manager

3/19/97

Date

1733 N. Padre Island Drive
Corpus Christi, TX 78403

PHONE: 512/289-2673
FAX: 512/289-2471

CORE LAB

CORE LABORATORIES

SAMPLE INFORMATION

Date: 03/19/97

Job Number.: 970777
Customer ..: City of Laredo
Attn.......: Adrian Montemayor

Project Number.........: 99999995
Customer Project ID....:
Project Description....: Walk in Projects

Laboratory Sample ID	Customer Sample ID	Sample Matrix	Date Sampled	Time Sampled	Date Received	Time Received
970777-1	AQ51	Water	03/10/97	09:45	03/13/97	11:00
970777-2	AQ23	Water	03/10/97	10:03	03/13/97	11:00
970777-3	AQ24	Water	03/10/97	12:45	03/13/97	11:00
970777-4	AQ22	Water	03/10/97	22:30	03/13/97	11:00
970777-5	AQ50	Water	03/10/97	15:00	03/13/97	11:00

CORELAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 970777 Date: 03/19/97

CUSTOMER: City of Laredo **PROJECT:** **ATTN:** Adrian Montemayor

Customer Sample ID: AQ51
Date Sampled......: 03/10/97
Time Sampled......: 09:45
Sample Matrix.....: Water

Laboratory Sample ID: 970777-1
Date Received.......: 03/13/97
Time Received.......: 11:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 200.7	Calcium (Ca), Total	5	1	mg/L	03/18/97	gcc
EPA 200.7	Magnesium (Mg), Total	1.03	0.05	mg/L	03/18/97	gcc
EPA 200.7	Potassium (K), Total	1	1	mg/L	03/18/97	gcc
EPA 200.7	Sodium (Na), Total	599	1	mg/L	03/18/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			03/14/97	dnw

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 970777 Date: 03/19/97

CUSTOMER: City of Laredo PROJECT: ATTN: Adrian Montemayor

Customer Sample ID: AQ23
Date Sampled......: 03/10/97
Time Sampled......: 10:03
Sample Matrix.....: Water

Laboratory Sample ID: 970777-2
Date Received.......: 03/13/97
Time Received.......: 11:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 200.7	Calcium (Ca), Total	7	1	mg/L	03/18/97	gcc
EPA 200.7	Magnesium (Mg), Total	1.38	0.05	mg/L	03/18/97	gcc
EPA 200.7	Potassium (K), Total	2	1	mg/L	03/18/97	gcc
EPA 200.7	Sodium (Na), Total	581	1	mg/L	03/18/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			03/14/97	dnw

COREL LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 970777 Date: 03/19/97

CUSTOMER: City of Laredo PROJECT: ATTN: Adrian Montemayor

Customer Sample ID: AQ24
Date Sampled......: 03/10/97
Time Sampled......: 12:45
Sample Matrix.....: Water

Laboratory Sample ID: 970777-3
Date Received.......: 03/13/97
Time Received.......: 11:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 200.7	Calcium (Ca), Total	6	1	mg/L	03/18/97	gcc
EPA 200.7	Magnesium (Mg), Total	1.12	0.05	mg/L	03/18/97	gcc
EPA 200.7	Potassium (K), Total	2	1	mg/L	03/18/97	gcc
EPA 200.7	Sodium (Na), Total	553	1	mg/L	03/18/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			03/14/97	dnw

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 970777

Date: 03/19/97

CUSTOMER: City of Laredo PROJECT: ATTN: Adrian Montemayor

Customer Sample ID: AQ22
Date Sampled......: 03/10/97
Time Sampled......: 22:30
Sample Matrix.....: Water

Laboratory Sample ID: 970777-4
Date Received.......: 03/13/97
Time Received.......: 11:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 200.7	Calcium (Ca), Total	10	1	mg/L	03/18/97	gcc
EPA 200.7	Magnesium (Mg), Total	2.00	0.05	mg/L	03/18/97	gcc
EPA 200.7	Potassium (K), Total	2	1	mg/L	03/18/97	gcc
EPA 200.7	Sodium (Na), Total	557	1	mg/L	03/18/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			03/14/97	dnw

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 970777

Date: 03/19/97

CUSTOMER: City of Laredo　　PROJECT:　　ATTN: Adrian Montemayor

Customer Sample ID: AQ50
Date Sampled......: 03/10/97
Time Sampled......: 15:00
Sample Matrix.....: Water

Laboratory Sample ID: 970777-5
Date Received.......: 03/13/97
Time Received.......: 11:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 200.7	Calcium (Ca), Total	6	1	mg/L	03/18/97	gcc
EPA 200.7	Magnesium (Mg), Total	1.00	0.05	mg/L	03/18/97	gcc
EPA 200.7	Potassium (K), Total	2	1	mg/L	03/18/97	gcc
EPA 200.7	Sodium (Na), Total	514	1	mg/L	03/18/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			03/14/97	dnw

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-22	LAB ID	AQ-22
DATE SAMPLED	03/08/97	DATE RECEIVED	03/10/97
TIME SAMPLED	22:30	TIME RECEIVED	11:05

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2830	1000	µS/cm	03/10/97	hm
SM 2540 C	Total Dissolved Solids	1660	20	mg/L	03/14/97	hm
SM 2540 H+B	pH	8.6		S.U.	03/10/97	hm
SM 2320 B	Total Alkalinity as CaCO3	215	10	mg/L	03/10/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	16	10	mg/L	03/10/97	hm
	Carbonate as CaCO3	19	Calculated	mg/l	03/24/97	am
	Bicarbonates as CaCO3	223	Calculated	mg/L	03/24/97	am
SM 2340 B	Hardness as CaCO3	40	20	mg/L	03/10/97	hm
EPA 300.0	Bromide	1.46	0.05	mg/L	03/14/97	jcm
EPA 300.0	Nitrate	ND	0.05	mg/L	03/14/97	jcm
EPA 300.0	Sulfate	491	0.08	mg/L	03/24/97	jcm
EPA 300.0	Chlorides	429	0.08	mg/L	03/24/97	jcm
EPA 300.0	Flouride	ND	0.01	mg/L	03/14/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	03/14/97	jcm
EPA 300.0	o-Phosphate	ND	0.003	mg/L	03/14/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-23	LAB ID	AQ-23
DATE SAMPLED	03/09/97	DATE RECEIVED	03/10/97
TIME SAMPLED	10:03	TIME RECEIVED	11:05

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2800	1000	µS/cm	03/10/97	hm
SM 2540 C	Total Dissolved Solids	1692	20	mg/L	03/14/97	hm
SM 2540 H+B	pH	8.6		S.U.	03/10/97	hm
SM 2320 B	Total Alkalinity as CaCO3	220	10	mg/L	03/10/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	15	10	mg/L	03/10/97	hm
	Carbonate as CaCO3	18	Calculated	mg/l	03/24/97	am
	Bicarbonates as CaCO3	232	Calculated	mg/L	03/24/97	am
SM 2340 B	Hardness as CaCO3	24	20	mg/L	03/10/97	hm
EPA 300.0	Bromide	1.44	0.05	mg/L	03/14/97	jcm
EPA 300.0	Nitrate	ND	0.05	mg/L	03/14/97	jcm
EPA 300.0	Sulfate	484	0.08	mg/L	03/24/97	jcm
EPA 300.0	Chlorides	425	0.08	mg/L	03/24/97	jcm
EPA 300.0	Flouride	ND	0.01	mg/L	03/14/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	03/14/97	jcm
EPA 300.0	o-Phosphate	ND	0.003	mg/L	03/14/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-24	LAB ID	AQ-24
DATE SAMPLED	03/09/97	DATE RECEIVED	03/10/97
TIME SAMPLED	12:45	TIME RECEIVED	11:05

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2800	1000	µS/cm	03/10/97	hm
SM 2540 C	Total Dissolved Solids	1670	20	mg/L	03/14/97	hm
SM 2540 H+B	pH	8.8		S.U.	03/10/97	hm
SM 2320 B	Total Alkalinity as CaCO3	219	10	mg/L	03/10/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	14	10	mg/L	03/10/97	hm
	Carbonate as CaCO3	17	Calculated	mg/l	03/24/97	am
	Bicarbonates as CaCO3	233	Calculated	mg/L	03/24/97	am
SM 2340 B	Hardness as CaCO3	32	20	mg/L	03/10/97	hm
EPA 300.0	Bromide	1.46	0.05	mg/L	03/14/97	jcm
EPA 300.0	Nitrate	ND	0.05	mg/L	03/14/97	jcm
EPA 300.0	Sulfate	484	0.08	mg/L	03/24/97	jcm
EPA 300.0	Chlorides	425	0.08	mg/L	03/24/97	jcm
EPA 300.0	Flouride	ND	0.01	mg/L	03/14/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	03/14/97	jcm
EPA 300.0	o-Phosphate	ND	0.003	mg/L	03/14/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-50	LAB ID	AQ-50
DATE SAMPLED	03/09/97	DATE RECEIVED	03/10/97
TIME SAMPLED	15:00	TIME RECEIVED	11:05

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2820	1000	µS/cm	03/10/97	hm
SM 2540 C	Total Dissolved Solids	1674	20	mg/L	03/14/97	hm
SM 2540 H+B	pH	8.7		S.U.	03/10/97	hm
SM 2320 B	Total Alkalinity as CaCO3	219	10	mg/L	03/10/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	14	10	mg/L	03/10/97	hm
	Carbonate as CaCO3	17	Calculated	mg/l	03/24/97	am
	Bicarbonates as CaCO3	233	Calculated	mg/L	03/24/97	am
SM 2340 B	Hardness as CaCO3	32	20	mg/L	03/10/97	hm
EPA 300.0	Bromide	1.48	0.05	mg/L	03/14/97	jcm
EPA 300.0	Nitrate	ND	0.05	mg/L	03/14/97	jcm
EPA 300.0	Sulfate	483	0.08	mg/L	03/24/97	jcm
EPA 300.0	Chlorides	425	0.08	mg/L	03/24/97	jcm
EPA 300.0	Flouride	ND	0.01	mg/L	03/14/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	03/14/97	jcm
EPA 300.0	o-Phosphate	ND	0.003	mg/L	03/14/97	jcm

LABORATORY TEST RESULTS

PROJECT: ASR

SAMPLE ID	AQ-51	LAB ID	AQ-51
DATE SAMPLED	03/10/97	DATE RECEIVED	03/10/97
TIME SAMPLED	09:45	TIME RECEIVED	11:05

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 2510 B	Conductivity	2820	1000	µS/cm	03/10/97	hm
SM 2540 C	Total Dissolved Solids	1670	20	mg/L	03/14/97	hm
SM 2540 H+B	pH	8.8		S.U.	03/10/97	hm
SM 2320 B	Total Alkalinity as CaCO3	218	10	mg/L	03/10/97	hm
SM 2320 B	Phenolphthalein Alk as CaCO3	13	10	mg/L	03/10/97	hm
	Carbonate as CaCO3	16	Calculated	mg/l	03/24/97	am
	Bicarbonates as CaCO3	234	Calculated	mg/L	03/24/97	am
SM 2340 B	Hardness as CaCO3	22	20	mg/L	03/10/97	hm
EPA 300.0	Bromide	1.46	0.05	mg/L	03/14/97	jcm
EPA 300.0	Nitrate	ND	0.05	mg/L	03/14/97	jcm
EPA 300.0	Sulfate	476	0.08	mg/L	03/24/97	jcm
EPA 300.0	Chlorides	418	0.08	mg/L	03/24/97	jcm
EPA 300.0	Flouride	ND	0.01	mg/L	03/14/97	jcm
EPA 300.0	Nitrite	ND	0.004	mg/L	03/14/97	jcm
EPA 300.0	o-Phosphate	ND	0.003	mg/L	03/14/97	jcm

QUALITY CONTROL REPORT

PROJECT: ASR

CONDUCTIVITY

QC METHOD	REAGENT	TRUE VALUE	QC RESULT	UNITS	% Deviation	
CAL. CHECK	Standard, KCL	1413	1412	uS/cm	0.4	

TOTAL DISSOLVED SOLIDS

QC METHOD	REAGENT	CONSTITUENT	ORIG. VALUE	TRUE VALUE	QC RESULT	UNITS	% Deviation	
DUPLICATE	AQ-51	TDS	1670		1698	mg/L	0.83	

ION CHROMATOGRAPHY- CHLORIDE

QC METHOD	REAGENT	CONSTITUENT	ORIG. VALUE	TRUE VALUE	QC RESULT	UNITS	% Deviation	% Recovery	
BLANK	DI water			0	0	mg/L			
DUPLICATE	AQ-22		429.273		428.948	mg/L	0.038		
LCS	Standard	Chloride		100	103	mg/L		103	
SPIKE	J2-18		66.98	75.00	143.70	mg/L		98.8	
SPIKE-DUP	J2-18		66.98	75.00	143.60	mg/L	0.034		
LCS	Standard	Chloride		100	99.819	mg/L		99.8	
BLANK	DI water			0	0	mg/L			

ION CHROMATOGRAPHY - SULFATE

QC METHOD	REAGENT	CONSTITUENT	ORIG. VALUE	TRUE VALUE	QC RESULT	UNITS	% Deviation	% Recovery	
BLANK	DI water			0	0	mg/L			
DUPLICATE	AQ-22		490.964		491.419	mg/L	0.046		
LCS	Standard	Sulfate		200	205.539	mg/L		102.8	
SPIKE	J2-18		99.06	150.0	255.863	mg/L		104.5	
SPIKE-DUP	J2-18		99.06	150.0	253.250	mg/L	0.51		
LCS	Standard	Sulfate		200	198.194	mg/L		99.1	
BLANK	DI water			0	0	mg/L			

ION CHROMATOGRAPHY - BROMIDE

QC METHOD	REAGENT	CONSTITUENT	ORIG. VALUE	TRUE VALUE	QC RESULT	UNITS	% Deviation	% Recovery	
BLANK	DI water			0	0	mg/L			
DUPLICATE	J2-21		0.175		0.172	mg/L	0.86		
LCS	Standard	Bromide		1	0.837	mg/L		83.7	
SPIKE	J2-21		0.14	0.2	0.311	mg/L		85.5	
SPIKE-DUP	J2-21		0.14	0.2	0.291	mg/L	3.3		
LCS	Standard	Bromide		5	4.502	mg/L		90	
BLANK	DI water			0	0	mg/L			

ION CHROMATOGRAPHY - NITRATE

QC METHOD	REAGENT	CONSTITUENT	ORIG. VALUE	TRUE VALUE	QC RESULT	UNITS	% Deviation	% Recovery	
BLANK	DI water			0	0	mg/L			
DUPLICATE	J2-21		3.52		3.543	mg/L	0.32		
LCS	Standard	Nitrate		1	0.835	mg/L		83.5	
SPIKE	J2-21		2.816	0.2	3.010	mg/L		97.0	
SPIKE-DUP	J2-21		2.816	0.2	2.969	mg/L	0.68		
LCS	Standard	Nitrate		5	4.725	mg/L		94.5	
BLANK	DI water			0	0	mg/L			

ION CHROMATOGRAPHY - NITRITE

QC METHOD	REAGENT	CONSTITUENT	ORIG. VALUE	TRUE VALUE	QC RESULT	UNITS	% Deviation	% Recovery	
BLANK	DI water			0	0	mg/L			
DUPLICATE	J2-21		0		0	mg/L	0		
LCS	Standard	Nitrite		1	0.829	mg/L		82.9	
SPIKE	J2-21		0	0	0	mg/L		0	
SPIKE-DUP	J2-21		0	0	0	mg/L		0	
LCS	Standard	Nitrite		5	4.492	mg/L		89.8	
BLANK	DI water			0	0	mg/L			

ION CHROMATOGRAPHY - o-PHOSPHATE

QC METHOD	REAGENT	CONSTITUENT	ORIG. VALUE	TRUE VALUE	QC RESULT	UNITS	% Deviation	% Recovery	
BLANK	DI water			0	0	mg/L			
DUPLICATE	J2-21		0		0	mg/L	0		
LCS	Standard	Phosphate		1	0.850	mg/L		85	
SPIKE	J2-21					mg/L			
SPIKE-DUP	J2-21					mg/L			
LCS	Standard	Phosphate		5	4.753	mg/L		95	
BLANK	DI water			0	0	mg/L			

CITY OF LAREDO, WATER UTILITIES DEPARTMENT
WATER POLLUTION CONTROL, LABORATORY SERVICES
REPORT DATE: 4/17/97

PROJECT: ASR
ATTENTION: PETER VAN NOORT

Sample Identification	AQ-52	Laboratory Identification	AQ52
Sample Date	4/ 9/97	Date Received	4/11/97
Sample Time	11:40	Time Received	13:15
Sample Location	TW-3	Sample Condition	No Color, HNO3?
Sampler	CHRISTIAN	Chain Of Custody No.	1589

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 4500 H+B	pH	8.70	0.00	SU	4/11/97	HM
SM 2320 B	Total Alkalinity	298.00	10.00	mg/L	4/11/97	HM
SM 2320 B	Phen. Alkalinity	19.00	10.00	mg/L	4/11/97	HM
SM 2340 C	Hardness	40.00	20.00	mg/L	4/11/97	HM
SM 3500 Ca D	Calcium, CaCO3	9.60	20.00	mg/L	4/11/97	HM
Calculated	Magnesium, CaCO3	3.89	0.00	mg/L	4/11/97	HM
SM 2510 B	Spec. Conductivity	2,390.00	0.00	uS/cm	4/11/97	HM
Calculated	Carbonate Ion	22.80				
Calculated	Bicarbonate Ion	317.00				
SM 2130 B	Turbidity	20.80	0.00	NTU	4/11/97	HM
SM 2540 C	Total Dissolved Sol.	1,470.00	20.00	mg/L	4/14/97	PA
EPA 300.0	Bromides	1.06	0.50	mg/L	4/11/97	JCM
EPA 300.0	Chlorides	317.00	1.00	mg/L	4/14/97	JCM
EPA 300.0	Nitrate-Nitrogen	0.00	0.05	mg/L	4/11/97	JCM
l 300.0	Nitrite-Nitrogen	0.00	0.05	mg/L	4/11/97	JCM
EPA 300.0	o-Phosphate	0.00	0.01	mg/L	4/11/97	JCM
EPA 300.0	Sulfate	438.00	1.00	mg/L	4/14/97	JCM

Reviewed Montemayor
Adrian Montemayor, WPC Supt.

CITY OF LAREDO, WATER UTILITIES DEPARTMENT
WATER POLLUTION CONTROL, LABORATORY SERVICES
REPORT DATE: 4/17/97

PROJECT: ASR
ATTENTION: PETER VAN NOORT

Sample Identification	AQ53	Laboratory Identification	AQ53
Sample Date	4/11/97	Date Received	4/11/97
Sample Time	10:51	Time Received	1315
Sample Location	TW-3, END	Sample Condition	PASS
Sampler	CHRISTIAN	Chain Of Custody No.	

TEST METHOD	PARAMETER	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SM 4500 H+B	pH	8.50	0.00	SU	4/11/97	HM
SM 2320 B	Total Alkalinity	302.00	10.00	mg/L	4/11/97	HM
SM 2320 B	Phen. Alkalinity	20.00	10.00	mg/L	4/11/97	HM
SM 2340 C	Hardness	18.00	20.00	mg/L	4/11/97	HM
SM 3500 Ca D	Calcium, CaCO3	4.00	20.00	mg/L	4/11/97	HM
Calculated	Magnesium, CaCO3	1.90	0.00	mg/L	4/11/97	HM
SM 2510 B	Spec. Conductivity	2,060.00	0.00	uS/cm	4/11/97	HM
Calculated	Carbonate Ion	24.00				
Calculated	Bicarbonate Ion	319.00				
SM 2130 B	Turbidity	8.68	0.00	NTU	4/11/97	HM
SM 2540 C	Total Dissolved Sol.	1,266.00	20.00	mg/L	4/14/97	PA
EPA 300.0	Bromides	0.27	0.50	mg/L	4/11/97	JCM
EPA 300.0	Chlorides	259.00	1.00	mg/L	4/14/97	JCM
EPA 300.0	Nitrate-Nitrogen	0.00	0.05	mg/L	4/11/97	JCM
I 300.0	Nitrite-Nitrogen	0.00	0.05	mg/L	4/11/97	JCM
EPA 300.0	o-Phosphate	0.00	0.01	mg/L	4/11/97	JCM
EPA 300.0	Sulfate	343.00	1.00	mg/L	4/14/97	JCM

Reviewed Montemayor
Adrian Montemayor, WPC Supt.

Water Pollution Control ——QC REPORT—— Laboratory

Test Method	Parameter	QC Type	Lab ID	QC Result	QC Result	True Value	Original Value	% Recovery	% Deviation	Date
EPA 300.0	CHLRIDE	MB	DI	0.0000				ERR	ERR	04/14/97
		LCS	CAL #1	46.5160		50.00		93.0		04/14/97
		DUP	AQ52	315.2920	316.6150			ERR	0.2094	04/14/97
		MS	970414-J2	129.2690		50.00	79.7370	99.1		04/14/97
		MSD	970414-J2	129.0060	129.2690			ERR	0.1018	04/14/97
		LCS	CAL #2	98.1540		100.00		98.2		04/14/97
		BLK	DI	0.0000				ERR	ERR	04/14/97
EPA 300.0	SULFATE	MB	DI	0.0000				ERR	ERR	04/14/97
		LCS	CAL #1	89.6360		100.00		89.6		04/14/97
		DUP	AQ52	435.4730	438.0670			ERR	0.2970	04/14/97
		MS	970414-J2	206.9700		100.00	108.8770	98.1	100.0000	04/14/97
		MSD	970414-J2	206.6820	206.9700			ERR	0.0696	04/14/97
		LCS	CAL #2	194.3910		200.00		97.2	100.0000	04/14/97
		BLK	DI	0.0000				ERR	ERR	04/14/97
EPA 300.0	NITRITE	MB	DI	0.0000				ERR	ERR	04/11/97
		LCS	CAL #3	9.8330		10.00		98.3		04/11/97
		DUP	AQ52	0.0000	0.0000			ERR	ERR	04/11/97
		MS	J2-11	2.6370		2.50	0.0000	105.5		04/11/97
		MSD	J2-11	2.4040	2.6370			ERR	4.6221	04/11/97
		LCS	CAL #2	4.5010		5.00		90.0		04/11/97
		BLK	DI	0.0000				ERR	ERR	04/11/97
EPA 300.0	BROMIDE	MB	DI	0.0000				ERR	ERR	04/11/97
		LCS	CAL #3	9.5080		10.00		95.1		04/11/97
		DUP	AQ52	1.0350	1.0570			ERR	1.0516	04/11/97
		MS	J2-11	2.4240		2.50	0.2090	88.6		04/11/97
		MSD	J2-11	2.3930	2.4240			ERR	0.6436	04/11/97
		LCS	CAL #2	4.6420		5.00		92.8		04/11/97
		BLK	DI	0.0000				ERR	ERR	04/11/97
EPA 300.0	NITRATE	MB	DI	0.0000				ERR	ERR	04/11/97
		LCS	CAL #3	9.8010		10.00		98.0		04/11/97
		DUP	AQ52	0.0000	0.0000			ERR	ERR	04/11/97
		MS	J2-11	3.7460		2.50	2.7920	38.2		04/11/97
		MSD	J2-11	3.7380	3.7460			ERR	0.1069	04/11/97
		LCS	CAL #3	4.6080		5.00		92.2		04/11/97
		BLK	DI	0.0000				ERR	ERR	04/11/97
EPA 300.0	o-PHOSPHATE	MB	DI	0.0000				ERR	ERR	04/11/97
		LCS	CAL #3	9.9360		10.00		99.4		04/11/97
		DUP	AQ52	0.0000	0.0000			ERR	ERR	04/11/97
		MS	J2-11	2.3720		2.50	0.0000	94.9		04/11/97
		MSD	J2-11	2.3860	2.3720			ERR	0.2942	04/11/97
		LCS	CAL #3	4.8130		5.00		96.3		04/11/97
		BLK	DI	0.0000				ERR	ERR	04/11/97

AQ-53452
~~Split~~ only

CORE LAB

CORE LABORATORIES

ANALYTICAL REPORT

JOB NUMBER: 971134

Prepared For:

City of Laredo
P. O. Box 2950
Laredo, TX 78044

Attention: Adrian Montemayor

Date: 04/18/97

Signature

Name: Charles Sassine

Title: Laboratory Supervisor

4/21/97

Date

1733 N. Padre Island Drive
Corpus Christi, TX 78403

PHONE: 512/289-2673
FAX: 512/289-2471

CORE LAB

CORE LABORATORIES

SAMPLE INFORMATION

Date: 04/18/97

Job Number.: 971134
Customer ..: City of Laredo
Attn.......: Adrian Montemayor

Project Number.........: 99999995
Customer Project ID....: ASR
Project Description....: Walk in Projects

Laboratory Sample ID	Customer Sample ID	Sample Matrix	Date Sampled	Time Sampled	Date Received	Time Received
971134-1	AQ 53	Water	04/11/97	10:51	04/16/97	08:30
971134-2	AQ 52	Water	04/09/97	11:40	04/16/97	08:30

CORELAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 971134 Date: 04/18/97

CUSTOMER: City of Laredo PROJECT: ASR ATTN: Adrian Montemayor

Customer Sample ID: AQ 53
Date Sampled......: 04/11/97
Time Sampled......: 10:51
Sample Matrix.....: Water

Laboratory Sample ID: 971134-1
Date Received.......: 04/16/97
Time Received.......: 08:30

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 200.7	Calcium (Ca), Total	3	1	mg/L	04/17/97	gcc
EPA 200.7	Magnesium (Mg), Total	0.94	0.05	mg/L	04/17/97	gcc
EPA 200.7	Potassium (K), Total	1	1	mg/L	04/17/97	gcc
EPA 200.7	Sodium (Na), Total	422	1	mg/L	04/17/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			04/16/97	dnw

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 971134 Date: 04/18/97

CUSTOMER: City of Laredo PROJECT: ASR ATTN: Adrian Montemayor

Customer Sample ID: AQ 52
Date Sampled......: 04/09/97
Time Sampled......: 11:40
Sample Matrix.....: Water

Laboratory Sample ID: 971134-2
Date Received.......: 04/16/97
Time Received.......: 08:30

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 200.7	Calcium (Ca), Total	8	1	mg/L	04/17/97	gcc
EPA 200.7	Magnesium (Mg), Total	3.88	0.05	mg/L	04/17/97	gcc
EPA 200.7	Potassium (K), Total	1	1	mg/L	04/17/97	gcc
EPA 200.7	Sodium (Na), Total	488	1	mg/L	04/17/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			04/16/97	dnw

CORELAB

CORE LABORATORIES

Q U A L I T Y   C O N T R O L   R E S U L T S

Job Number: 971134   Date: 04/18/97

CUSTOMER: City of Laredo   PROJECT: ASR   ATTN: Adrian Montemayor

Test Method........: EPA 200.7   Batch.............: 14427   Analyst...: gcc
Method Description.: Metals Analysis (ICAP)   Reporting Limit...: 1
Parameter..........: Calcium (Ca)   Units.............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
ICV		M0066	1.03077		1.00		103.1	% REC	04/17/97 0933
CCV		M0061	4.97310		5.00		99.5	% REC	04/17/97 1013
CCB			0.01178						04/17/97 1026
MB		200.7	0.00771						04/17/97 1034
LCS		M3520	1.06894		1.00		106.9	% REC	04/17/97 1036
CCV		M0068	5.06687		5.00		101.3	% REC	04/17/97 1112
CCB			0.02142						04/17/97 1121
CCV		M0068	5.01746		5.00		100.3	% REC	04/17/97 1306
CCB			0.00961						04/17/97 1313
MD	971134-1		2.86969			3.07742	0.20773	ABS Diff.	04/17/97 1318
MD	970986-13		166.46038			161.36743	3.1	RPD	04/17/97 1331
MD	970987-13		23.05810			21.52145	6.9	RPD	04/17/97 1343
CCV		M0068	5.08363		5.00		101.7	% REC	04/17/97 1401
CCB			0.04517						04/17/97 1409
MB		3050	0.10846						04/17/97 1412
LCS		M3520	1.17223		1.00		117.2	% REC	04/17/97 1414
[illegible]	971156-1		16.79791			18.82543	11.4	RPD	04/17/97 1420
[illegible]		3005	-2.38997						04/17/97 1454
[illegible]D	971101-1		149.42288			145.44122	2.7	RPD	04/17/97 1510
PDS	971101-1	M3520	146.30471		1.00	145.44122	86.3	% REC	04/17/97 1514
CCV		M0068	5.16801		5.00		103.4	% REC	04/17/97 1525
CCB			-0.03497						04/17/97 1531
MB		3010	-0.06553						04/17/97 1544
MD	971131-1		3506.08471			3505.87744	0.0	RPD	04/17/97 1557
CCV		M0068	5.04927		5.00		101.0	% REC	04/17/97 1649
CCB			0.21472						04/17/97 1656
MD	971084-1		162.09387			161.17480	0.6	RPD	04/17/97 1706
SB		M3520B	2.21102		2.00		110.6	% REC	04/17/97 1720
SBD		M3520B	2.21515	2.21102	2.00	2.21102	110.8	% REC	04/17/97 1723
							0.2	RPD	
CCV		M0068	5.17391		5.00		103.5	% REC	04/17/97 1728
CCB			0.07189						04/17/97 1737

Test Method........: EPA 200.7   Batch.............: 14427   Analyst...: gcc
Method Description.: Metals Analysis (ICAP)   Reporting Limit...: 0.05
Parameter..........: Magnesium (Mg)   Units.............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
ICV		M0066	1.01932		1.00		101.9	% REC	04/17/97 0929
ICV		M0066	0.99880		1.00		99.9	% REC	04/17/97 0933
CCV		M0061	4.99527		5.00		99.9	% REC	04/17/97 1013
CCB			0.01162						04/17/97 1026
MB		200.7	-0.01543						04/17/97 1034
LCS		M3520	1.00570		1.00		100.6	% REC	04/17/97 1036
CCV		M0068	5.15342		5.00		103.1	% REC	04/17/97 1112
CCB			-0.00458						04/17/97 1121
CCV		M0068	4.97870		5.00		99.6	% REC	04/17/97 1306
CCB			-0.01107						04/17/97 1313
[illegible]	971134-1		0.84073			0.93858	11.0	RPD	04/17/97 1318
[illegible]	971134-1	M3520	1.78271		1.00	0.93858	84.4	% REC	04/17/97 1321
MD	970986-13		36.42530			35.72489	1.9	RPD	04/17/97 1331

CORELAB

CORE LABORATORIES

Q U A L I T Y   C O N T R O L   R E S U L T S

Job Number: 971134 Date: 04/18/97

CUSTOMER: City of Laredo PROJECT: ASR ATTN: Adrian Montemayor

Test Method........: EPA 200.7 Batch..............: 14427 Analyst...: gcc
Method Description.: Metals Analysis (ICAP) Reporting Limit...: 0.05
Parameter..........: Magnesium (Mg) Units..............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
MD	970987-13		4.09183			3.87103	5.5	RPD	04/17/97 1343
MS	970987-13	M3520	5.04196		1.00	3.87103	117.1	% REC	04/17/97 1345
CCV		M0068	5.17245		5.00		103.4	% REC	04/17/97 1358
CCV		M0068	5.16376		5.00		103.3	% REC	04/17/97 1401
CCB			0.02275						04/17/97 1409
MB		3050	0.04982						04/17/97 1412
LCS		M3520	1.10935		1.00		110.9	% REC	04/17/97 1414
MD	971156-1		3.85538			4.41568	13.5	RPD	04/17/97 1420
MB		3005	-0.49660						04/17/97 1454
PDD	971101-1		12.53684			12.01777	4.2	RPD	04/17/97 1510
PDS	971101-1	M3520	13.14234		1.00	12.01777	112.5	% REC	04/17/97 1514
CCV		M0068	5.10858		5.00		102.2	% REC	04/17/97 1525
CCB			0.00589						04/17/97 1531
MB		3010	-0.02494						04/17/97 1544
LCS		M3520	0.99695		1.00		99.7	% REC	04/17/97 1552
MD	971131-1		18.44528			18.46087	0.1	RPD	04/17/97 1557
MS	971131-1	M3520	19.72155		1.00	18.46087	126.1	% REC	04/17/97 1600
		3010	-0.04894						04/17/97 1610
LCS		M3520	0.89668		1.00		89.7	% REC	04/17/97 1613
CCV		M0068	5.13560		5.00		102.7	% REC	04/17/97 1649
CCB			-0.00064						04/17/97 1656
MD	971084-1		4.45774			4.42528	0.7	RPD	04/17/97 1706
SB		M3520B	2.06255		2.00		103.1	% REC	04/17/97 1720
SBD		M3520B	2.09118	2.06255	2.00	2.06255	104.6	% REC	04/17/97 1723
							1.4	RPD	
CCV		M0068	5.10048		5.00		102.0	% REC	04/17/97 1728
CCB			0.14158						04/17/97 1737

Test Method........: EPA 200.7 Batch..............: 14427 Analyst...: gcc
Method Description.: Metals Analysis (ICAP) Reporting Limit...: 1
Parameter..........: Potassium (K) Units..............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
ICV		M0067	10.26239		10.00		102.6	% REC	04/17/97 0951
CCV		M0061	4.82620		5.00		96.5	% REC	04/17/97 1013
CCB			-0.26737						04/17/97 1026
LCS		M3520	1.25668		1.00		125.7	% REC	04/17/97 1036
CCV		M0068	4.37577		5.00		87.5	% REC	04/17/97 1112
CCB			0.53152						04/17/97 1121
CCV		M0068	5.24390		5.00		104.9	% REC	04/17/97 1306
CCB			-0.43360						04/17/97 1313
MD	971134-1		1.19241			1.40914	0.21673	ABS Diff.	04/17/97 1318
MS	971134-1	M3520	2.52032		1.00	1.40914	111.1	% REC	04/17/97 1321
MD	970986-13		50.16260			48.84823	2.7	RPD	04/17/97 1331
MD	970987-13		8.92953			7.85907	12.8	RPD	04/17/97 1343
CCV		M0068	5.24390		5.00		104.9	% REC	04/17/97 1401
CCB			-0.47425						04/17/97 1409
MB		3050	-0.40650						04/17/97 1412
	971156-1		1.05691			0.81300	0.24391	ABS Diff.	04/17/97 1420
	971156-1	M3520	1.76151		1.00	0.81300	94.9	% REC	04/17/97 1422
MB		3005	0.05420						04/17/97 1454

CORE LAB

CORE LABORATORIES

QUALITY CONTROL RESULTS

Job Number: 971134 Date: 04/18/97

CUSTOMER: City of Laredo PROJECT: ASR ATTN: Adrian Montemayor

Test Method........: EPA 200.7 Batch..............: 14427 Analyst...: gcc
Method Description.: Metals Analysis (ICAP) Reporting Limit...: 1
Parameter..........: Potassium (K) Units..............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
PDD	971101-1		15.75880			16.02981	1.7	RPD	04/17/97 1510
PDS	971101-1	M3520	17.27642		1.00	16.02981	124.7	% REC	04/17/97 1514
CCV		M0068	4.60704		5.00		92.1	% REC	04/17/97 1525
CCB			-0.98916						04/17/97 1531
MB		3010	-0.44715						04/17/97 1544
LCS		M3520	1.24661		1.00		124.7	% REC	04/17/97 1552
MD	971131-1		8.65853			8.52303	1.6	RPD	04/17/97 1557
MB		3010	0.42005						04/17/97 1610
LCS		M3520	1.20596		1.00		120.6	% REC	04/17/97 1613
CCV		M0068	5.54200		5.00		110.8	% REC	04/17/97 1649
CCB			0.48780						04/17/97 1656
MD	971084-1		4.60704			4.62059	0.01355	ABS Diff.	04/17/97 1706
CCB			-0.62330						04/17/97 1737

Test Method........: EPA 200.7 Batch..............: 14427 Analyst...: gcc
Method Description.: Metals Analysis (ICAP) Reporting Limit...: 1.0
Parameter..........: Sodium (Na) Units..............: mg/L

QC	Lab ID	Reagent	QC Result	QC Result	True Value	Orig. Value	Calc. Result	Units	Date/Time
ICV		M0067	1.00354		1.00		100.4	% REC	04/17/97 0946
ICV		M0067	0.99559		1.00		99.6	% REC	04/17/97 0951
CCV		M0061	4.94064		5.00		98.8	% REC	04/17/97 1013
CCB			-0.00518						04/17/97 1026
MB		200.7	-0.01395						04/17/97 1034
LCS		M3520	1.16442		1.00		116.4	% REC	04/17/97 1036
CCV		M0068	5.12579		5.00		102.5	% REC	04/17/97 1112
CCB			0.02974						04/17/97 1121
CCV		M0068	4.92070		5.00		98.4	% REC	04/17/97 1306
CCB			0.01665						04/17/97 1313
MD	971134-1		420.52700			421.95758	0.3	RPD	04/17/97 1318
MD	970986-13		8294.01562			8294.58203	0.0	RPD	04/17/97 1331
MS	970986-13	M3520	8295.48632		1.00	8294.58203	90.4	% REC	04/17/97 1334
CCV		M0068	5.10276		5.00		102.1	% REC	04/17/97 1358
CCV		M0068	5.21717		5.00		104.3	% REC	04/17/97 1401
CCB			0.30990						04/17/97 1409
MB		3050	0.44281						04/17/97 1412
MD	971156-1		0.56244			0.57502	0.01258	ABS Diff.	04/17/97 1420
MS	971156-1	M3520	1.45462		1.00	0.57502	88.0	% REC	04/17/97 1422
MB		3005	7049.49658						04/17/97 1454
CCV		M0068	4.51850		5.00		90.4	% REC	04/17/97 1525
CCB			-0.31925						04/17/97 1531
MB		3010	-0.42588						04/17/97 1544
MD	971131-1		41.37551			41.16996	0.5	RPD	04/17/97 1557
MB		3010	-0.42285						04/17/97 1610
CCV		M0068	3.75467		5.00		75.1	% REC	04/17/97 1649
CCB			0.38269						04/17/97 1656
MD	971084-1		4755.81738			4752.88476	0.1	RPD	04/17/97 1706
SB		M3520B	2.13557		2.00		106.8	% REC	04/17/97 1720
SD		M3520B	1.96238	2.13557	2.00	2.13557	98.1	% REC	04/17/97 1723
							8.5	RPD	
CCB			-0.33139						04/17/97 1737

QUALITY ASSURANCE METHODS

REFERENCES AND NOTES

Report Date: 04/18/97

(1) EPA 600/4-79-020, Methods for Chemical Analysis of Water and Wastes, March 1983
(2) EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1990 and July 1992 Update
(3) Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1995
(4) Federal Register, July 1, 1992 (40 CFR Part 136)
(5) EPA 600/2-78-054, Field and Laboratory Methods Applicable to Overburdens and Minesoils
(6) Methods of Soil Analysis, American Society of Agronomy, Agronomy No. 9, 1965
(7) ASTM, Section 11 Water and Environmental Technology, Volume 11.01 Water (1), 1991
(8) ASTM, Section 5, Petroleum Products, Lubricants, and Fossil Fuels, Volume 05.05, Gaseous Fuels, Coal, and Coke

Comments:
Data in the QA report may differ from final results due to digestion and/or dilution of sample into analytical ranges. The "Time Analyzed" in the QA report refers to the start time of the analytical batch which may not reflect the actual time of each analysis. The "Date Analyzed" is the actual date of analysis. Results for soil and sludge samples are reported on a wet weight basis (i.e. not corrected for percent moisture) unless otherwise indicated.

NC = Not Calculable Due to Value(s) lower than the Detection Limit.

Quality Control acceptance criteria are method dependent.

All data reported on sample "as received" unless noted.

Sample IDs with a "-00" at the end indicate a blank spike or blank spike duplicate associated with the numbered sample.

BLANK QC SAMPLE IDENTIFICATION

MB	Method Blank
ICB	Initial Calibration Blank
CCB	Continuing Calibration Blank

SPIKE QC SAMPLE IDENTIFICATION

MS	Method (Matrix) Blank
MSD	Method (Matrix) Spike Duplicate
PDS	Post Digestion Spike
SB	Spiked Blank
SBD	Spiked Blank Duplicate

REFERENCE STANDARD QC SAMPLE IDENTIFICATION

LCS	Laboratory Control Standard
RS	Reference Standard
ICV	Initial Calibration Verification Standard
CCV	Continuing Calibration Verification Standard
ISA/ISB	ICP Interface Check Sample
ICL	Initial Calibration/Laboratory Control Sample
DSC	Distilled Standard Check

QUALITY ASSURANCE METHODS

REFERENCES AND NOTES

Report Date: 04/18/97

DUPLICATE QC SAMPLE IDENTIFICATION

MD	Method (Matrix) Duplicate
ED	Extraction Duplicate
DD	Digestion Duplicate
PDD	Post Digestion Duplicate

Analyses performed by a subcontract laboratory are indicated on the analytical and/or quality control reports under "technician" using the following codes:

SUBCONTRACT LABORATORY	CODE
Core Laboratories - Anaheim, CA	* an
Core Laboratories - Aurora, CO	* au
Core Laboratories - Casper, WY	* ca
Core Laboratories - Edison, NJ	* ed
Core Laboratories - Houston (Env.), TX	* he
Core Laboratories - Houston (Pet.), TX	* hp
Core Laboratories - Indianapolis, IN	* in
Core Laboratories - Lake Charles, LA	* lc
Core Laboratories - Long Beach, CA	* lb
Core Laboratories - Tampa, FL	* tp
Core Laboratories - Valparaiso, IN	* vp
Other Subcontract Laboratories	* xx
Pollution Control Srv. - San Antonio, TX	* pc
Client Provided data	* cp

EXPLANATION OF DATA FLAGS

- B - This flag is used to indicate that an analyte is present in the method blank as well as in the sample. It indicates that the client should consider this when evaluating the results.
- D - This flag indicates that surrogates were diluted out of calibration range and cannot be quantified.
- E - Indicates that a sample result is an estimate because the concentration exceeded the calibration range of the instrument.
- I - Used to indicate matrix interference.
- J - Indicates that a value is an estimate. It is used when a compound is determined to be present based on the mass spectral data, but at a concentration less than the practical quantitation limit of the method. This flag is also used when estimating the concentration of a tentatively identified compound.
- X - Indicates that a surrogatge recovery is outside the specified quality control limits.
- Y - Used to identify a spike or spike duplicate recovery and spike duplicate is outside the specified quality control limits.
- * - Indicates a relative percent difference for a duplicate analysis is outside the specified quality control limits.
- ^ - Used to indicate that a standard is outside specified quality control limits.

CITY OF LAREDO, WATER UTILITIES LAB SERVICES

PROJECT: ASR

DATE: Mar. 11,1998

Sample ID: TW-2
Date Sampled: 7/29/97
Time Sampled: 14:25

Lab ID: TW-2
Date Received: 7/29/97
Time Received: 2:25

TEST METHOD	PARAMETER	SAMPLE RESULT	UNITS	DATE	TECH
SM 2510B	Conductivity	2550	us/cm	7/31/97	HM
SM 2540C	Total Dissolved Solids	1440	mg/L	7/31/97	AG
SM 2540 H+B	pH	8.8	S.U.	7/31/97	HM
SM 2320 B	Total Alkalinity	228	mg/L	7/31/97	HM
SM 2320 B	Phenolphthalein Alkalinity	17	mg/L	7/31/97	HM
SM 2320 B	Carbonate	34	mg/L	CALC.	
SM 2320 B	Bicarbonate	225	mg/L	CALC.	
SM 2320 B	Hardness	15	mg/L	7/31/97	HM
EPA 300.7	Calcium	4	mg/L	7/31/97	HM
EPA 300.0	Magnesium	1	mg/L	7/31/97	HM
EPA 300.0	Bromide	NA	mg/L		
EPA 300.0	Nitrate	NA	mg/L		
EPA 300.0	Sulfate	ERR	mg/L	8/25/97	JCM
EPA 300.0	Chloride	357	mg/L	8/25/97	JCM
EPA 300.0	Flouride	NA	mg/L		
EPA 300.0	Nitrite	NA	mg/L		
EPA 300.0	Ortho-Phosphate	NA	mg/L		
EPA 300.7	Lithium	NA	mg/L		
EPA 300.7	Potassium	NA	mg/L		
AM 4500 MH3	Ammonia Nitrogen	NA	mg/L		

City of Laredo, Water Utilities Department

Laboratory Services

PROJECT: Aquifer Storage and Recovery
PROJECT ID: ASR
DATE: 8/26/97

Sample ID	TW2	Sample Date	7/28/97	Sampler	BC
Lab ID	972907-TW	Sample Time	2045	Sample Condition	Good
Sample Location	Pump Test Disch	Date Received	7/29/97		
Chain of Custody	0308	Time Received	1425		

CONSTITUENT	RESULT	UNITS	DATE COMPLETE	TECH.
pH	8.80	S.U.	7/31/97	HM
T-Alkal	228.00	mg/L	7/31/97	HM
P-Alkal	17.00	mg/L	7/31/97	HM
Hardness	15.00	mg/L	7/31/97	HM
Calcium	4.00	mg/L	7/31/97	HM
Magnesium	1.00	mg/L	7/31/97	HM
Conduct	2,550.00	uS/cm	7/31/97	HM
TDS	~~1~~,440.00	mg/L	8/ 1/97	HM
Bromide	1.43	mg/L	8/22/97	JCM
Chloride	357.10	mg/L	8/25/97	JCM
Fluoride	1.00	Not Detect	8/22/97	JCM
Nitrate	0.05	Not Detect	8/22/97	JCM
Nitrite	0.05	Not Detect	8/22/97	JCM
O-Phosphat	0.85	mg/L	8/22/97	JCM
Sulfate	2,065.00	Error	8/25/97	JCM
Amm. Nitro	0.27	mg/L	8/ 5/97	JCM
TKN	1.00	Not Detect	8/ 7/97	Cor
TOC	1.00	mg/L	8/12/97	Cor
Aluminum	0.05	Not Detect	8/12/97	Cor
Iron	0.05	Not Detect	8/14/97	Cor
Lithium	0.03	mg/L	8/10/97	Cor
Magnesium	0.49	mg/L	8/14/97	Cor
Manganese	0.05	Not Detect	8/14/97	Cor
Potassium	2.00	mg/L	8/14/97	Cor
SiO2 Total	12.50	mg/L	8/14/97	Cor
Sodium	501.00	mg/L	8/14/97	Cor
	0.00			
	0.00			
	0.00			

Post-it® Fax Note 7671

To	Kevin Brat	Date 8/27/97	# of pages ▸ 5
Co./Dept.	Dick Worman	From	R. Van Noort
Phone #		Co.	
Fax #		Phone #	
		Fax #	

LABORATORY TEST RESULTS

Job Number: 972383

Date: 08/15/97

CUSTOMER: City of Laredo PROJECT: ASR ATTN: Adrian Montemayor

Customer Sample ID: ASR-TW#2
Date Sampled......: 07/28/97
Time Sampled......: 20:45
Sample Matrix.....: Water

Laboratory Sample ID: 972383-1
Date Received.......: 08/01/97
Time Received.......: 09:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 351.3	Nitrogen, Total Kjeldahl as N (TKN)	<1.0	1.0	mg/L	08/07/97	deh
SM 5310C	Organic Carbon, Total (TOC)	1	1	mg/L	08/12/97	seb
EPA 200.7	Aluminum (Al), Total	<0.05	0.05	mg/L	08/14/97	gcc
EPA 200.7	Iron (Fe), Total	<0.05	0.05	mg/L	08/14/97	gcc
EPA 200.7	Lithium (Li), Total	0.03	0.01	mg/L	08/10/97	sag
EPA 200.7	Magnesium (Mg), Total	0.49	0.05	mg/L	08/14/97	gcc
EPA 200.7	Manganese (Mn), Total	<0.05	0.05	mg/L	08/14/97	gcc
EPA 200.7	Potassium (K), Total	2	1	mg/L	08/14/97	gcc
EPA 200.7	Silica Dioxide (SiO2), Total	12.5	0.1	mg/L	08/14/97	gcc
EPA 200.7	Sodium (Na), Total	501	1	mg/L	08/14/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			08/04/97	drw

CITY OF LAREDO, WATER UTILITIES LAB SERVICES

PROJECT: ASR

DATE: Mar. 27,1998

Sample ID: Unitec
Date Sampled: 7/13/97
Time Sampled: 13:15

Lab ID: 971407
Date Received: 7/14/97
Time Received: 10:42

TEST METHOD	PARAMETER	SAMPLE RESULT	UNITS	DATE	TECH
SM 2510B	Conductivity	4730	us/cm	7/14/97	HM
SM 2540C	Total Dissolved Solids	2164	mg/L	7/18/97	AG
SM 2540 H+B	pH	8	S.U.	7/14/97	HM
SM 2320 B	Total Alkalinity	1196	mg/L	7/14/97	HM
SM 2320 B	Phenolphthalein Alkalinity	ND	mg/L	7/14/97	HM
SM 2320 B	Carbonate	0	mg/L	CALC.	
SM 2320 B	Bicarbonate	1196	mg/L	CALC.	
SM 2320 B	Hardness	20	mg/L	7/14/97	HM
EPA 300.7	Calcium	6	mg/L	7/14/97	HM
EPA 300.0	Magnesium	1	mg/L	7/14/97	HM
EPA 300.0	Bromide	3.275	mg/L	7/16/97	JCM
EPA 300.0	Nitrate	ND	mg/L	7/16/97	JCM
EPA 300.0	Sulfate	ND	mg/L	7/14/97	JCM
EPA 300.0	Chloride	943	mg/L	7/14/97	JCM
EPA 300.0	Flouride	2.924	mg/L	7/16/97	JCM
EPA 300.0	Nitrite	ND	mg/L	7/16/97	JCM
EPA 300.0	Ortho-Phosphate	ND	mg/L	7/16/97	JCM
EPA 300.7	Lithium	NA	mg/L		
EPA 300.7	Potassium	NA	mg/L		
AM 4500 MH3	Ammonia Nitrogen	1	mg/L	7/24/97	JCM

City of Laredo, Water Utilities Department

Laboratory Services

PROJECT: Aquifer Storage and Recovery
PROJECT ID: ASR
DATE: 8/26/97

Sample ID	Unitec	Sample Date	7/13/97	Sampler	PVN, BC
Lab ID	971407-UN	Sample Time	1315	Sample Condition	Good
Sample Location	Pump Discharge	Date Received	7/14/97		
Chain of Custody	0304	Time Received	1042		

CONSTITUENT	RESULT	UNITS	DATE COMPLETE	TECH.
pH	8.00	S.U.	7/14/97	HM
T-Alkal	1,196.00	mg/L	7/14/97	HM
P-Alkal	0.00	Not Detect	7/14/97	HM
Hardness	20.00	mg/l	7/14/97	HM
Calcium	6.00	mg/L	7/14/97	HM
Magnesium	0.97	mg/l	7/14/97	HM
Conduct	4,730.00	uS/cm	7/14/97	HM
TDS	2,164.00	mg/l	7/18/97	HM
Bromide	3.28	mg/L	7/16/97	JCM
Chloride	942.97	mg/L	7/14/97	JCM
Fluoride	2.92	mg/L	7/14/97	JCM
Nitrate	0.05	Not Detect	7/16/97	JCM
Nitrite	0.05	Not Detect	7/16/97	JCM
O-Phosphat	0.01	Not Detect	7/16/97	JCM
Sulfate	1.00	Not Detect	7/14/97	JCM
Amm. Nitro	1.01	mg/L	7/24/97	JCM
TKN	1.20	mg/L	7/31/97	Cor
TOC	2.00	mg/L	8/ 8/97	Cor
Aluminum	0.06	mg/L	7/21/97	Cor
Iron	0.22	mg/L	7/21/97	Cor
Lithium	0.18	mg/L	7/29/97	Cor
Magnesium	10.00	mg/L	7/21/97	Cor
Manganese	0.05	Not Detect	7/21/97	Cor
Potassium	5.00	mg/l	7/21/97	Cor
SiO2 Total	23.40	mg/l	7/21/97	Cor
Sodium	13,900.00	mg/L	7/21/97	Cor
	0.00			
	0.00			
	0.00			

totals

CORELAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 972188

Date: 08/11/97

CUSTOMER: City of Laredo PROJECT: ASR ATTN: Adrian Montemayor

Customer Sample ID: ASR-UNITEC
Date Sampled......: 07/13/97
Time Sampled......: 13:15
Sample Matrix.....: Water

Laboratory Sample ID: 972188-2
Date Received.......: 07/16/97
Time Received.......: 09:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 351.3	Nitrogen, Total Kjeldahl as N (TKN)	1.2	1.0	mg/L	07/31/97	deh
SM 5310C	Organic Carbon, Total (TOC)	2	1	mg/L	08/08/97	deh
EPA 200.7	Aluminum (Al), Total	0.06	0.05	mg/L	07/21/97	gcc
EPA 200.7	Iron (Fe), Total	0.22	0.05	mg/L	07/21/97	gcc
EPA 200.7	Lithium (Li), Total	0.18	0.01	mg/L	07/29/97	*au
EPA 200.7	Magnesium (Mg), Total	10	5	mg/L	07/21/97	gcc
EPA 200.7	Manganese (Mn), Total	<0.05	0.05	mg/L	07/21/97	gcc
EPA 200.7	Potassium (K), Total	5	1	mg/L	07/21/97	gcc
EPA 200.7	Silica Dioxide (SiO2), Total	23.4	0.1	mg/L	07/21/97	gcc
EPA 200.7	Sodium (Na), Total	13900	100	mg/L	07/21/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			07/17/97	drw

CITY OF LAREDO, WATER UTILITIES LAB SERVICES

PROJECT: ASR

DATE: Mar. 11,1998

Sample ID: LCC
Date Sampled: 7/13/97
Time Sampled: 9:55

Lab ID: LCC
Date Received: 7/14/97
Time Received: 10:42

TEST METHOD	PARAMETER	SAMPLE RESULT	UNITS	DATE	TECH
SM 2510B	Conductivity	3250	us/cm	7/14/97	HM
SM 2540C	Total Dissolved Solids	1552	mg/L	7/18/97	HM
SM 2540 H+B	pH	8.5	S.U.	7/14/97	HM
SM 2320 B	Total Alkalinity	244	mg/L	7/14/97	HM
SM 2320 B	Phenolphthalein Alkalinity	8.5	mg/L	7/14/97	HM
SM 2320 B	Carbonate	17	mg/L	CALC.	
SM 2320 B	Bicarbonate	227	mg/L	CALC.	
SM 2320 B	Hardness	20	mg/L	7/14/97	HM
EPA 300.7	Calcium	6	mg/L	7/14/97	HM
EPA 300.0	Magnesium	1	mg/L	7/14/97	HM
EPA 300.0	Bromide	1.846	mg/L	7/16/97	JCM
EPA 300.0	Nitrate	ND	mg/L	7/16/97	JCM
EPA 300.0	Sulfate	590	mg/L	7/14/97	JCM
EPA 300.0	Chloride	495	mg/L	7/14/97	JCM
EPA 300.0	Flouride	1.713	mg/L	7/16/97	JCM
EPA 300.0	Nitrite	ND	mg/L	7/16/97	JCM
EPA 300.0	Ortho-Phosphate	ND	mg/L	7/16/97	JCM
EPA 300.7	Lithium	NA	mg/L		
EPA 300.7	Potassium	NA	mg/L		
AM 4500 MH3	Ammonia Nitrogen	0.278	mg/L	7/24/97	JCM

City of Laredo, Water Utilities Department

Laboratory Services

PROJECT: Aquifer Storage and Recovery
PROJECT ID: ASR
DATE: 8/26/97

Sample ID	LCC	Sample Date	7/13/97	Sampler	PVN, BC
Lab ID	971407-LC	Sample Time	0955	Sample Condition	Good
Sample Location	Pump Discharge	Date Received	7/14/97		
Chain of Custody	0303	Time Received	1042		

CONSTITUENT	RESULT	UNITS	DATE COMPLETE	TECH.
pH	8.50	S.U.	7/14/97	HM
T-Alkal	244.00	mg/l	7/14/97	HM
P-Alkal	8.50	mg/L	7/14/97	HM
Hardness	20.00	mg/L	7/14/97	HM
Calcium	6.00	mg/l	7/14/97	HM
Magnesium	1.00	mg/l	7/14/97	HM
Conduct	3,250.00	uS/cm	7/14/97	HM
TDS	1,552.00	mg/l	7/18/97	HM
Bromide	1.85	mg/L	7/16/97	JCM
Chloride	494.71	mg/L	7/14/97	JCM
Fluoride	1.71	mg/L	7/14/97	JCM
Nitrate	0.05	Not Detect	7/16/97	JCM
Nitrite	0.05	Not Detect	7/16/97	JCM
O-Phosphat	0.01	Not Detect	7/16/97	JCM
Sulfate	589.79	mg/L	7/14/97	JCM
Amm. Nitro	0.28	mg/L	7/24/97	JCM
TKN	1.00	Not Detect	7/31/97	Cor
TOC	1.00	mg/l	8/ 8/97	Cor
Aluminum	0.07	mg/L	7/21/97	Cor
Iron	0.05	Not Detect	7/21/97	Cor
Lithium	0.09	mg/L	7/29/97	Cor
Magnesium	1.58	mg/L	7/21/97	Cor
Manganese	0.05	Not Detect	7/21/97	Cor
Potassium	1.00	mg/L	7/21/97	Cor
SiO2 Total	12.50	mg/L	7/21/97	Cor
Sodium	618.00	mg/L	7/21/97	Cor
	0.00			
	0.00			
	0.00			

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 972188 Date: 08/11/97

CUSTOMER: City of Laredo PROJECT: ASR ATTN: Adrian Montemayor

Customer Sample ID: ASR-LCC
Date Sampled......: 07/13/97
Time Sampled......: 09:55
Sample Matrix.....: Water

Laboratory Sample ID: 972188-1
Date Received.......: 07/16/97
Time Received.......: 09:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 351.3	Nitrogen, Total Kjeldahl as N (TKN)	<1.0	1.0	mg/L	07/31/97	deh
SM 5310C	Organic Carbon, Total (TOC)	1	1	mg/L	08/08/97	deh
EPA 200.7	Aluminum (Al), Total	0.07	0.05	mg/L	07/21/97	gcc
EPA 200.7	Iron (Fe), Total	<0.05	0.05	mg/L	07/21/97	gcc
EPA 200.7	Lithium (Li), Total	0.09	0.01	mg/L	07/29/97	*au
EPA 200.7	Magnesium (Mg), Total	1.58	0.05	mg/L	07/21/97	gcc
EPA 200.7	Manganese (Mn), Total	<0.05	0.05	mg/L	07/21/97	gcc
EPA 200.7	Potassium (K), Total	1	1	mg/L	07/21/97	gcc
EPA 200.7	Silica Dioxide (SiO2), Total	12.5	0.1	mg/L	07/21/97	gcc
EPA 200.7	Sodium (Na), Total	618	1	mg/L	07/21/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			07/17/97	dnw

CITY OF LAREDO, WATER UTILITIES LAB SERVICES

PROJECT: ASR

DATE: Mar. 27,1998

Sample ID:	Jefferson Plant	Lab ID:	971607
Date Sampled:	7/16/97	Date Received:	7/16/97
Time Sampled:	11:30	Time Received:	12:02

TEST METHOD	PARAMETER	SAMPLE RESULT	UNITS	DATE	TECH
SM 2510B	Conductivity	1093	us/cm	7/16/97	HM
SM 2540C	Total Dissolved Solids	516	mg/L	7/18/97	AG
SM 2540 H+B	pH	8.2	S.U.	7/16/97	HM
SM 2320 B	Total Alkalinity	101	mg/L	7/16/97	HM
SM 2320 B	Phenolphthalein Alkalinity	1	mg/L	7/16/97	HM
SM 2320 B	Carbonate	2	mg/L	CALC.	
SM 2320 B	Bicarbonate	99	mg/L	CALC.	
SM 2320 B	Hardness	266	mg/L	7/16/97	HM
EPA 300.7	Calcium	78	mg/L	7/16/97	HM
EPA 300.0	Magnesium	17	mg/L	7/16/97	HM
EPA 300.0	Bromide	0.128	mg/L	7/18/97	JCM
EPA 300.0	Nitrate	0.112	mg/L	7/18/97	JCM
EPA 300.0	Sulfate	179	mg/L	7/21/97	JCM
EPA 300.0	Chloride	141	mg/L	7/21/97	JCM
EPA 300.0	Flouride	0.724	mg/L	7/18/97	JCM
EPA 300.0	Nitrite	ND	mg/L	7/18/97	JCM
EPA 300.0	Ortho-Phosphate	ND	mg/L	7/18/97	JCM
EPA 300.7	Lithium	NA	mg/L		
EPA 300.7	Potassium	NA	mg/L		
AM 4500 MH3	Ammonia Nitrogen	0.989	mg/L	35635	JCM

City of Laredo, Water Utilities Department

Laboratory Services

PROJECT: Aquifer Storage and Recovery
PROJECT ID: ASR
DATE: 8/26/97

water treatment plant

Sample ID	Jefferson	Sample Date	7/16/97	Sampler	BC
Lab ID	971607-JW	Sample Time	1130	Sample Condition	Good
Sample Location	Spicket	Date Received	7/16/97		
Chain of Custody	0306	Time Received	1202		

CONSTITUENT	RESULT	UNITS	DATE COMPLETE	TECH.
pH	8.20	S.U.	7/16/97	HM
T-Alkal	101.00	mg/L	7/16/97	HM
P-Alkal	1.00	mg/L	7/16/97	HM
Hardness	266.00	mg/L	7/16/97	HM
Calcium	78.00	mg/L	7/16/97	HM
Magnesium	17.00	mg/L	7/16/97	HM
Conduct	1,093.06	uS/cm	7/16/97	HM
TDS	516.00	mg/L	7/16/97	HM
Bromide	0.13	mg/L	7/18/97	JCM
Chloride	141.03	mg/L	7/21/97	JCM
Fluoride	0.72	mg/L	7/18/97	JCM
Nitrate	0.11	mg/L	7/21/97	JCM
Nitrite	0.05	Not Detect	7/21/97	JCM
O-Phosphat	0.01	Not Detect	7/21/97	JCM
Sulfate	178.98	mg/L	7/18/97	JCM
Amm. Nitro	0.99	mg/L	7/24/97	JCM
—TKN	3.40	mg/L	7/31/97	Cor
—TOC	5.00	mg/L	8/12/97	Cor
—Aluminum	0.35	mg/L	8/12/97	Cor
— Iron	0.05	Not Detect	8/12/97	Cor
— Lithium	0.02	Not Detect	7/29/97	Cor
— Magnesium	20.90	mg/L	8/12/97	Cor
Manganese	0.05	Not Detect	8/12/97	Cor
Potassium	4.00	mg/L	8/12/97	Cor
SiO2 Total	9.50	mg/l	8/12/97	Cor
Sodium	121.00	mg/L	8/12/97	Cor
	0.00			
	0.00			
	0.00			

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 972264 Date: 08/15/97

[illegible] PROJECT: [illegible] [illegible]

Customer Sample ID: ASR-WTP → Water treatment Plant
Date Sampled......: 07/16/97
Time Sampled......: 11:30
Sample Matrix.....: Water

Laboratory Sample ID: 972264-1
Date Received.......: 07/23/97
Time Received.......: 09:30

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 351.3	Nitrogen, Total Kjeldahl as N (TKN)	3.4	1.0	mg/L	07/31/97	deh
SM 5310C	Organic Carbon, Total (TOC)	5	1	mg/L	08/12/97	eab
EPA 200.7	Aluminum (Al), Total	0.35	0.05	mg/L	08/12/97	gcc
EPA 200.7	Iron (Fe), Total	<0.05	0.05	mg/L	08/12/97	gcc
EPA 200.7	Lithium (Li), Total	<0.02	0.02	mg/L	07/29/97	*au
EPA 200.7	Magnesium (Mg), Total	20.9	0.05	mg/L	08/12/97	gcc
EPA 200.7	Manganese (Mn), Total	<0.05	0.05	mg/L	08/12/97	gcc
EPA 200.7	Potassium (K), Total	4	1	mg/L	08/12/97	gcc
EPA 200.7	Silica Dioxide (SiO2), Total	9.5	0.1	mg/L	08/12/97	gcc
EPA 200.7	Sodium (Na), Total	121	1	mg/L	08/12/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			07/24/97	drw

CITY OF LAREDO, WATER UTILITIES LAB SERVICES

PROJECT: ASR

DATE: Mar. 11,1998

Sample ID: DEL MAR
Date Sampled: 7/15/97
Time Sampled: 15:55

Lab ID: DEL MAR
Date Received: 7/16/97
Time Received: 12:02

TEST METHOD	PARAMETER	SAMPLE RESULT	UNITS	DATE	TECH
SM 2510B	Conductivity	NA	us/cm		
SM 2540C	Total Dissolved Solids	NA	mg/L		
SM 2540 H+B	pH	NA	S.U.		
SM 2320 B	Total Alkalinity	NA	mg/L		
SM 2320 B	Phenolphthalein Alkalinity	NA	mg/L		
SM 2320 B	Carbonate	NA	mg/L	CALC.	
SM 2320 B	Bicarbonate	NA	mg/L	CALC.	
SM 2320 B	Hardness	262	mg/L	7/16/97	HM
EPA 300.7	Calcium	NA	mg/L		
EPA 300.0	Magnesium	NA	mg/L		
EPA 300.0	Bromide	NA	mg/L		
EPA 300.0	Nitrate	NA	mg/L		
EPA 300.0	Sulfate	1990	mg/L	8/25/97	JCM
EPA 300.0	Chloride	137	mg/L	8/25/97	JCM
EPA 300.0	Flouride	NA	mg/L		
EPA 300.0	Nitrite	NA	mg/L		
EPA 300.0	Ortho-Phosphate	NA	mg/L		
EPA 300.7	Lithium	NA	mg/L		
EPA 300.7	Potassium	NA	mg/L		
AM 4500 MH3	Ammonia Nitrogen	NA	mg/L		

City of Laredo, Water Utilities Department

Laboratory Services

PROJECT: Aquifer Storage and Recovery
PROJECT ID: ASR
DATE: 8/26/97

Sample ID	Del Mar	Sample Date	7/15/97	Sampler	PVN, BC
Lab ID	971607-DM	Sample Time	1555	Sample Condition	Good
Sample Location	Plant Spicket	Date Received	7/16/97		
Chain of Custody	0305	Time Received	1202		

CONSTITUENT	RESULT	UNITS	DATE COMPLETE	TECH.
pH	0.00	Not Analyz		
T-Alkal	0.00	Not Analyz		
P-Alkal	0.00	Not Analyz		
Hardness	262.00	mg/L	7/16/97	HM
Calcium	0.00	Not Analyz		
Magnesium	0.00	Not Analyz		
Conduct	0.00	Not Analyz		
TDS	0.00	Not Analyz		
Bromide	1.37	mg/L	8/22/97	JCM
Chloride	136.98	mg/L	8/22/97	JCM
Fluoride	1.00	Not Detect	8/22/97	JCM
Nitrate	0.05	Not Detect	8/23/97	JCM
Nitrite	0.05	Not Detect	8/23/97	JCM
O-Phosphat	0.01	Not Detect	8/23/97	JCM
Sulfate	1,999.16	Error	8/23/97	JCM
Amm. Nitro	0.44	mg/L	7/24/97	JCM
TKN	1.00	Not Detect	7/31/97	Cor
TOC	2.00	mg/L	8/12/97	Cor
Aluminum	0.18	mg/L	8/12/97	Cor
Iron	0.05	Not Detect	8/12/97	Cor
Lithium	0.02	Not Detect	8/12/97	Cor
Magnesium	21.10	mg/L	8/12/97	Cor
Manganese	0.05	Not Detect	8/12/97	Cor
Potassium	4.00	mg/L	8/12/97	Cor
SiO2 Total	8.30	mg/L	8/12/97	Cor
Sodium	119.00	mg/L	8/12/97	Cor
	0.00			
	0.00			
	0.00			

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 972264 Date: 08/15/97

CUSTOMER: [illegible] PROJECT: ASR ATTN: [illegible]

Customer Sample ID: ASR-DEL MAR
Date Sampled......: 07/16/97
Time Sampled......: 15:55
Sample Matrix.....: Water

Laboratory Sample ID: 972264-2
Date Received.......: 07/23/97
Time Received.......: 09:30

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
EPA 351.3	Nitrogen, Total Kjeldahl as N (TKN)	<1.0	1.0	mg/L	07/31/97	deh
SM 5310C	Organic Carbon, Total (TOC)	2	1	mg/L	08/12/97	acb
EPA 200.7	Aluminum (Al), Total	0.18	0.05	mg/L	08/12/97	gcc
EPA 200.7	Iron (Fe), Total	<0.05	0.05	mg/L	08/12/97	gcc
EPA 200.7	Lithium (Li), Total	<0.02	0.02	mg/L	07/29/97	*eu
EPA 200.7	Magnesium (Mg), Total	21.1	0.05	mg/L	08/12/97	gcc
EPA 200.7	Manganese (Mn), Total	<0.05	0.05	mg/L	08/12/97	gcc
EPA 200.7	Potassium (K), Total	6	1	mg/L	08/12/97	gcc
EPA 200.7	Silica Dioxide (SiO2), Total	8.3	0.1	mg/L	08/12/97	gcc
EPA 200.7	Sodium (Na), Total	119	1	mg/L	08/12/97	gcc
EPA 200.7	Acid Digestion, Total Metals	Complete			07/24/97	drw

LABORATORY REPORT

City of Laredo, Water Utilities
Water Pollution Control Div.

DATE: FEBRUARY 26, 1998

TO: PETER VAN NOORT, CH2MHILL

CC: FERNANDO ROMAN, P.E., UTILITIES DIR.
GARARDO PINZON, P.E., ASST. DIRECTOR

FROM: ADRIAN MONTEMAYOR , LAB SUPT. A. Montemayor

RE: ASR, COMPATIBILITY TEST RESULTS

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

OVERVIEW REPORT

Sample ID..............	Iron (Fe)	Mn	Calcium	Alk.- T	Alk.- P	Hard.	Chloride	TDS	Cond.	Sulfate	pH	HCO3	Mg	Sodium	Turbidity
SD.I.01	0.05	0.05	89.80	114.00	0.00	276.00	129.00	682.00	1,057.00	183.00	7.60	139.00	12.60	99.00	0.12
SD.I.02	0.05	0.05	89.80	113.00	0.00	282.00	135.00	680.00	1,075.00	191.00	7.60	113.00	14.10	103.00	0.78
SD.R.01	0.99	0.05	74.50	128.00	2.00	236.00	141.00	708.00	1,156.00	198.00	8.10	15.10	12.20	143.00	4.43
SD.R.02	0.20	0.05	21.60	160.00	16.00	92.00	176.00	846.00	1,452.00	233.00	8.80	156.00	9.20	255.00	0.71
SD.R.03	0.16	0.05	24.80	240.00	20.00	86.00	370.00	1,466.00	2,410.00	440.00	8.80	244.00	5.80	500.00	0.60
CY1.I.01	0.05	0.05	93.00	120.00	0.00	292.00	139.00	642.00	1,106.00	196.00	7.60	146.00	12.20	105.00	0.30
CY1.I.02	0.05	0.05	80.96	121.00	0.00	286.00	132.00	658.00	1,105.00	187.00	7.90	148.00	20.40	106.00	0.46
CY1.I.03	0.05	0.05	78.60	119.00	0.00	280.00	133.00	668.00	1,104.00	188.00	7.60	145.00	20.40	105.00	0.13
CY1.R.01	0.17	0.05	86.60	127.00	0.00	296.00	137.00	716.00	1,124.00	195.00	7.60	155.00	19.40	97.00	1.67
CY1.R.02	0.10	0.05	83.40	124.00	0.00	294.00	137.00	618.00	1,132.00	196.00	7.60	151.00	20.90	96.00	0.76
CY1.R.03	0.05	0.05	26.40	160.00	5.00	86.00	191.00	890.00	1,514.00	250.00	8.40	183.00	4.90	~~21.00~~ 210.00	0.16
CY1.R.04	0.18	0.05	20.00	191.00	7.00	65.00	211.00	1,010.00	1,677.00	264.00	8.60	216.00	3.60	250.00	0.10
DLY.CY1.01				120.00	0.00	298.00	134.00		1,089.00	190.00	7.60	146.00			0.07
DLY.CY1.02				121.00	0.00	300.00	133.00		1,094.00	189.00	7.60	147.00			0.07
DLY.CY1.03				120.00	0.00	279.00	132.00		1,107.00	187.00	7.60	146.00			0.24
DLY.CY1.04				119.00	0.00	274.00	128.00		1,095.00	181.00	7.60	145.00			0.68
DLY.CY1.05				118.00	0.00	300.00	132.00		1,099.00	186.00	7.60	144.00			0.21
DLY.CY1.06				118.00	0.00	284.00	137.00		1,102.00	192.00	7.60	144.00			0.26

PvN 3/3/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

OVERVIEW REPORT

Sample ID..............	Iron (Fe)	Mn	Calcium	Alk.- T	Alk.- P	Hard.	Chloride	TDS	Cond.	Sulfate	pH	HCO3	Mg	Sodium	Turbidity
DLY.CY1.07				124.00	0.00	290.00	137.00		1,114.00	192.00	7.60	157.00			0.16
DLY.CY1.08				117.00	0.00	290.00	137.00		1,112.00	192.00	7.60	143.00			0.17
DLY.CY1.09				122.00	0.00	284.00	136.00		1,120.00	194.00	7.60	149.00			0.91
DLY.CY1.10				147.00	0.00	148.00	136.00		1,206.00	191.00	8.00	179.00			0.28
DLY.CY1.11				160.00	5.00	88.00	188.00		1,491.00	245.00	8.40	183.00			0.16
DLY.CY1.12				186.00	8.00	70.00	202.00		1,630.00	260.00	8.50	207.00			0.16
CY1.I.04	0.05	0.05	85.80	126.00	0.00	290.00	136.00	666.00	1,105.00	190.00	7.60	154.00	18.50	107.00	0.19
CY1.R.05	0.05	0.05	18.00	205.00	8.00	67.00	231.00	1,096.00	1,809.00	279.00	8.60	231.00	5.30	260.00	0.10
DLY.CY1.13				205.00	10.00	67.00	230.00		1,807.00	277.00	8.60	226.00			0.18
CY1.R.06	0.06	0.05	18.00	210.00	9.00	70.00	282.00	1,254.00	2,070.00	325.00	8.60	234.00	6.08	350.00	0.07
DLY.CY1.14				211.00	13.00	62.00	281.00		2,060.00	323.00	8.60	226.00			0.10
CY1.R.07	0.05	0.05	17.20	216.00	10.00	61.00	306.00	1,350.00	2,230.00	351.00	8.60	239.00	4.38	380.00	0.07
DLY.CY1.15				217.00	11.00	59.00	300.00		2,230.00	352.00	8.60	238.00			0.07
CY1.R.08	0.05	0.05	15.60	213.00	11.00	58.00	324.00	1,410.00	2,370.00	359.00	8.60	233.00	4.62	410.00	0.07
DLY.CY1.16				215.00	12.00	55.00	326.00		2,370.00	362.00	8.60				0.18

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....SD.I.01   Sample Date......1/14/98   Date Received.....1/14/98   Sample Location.....Del Mar Plant   Custody.....1702
Lab ID..........LAB-A   Sample Time.....1430   Time Received....1500   Sampler..................P. VanNoort

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Det	0.05	mg/L	Core Labs	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	89.80			mg/L	CC	1/15/98
Alkalinity - Total	114.00			mg/L	CC	1/15/98
Alkalinity - Phen	0.00			mg/L	CC	1/15/98
Total Hardness	276.00			mg/L	CC	1/15/98
Sulfate	183.00			mg/L	CC	1/19/98
Chloride	129.00			mg/L	CC	1/19/98
TDS	682.00			mg/L	JCM	1/16/98
Conductivity	1,057.00			uS/cm	CC	1/15/98
pH	7.60			S.U.	CC	1/15/98
Bicarbonate	139.00			mg/L	Cal	
Magnesium	12.60			mg/L	CC	1/15/98
Sodium (Na)	99.00		1.00	mg/L	Core Lab	
Turbidity	0.12			NTU	CC	1/15/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....SD.I.02	Sample Date......1/14/98	Date Received.....1/15/98	Sample Location.....Del Mar Plant	Custody.....1703
Lab ID..........LAB-A	Sample Time.....1615	Time Received.....1005	Sampler..................P. VanNoort	

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Dec	0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Dec	0.05	mg/L	Core Lab	
Calcium	89.80			mg/L	CC	1/15/98
Alkalinity - Total	113.00			mg/L	CC	1/15/98
Alkalinity - Phen	0.00			mg/L	CC	1/15/98
Total Hardness	282.00			mg/L	CC	1/15/98
Sulfate	191.00			mg/L	CC	1/19/98
Chloride	135.00			mg/L	CC	1/19/98
TDS	680.00			mg/L	JCM	1/16/98
Conductivity	1,075.00			uS/cm	CC	1/15/98
pH	7.60			S.U.	CC	1/15/98
Bicarbonate	113.00			mg/L	Cal	
Magnesium	14.10			mg/L	CC	1/15/98
Sodium (Na)	103.00		1.00	mg/L	Core Lab	
Turbidity	0.78			NTU	CC	1/15/98

Form (Lab A)

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....SD.R.01	Sample Date......1/14/98	Date Received.....1/15/98	Sample Location.....Del Mar Plant	Custody.....1704
Lab ID..........LAB-A	Sample Time.....1700	Time Received.....1005	Sampler..................P. VanNoort	

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.99		0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Dec	0.05	mg/L	Core Lab	
Calcium	74.50			mg/L	CC	1/15/98
Alkalinity - Total	128.00			mg/L	CC	1/15/98
Alkalinity - Phen	2.00			mg/L	CC	1/15/98
Total Hardness	236.00			mg/L	CC	1/15/98
Sulfate	198.00			mg/L	CC	1/19/98
Chloride	141.00			mg/L	CC	1/19/98
TDS	708.00			mg/L	JCM	1/16/98
Conductivity	1,156.00			uS/cm	CC	1/15/98
pH	8.10			S.U.	CC	1/15/98
Bicarbonate	15.10			mg/L	Cal	
Magnesium	12.20			mg/L	CC	1/15/98
Sodium (Na)	143.00		1.00	mg/L	Core Lab	
Turbidity	4.43			NTU	CC	1/15/98

Form (Lab A)

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....SD.R.02   Sample Date......1/14/98   Date Received.....1/15/98   Sample Location.....Del Mar Plant   Custody.....1705
Lab ID..........LAB-A   Sample Time.....1730   Time Received....1005   Sampler..................P. VanNoort

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.20		0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	21.60			mg/L	CC	1/15/98
Alkalinity - Total	160.00			mg/L	CC	1/15/98
Alkalinity - Phen	16.00			mg/L	CC	1/15/98
Total Hardness	92.00			mg/L	CC	1/15/98
Sulfate	233.00			mg/L	CC	1/19/98
Chloride	176.00			mg/L	CC	1/19/98
TDS	846.00			mg/L	JCM	1/16/98
Conductivity	1,452.00			uS/cm	CC	1/15/98
pH	8.80			S.U.	CC	1/15/98
Bicarbonate	156.00			mg/L	Cal	
Magnesium	9.20			mg/L	CC	1/15/98
Sodium (Na)	255.00		5.00	mg/L	Core Lab	
Turbidity	0.71			NTU	CC	1/15/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....SD.R.03 Sample Date......1/14/98 Date Received.....1/15/98 Sample Location.....Del Mar Plant Custody.....1706
Lab ID..........LAB-A Sample Time.....1830 Time Received.....1005 Sampler..................P. VanNoort

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.16		0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	24.80			mg/L	CC	1/15/98
Alkalinity - Total	240.00			mg/L	CC	1/15/98
Alkalinity - Phen	20.00			mg/L	CC	1/15/98
Total Hardness	86.00			mg/L	CC	1/15/98
Sulfate	440.00			mg/L	CC	1/19/98
Chloride	370.00			mg/L	CC	1/19/98
TDS	1,466.00			mg/L	JCM	1/16/98
Conductivity	2,410.00			uS/cm	CC	1/15/98
pH	8.80			S.U.	CC	1/15/98
Bicarbonate	244.00			mg/L	Cal	
Magnesium	5.80			mg/L	CC	1/15/98
Sodium (Na)	500.00		10.00	mg/L	Core Lab	
Turbidity	0.60			NTU	CC	1/15/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....CY1.I.01 Sample Date......1/15/98 Date Received.....1/16/98 Sample Location.....Del Mar Plant Custody....1708
Lab ID..........LAB-A Sample Time.....1345 Time Received....1120 Sampler..................P. VanNoort

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Det	0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	93.00			mg/L	HM	1/16/98
Alkalinity - Total	120.00			mg/L	HM	1/16/98
Alkalinity - Phen	0.00			mg/L	HM	1/16/98
Total Hardness	292.00			mg/L	HM	1/16/98
Sulfate	196.00			mg/L	CC	1/19/98
Chloride	139.00			mg/L	CC	1/19/98
TDS	642.00			mg/L	JCM	1/22/98
Conductivity	1,106.00			uS/cm	HM	1/16/98
pH	7.60			S.U.	HM	1/16/98
Bicarbonate	146.00			mg/L	Cal	
Magnesium	12.20			mg/L	HM	1/16/98
Sodium (Na)	105.00		1.00	mg/L	Core Lab	
Turbidity	0.30			NTU	HM	1/16/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....CY1.I.02 Sample Date......1/17/98 Date Received.....1/19/98 Sample Location.....Del Mar Plant Custody.....1710
Lab ID..........LAB-A Sample Time.....1045 Time Received....0925 Sampler..................P. VanNoort

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Det	0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	80.96			mg/L	JCM	1/19/98
Alkalinity - Total	121.00			mg/L	JCM	1/19/98
Alkalinity - Phen	0.00			mg/L	JCM	1/19/98
Total Hardness	286.00			mg/L	JCM	1/19/98
Sulfate	187.00			mg/L	CC	1/19/98
Chloride	132.00			mg/L	CC	1/19/98
TDS	658.00			mg/L	JCM	1/22/98
Conductivity	1,105.00			uS/cm	JCM	1/19/98
pH	7.90			S.U.	JCM	1/19/98
Bicarbonate	148.00			mg/L	Cal	
Magnesium	20.40			mg/L	JCM	1/19/98
Sodium (Na)	106.00		1.00	mg/L	Core Lab	
Turbidity	0.46			NTU	JCM	1/19/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....CY1.I.03   Sample Date......1/19/98   Date Received.....1/19/98   Sample Location.....Del Mar Plant   Custody.....1710
Lab ID..........LAB-A   Sample Time.....0900   Time Received....0925   Sampler.................P. VanNoort

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Det	0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	78.60			mg/L	JCM	1/19/98
Alkalinity - Total	119.00			mg/L	JCM	1/19/98
Alkalinity - Phen	0.00			mg/L	JCM	1/19/98
Total Hardness	280.00			mg/L	JCM	1/19/98
Sulfate	188.00			mg/L	CC	1/19/98
Chloride	133.00			mg/L	CC	1/19/98
TDS	668.00			mg/L	JCM	1/22/98
Conductivity	1,104.00			uS/cm	JCM	1/19/98
pH	7.60			S.U.	JCM	1/19/98
Bicarbonate	145.00			mg/L	Cal	
Magnesium	20.40			mg/L	JCM	1/19/98
Sodium (Na)	105.00		1.00	mg/L	Core Lab	
Turbidity	0.13			NTU	JCM	1/19/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....CY1.R.01	Sample Date......1/23/98	Date Received.....1/26/98	Sample Location.....Del Mar Plant	Custody.....1714
Lab ID..........LAB-A	Sample Time.....1340	Time Received....1031	Sampler..................Porter/Salas	

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.17		0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	86.60			mg/L	CC	1/27/98
Alkalinity - Total	127.00			mg/L	CC	1/27/98
Alkalinity - Phen	0.00			mg/L	CC	1/27/98
Total Hardness	296.00			mg/L	CC	1/27/98
Sulfate	195.00			mg/L	CC	1/26/98
Chloride	137.00			mg/L	CC	1/26/98
TDS	716.00			mg/L		1/23/98
Conductivity	1,124.00			uS/cm	CC	1/27/98
pH	7.60			S.U.	CC	1/27/98
Bicarbonate	155.00			mg/L	Cal	
Magnesium	19.40			mg/L	CC	1/27/98
Sodium (Na)	97.00		1.00	mg/L	Core Lab	
Turbidity	1.67			NTU	CC	1/27/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....CY1.R.02   Sample Date......1/23/98   Date Received.....1/26/98   Sample Location.....Del Mar Plant   Custody.....1714
Lab ID..........LAB-A   Sample Time.....1620   Time Received....1031   Sampler..................Porter/Salas

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.10		0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	83.40			mg/L	CC	1/27/98
Alkalinity - Total	124.00			mg/L	CC	1/27/98
Alkalinity - Phen	0.00			mg/L	CC	1/27/98
Total Hardness	294.00			mg/L	CC	1/27/98
Sulfate	196.00			mg/L	CC	1/26/98
Chloride	137.00			mg/L	CC	1/26/98
TDS	618.00			mg/L		1/23/98
Conductivity	1,132.00			uS/cm	CC	1/27/98
pH	7.60			S.U.	CC	1/27/98
Bicarbonate	151.00			mg/L	Cal	
Magnesium	20.90			mg/L	CC	1/27/98
Sodium (Na)	96.00		1.00	mg/L	Core Lab	
Turbidity	0.76			NTU	CC	1/27/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....CY1.R.03 | Sample Date......1/25/98 | Date Received.....1/26/98 | Sample Location.....Del Mar Plant | Custody.....1714
Lab ID..........LAB-A | Sample Time.....1305 | Time Received....1031 | Sampler..................Porter/Salas

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Det	0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	26.40			mg/L	CC	1/27/98
Alkalinity - Total	160.00			mg/L	CC	1/27/98
Alkalinity - Phen	5.00			mg/L	CC	1/27/98
Total Hardness	86.00			mg/L	CC	1/27/98
Sulfate	250.00			mg/L	CC	1/26/98
Chloride	191.00			mg/L	CC	1/26/98
TDS	890.00			mg/L		1/23/98
Conductivity	1,514.00			uS/cm	CC	1/27/98
pH	8.40			S.U.	CC	1/27/98
Bicarbonate	183.00			mg/L	Cal	
Magnesium	4.90			mg/L	CC	1/27/98
Sodium (Na)	21.00		1.00	mg/L	Core Lab	
Turbidity	0.16			NTU	CC	1/27/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....CY1.R.04   Sample Date......1/26/98   Date Received.....1/27/98   Sample Location.....Del Mar Plant   Custody.....1716
Lab ID..........LAB-A   Sample Time.....1628   Time Received....1027   Sampler..................Porter/Salas

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.18		0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	20.00			mg/L	CC	1/27/98
Alkalinity - Total	191.00			mg/L	CC	1/27/98
Alkalinity - Phen	7.00			mg/L	CC	1/27/98
Total Hardness	65.00			mg/L	CC	1/27/98
Sulfate	264.00			mg/L	CC	2/ 2/98
Chloride	211.00			mg/L	CC	2/ 2/98
TDS	1,010.00			mg/L		1/27/98
Conductivity	1,677.00			uS/cm	CC	1/27/98
pH	8.60			S.U.	CC	1/27/98
Bicarbonate	216.00			mg/L	Cal	
Magnesium	3.60			mg/L	CC	1/27/98
Sodium (Na)	250.00		10.00	mg/L	Core Lab	
Turbidity	0.10			NTU	CC	1/27/98

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....CY1.I.04 Sample Date......1/21/98 Date Received.....1/21/98 Sample Location.....Del Mar Plant Custody.....1712
Lab ID.........LAB-A Sample Time.....0900 Time Received....0925 Sampler..................Porter/Salas

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Detect	0.05	mg/L	Core Labs	
Manganese (Mn)	0.05	Non-Detect	0.05	mg/L	Core Labs	
Calcium	85.80			mg/L	Hm	1/21/98
Alkalinity - Total	126.00			mg/L	HM	1/21/98
Alkalinity - Phen	0.00			mg/L	HM	1/21/98
Total Hardness	290.00			mg/L	HM	1/21/98
Sulfate	190.00			mg/L	CC	1/26/98
Chloride	136.00			mg/L	CC	1/26/98
TDS	666.00			mg/L	JCM	1/22/98
Conductivity	1,105.00			uS/cm	HM	1/21/98
pH	7.60			S.U.	HM	1/21/98
Bicarbonate	154.00			mg/L	Cal	
Magnesium	18.50			mg/L	Hm	1/21/98
Sodium (Na)	107.00		1.00	mg/L	Core Labs	
Turbidity	0.19			NTU	HM	1/21/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....CY1.R.05	Sample Date......1/27/98	Date Received.....1/27/98	Sample Location.....Del Mar plant	Custody.....1716
Lab ID..........LAB-A	Sample Time.....0950	Time Received.....1027	Sampler..................Porter/Salas	

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Det	0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	18.00			mg/L	CC	1/27/98
Alkalinity - Total	205.00			mg/L	CC	1/27/98
Alkalinity - Phen	8.00			mg/L	CC	1/27/98
Total Hardness	67.00			mg/L	CC	1/27/98
Sulfate	279.00			mg/L	CC	2/ 2/98
Chloride	231.00			mg/L	CC	2/ 2/98
TDS	1,096.00			mg/L		1/28/98
Conductivity	1,809.00			uS/cm	CC	1/27/98
pH	8.60			S.U.	CC	1/27/98
Bicarbonate	231.00			mg/L	Cal	
Magnesium	5.30			mg/L	CC	1/27/98
Sodium (Na)	260.00		10.00	mg/L	Core Lab	
Turbidity	0.10			NTU	CC	1/27/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....CY1.R.06	Sample Date......1/28/98	Date Received.....1/28/98	Sample Location.....Del Mar Plant	Custody.....1717
Lab ID..........LAB-A	Sample Time.....1405	Time Received....1424	Sampler..................Porter/Salas	

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.06		0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	18.00			mg/L	HM	1/30/98
Alkalinity - Total	210.00			mg/L	HM	1/30/98
Alkalinity - Phen	9.00			mg/L	HM	1/30/98
Total Hardness	70.00			mg/L	CC	1/30/98
Sulfate	325.00			mg/L	CC	2/ 2/98
Chloride	282.00			mg/L	CC	2/ 2/98
TDS	1,254.00			mg/L		1/28/98
Conductivity	2,070.00			uS/cm	HM	1/30/98
pH	8.60			S.U.	HM	1/30/98
Bicarbonate	234.00			mg/L	Cal	
Magnesium	6.08			mg/L	HM	1/30/98
Sodium (Na)	350.00		10.00	mg/L	Core Lab	
Turbidity	0.07			NTU	HM	1/30/98

Form (Lab A)

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....CY1.R.07	Sample Date......1/29/98	Date Received.....1/29/98	Sample Location.....Del Mar Plant	Custody....1718
Lab ID..........LAB-A	Sample Time.....1000	Time Received....1040	Sampler..................Porter/Salas	

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Det	0.05	mg/L	Core Lab	
Manganese (Mn)	0.05	Non-Det	0.05	mg/L	Core Lab	
Calcium	17.20			mg/L	HM	1/30/98
Alkalinity - Total	216.00			mg/L	HM	1/30/98
Alkalinity - Phen	10.00			mg/L	HM	1/30/98
Total Hardness	61.00			mg/L	HM	1/30/98
Sulfate	351.00			mg/L	CC	2/ 2/98
Chloride	306.00			mg/L	CC	2/ 2/98
TDS	1,350.00			mg/L		1/29/98
Conductivity	2,230.00			uS/cm	HM	1/30/98
pH	8.60			S.U.	HM	1/30/98
Bicarbonate	239.00			mg/L	Cal	
Magnesium	4.38			mg/L	HM	1/30/98
Sodium (Na)	380.00		10.00	mg/L	Core Lab	
Turbidity	0.07			NTU	HM	1/30/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....CY1.R.08	Sample Date......1/30/98	Date Received.....1/30/98	Sample Location.....Del Mar Plant	Custody.....1719
Lab ID..........LAB-A	Sample Time.....0930	Time Received....1024	Sampler..................Porter/Salas	

LAB - A ANALYSES

PARAMETER	RESULT	DETECTION	REPORTING LIMIT	UNITS	TECH	DATE COMPLETED
Iron (Fe)	0.05	Non-Detect	0.05	mg/L	Core Labs	
Manganese (Mn)	0.05	Non-Detect	0.05	mg/L	Core Labs	
Calcium	15.60			mg/L	HM	1/30/98
Alkalinity - Total	213.00			mg/L	HM	1/30/98
Alkalinity - Phen	11.00			mg/L	HM	1/30/98
Total Hardness	58.00			mg/L	HM	1/30/98
Sulfate	359.00			mg/L	CC	2/ 2/98
Chloride	324.00			mg/L	CC	2/ 2/98
TDS	1,410.00			mg/L		1/28/98
Conductivity	2,370.00			uS/cm	HM	1/30/98
pH	8.60			S.U.	HM	1/30/98
Bicarbonate	233.00			mg/L	Cal	
Magnesium	4.62			mg/L	HM	1/30/98
Sodium (Na)	410.00		20.00	mg/L	Core Labs	
Turbidity	0.07			NTU	HM	1/30/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....DLY.CY1.01   Sample Date......1/15/98   Date Received.....1/16/98   Sample Location.....Del Mar Plant   Custody.....1708
Lab ID..........LAB-B   Sample Time.....1345   Time Received....1120   Sampler..................P. VanNoort

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	134.00	mg/L	CC	1/19/98
Conductivity	1,089.00	uS/cm	HM	10/16/98
pH	7.60	S.U.	HM	1/16/98
Alkalinity - Total	120.00	mg/L	HM	1/16/98
Alkalinity - Phen	0.00	mg/L	HM	1/16/98
Total Hardness	298.00	mg/L	HM	1/16/98
Turbidity	0.07	NTU	HM	1/16/98

Sample ID....DLY.CY1.02   Sample Date......1/16/98   Date Received.....1/16/98   Sample Location.....Del Mar Plant   Custody.....1708
Lab ID..........LAB-B   Sample Time.....1105   Time Received....1120   Sampler..................P. VanNoort

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	133.00	mg/L	CC	1/19/98
Conductivity	1,094.00	uS/cm	HM	1/16/98
pH	7.60	S.U.	HM	1/16/98
Alkalinity - Total	121.00	mg/L	HM	1/16/98
Alkalinity - Phen	0.00	mg/L	HM	1/16/98
Total Hardness	300.00	mg/L	HM	1/16/98
Turbidity	0.07	NTU	HM	1/16/98

Sample ID....DLY.CY1.03   Sample Date......1/17/98   Date Received.....1/19/98   Sample Location.....Del Mar Plant   Custody.....1710
Lab ID..........LAB-B   Sample Time.....1045   Time Received....0925   Sampler..................P. VanNoort

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	132.00	mg/L	CC	1/19/98
Conductivity	1,107.00	uS/cm	JCM	1/19/98
pH	7.60	S.U.	JCM	1/19/98
Alkalinity - Total	120.00	mg/L	JCM	1/19/98
Alkalinity - Phen	0.00	mg/L	JCM	1/19/98
Total Hardness	279.00	mg/L	JCM	1/19/98
Turbidity	0.24	NTU	JCM	1/19/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....DLY.CY1.04 Sample Date......1/18/98 Date Received.....1/19/08 Sample Location.....Del Mar Plant Custody.....1710
Lab ID..........LAB-B Sample Time.....1010 Time Received....0925 Sampler..................P. VanNoort

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	128.00	mg/L	CC	1/19/98
Conductivity	1,095.00	uS/cm	JCM	1/19/98
pH	7.60	S.U.	JCM	1/19/98
Alkalinity - Total	119.00	mg/L	JCM	1/19/98
Alkalinity - Phen	0.00	mg/L	JCM	1/19/98
Total Hardness	274.00	mg/L	JCM	1/19/98
Turbidity	0.68	NTU	JCM	1/19/98

Sample ID....DLY.CY1.05 Sample Date......1/19/98 Date Received.....1/19/98 Sample Location.....Del Mar Plant Custody.....1710
Lab ID..........LAB-B Sample Time.....0900 Time Received....0925 Sampler..................P. VanNoort

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	132.00	mg/L	CC	1/19/98
Conductivity	1,099.00	uS/cm	JCM	1/19/98
pH	7.60	S.U.	JCM	1/19/98
Alkalinity - Total	118.00	mg/L	JCM	1/19/98
Alkalinity - Phen	0.00	mg/L	JCM	1/19/98
Total Hardness	300.00	mg/L	JCM	1/19/98
Turbidity	0.21	NTU	JCM	1/19/98

Sample ID....DLY.CY1.06 Sample Date......1/20/98 Date Received.....1/20/98 Sample Location.....Del Mar Plant Custody.....1711
Lab ID..........LAB-B Sample Time.....0950 Time Received....1018 Sampler..................P. VanNoort

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	137.00	mg/L	CC	1/26/98
Conductivity	1,102.00	uS/cm	CC	1/20/98
pH	7.60	S.U.	CC	1/20/98
Alkalinity - Total	118.00	mg/L	CC	1/20/98
Alkalinity - Phen	0.00	mg/L	CC	1/20/98
Total Hardness	284.00	mg/L	CC	1/20/98
Turbidity	0.26	NTU	CC	1/20/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....DLY.CY1.07 Sample Date......1/21/98 Date Received.....1/21/98 Sample Location.....Del Mar Plant Custody.....1712
Lab ID..........LAB-B Sample Time.....0900 Time Received....0925 Sampler..................Porter/Salas

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	137.00	mg/L	CC	1/26/98
Conductivity	1,114.00	uS/cm	HM	1/21/98
pH	7.60	S.U.	HM	1/21/98
Alkalinity - Total	124.00	mg/L	HM	1/21/98
Alkalinity - Phen	0.00	mg/L	HM	1/21/98
Total Hardness	290.00	mg/L	HM	1/21/98
Turbidity	0.16	NTU	HM	1/21/98

Sample ID....DLY.CY1.08 Sample Date......1/22/98 Date Received.....1/22/98 Sample Location.....Del Mar Plant Custody.....1713
Lab ID..........LAB-B Sample Time.....0900 Time Received....0920 Sampler..................Porter/Salas

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	137.00	mg/L	CC	1/26/98
Conductivity	1,112.00	uS/cm	CC	1/22/98
pH	7.60	S.U.	CC	1/22/98
Alkalinity - Total	117.00	mg/L	CC	1/22/98
Alkalinity - Phen	0.00	mg/L	CC	1/22/98
Total Hardness	290.00	mg/L	CC	1/22/98
Turbidity	0.17	NTU	CC	1/22/98

Sample ID....DLY.CY1.09 Sample Date......1/23/98 Date Received.....1/26/98 Sample Location.....Del Mar Plant Custody.....1714
Lab ID..........LAB-B Sample Time.....1620 Time Received....1031 Sampler..................Porter/Salas

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	136.00	mg/L	CC	1/26/98
Conductivity	1,120.00	uS/cm	CC	1/27/98
pH	7.60	S.U.	CC	1/27/98
Alkalinity - Total	122.00	mg/L	CC	1/27/98
Alkalinity - Phen	0.00	mg/L	CC	1/27/98
Total Hardness	284.00	mg/L	CC	1/27/98
Turbidity	0.91	NTU	CC	1/27/98

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....DLY.CY1.10 Sample Date......1/24/98 Date Received.....1/26/98 Sample Location.....Del Mar Plant Custody.....1714
Lab ID..........LAB-B Sample Time.....1225 Time Received.....1031 Sampler..................Porter/Salas

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	136.00	mg/L	CC	1/26/98
Conductivity	1,206.00	uS/cm	CC	1/27/98
pH	8.00	S.U.	CC	1/27/98
Alkalinity - Total	147.00	mg/L	CC	1/27/98
Alkalinity - Phen	0.00	mg/L	CC	1/27/98
Total Hardness	148.00	mg/L	CC	1/27/98
Turbidity	0.28	NTU	CC	1/27/98

Sample ID....DLY.CY1.11 Sample Date......1/25/98 Date Received.....1/26/98 Sample Location.....Del Mar Plant Custody.....1714
Lab ID..........LAB-B Sample Time.....1305 Time Received.....1031 Sampler..................Porter/Salas

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	188.00	mg/L	CC	1/26/98
Conductivity	1,491.00	uS/cm	CC	1/27/98
pH	8.40	S.U.	CC	1/27/98
Alkalinity - Total	160.00	mg/L	CC	1/27/98
Alkalinity - Phen	5.00	mg/L	CC	1/27/98
Total Hardness	88.00	mg/L	CC	1/27/98
Turbidity	0.16	NTU	CC	1/27/98

Sample ID....DLY.CY1.12 Sample Date......1/26/98 Date Received.....1/26/98 Sample Location.....Del Mar Plant Custody.....1715
Lab ID..........LAB-B Sample Time.....1005 Time Received.....1031 Sampler..................Porter/Salas

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	202.00	mg/L	CC	1/26/98
Conductivity	1,630.00	uS/cm	CC	1/27/98
pH	8.50	S.U.	CC	1/27/98
Alkalinity - Total	186.00	mg/L	CC	1/27/98
Alkalinity - Phen	8.00	mg/L	CC	1/27/98
Total Hardness	70.00	mg/L	CC	1/27/98
Turbidity	0.16	NTU	CC	1/27/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR) Report Date: 2/25/98

Sample ID....DLY.CY1.13 Sample Date......1/27/98 Date Received.....1/27/98 Sample Location.....Del Mar Plant Custody.....1716
Lab ID..........LAB-B Sample Time.....0950 Time Received.....1027 Sampler..................Porter/Salas

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	230.00	mg/L	CC	2/ 2/98
Conductivity	1,807.00	uS/cm	CC	1/27/98
pH	8.60	S.U.	CC	1/27/98
Alkalinity - Total	205.00	mg/L	CC	1/27/98
Alkalinity - Phen	10.00	mg/L	CC	1/27/98
Total Hardness	67.00	mg/L	CC	1/27/98
Turbidity	0.18	NTU	CC	1/27/98

Sample ID....DLY.CY1.14 Sample Date......1/28/98 Date Received.....1/28/98 Sample Location.....Del Mar Plant Custody.....1717
Lab ID..........LAB-B Sample Time.....1405 Time Received.....1424 Sampler..................Porter/Salas

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	281.00	mg/L	CC	2/ 2/98
Conductivity	2,060.00	uS/cm	HM	1/30/98
pH	8.60	S.U.	HM	1/30/98
Alkalinity - Total	211.00	mg/L	HM	1/30/98
Alkalinity - Phen	13.00	mg/L	HM	1/30/98
Total Hardness	62.00	mg/L	HM	1/30/98
Turbidity	0.10	NTU	HM	1/30/98

Sample ID....DLY.CY1.15 Sample Date......1/29/98 Date Received.....1/29/98 Sample Location.....Del Mar Plant Custody.....1718
Lab ID..........LAB-B Sample Time.....1000 Time Received.....1040 Sampler..................Porter/Salas

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	300.00	mg/L	CC	2/ 2/98
Conductivity	2,230.00	uS/cm	HM	1/30/98
pH	8.60	S.U.	CC	1/30/98
Alkalinity - Total	217.00	mg/L	HM	1/30/98
Alkalinity - Phen	11.00	mg/L	HM	1/30/98
Total Hardness	59.00	mg/L	HM	1/30/98
Turbidity	0.07	NTU	CC	1/30/98

City of Laredo, Water Utilities Laboratory Services

Project: Aquifer Storage and Recovery (ASR)   Report Date: 2/25/98

Sample ID....DLY.CY1.16	Sample Date......1/30/98	Date Received.....1/30/98	Sample Location.....Del Mar Plant	Custody.....1719
Lab ID..........LAB-B	Sample Time.....0930	Time Received....1024	Sampler..................Porter/Salas	

LAB - B ANALYSES

PARAMETER	RESULT	UNITS	TECH	DATE COMPLETED
Chloride	326.00	mg/L	CC	2/ 2/98
Conductivity	2,370.00	uS/cm	HM	1/30/98
pH	8.60	S.U.	HM	1/30/98
Alkalinity - Total	215.00	mg/L	HM	1/30/98
Alkalinity - Phen	12.00	mg/L	HM	1/30/98
Total Hardness	55.00	mg/L	HM	1/30/98
Turbidity	0.18	NTU	HM	1/30/98

CORE LAB

CORE LABORATORIES

ANALYTICAL REPORT

JOB NUMBER: 980484

Prepared For:

City of Laredo
P. O. Box 2950
Laredo, TX 78044

Attention: Adrian Montemayor

Date: 02/18/98

Signature

Name: Charles Sassine

Title: Laboratory Supervisor

2/18/98

Date

1733 N. Padre Island Drive
Corpus Christi, TX 78403

PHONE: 512/289-2673
FAX: 512/289-2471

CORE LAB

CORE LABORATORIES

S A M P L E I N F O R M A T I O N

Date: 02/18/98

Job Number.: 980484
Customer ..: City of Laredo
Attn.......: Adrian Montemayor

Project Number.........: 99999995
Customer Project ID....: LAREDO ASR DEL MAR
Project Description....: Walk in Projects

Laboratory Sample ID	Customer Sample ID	Sample Matrix	Date Sampled	Time Sampled	Date Received	Time Received
980484-1	CYI.R.01	Water	01/23/98	13:40	02/06/98	08:00
980484-2	CYI.R.02	Water	01/23/98	16:20	02/06/98	08:00
980484-3	CYI.R.03	Water	01/25/98	13:08	02/06/98	08:00
980484-4	CYI.R.04	Water	01/26/98	16:25	02/06/98	08:00
980484-5	CYI.R.05	Water	01/27/98	09:50	02/06/98	08:00
980484-6	CYI.R.06	Water	01/28/98	14:05	02/06/98	08:00
980484-7	CYI.R.07	Water	01/29/98	10:00	02/06/98	08:00
980484-8	CYI.R.08	Water	01/30/98	09:30	02/06/98	08:00

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980484

Date: 02/18/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: CYI.R.01
Date Sampled......: 01/23/98
Time Sampled......: 13:40
Sample Matrix.....: Water

Laboratory Sample ID: 980484-1
Date Received.......: 02/06/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	0.17	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Sodium (Na), Total	97	1	mg/L	02/17/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			02/06/98	ah

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980484

Date: 02/18/98

CUSTOMER: City of Laredo   PROJECT: LAREDO ASR DEL MAR   ATTN: Adrian Montemayor

Customer Sample ID: CYI.R.02
Date Sampled......: 01/23/98
Time Sampled......: 16:20
Sample Matrix.....: Water

Laboratory Sample ID: 980484-2
Date Received.......: 02/06/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TEC
SW-846 6010B	Iron (Fe), Total	0.10	0.05	mg/L	02/17/98	gc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	02/17/98	gc
SW-846 6010B	Sodium (Na), Total	96	1	mg/L	02/17/98	gc
SW-846 3015	Acid Digestion, Total Metals	Complete			02/06/98	ah

CORE LAB

CORE LABORATORIES

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 980484

Date: 02/18/98

CUSTOMER: City of Laredo   PROJECT: LAREDO ASR DEL MAR   ATTN: Adrian Montemayor

Customer Sample ID: CYI.R.03
Date Sampled......: 01/25/98
Time Sampled......: 13:08
Sample Matrix.....: Water

Laboratory Sample ID: 980484-3
Date Received.......: 02/06/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Sodium (Na), Total	21	1	mg/L	02/17/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			02/06/98	ah

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980484 Date: 02/18/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: CYI.R.04
Date Sampled......: 01/26/98
Time Sampled......: 16:25
Sample Matrix.....: Water

Laboratory Sample ID: 980484-4
Date Received.......: 02/06/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	0.18	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Sodium (Na), Total	250	10	mg/L	02/17/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			02/06/98	ah

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980484

Date: 02/18/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: CYI.R.05
Date Sampled......: 01/27/98
Time Sampled......: 09:50
Sample Matrix.....: Water

Laboratory Sample ID: 980484-5
Date Received.......: 02/06/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Sodium (Na), Total	260	10	mg/L	02/17/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			02/06/98	ah

CORE LAB

CORE LABORATORIES

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 980484 Date: 02/18/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: CYI.R.06
Date Sampled......: 01/28/98
Time Sampled......: 14:05
Sample Matrix.....: Water

Laboratory Sample ID: 980484-6
Date Received.......: 02/06/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	0.06	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Sodium (Na), Total	350	10	mg/L	02/17/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			02/06/98	ah

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980484

Date: 02/18/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: CYI.R.07
Date Sampled......: 01/29/98
Time Sampled......: 10:00
Sample Matrix.....: Water

Laboratory Sample ID: 980484-7
Date Received.......: 02/06/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Sodium (Na), Total	380	10	mg/L	02/17/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			02/06/98	ah

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980484 Date: 02/18/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: CYI.R.08
Date Sampled......: 01/30/98
Time Sampled......: 09:30
Sample Matrix.....: Water

Laboratory Sample ID: 980484-8
Date Received.......: 02/06/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	02/17/98	gcc
SW-846 6010B	Sodium (Na), Total	410	20	mg/L	02/17/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			02/06/98	ah

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 980696

Date: 02/25/98

CUSTOMER: City of Laredo   PROJECT: ATTN: Adrian Montemayor

Customer Sample ID: CY1.I.04
Date Sampled......: 01/21/98
Time Sampled......: 09:00
Sample Matrix.....: Water

Laboratory Sample ID: 980696-1
Date Received.......: 02/21/98
Time Received.......: 11:10

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	02/24/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	02/24/98	gcc
SW-846 6010B	Sodium (Na), Total	107	1	mg/L	02/24/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			02/24/98	ah

CORE LAB

CORE LABORATORIES

ANALYTICAL REPORT

JOB NUMBER: 980220

Prepared For:

City of Laredo
P. O. Box 2950
Laredo, TX 78044

Attention: Adrian Montemayor

Date: 01/28/98

Signature

Date: 1/28/98

Name: Chip Meador

Title: Regional Manager

1733 N. Padre Island Drive
Corpus Christi, TX 7840[illegible]

PHONE: 512/289-2673
FAX: 512/289-2471

CORE LABORATORIES

S A M P L E   I N F O R M A T I O N
Date: 01/28/98

Job Number.: 980220
Customer ..: City of Laredo
Attn.......: Adrian Montemayor

Project Number.........: 99999995
Customer Project ID....: LAREDO ASR DEL MAR
Project Description....: Walk in Projects

Laboratory Sample ID	Customer Sample ID	Sample Matrix	Date Sampled	Time Sampled	Date Received	Time Received
980220-1	SD.I.01-A	Water	01/14/98	14:30	01/20/98	08:00
980220-2	SD.I.02-A	Water	01/14/98	16:15	01/20/98	08:00
980220-3	SD.R.01-A	Water	01/14/98	17:00	01/20/98	08:00
980220-4	SD.R.02-A	Water	01/14/98	17:30	01/20/98	08:00
980220-5	SD.R.03-A	Water	01/14/98	18:30	01/20/98	08:00
980220-6	CY1.I.01-A	Water	01/15/98	13:45	01/20/98	08:00
980220-7	CY1.I.02-A	Water	01/17/98	10:45	01/20/98	08:00
980220-8	CY1.I.03-A	Water	01/19/98	09:00	01/20/98	08:00

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980220 Date: 01/28/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: SD.I.01-A
Date Sampled......: 01/14/98
Time Sampled......: 14:30
Sample Matrix.....: Water

Laboratory Sample ID: 980220-1
Date Received.......: 01/20/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Sodium (Na), Total	99	1	mg/L	01/27/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			01/21/98	ah

CORELAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980220

Date: 01/28/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: SD.I.02-A
Date Sampled......: 01/14/98
Time Sampled......: 16:15
Sample Matrix.....: Water

Laboratory Sample ID: 980220-2
Date Received.......: 01/20/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TE(
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	01/27/98	gc(
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	01/27/98	gc(
SW-846 6010B	Sodium (Na), Total	103	1	mg/L	01/27/98	gc:
SW-846 3015	Acid Digestion, Total Metals	Complete			01/21/98	ah

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980220

Date: 01/28/98

CUSTOMER: City of Laredo | PROJECT: LAREDO ASR DEL MAR | ATTN: Adrian Montemayor

Customer Sample ID: SD.R.01-A
Date Sampled......: 01/14/98
Time Sampled......: 17:00
Sample Matrix.....: Water

Laboratory Sample ID: 980220-3
Date Received.......: 01/20/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	0.99	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Sodium (Na), Total	143	1	mg/L	01/27/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			01/21/98	ah

CORE LAB

CORE LABORATORIES

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 980220

Date: 01/28/98

CUSTOMER: City of Laredo   PROJECT: LAREDO ASR DEL MAR   ATTN: Adrian Montemayor

Customer Sample ID: SD.R.02-A
Date Sampled......: 01/14/98
Time Sampled......: 17:30
Sample Matrix.....: Water

Laboratory Sample ID: 980220-4
Date Received.......: 01/20/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TEC
SW-846 6010B	Iron (Fe), Total	0.20	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Sodium (Na), Total	255	5	mg/L	01/27/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			01/21/98	ah

CORE LAB

CORE LABORATORIES

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 980220 Date: 01/28/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: SD.R.03-A
Date Sampled......: 01/14/98
Time Sampled......: 18:30
Sample Matrix.....: Water

Laboratory Sample ID: 980220-5
Date Received.......: 01/20/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	0.16	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Sodium (Na), Total	500	10	mg/L	01/27/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			01/21/98	ah

CORE LAB

CORE LABORATORIES

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 980220

Date: 01/28/98

CUSTOMER: City of Laredo   PROJECT: LAREDO ASR DEL MAR   ATTN: Adrian Montemayor

Customer Sample ID: CY1.I.01-A
Date Sampled......: 01/15/98
Time Sampled......: 13:45
Sample Matrix.....: Water

Laboratory Sample ID: 980220-6
Date Received.......: 01/20/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TE(
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	01/27/98	gc(
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	01/27/98	gc(
SW-846 6010B	Sodium (Na), Total	105	1	mg/L	01/27/98	gc(
SW-846 3015	Acid Digestion, Total Metals	Complete			01/21/98	ah

CORE LAB

CORE LABORATORIES

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 980220

Date: 01/28/98

CUSTOMER: City of Laredo   PROJECT: LAREDO ASR DEL MAR   ATTN: Adrian Montemayor

Customer Sample ID: CY1.I.02-A
Date Sampled......: 01/17/98
Time Sampled......: 10:45
Sample Matrix.....: Water

Laboratory Sample ID: 980220-7
Date Received.......: 01/20/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	01/27/98	gcc
SW-846 6010B	Sodium (Na), Total	106	1	mg/L	01/27/98	gcc
SW-846 3015	Acid Digestion, Total Metals	Complete			01/21/98	ah

CORE LAB

CORE LABORATORIES

LABORATORY TEST RESULTS

Job Number: 980220

Date: 01/28/98

CUSTOMER: City of Laredo PROJECT: LAREDO ASR DEL MAR ATTN: Adrian Montemayor

Customer Sample ID: CY1.I.03-A
Date Sampled......: 01/19/98
Time Sampled......: 09:00
Sample Matrix.....: Water

Laboratory Sample ID: 980220-8
Date Received.......: 01/20/98
Time Received.......: 08:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	REPORTING LIMIT	UNITS	DATE	TE
SW-846 6010B	Iron (Fe), Total	<0.05	0.05	mg/L	01/27/98	gc
SW-846 6010B	Manganese (Mn), Total	<0.05	0.05	mg/L	01/27/98	gc
SW-846 6010B	Sodium (Na), Total	105	1	mg/L	01/27/98	gc
SW-846 3015	Acid Digestion, Total Metals	Complete			01/21/98	ah

Appendix G
Core Analysis Report

CORE ANALYSIS RESULTS

CH2M HILL, INC.
LAREDO ASR; WELL TW-2A
PROJECT # 118069

Mineralogy, Inc. Job No.: 97-288

MINERALOGY INCORPORATED

3228 East 15th Street / Tulsa, Oklahoma 74104-5252 / (918) 744-8284 / FAX 743-7460

Where Science Gets Down to Earth

August 11, 1997

Mr. Peter VanNoort
CH2M Hill, Inc.
5339 Alpha Rd. Suite 300
Dallas, TX 75240-7352

RE: *Core Analysis Results*
CH2M Hill, Inc.; Laredo ASR - Well TW-2A; Project No.: 118069
Mineralogy, Inc. Job No.: 97-288

Gentlemen:

The following report provides the final results of a series of laboratory analyses performed on three selected intervals from the above captioned well. The core intervals examined in this reservoir study include: core # C-2 (292.05 - 293.4 ft.), core # C-3 (330.0 - 330.95 ft.) and core # C-7 (400.65 - 401.9 ft.). Analytical procedures include: x-ray diffraction analysis, macroscopic sedimentological analysis (core description), thin section petrographic analysis, scanning electron microscopy (SEM analysis), routine core analysis (helium porosity, air permeability and grain density), cation exchange capacity - leachate analysis (CEC), acid insoluble residue analysis, specific gravity analysis and laser particle size analysis. The results of these various analytical procedures are summarized and described in the report text, with an interpretive emphasis which addresses those mineralogical and petrophysical properties which directly influence the reservoir quality of this aquifer.

It is our hope that these results will contribute to an understanding of the rock properties characterizing these intervals and thereby promote the successful utilization and development of this aquifer. The conditions under which this report is presented are summarized immediately following this letter. If you should have any questions regarding these results, or if we can be of further service, please don't hesitate to call.

Sincerely,

Timothy B. Murphy, President
Mineralogy, Inc.

II. CONDITIONS AND QUALIFICATIONS

Mineralogy, Inc. will endeavor to provide accurate and reliable laboratory measurements of the samples provided by the client. The results of any x-ray diffraction, petrographic or core analysis test are necessarily influenced by the condition and selection of the samples to be analyzed. It should be recognized that mineralogical samples are commonly heterogeneous and lack uniform properties. Unless otherwise directed, the samples selected for analysis will be chosen to reflect a visually representative portion of the bulk sample submitted for analysis. Where provided, the interpretation of x-ray diffraction, petrographic or core analysis results constitutes the best geological judgement of Mineralogy, Inc., and is subject to the sampling limitations described above, and detection limits inherent to semi-quantitative mineralogical analysis. Mineralogy, Inc. assumes no responsibility nor offers any guarantee of the productivity or performance of any oil or gas well or hydrocarbon recovery process, based upon the data presented in this report.

SUMMARY

The three cores analyzed from the TW-2A well display striking similarities with one another with respect to mineralogy, texture and reservoir quality. Each of these sandstones is described as very fine-grained, very well sorted, porous and permeable, glauconitic, sublitharenitic sandstone. The detrital framework of these sandstones is mildly to moderately compacted, weakly cemented and friable. The cores display a low angle cross-bedded to ripple-bedded sedimentary fabric, locally accentuated by a few scattered lenses and lamina of thin detrital clay matrix. Portions of core # C-7 display a massively bedded fabric, with irregular lobe-shaped concentrations of infiltrated detrital clay, suggesting the possibility of limited amounts of bioturbation. Helium porosity values range between 30.2 - 32.1%, with horizontal permeabilities between 631 - 809 md. The sandstones display a quartz-rich mineralogy, with moderate volumes of clay matrix minerals (9%) and feldspar (2 - 3%). The bulk of the clay is present as intragranular matrix within glauconite pellets and sedimentary mudstone and shale clasts. These ductile grain types are locally deformed and squashed due to mechanical compaction between adjoining brittle framework grains, resulting in scattered concentrations of pseudomatrix. The clay mineralogy is dominated by mixed-layer illite/smectite and relatively minor volumes of chlorite and illite. Kaolinite is present as an accessory clay mineral constituent. The sandstones are weakly cemented with authigenic quartz, which occurs as weakly developed syntaxial overgrowths nucleated on the detrital quartz grains. Calcite, dolomite, ferroan dolomite, pyrite and siderite are also locally present as accessory cement constituents.

The sandstones from these aquifer intervals should prove to be excellent reservoir rocks in terms of their overall reservoir quality and relatively low susceptibility to formation damage. The clay matrix phases present within these sandstones are generally concentrated with lithic fragments, glauconite pellets and patches of pseudomatrix, with relatively minor volumes of grain-coating chlorite irregularly distributed throughout the sandstone framework. Minor amounts of pseudomatrix have been mobilized within the pore network, resulting in scattered occurrences of matrix occluded pore throats due to "brush-piling" of fines. The few irregular lenses and lamina of detrital matrix (especially concentrated within portions of core # C-3) have locally contributed to a reduction of the vertical permeability, however, the abundance and interconnected nature of the pore network is expressed by consistently high horizontal flow capacity within each of these sandstones. The mixed-layer illite/smectite is moderately expansive, with illite layers accounting for roughly half of the clay layers within this hybrid clay species. The smectite inter-layers are susceptible to expansion, especially in the event of sharp changes in the pore fluid salinity, however, assuming a constant hydration state with relatively constant salinity values, the potential for formation damage related to the volumetric expansion of these clays should be minimal.

TABLE I. X-RAY DIFFRACTION MINERALOGICAL ANALYSIS

The results of the x-ray diffraction mineralogical analysis are summarized on Table I. These cores are strikingly similar with respect to mineralogy, displaying a rather homogenous mineral suite dominated by quartz (88-89%), clay matrix minerals (9%) and feldspar (plagioclase [1-2%] and k-feldspar [1%] varieties). The clay mineral suite (< 2 micrometer) is dominated by mixed-layer illite/smectite (6-7%) and chlorite (2%), with minor to accessory amounts of illite/mica (trc - 1%) and kaolinite (trc). The mixed-layer illite/smectite is moderately expansive and is characterized by subequal volumes of illite and smectite interlayers (estimated 40 - 55% illite layers). Accessory (or trace) mineral phases detected within one or more of the sandstone samples include: calcite, ferroan dolomite (+ dolomite), gypsum and pyrite.

TABLE II. ROUTINE CORE ANALYSIS (Helium Porosity, Air Permeability & Grain Density)

The results of the routine core analysis test suite are provided on Table II. One inch diameter core plugs drilled from the core intervals displayed comparable values of helium porosity (30.2 - 32.1%), horizontal permeability (631 - 809 md.) and grain density (2.63 g/cc). The vertical permeability values measured for these plug samples were somewhat more variable, with core # C-3 displaying a significant decline in flow capacity relative to the horizontal permeability value for this sandstone. These data reflect the localized presence of detrital matrix lenses and lamina within core # C-3 (330.65 ft.; 207 md.). Vertical permeability values for core C-2 (292.5 ft.; 729 md.) and core C-7 (401.3 ft.; 749 md.) were only slightly lower than the measured values for horizontal flow within these sandstone intervals, reflecting excellent inter-connectivity of the pore network oriented perpendicular to the bedding planes.

TABLE III. CATION EXCHANGE CAPACITY - LEACHATE ANALYSIS

Cation exchange capacity measurements for these sandstones are summarized in Table III. Total CEC values (representing the sum of CEC data for each ionic species measured for a given sandstone) range between 3.86 - 9.48 meq/100g of core material. The sandstones within cores C-2 and C-7 are quite similar with respect to the relative hierarchy of exchangeable cationic species (Ca>K>Mg>Na). Core C-3 displays a somewhat modified cation sequence, characterized by a significantly reduced CEC value for Ca (0.9 meq/100g), and a total CEC value which is the lowest value measured for these three core samples. The relative hierarchy of exchangeable cation species for core C-3 is K>Ca>Mg>Na.

TABLE IV AND TABLE V. SPECIFIC GRAVITY ANALYSIS and ACID INSOLUBLE RESIDUE ANALYSIS

The results of the specific gravity analysis are summarized on Table IV, while the acid insoluble residue data is presented in Table V. The specific gravity values measured for the sandstones range between 2.49 - 2.51 g/cc. These data are somewhat lower than the grain density measurements obtained via the helium porosity analysis (2.63 g/cc; see Table II). The discrepancy is probably related to the incomplete water saturation of micropores associated with the glauconite pellets and lithic mudstone and shale fragments contained in the detrital assemblage of these sandstones. The acid insoluble residue data presented on Table V, range between 98.4 - 98.8%, indicating the presence of minor volumes of acid soluble mineral species (predominantly calcite, ferroan dolomite, dolomite and/or siderite).

SEDIMENTOLOGICAL ANALYSIS RESULTS and RESERVOIR QUALITY

The sedimentological analysis of these cores consists of macroscopic core description, thin section petrography, scanning electron microscopy and laser particle size analysis. Given the inter-dependence of the data sets from each of these analyses and their respective influence on reservoir quality, the results of these assessments have been presented sequentially for each of the core samples. This presentation will hopefully afford the reader with an integrated view of the sedimentology for each of the sandstone intervals from this aquifer. The following discussion provides an interpretive focus on the sedimentological factors which influence the reservoir quality of these aquifer intervals. The similarity of these sandstones with respect to mineralogy, framework composition, cement constituents, clay matrix components and texture allow for a general overview of the clastic sedimentology.

The sandstone cores from this suite of aquifer intervals display a similar character with respect to current-induced bedding features. Low angle cross-bedding is the dominant bed-form present, with fore-set dips commonly ranging from 5 - 15 degrees relative to the horizontal. Some evidence of ripple bedding is present, especially within the relatively finest sand-sized fractions of core C-3 (330 - 330.95'). Minor evidence of clay matrix infiltration is present, especially within cores C-3 (330.0 - 330.95') and C-7 (400.65 - 401.9'), typically occurring as subtle, lenticular to laminar concentrations of clay-rich sand (with traces of silt) draping selected rippled cross-bed sets. Core C-7 displays a subtly massive subinterval which contains a few scattered lobe-shaped concentrations of clay matrix, suggestive of minor burrow mottling.

Examination of the thin sections and SEM mounts prepared from these core samples reveals a detrital mineralogy which is dominated by monocrystalline quartz, together with significant volumes of glauconite pellets, sedimentary shale and mudstone clasts and feldspar grains. Minor to accessory grain types include volcanic rock fragments (VRF's), chert, mica, hornblende, metamorphic RF's, magnetite, carbonized woody plant fragments and residue and epidote. The grain constituents are generally mildly compacted, typically displaying a predominance of point-to-point and elongated intergranular contacts. The ductile framework grains are locally deformed due to compression between adjoining brittle grains (generally quartz and/or feldspar), locally yielding pseudomatrix. The term pseudomatrix, as applied here, is defined as pore-filling clay matrix derived from a matrix-rich, lithic grain source, which has been compressed and deformed to result in the injection of clay matrix into the adjoining intergranular pores. The relative abundance of ductile grain constituents (especially glauconite and mudstone RF's) within these sandstones has contributed to the localized presence of plastically deformed and deeply embayed ductile grain boundaries and scattered patches of pseudomatrix.

These sandstones are rather weakly cemented with a combination of authigenic quartz overgrowths, and traces of carbonate minerals (calcite +/- dolomite +/- ferroan dolomite +/- siderite). The quartz overgrowths are the most significant cement constituents, occurring as weakly developed syntaxial rims and nodules flanking the detrital quartz grains. It is largely the quartz cement that accounts for the weakly lithified character of these sandstone intervals. Quartz overgrowth cement is visually estimated to account for approximately 2 - 4% of the bulk volume. Traces of iron oxide and pyrite cement are also locally present, with the pyrite typically occurring as a microcrystalline replacement for scattered patches and lenses of organic matter (woody plant fragments ?).

As described above, much of the clay present within these sandstones is present as intragranular matrix within the glauconite pellets and matrix-rich SRF's (shale and mudstone particles), and as scattered patches of pseudomatrix (derived from these matrix-rich grain sources). Additionally, clay matrix minerals are present as replacements for leached and altered detrital grains (especially feldspar and VRF's), as localized lenses and lamina of detrital clay matrix, and as irregularly distributed grain-coating / pore-lining matrix. The detrital matrix lenses and lamina are most commonly expressed as concentrations of infiltrated matrix admixed with sand and traces of quartz-rich silt. This description is also valid for the lobe-shaped, irregular concentrations of clay detected within core C-7 (401.3 ft.) which have been tentatively attributed to the mixing influence of burrowing organisms soon after deposition. The grain-coating and pore-lining clay is generally comprised of chlorite, which appears as a firmly attached, inter-connected network of clay crystallites, arranged in a characteristic "edge to face" configuration on the detrital grain surfaces. At sufficiently high magnification (generally > 2000 X), the grain-coating chlorite commonly resembles a honey-comb morphology, and is characterized by an extremely high ratio of surface area to mass.

The macropore network within these sandstones is comprised of very well preserved (and inter-connected) intergranular voids and subordinate amounts of secondary porosity (intragranular dissolution voids and grain-moldic pores). The primary or intergranular pores are estimated to display average pore diameters which range between 0.25 - 0.35mm (approximately 1/4 - 1/3 the mean grain diameter), supporting excellent fluid communication throughout the pore system. The secondary pores are present due to the partial to complete dissolution of metastable grain constituents (especially feldspar, VRF's, and less commonly amphibole grains). The pore volumes calculated from the helium porosity analysis are consistent with estimated porosity values obtained from the thin section samples. Intercrystalline microporosity is present in association with the matrix-rich detrital grains (especially glauconite), and may account for as much as 2 - 4% of the reported storage capacity within these sandstones.

TABLE I.
X-RAY DIFFRACTION MINERALOGICAL ANALYSIS

CH2M Hill, Inc.
Laredo ASR; TW-2A
Project No.: 118069

Mineralogy, Inc. Job No.: 97-288

Core No.	***C-2***	***C-3***	***C-7***
Depth (ft.)	***292.5***	***330.65***	***401.3***
MINERAL CONSTITUENTS	***RELATIVE ABUNDANCE (%)***		
Quartz	88	89	89
Plagioclase Feldspar	2	1	1
K-Feldspar	1	1	1
Calcite	trc		trc
Ferroan Dolomite	trc	trc	
Gypsum		trc	
Pyrite	trc	trc	trc
Kaolinite	trc	trc	trc
Chlorite	2	2	2
Illite/Mica	trc	trc	1
Mixed-Layer Illite/Smectite	7	7	6
% Illite Layers in M.L.Illite/Smectite	***45-55%***	***40-50%***	***45-55%***
TOTAL	***100***	***100***	***100***

TABLE II.
ROUTINE CORE ANALYSIS RESULTS

CH2M Hill, Inc.
Laredo ASR; TW-2A
Project No.: 118069

Mineralogy, Inc. Job No.: 97-288

CORE # / DEPTH (ft.)	***AIR PERMEABILITY*** Horizontal (md)	Vertical (md)	***Helium Porosity (%)***	***Grain Density (g/cc)***
C-2 / 292.5	761	729	30.2	2.63
C-3 / 330.65	631	207	32.1	2.63
C-7 / 401.3	809	749	30.4	2.63

TABLE III.
CATION EXCHANGE CAPACITY - LEACHATE ANALYSIS

CH2M Hill, Inc.
Laredo ASR; TW-2A
Project No.: 118069

Mineralogy, Inc. Job No.: 97-288

	CEC Leachate Analysis							
	Calcium		Magnesium		Potassium		Sodium	
CORE # / DEPTH (ft.)	Results (meq/100g)	PQL* (meq/100g)	Results (meq/100g)	PQL* (meq/100g)	Results (meq/100g)	PQL* (meq/100g)	Results (meq/100g)	PQL* (meq/100g)
C-2 / 292.5	*6.4*	0.04	*0.8*	0.01	*1.9*	0.01	*0.38*	0.0013
C-3 / 330.65	*0.9*	0.005	*0.77*	0.01	*1.7*	0.01	*0.5*	0.0064
C-7 / 401.3	*4.8*	0.04	*0.6*	0.01	*1.6*	0.01	*0.24*	0.0013

Method Reference: 40 CFR 136, 261, Method for Chemical Analysis of Water and Waste EPA-600/4-79-020 March 1983
CEC Method Reference: Methods of Soil Analysis, Chemical and Microbiological Properties, 2nd Ed.; American Society of Agronomy, Inc., Soil Science Society of America, Inc., page 160.

** PQL = Practical Quantitation Limit*

TABLE IV.
SPECIFIC GRAVITY ANALYSIS

CH2M Hill, Inc.
Laredo ASR; TW-2A
Project No.: 118069

Mineralogy, Inc. Job No.: 97-288

CORE # / DEPTH (ft.)	*SPECIFIC GRAVITY (g/cc)*
C-2 / 292.5	2.53
C-3 / 330.65	2.49
C-7 / 401.3	2.51

TABLE V.
ACID INSOLUBLE RESIDUE ANALYSIS

CH2M Hill, Inc.
Laredo ASR; TW-2A
Project No.: 118069

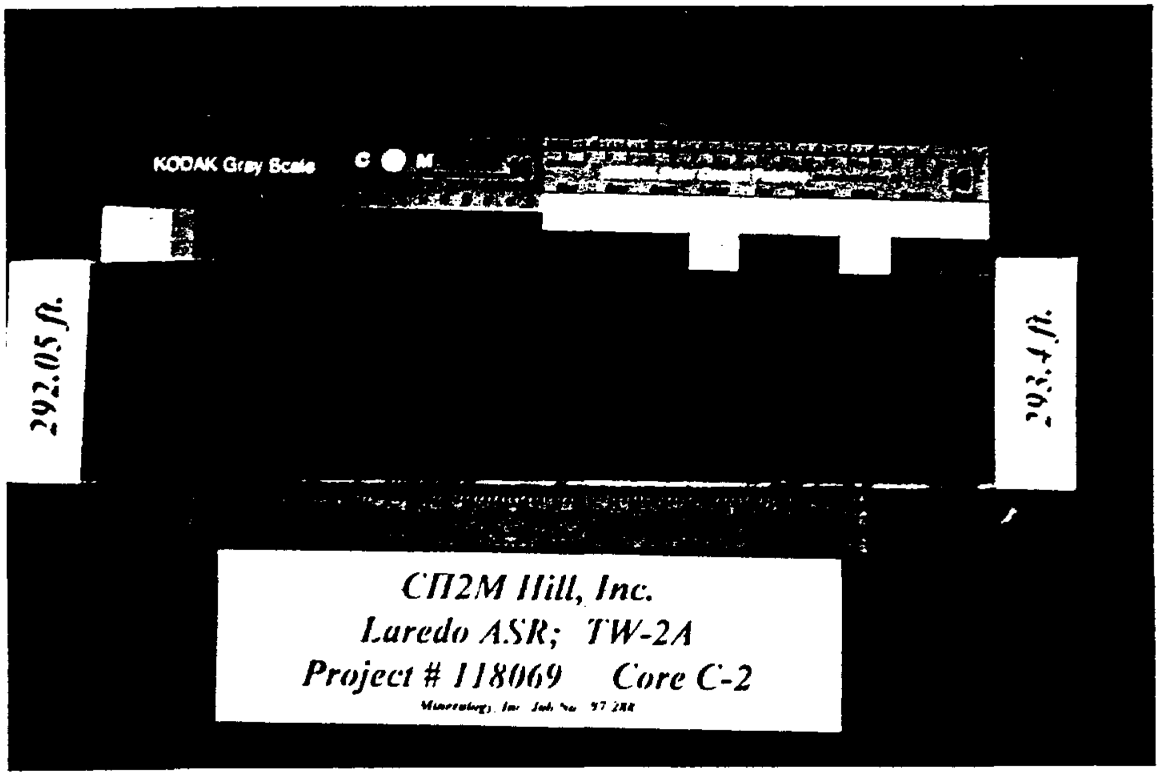
Mineralogy, Inc. Job No.: 97-288

CORE # / DEPTH (ft.)	***ACID RESIDUE (%)***
C-2 / 292.5	98.4
C-3 / 330.65	98.8
C-7 / 401.3	98.4

CH2M HILL, INC.
LAREDO ASR; WELL TW-2A
PROJECT # 118069

CORE NO. C-2; 292.05 - 293.4 ft.

MACROSCOPIC CORE DESCRIPTION,
THIN SECTION PETROGRAPHY,
SCANNING ELECTRON MICROSCOPY
and
LASER PARTICLE SIZE ANALYSIS RESULTS



MACROSCOPIC CORE DESCRIPTION

CH2M Hill, Inc.
Laredo ASR; TW-2A; Project No.: 118069

Core No.: C-2; 292.05 - 293.4 ft.

Mineralogy, Inc. Job No.: 97-288-01

A light gray, very fine-grained, very well sorted, weakly consolidated, friable, low angle cross-bedded, porous and permeable sublitharenitic sandstone. The cross bed sets display fore-set dips which range from approximately 5-15 degrees throughout the bulk of the interval. The interval between approximately 292.4 - 292.75 ft. is characterized by relatively steeply dipping fore-set lamina (approximately 35-45 degrees), with some evidence of slumping. The sandstone framework is glauconitic throughout the interval, with pelletal grains displaying a light to medium green appearance at low magnification. Traces of calcite and dolomite cement are present as widely scattered patches of intergranular cement. The principal stabilizing force within this weakly consolidated and friable sandstone appears to be pseudomatrix derived from mechanically deformed glauconite pellets coupled with minor quartz overgrowth cement. Intergranular porosity is evenly distributed throughout the interval and appears well interconnected given the small volumes of intergranular clay and cement constituents.

PETROGRAPHIC ANALYSIS

CLIENT: CH2M Hill, Inc.
PROJECT IDENTIFICATION / WELL: Laredo ASR - TW-2A; #118069
CORE NO. / DEPTH (ft.): *#C-2 / 292.5 ft.*
MINERALOGY, INC. JOB NO: *97-288-01*
LITHOLOGY: *Porous, Glauconitic, Sublitharenitic Sandstone*
CLASTIC TEXTURE (mm): **Mean** = 0.11 **Max** = 0.68
PORE DIAMETER (mm): **Mean** = 0.035
HELIUM POROSITY: *30.2%* **AIR PERMEABILITY** *(Horiz.): 761 md.*

FABRIC / TEXTURE: This core sample is comprised of very fine-grained, very well sorted, slightly calcareous and glauconite-rich, sublitharenitic sandstone. The depositional fabric is mildly compacted and displays common point-to-point and elongated intergranular contacts. Pseudomatrix is locally present due to the compression and injection of clay derived from glauconite pellets and matrix-rich SRF's into the adjoining pore spaces. The sandstone fabric is porous (30.2%) and permeable (Kh=761 md.) and displays a well interconnected intergranular pore network. The sandstone is best described as very weakly consolidated and friable.

FRAMEWORK COMPONENTS: Detrital grain types included within this core sample are listed below, in order of decreasing relative abundance:

Quartz; Monocrystalline quartz and minor polycrystalline quartz varieties.
Glauconite; Locally deformed due to compaction - comprised of light to dark green- colored, microcrystalline clay matrix minerals (chiefly mixed-layer illite/smectite, illite and chlorite).
Sedimentary Rock Fragments (SRF's); Shale and mudstone clasts - typically laminated and locally silty
Feldspar; Plagioclase + k-feldspar locally leached and replaced with clay matrix with common intragranular dissolution porosity.
Volcanic Rock Fragments (VRF's); Extensively matrix-replaced - VRF's typically display a glassy groundmass with randomly oriented laths of altered plagioclase feldspar.
Chert

Muscovite and biotite mica, amphibole (basaltic hornblende), metamorphic RF's and magnetite are present as accessory constituents.

MATRIX / CEMENTS: Traces of carbonate cement are locally scattered within the pore network as patches of finely crystalline calcite, dolomite, siderite(?) and ferroan dolomite. Traces of quartz overgrowth cement are present on scattered quartz grains as weakly developed syntaxial rims and nodules. Iron oxide cement and pyrite are present as accessory cement varieties. Clay is present throughout the framework as a primary constituent within the glauconite pellets and SRF's, as scattered patches of microporous pore-filling matrix (mostly pseudomatrix derived from squashed glauconite) and as grain-coating matrix which is locally concentrated within the intergranular pore throats. The clay mineralogy is dominated by mixed-layer illite/smectite and chlorite, together with minor amounts of illite and kaolinite.

PORE SYSTEM: Macropore types present within this sandstone include intergranular voids and secondary intragranular and grain-moldic dissolution pores. The intergranular pore network is very well preserved and interconnected, given the paucity of intergranular cements and pore-filling clays. Secondary voids are present throughout the sandstone framework due to the partial to complete dissolution of feldspar grains and metastable RF's. Secondary void space is visually estimated to account for approximately 2 - 4% of the bulk volume. Intercrystalline microporosity is present in association with the matrix-rich glauconite pellets and the scattered patches of pore-filling pseudomatrix. Some constrictions of the pore throat apertures are apparent due to the concentration of grain-coating clay and the localized "brush-piling" of matrix clusters, however, the impact of these factors on overall reservoir quality for this interval is interpreted as minimal.

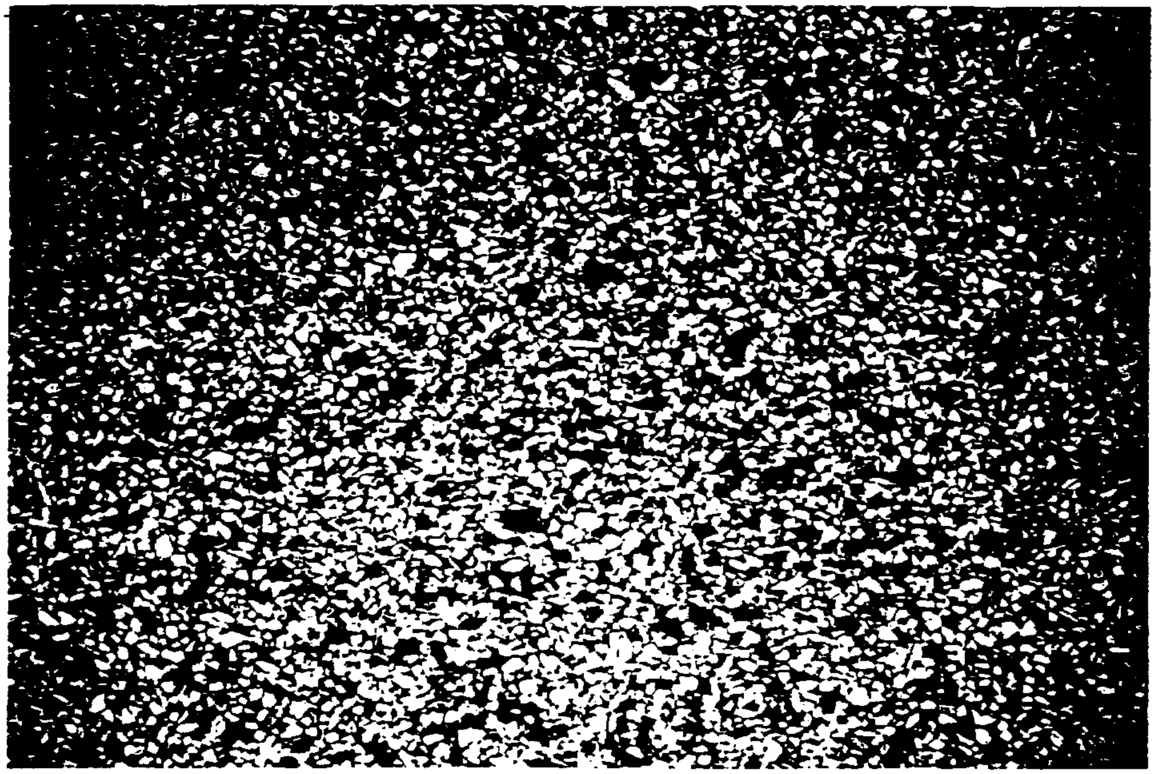


Figure A. A low magnification view illustrating the porous character of this weakly consolidated, glauconite-rich, sublitharenitic sandstone. The dark green colored grains distributed throughout this field of view are comprised of glauconite pellets admixed with minor amounts of shale and mudstone clasts. 16X uncrossed nicols 1.25"=2.0mm

CH2M Hill, Inc.; Laredo ASR; TW-2A; Project # 118069; Core C-2; 292.5 ft.
Mineralogy, Inc. Job # 97-288-01

Figure B. A detailed view of the micro-texture of the glauconite pellets (e.g., center-left) contained within this sandstone. These grains are comprised almost exclusively of clay matrix minerals (mixed-layer illite/smectite + chlorite). Note the marginally deformed character of the pellet on the left. Also note the intragranular dissolution porosity and the grain-coating chlorite in the extreme lower-right of this field of view. 100X crossed nicols 1"=0.25mm

SCANNING ELECTRON MICROSCOPY

CH2M Hill, Inc.
Laredo ASR; TW-2A; Project No.: 118069

Core No.: C-2; 292.5 ft.

Mineralogy, Inc. Job No.: 97-288-01

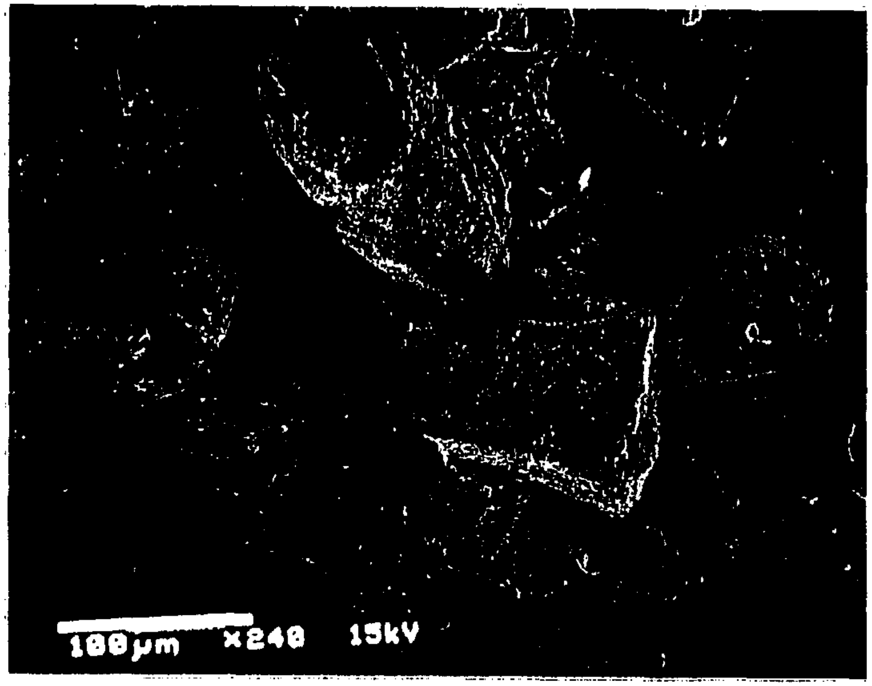
A & B

Low and high magnification SEM views illustrating a concentration of pseudomatrix derived from a squashed glauconite pellet (center; Figure A & Figure B). Note the patch of pore-filling carbonate cement (upper left; Figure A) and the microcrystalline crust of matrix coating several of the grain surfaces throughout Figure A (e.g., center and upper-right). Figure B provides a detailed view of the deformed glauconite pellet, revealing a composition dominated by matted laths of mixed-layer illite/smectite. The intragranular void at the center of Figure B contains a few relatively large, pseudo-hexagonal clay platelets which are tentatively identified as kaolinite.

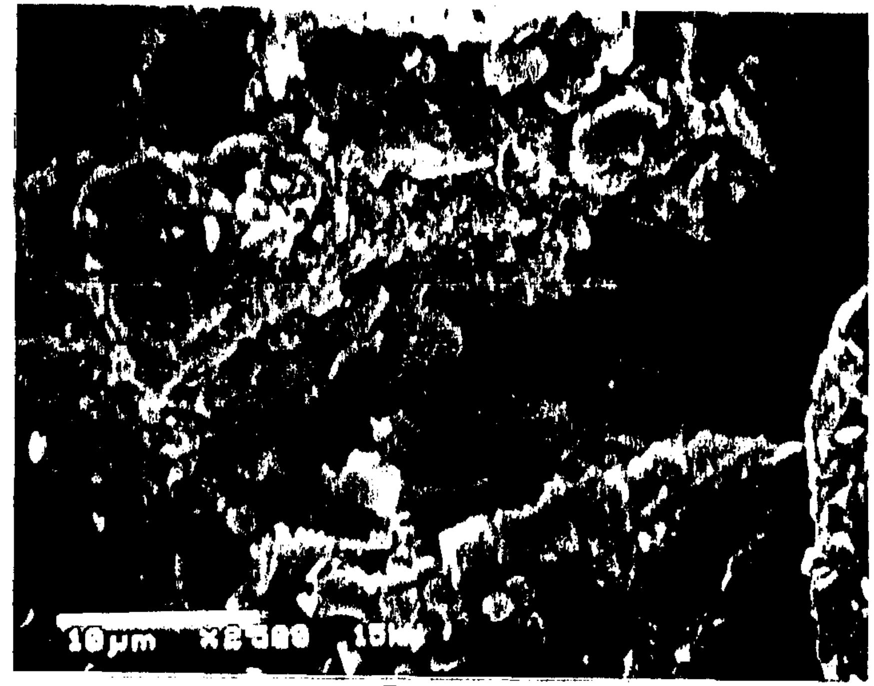
C & D

This sand sample is characterized by an abundance of intergranular porosity as depicted in Figure C. The grains are locally encrusted with chlorite clay, which displays an "edge to face" crystalline morphology which is especially visible on the detrital grain in the lower right quadrant of Figure D. Note the unattached clusters off matrix (illite?) occupying the pore in the bottom-center of Figure D. Unlike the grain-coating chlorite which is firmly attached to the grain surface, these pore-filling clay clusters (probably derived from a mechanically deformed lithic grain) are relatively mobile and are prone to "brush-pile" within the intergranular pore throats, thus reducing the permeability.

CH2M Hill, Inc.; Laredo ASR; TW-2A; Proj. #118069; Core # C-2 - 292.5 ft.; Mineralogy, Inc. # 97-288-01

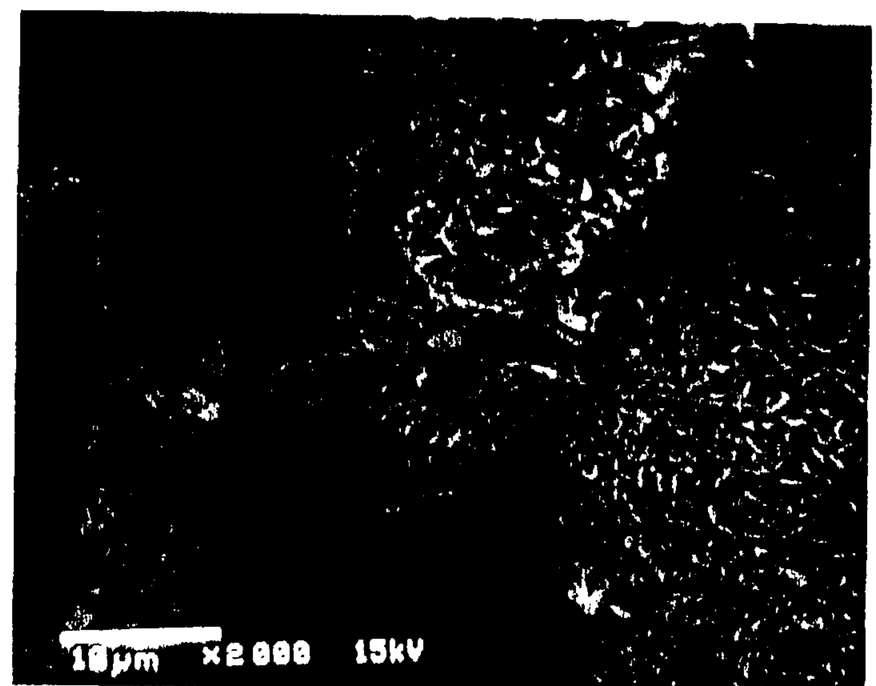


A.



B.

C.



D.

Mineralogy Incorporated
3228 E. 15th Street
Tulsa, Okla. 74104

Particle Size Analysis

CH2M Hill, Inc.
Laredo ASR; TW-2A; Project No.: 118069 - Core C-2; 292.5 ft.
Mineralogy, Inc. Job # 97-288-01

Mesh Count	Phi Value	Inches	Millimeter	Microns	Inc. Percent	Cum. % Larger Than	Cum. % Smaller Than
18	0	0.0394	1.0000	1000		0.00	100.00
20	0.25	0.0331	0.8410	841	0.00	0.00	100.00
25	0.50	0.0278	0.7070	707	0.00	0.00	100.00
30	0.75	0.0234	0.5950	595	0.00	0.00	100.00
35	1.00	0.0197	0.5000	500	0.00	0.00	100.00
40	1.25	0.0165	0.4200	420	0.00	0.00	100.00
45	1.50	0.0139	0.3540	354	0.10	0.10	99.90
50	1.75	0.0117	0.2970	297	0.60	0.70	99.30
60	2.00	0.0098	0.2500	250	1.80	2.50	97.50
70	2.25	0.0083	0.2100	210	3.90	6.40	93.60
80	2.50	0.0070	0.1770	177	7.00	13.40	86.60
100	2.75	0.0059	0.1490	149	10.50	23.90	76.10
120	3.00	0.0049	0.1250	125	13.30	37.20	62.80
140	3.25	0.0041	0.1050	105	14.50	51.70	48.30
170	3.50	0.0035	0.0880	88	13.90	65.60	34.40
200	3.75	0.0029	0.0740	74	11.30	76.90	23.10
230	4.00	0.0025	0.0630	63	8.00	84.90	15.10
270	4.25	0.0021	0.0530	53	4.80	89.70	10.30
325	4.50	0.0017	0.0440	44	2.50	92.20	7.80
400	4.75	0.0015	0.0370	37	1.20	93.40	6.60
450	5.00	0.0012	0.0310	31	0.70	94.00	5.90
500	5.25	0.0010	0.0260	26	0.40	94.40	5.50
635	5.50	0.0009	0.0220	22	0.40	94.80	5.10
	5.75	0.0007	0.0190	19	0.30	95.10	4.80
	6.00	0.0006	0.0160	16	0.30	95.40	4.50
	6.25	0.0005	0.0130	13	0.30	95.70	4.20
	6.50	0.0004	0.0110	11	0.30	95.90	3.90
	6.75	0.0004	0.0093	9.3	0.30	96.20	3.60
	7.00	0.0003	0.0078	7.8	0.20	96.40	3.40
	7.25	0.0003	0.0065	6.5	0.20	96.70	3.20
	7.50	0.0002	0.0055	5.5	0.20	96.90	3.00
	7.75	0.0002	0.0046	4.6	0.20	97.20	2.80
	8.00	0.0002	0.0039	3.9	0.20	97.40	2.60
	8.25	0.0001	0.0033	3.3	0.20	97.60	2.40
	8.50	0.0001	0.0028	2.8	0.20	97.80	2.20
	8.75	0.0001	0.0023	2.3	0.20	98.00	2.00
	9.00	0.0001	0.0019	1.9	0.20	98.20	1.80
	9.25	0.0001	0.0016	1.6	0.20	98.40	1.60
	9.50	0.0001	0.0014	1.4	0.20	98.60	1.40
	9.75	0.0000	0.0012	1.2	0.20	98.90	1.20
	10.00	0.0000	0.0010	1	0.20	99.10	1.00
	10.25	0.0000	0.0008	0.8	0.20	99.30	0.80
	10.50	0.0000	0.0007	0.7	0.20	99.50	0.60
	10.75	0.0000	0.0006	0.6	0.20	99.70	0.40
	11.00	0.0000	0.0005	0.5	0.10	99.90	0.30
	11.25	0.0000	0.0004	0.4	0.10	100.00	0.20
	14.9	0.0000	0.0000	0.01	0.00	100.00	0.20

Percent Larger Than	Phi	microns	mm	inches
5	2.16	223.7	0.2237	0.00881
10	2.38	192.3	0.1923	0.00757
16	2.56	169.4	0.1694	0.00667
25	2.77	146.5	0.1465	0.00577
50	3.22	107.3	0.1073	0.00422
75	3.71	76.5	0.0765	0.00301
84	3.97	63.7	0.0637	0.00251
90	4.28	51.5	0.0515	0.00203
95	5.67	19.7	0.0197	0.00078

	Phi	microns	mm	inches
Median Value	3.22	107.27	0.10727	0.00422
Primary	Peak Value =		14.50	
Mode	3.13	114.63	0.1146	0.00451
Secondary	Peak Value =		0.00	
Mode	11.125	0.45	0.0004	0.00002

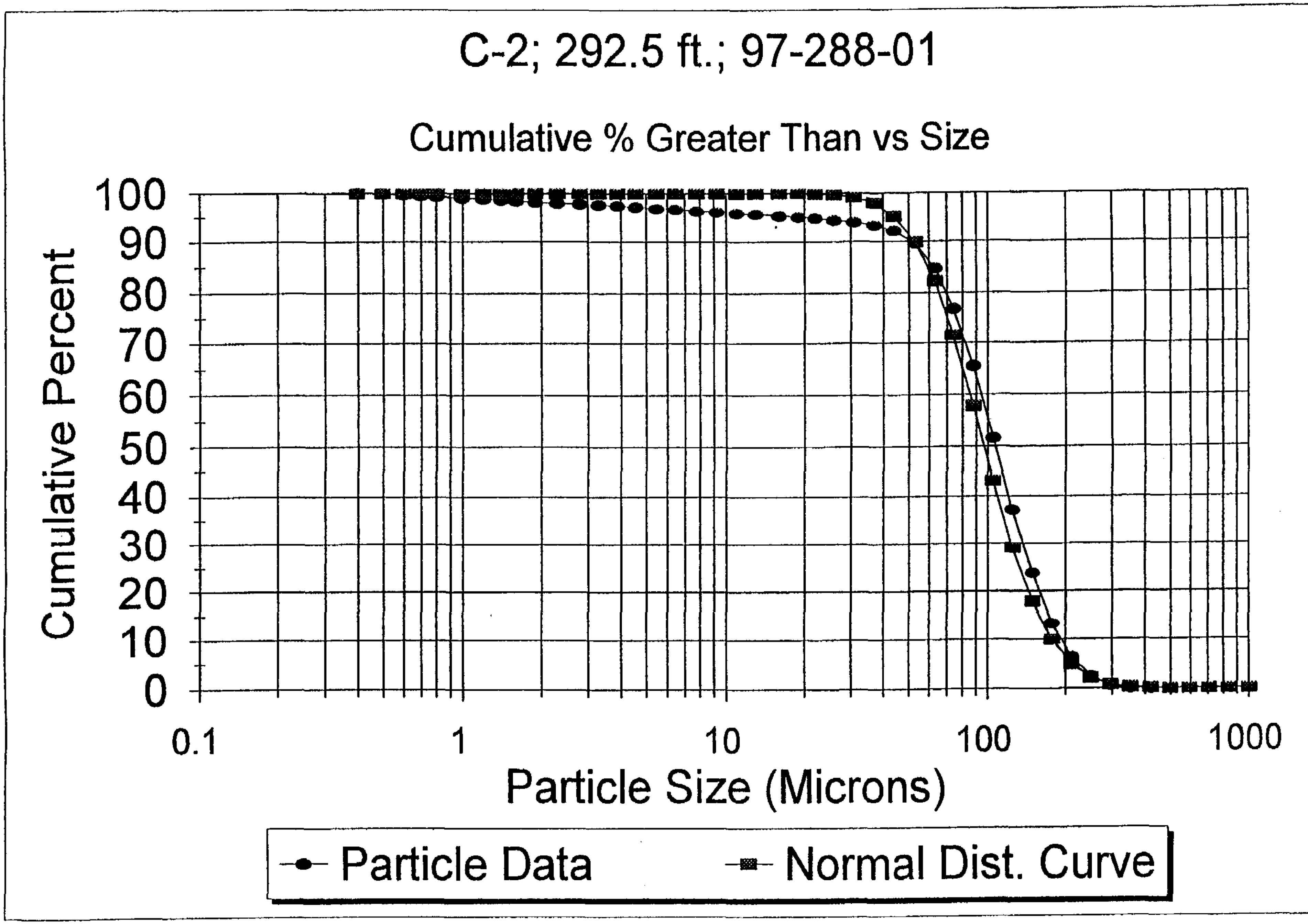
	Trask Values Phi	Trask Values mm	Folk Values Phi	Folk Values mm
Mean		0.107	3.251	0.11
Sorting		0.4027		0.5767
Skewness		0.5017	0.230	0.8
Kurtosis		0.1828	1.533	0.3032

Moment Values (mm)	
Mean (First Moment)	0.0914
Std. Dev. (Second Moment	0.627

Sand Contents	
% Coarse	0.00
% Medium	2.50
% Fine	34.70
% Very Fine	47.70
% Total Sand	84.90

Silt Contents	
% Coarse	9.10
% Medium	1.40
% Fine	1.00
% Very Fine	1.00
% Total Silt	12.50

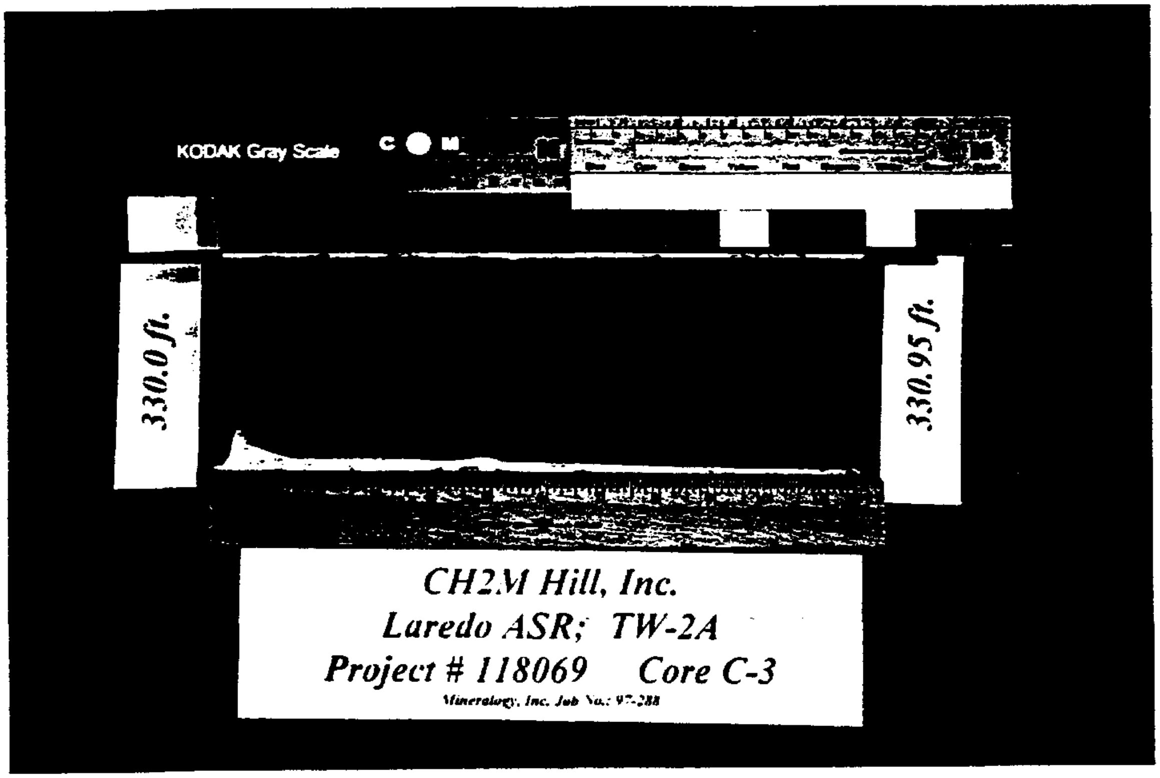
Clay Content	
% Clay	2.60


C-2; 292.5 ft.; 97-288-01
Cumulative % Greater Than vs Size
Cumulative Percent
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
1000
Particle Size (Microns)
Particle Data
Normal Dist. Curve

CH2M HILL, INC.
LAREDO ASR; WELL TW-2A
PROJECT # 118069

CORE NO. C-3; 330.0 - 330.95 ft.

MACROSCOPIC CORE DESCRIPTION,
THIN SECTION PETROGRAPHY,
SCANNING ELECTRON MICROSCOPY
and
LASER PARTICLE SIZE ANALYSIS RESULTS



MACROSCOPIC CORE DESCRIPTION

CH2M Hill, Inc.
Laredo ASR; TW-2A; Project No.: 118069

Core No.: C-3; 330.0 - 330.95 ft.

Mineralogy, Inc. Job No.: 97-288-02

A light gray, very fine-grained, very well sorted, weakly consolidated, friable, ripple-bedded to low angle cross-bedded, silty, porous and permeable sublitharenitic sandstone. The interval between 330.0 - 330.45 ft. is characterized by a predominance ripple-bedded lamina alternating with low angle cross bed sets (5-10 degrees). The ripple troughs are locally highlighted by very thin, flaser-like lenses of detrital clay matrix. This sub-interval is underlain (330.45 - 330.95 ft.) by subtly higher energy, low angle cross bedded sandstone (5 - 10 degrees), which is characterized by a lower density of detrital matrix lenses capping the individual cross bed sets. As within core C-2, this interval is glauconitic and slightly calcareous to dolomitic. The common presence of the interbedded clay matrix lenses (especially within the uppermost one-third of this core, will reduce the vertical permeability of this sandstone interval. The principal stabilizing force within this weakly consolidated and friable sandstone appears to be pseudomatrix derived from mechanically deformed glauconite pellets coupled with minor quartz overgrowth cement. Intergranular porosity appears to be slightly more abundant within the lower, cross-bedded sandstone (330.45 - 330.95 ft.), with voids well interconnected.

PETROGRAPHIC ANALYSIS

CLIENT: CH2M Hill, Inc.
PROJECT IDENTIFICATION / WELL: Laredo ASR - TW-2A; #118069
CORE NO. / DEPTH (ft.): *#C-3 / 330.65 ft.*
MINERALOGY, INC. JOB NO: *97-288-02*
LITHOLOGY: *Porous, Glauconitic, Sublitharenitic Sandstone*
CLASTIC TEXTURE (mm): **Mean** = 0.09 **Max** = 0.34
PORE DIAMETER (mm): **Mean** = 0.025
HELIUM POROSITY: *32.1%* **AIR PERMEABILITY** *(Horiz.): 631 md.*

FABRIC / TEXTURE: This core sample is comprised of very fine-grained, very well sorted, slightly calcareous and glauconite-rich, sublitharenitic sandstone. The fabric contains a few lenses and lamina of detrital-clay-rich sand, oriented parallel to the bedding plane of the sandstone. The lamina lack continuity across the thin section, and reflect episodes of depositional quiescence which were characterized by the patchy accumulation/infiltration of suspended sediment within the sandstone fabric. The detrital clay-rich lenses have contributed to a sharp drop in the vertical permeability (207 md.), relative to the horizontal permeability (631 md.) for this interval. The depositional fabric is mildly compacted and displays common point-to-point and elongated intergranular contacts, with lenses of detrital clay and ductile grains locally deformed due to mechanical compaction. Pseudomatrix is locally present due to the compression and injection of clay derived from glauconite pellets and matrix-rich SRF's into the adjoining pore spaces. The sandstone fabric is porous (32.1%) and displays a well interconnected intergranular pore network. The sandstone is best described as very weakly consolidated and friable.

FRAMEWORK COMPONENTS: Detrital grain types included within this core sample are listed below, in order of decreasing relative abundance:

- *Quartz*; Monocrystalline quartz and minor polycrystalline quartz varieties.
- *Glauconite;* Locally deformed due to compaction - comprised of light to dark green- colored, microcrystalline clay matrix minerals (chiefly mixed-layer illite/smectite, illite and chlorite).
- *Sedimentary Rock Fragments (SRF's);* Shale and mudstone clasts - typically laminated and locally silty
- *Feldspar;* Plagioclase + k-feldspar locally leached and replaced with clay matrix with common intragranular dissolution porosity.
- *Volcanic Rock Fragments (VRF's);* Extensively matrix-replaced
- *Chert*

Muscovite and biotite mica, amphibole (basaltic hornblende), metamorphic RF's, magnetite, ilmenite/leucoxene and epidote are present as accessory constituents.

MATRIX / CEMENTS: Traces of carbonate cement are locally scattered within the pore network as patches of finely crystalline dolomite, siderite and ferroan dolomite. Traces of quartz overgrowth cement are present on scattered quartz grains as weakly developed syntaxial rims and nodules. Iron oxide cement and pyrite are present as accessory cement varieties which are locally concentrated within the matrix-rich lamina of the sandstone. Clay is present throughout the framework as a primary constituent within the glauconite pellets and SRF's, as scattered patches of microporous pore-filling matrix (mostly pseudomatrix derived from squashed glauconite) and as grain-coating matrix which is locally concentrated within the intergranular pore throats. Lenticular concentrations of detrital clay are concentrated along discontinuous, bedding plane lamina. The clay mineralogy is dominated by mixed-layer illite/smectite and chlorite, together with minor amounts of illite and kaolinite.

PORE SYSTEM: The intergranular pore network is very well preserved and interconnected, given the paucity of intergranular cements and pore-filling clays. Vertical permeability is somewhat compromised due to the detrital clay lenses. Secondary voids are present owing to the partial to complete dissolution of feldspar grains and metastable RF's. Microporosity is present in association with the matrix-rich glauconite pellets and the scattered patches of pore-filling pseudomatrix.

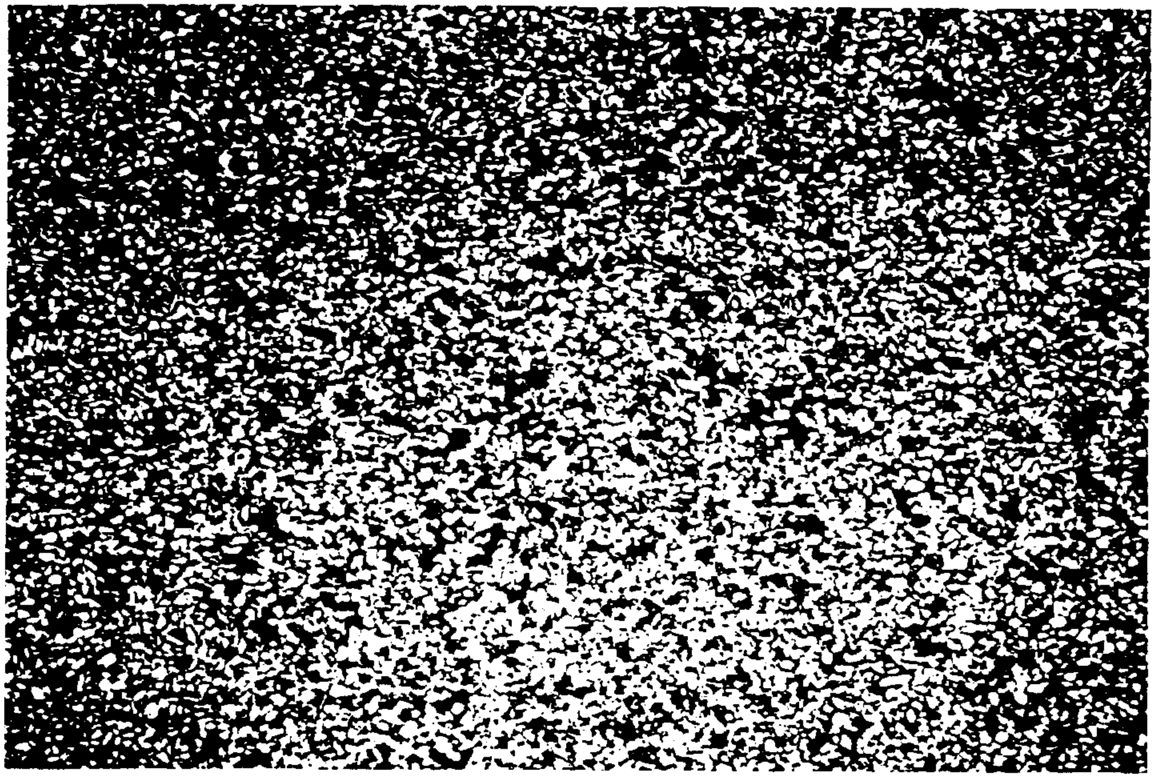
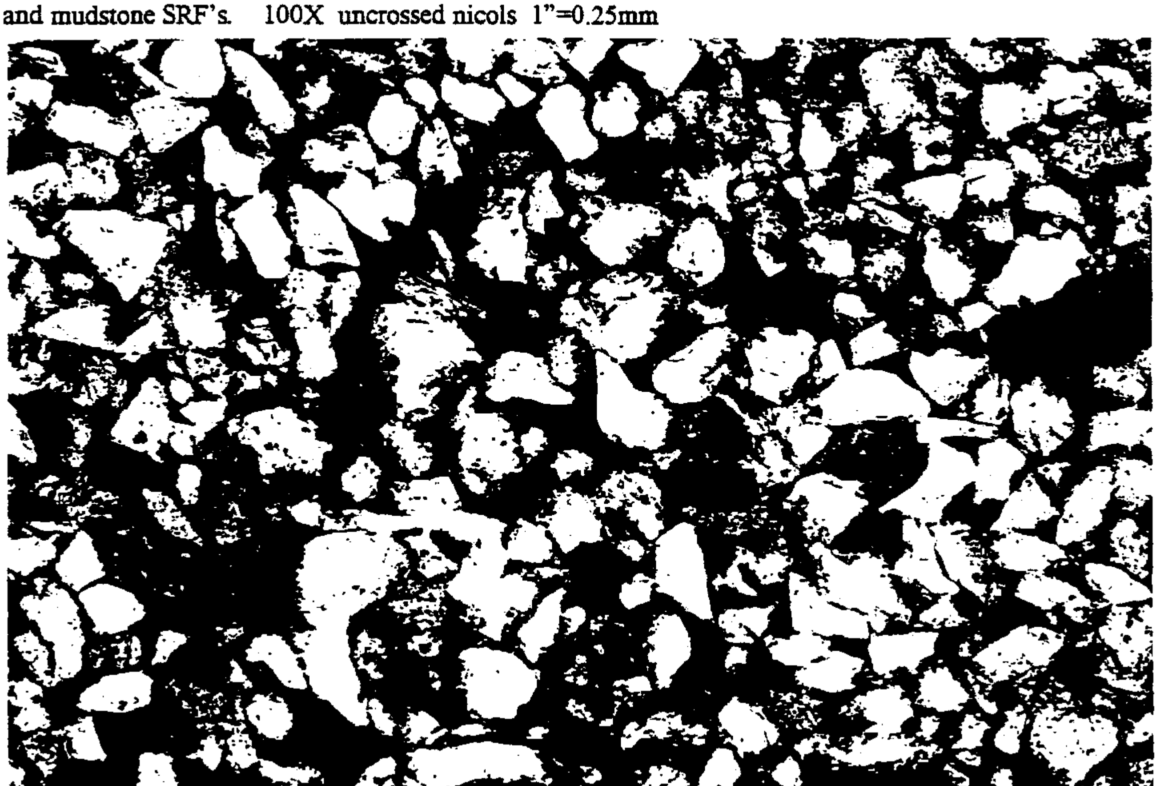


Figure A. A low magnification view of this very fine-grained, porous and glauconitic sublitharenitic sandstone. Note the discontinuous laminae of matrix-rich sand along the upper margin of this photomicrograph. The matrix contained in this laminae is a combination of infiltrated detrital clay, pelletal grains and matrix-rich SRF's and pseudomatrix. 16X uncrossed nicols 1.25"=2.0mm

CH2M Hill, Inc.; Laredo ASR; TW-2A; Project # 118069; Core C-3; 330.65 ft.
Mineralogy, Inc. Job # 97-288-02

Figure B. A detailed view of a rather typical, wispy lens of matrix-rich sand, in which the clay has effectively obstructed fluid communication. Note the deformed glauconite pellets (right-center). Much of the clay present within this lens is interpreted as pseudomatrix derived from squashed glauconite pellets and mudstone SRF's. 100X uncrossed nicols 1"=0.25mm



SCANNING ELECTRON MICROSCOPY

CH2M Hill, Inc.
Laredo ASR; TW-2A; Project No.: 118069

Core No.: C-3; 330.65 ft.

Mineralogy, Inc. Job No.: 97-288-02

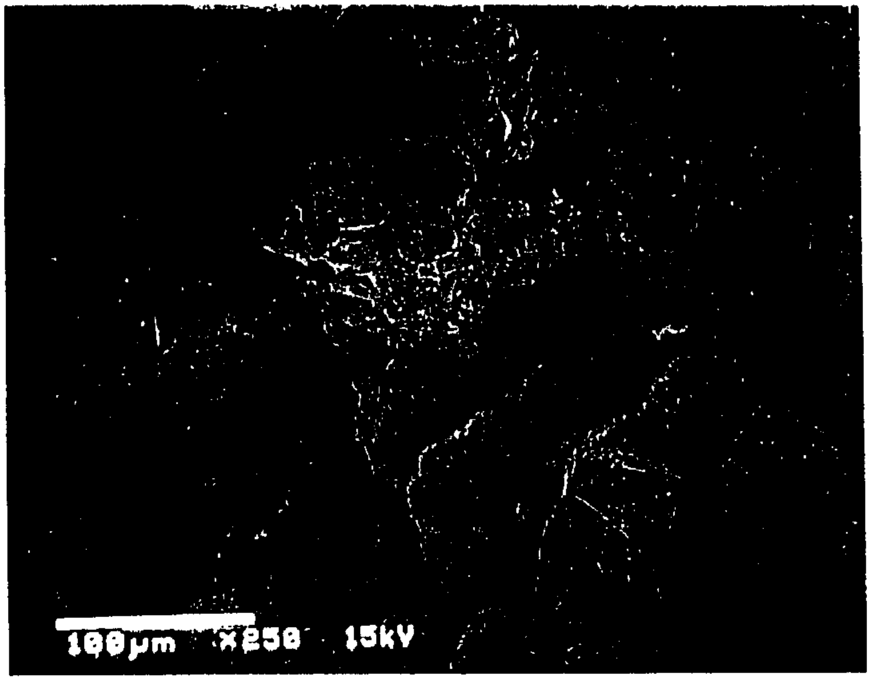
A & B

This sample is comprised of porous and permeable, very fine-grained, very well sorted, sublitharenitic sandstone. Note the well interconnected voids distributed throughout Figure A, and the localized presence of pore-filling clay matrix (e.g., center), and weakly developed quartz overgrowths (e.g., extreme lower-left). Note the large irregular-shaped grain near the center of Figure A - representing a matrix-rich lithic fragment (possibly multiple glauconite pellets and/or mudstone clasts). Figure B provides a detailed view of the matrix concentrated in the pore throat present on the lower margin of this grain cluster. The matrix is comprised of mixed-layer illite/smectite together with traces of vermicular (authigenic) kaolinite (top-center; Figure B).

C & D

The cluster of pore-filling matrix at the center of Figure C represents pseudomatrix derived from a quashed glauconite pellet. Note the laminated, clay-rich lithic fragment (shale) in the upper-right quadrant of Figure C and the aggressively leached feldspar (?) grain in the lower-right corner of this photomicrograph. Figure D provides a detailed view of the microcrystalline clay within the glauconitic pseudomatrix visible at the center of Figure C. The clay is comprised of mixed-layer illite/smectite and chlorite. Note the abundance of intercrystalline microporosity associated with this cluster of matrix material.

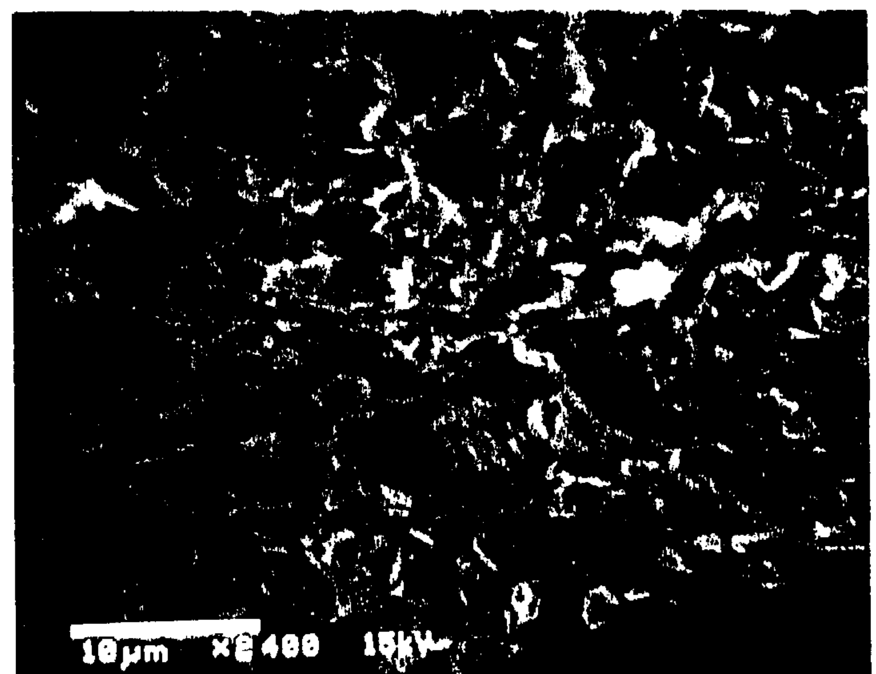
CH2M Hill, Inc.; Laredo ASR; TW-2A; Proj. #118069; Core # C-3 - 330.65 ft.; Mineralogy, Inc. # 97-288-02



A.

B.

C.



D.

Mineralogy
Incorporated
3228 E. 15th Street
Tulsa, Okla. 74104

Particle Size Analysis

CH2M Hill, Inc.
Laredo ASR; TW-2A; Project No.: 118069 - Core C-3; 330.65 ft.
Mineralogy, Inc. Job # 97-288-02

Mesh Count	Phi Value	Inches	Millimeter	Microns	Inc. Percent	Cum. % Larger Than	Cum. % Smaller Than
18	0	0.0394	1.0000	1000	0.00	0.00	100.00
20	0.25	0.0331	0.8410	841	0.00	0.00	100.00
25	0.50	0.0278	0.7070	707	0.00	0.00	100.00
30	0.75	0.0234	0.5950	595	0.00	0.00	100.00
35	1.00	0.0197	0.5000	500	0.00	0.00	100.00
40	1.25	0.0165	0.4200	420	0.00	0.00	100.00
45	1.50	0.0139	0.3540	354	0	0.00	100.00
50	1.75	0.0117	0.2970	297	0.10	0.10	99.90
60	2.00	0.0098	0.2500	250	0.40	0.50	99.50
70	2.25	0.0083	0.2100	210	1.40	1.90	98.10
80	2.50	0.0070	0.1770	177	3.30	5.20	94.80
100	2.75	0.0059	0.1490	149	6.20	11.40	88.60
120	3.00	0.0049	0.1250	125	9.50	20.90	79.10
140	3.25	0.0041	0.1050	105	12.40	33.30	66.70
170	3.50	0.0035	0.0880	88	13.90	47.20	52.80
200	3.75	0.0029	0.0740	74	13.30	60.50	39.50
230	4.00	0.0025	0.0630	63	11.30	71.80	28.20
270	4.25	0.0021	0.0530	53	8.30	80.10	19.90
325	4.50	0.0017	0.0440	44	5.20	85.30	14.70
400	4.75	0.0015	0.0370	37	2.90	88.20	11.80
450	5.00	0.0012	0.0310	31	1.60	89.80	10.20
500	5.25	0.0010	0.0260	26	0.90	90.70	9.30
635	5.50	0.0009	0.0220	22	0.60	91.30	8.70
	5.75	0.0007	0.0190	19	0.60	91.90	8.10
	6.00	0.0006	0.0160	16	0.50	92.40	7.60
	6.25	0.0005	0.0130	13	0.50	92.90	7.10
	6.50	0.0004	0.0110	11	0.50	93.40	6.60
	6.75	0.0004	0.0093	9.3	0.50	93.90	6.10
	7.00	0.0003	0.0078	7.8	0.50	94.40	5.60
	7.25	0.0003	0.0065	6.5	0.50	94.90	5.10
	7.50	0.0002	0.0055	5.5	0.50	95.40	4.60
	7.75	0.0002	0.0046	4.6	0.40	95.80	4.20
	8.00	0.0002	0.0039	3.9	0.40	96.20	3.80
	8.25	0.0001	0.0033	3.3	0.40	96.60	3.40
	8.50	0.0001	0.0028	2.8	0.30	96.90	3.10
	8.75	0.0001	0.0023	2.3	0.30	97.20	2.80
	9.00	0.0001	0.0019	1.9	0.30	97.50	2.50
	9.25	0.0001	0.0016	1.6	0.30	97.80	2.20
	9.50	0.0001	0.0014	1.4	0.30	98.10	1.90
	9.75	0.0000	0.0012	1.2	0.30	98.40	1.60
	10.00	0.0000	0.0010	1	0.30	98.70	1.30
	10.25	0.0000	0.0008	0.8	0.30	99.00	1.00
	10.50	0.0000	0.0007	0.7	0.30	99.30	0.70
	10.75	0.0000	0.0006	0.6	0.20	99.50	0.50
	11.00	0.0000	0.0005	0.5	0.20	99.70	0.30
	11.25	0.0000	0.0004	0.4	0.20	99.90	0.10
	14.9	0.0000	0.0000	0.01	0.00	99.90	0.10

Percent Larger Than	Phi	microns	mm	inches
5	2.48	178.6	0.1786	0.00703
10	2.69	154.6	0.1546	0.00609
16	2.87	136.7	0.1367	0.00538
25	3.08	118.0	0.1180	0.00465
50	3.55	85.2	0.0852	0.00336
75	4.10	58.5	0.0585	0.00230
84	4.44	46.2	0.0462	0.00182
90	5.06	30.1	0.0301	0.00118
95	7.30	6.3	0.0063	0.00025

	Phi	microns	mm	inches
Median Value	3.55	85.22	0.08522	0.00336
Primary Mode				
Secondary Mode				

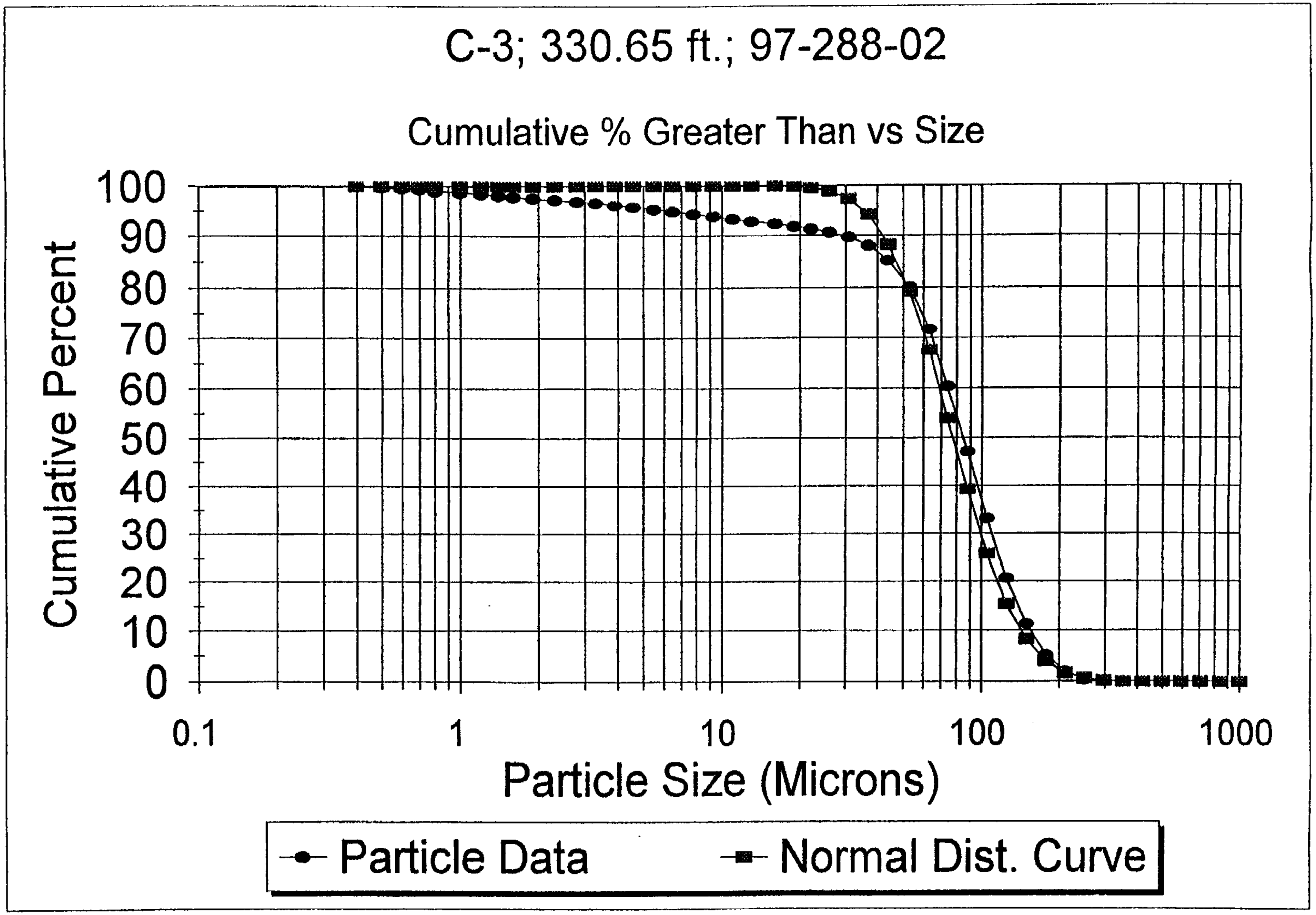
	Trask Values		Folk Values	
	Phi	mm	Phi	mm
Mean		0.0848	3.620	0.08
Sorting		0.396		0.4928
Skewness		0.4999	0.343	0.8
Kurtosis		0.1327	1.947	0.2092

Moment Values (mm)	
Mean (First Moment)	0.0684
Std. Dev. (Second Moment	0.6113

Sand Contents	
% Coarse	0.00
% Medium	0.50
% Fine	20.40
% Very Fine	50.90
% Total Sand	71.80

Silt Contents	
% Coarse	18.00
% Medium	2.60
% Fine	2.00
% Very Fine	1.80
% Total Silt	24.40

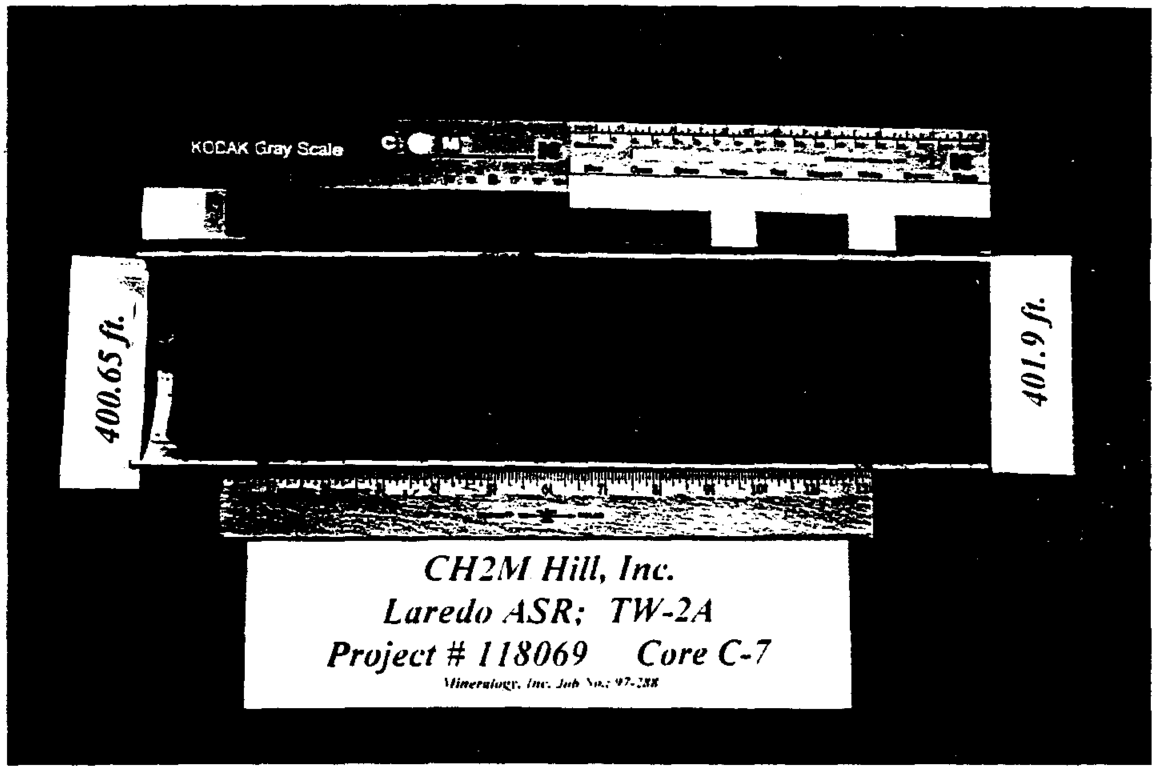
Clay Content	
% Clay	3.80


C-3; 330.65 ft.; 97-288-02
Cumulative % Greater Than vs Size
Cumulative Percent
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
1000
Particle Size (Microns)
Particle Data
Normal Dist. Curve

CH2M HILL, INC.
LAREDO ASR; WELL TW-2A
PROJECT # 118069

CORE NO. C-7; 400.65 - 401.9 ft.

MACROSCOPIC CORE DESCRIPTION,
THIN SECTION PETROGRAPHY,
SCANNING ELECTRON MICROSCOPY
and
LASER PARTICLE SIZE ANALYSIS RESULTS



MACROSCOPIC CORE DESCRIPTION

CH2M Hill, Inc.
Laredo ASR; TW-2A; Project No.: 118069

Core No.: C-7; 400.65 - 401.9 ft.

Mineralogy, Inc. Job No.: 97-288-03

A light gray, very fine-grained, very well sorted, weakly consolidated, friable, low angle cross-bedded to massive, porous and permeable sublitharenitic sandstone. The interval between 400.9 - 401.25 ft. is massively bedded and contains localized lobes of detrital matrix which appear to represent in-filled burrow molds. The balance of the core interval is characterized by low angle cross bed sets (5-10 degrees) with subtle traces of infiltrated detrital matrix situated near the tops of the cross bed sets. The sandstone framework is quartz-rich and contains scattered glauconite pellets and woody plant fragments which have been locally replaced with pyrite. Traces of dolomite cement are present as an intergranular pore-filling component. The sandstone is porous and permeable as evidenced by the rapid absorption of water on the core surface.

PETROGRAPHIC ANALYSIS

CLIENT / PROJECT IDENTIFICATION: CH2M Hill, Inc. / Laredo ASR - TW-2A; #118069

CORE NO. / DEPTH (ft.): *#C-7 / 401.3 ft.*

MINERALOGY, INC. JOB NO: *97-288-03*

LITHOLOGY: *Porous, Glauconitic, Sublitharenitic Sandstone*

CLASTIC TEXTURE (mm): **Mean** = 0.105 **Max** = 0.47

PORE DIAMETER (mm): **Mean** = 0.030

HELIUM POROSITY: *30.4%* **AIR PERMEABILITY** ***(Horiz.):*** *809 md.*

FABRIC / TEXTURE: This core sample is comprised of very fine-grained, very well sorted, slightly dolomitic and glauconite-rich, sublitharenitic sandstone. The fabric contains a few scattered lobes and lenses of organic-matter and detrital clay-rich sand, suggestive of bioturbation. The surrounding sandstone framework is mildly compacted and contains a predominance of point-to-point and elongated intergranular contacts, with lenses of detrital clay and ductile grains locally deformed due to mechanical compaction. as within the previously described sandstones from this aquifer, scattered patches of pseudomatrix are locally present owing to the compaction and subsequent injection of clay (derived from glauconite pellets and matrix-rich SRF's) into the adjoining pore spaces. The sandstone fabric is weakly consolidated, friable, porous (30.4%) and permeable (Kh=809md.) and displays a well interconnected intergranular pore network.

FRAMEWORK COMPONENTS: Detrital grain types included within this core sample are listed below, in order of decreasing relative abundance:

- ***Quartz;*** Monocrystalline quartz and minor polycrystalline quartz varieties.
- ***Glauconite;*** Locally deformed due to compaction - comprised of light to dark green-colored, microcrystalline clay matrix minerals (chiefly mixed-layer illite/smectite, illite and chlorite).
- ***Sedimentary Rock Fragments (SRF's);*** Shale and mudstone clasts - typically laminated and locally silty
- ***Feldspar;*** Plagioclase + k-feldspar locally leached and replaced with clay matrix with common intragranular dissolution porosity.
- ***Volcanic Rock Fragments (VRF's);*** Extensively matrix-replaced, feldspar-rich grains
- ***Woody Plant Fragments;*** Extensively replaced with pyrite and preferentially associated with the lobes of matrix-rich sand.
- ***Chert***

Muscovite and biotite mica, amphibole (basaltic hornblende), metamorphic RF's, magnetite and epidote are present as accessory constituents.

MATRIX / CEMENTS: Traces of carbonate cement are locally scattered within the pore network as patches of finely crystalline dolomite and ferroan dolomite. The dolomite displays very faint traces of alizarin-red stain, confirming the origin of the dolomite as a replacement for precursor calcite. Pyrite is a minor replacement variety associated with the woody plant debris. Traces of quartz overgrowth cement are present on scattered quartz grains as weakly developed syntaxial rims and nodules. Clay is present throughout the framework as a primary constituent within the glauconite pellets and SRF's, as scattered patches of microporous pore-filling matrix (mostly pseudomatrix derived from squashed glauconite) and as irregularly distributed grain-coating matrix which is locally concentrated within the intergranular pore throats. Lenticular and lobe-shaped concentrations of detrital clay are irregularly distributed as a pore-filling constituent - probably derived as infiltrated clay associated with bioturbation. The clay mineralogy is dominated by mixed-layer illite/smectite and chlorite, with minor illite and kaolinite.

PORE SYSTEM: The intergranular pore network is very well preserved and interconnected, with macropore types including intergranular (primary) and secondary (intragranular & grain-moldic) voids. Secondary voids are present owing to the partial to complete dissolution of feldspar grains and metastable RF's. Microporosity is present in association with the matrix-rich glauconite pellets and the scattered patches of pore-filling pseudomatrix.

SCANNING ELECTRON MICROSCOPY

CH2M Hill, Inc.
Laredo ASR; TW-2A; Project No.: 118069

Core No.: C-7; 401.3 ft.

Mineralogy, Inc. Job No.: 97-288-03

A & B

This sample is comprised of porous and permeable, very fine-grained, very well sorted, glauconitic, sublitharenitic sandstone. Figure A provides a typical, low magnification view of the sandstone framework, illustrating the well interconnected character of the pore network within this core interval. Figure B provides a detailed view of the leached detrital grain visible at the center of Figure A. This grain is tentatively identified as a leached volcanic RF which is marginally encrusted with a lacy network of microcrystalline iron oxide cement. The interior of this grain appears to be replaced with chlorite-rich matrix material.

C & D

Figure C provides a general view of this sandstone illustrating a leached rock fragment with intragranular dissolution porosity (top-center), a pore-filling concentration of dolomite cement (upper-left) and weakly developed rims of quartz overgrowth cement (e.g., lower-right and right-center). Figure D provides a close-up image of the pore throat situated to the lower-left of the leached grain noted in Figure C. The matrix cluster occupying this pore throat (top-center; Figure D) is comprised of a combination of mixed-layer illite/smectite and chlorite. Note the grain-coating chlorite matrix visible on the grain surface adjoining this pore (e.g., left-center).

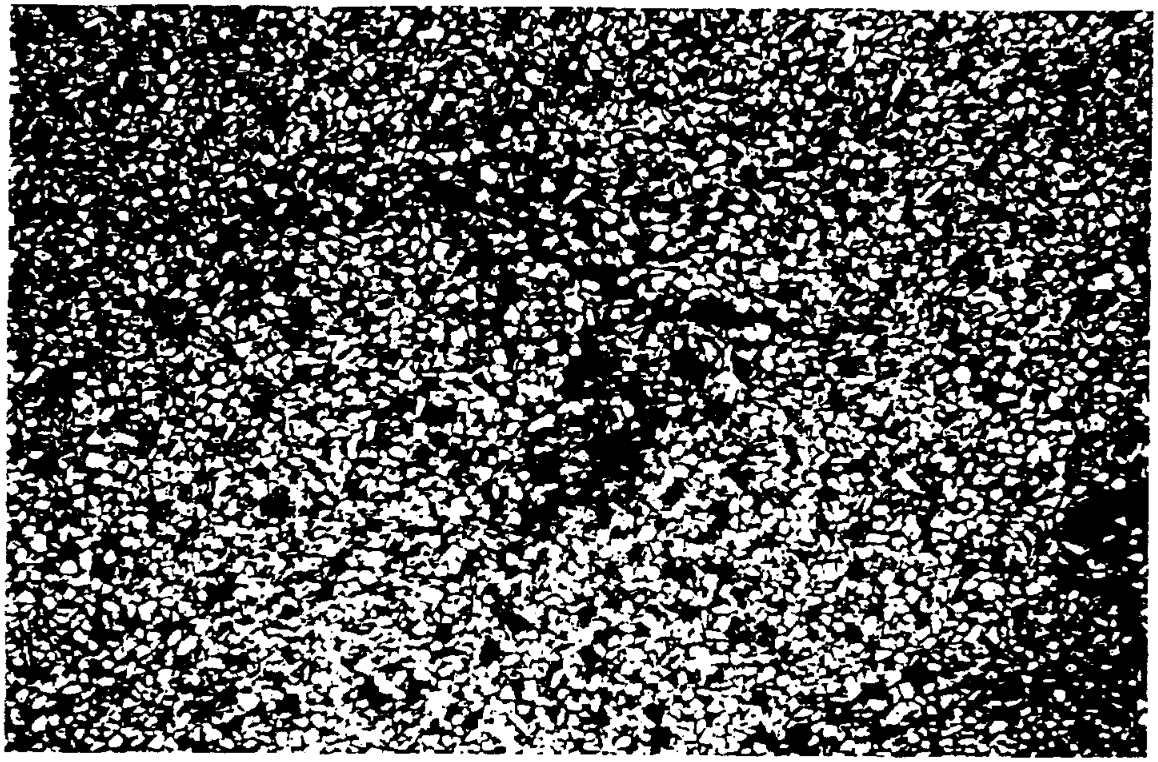
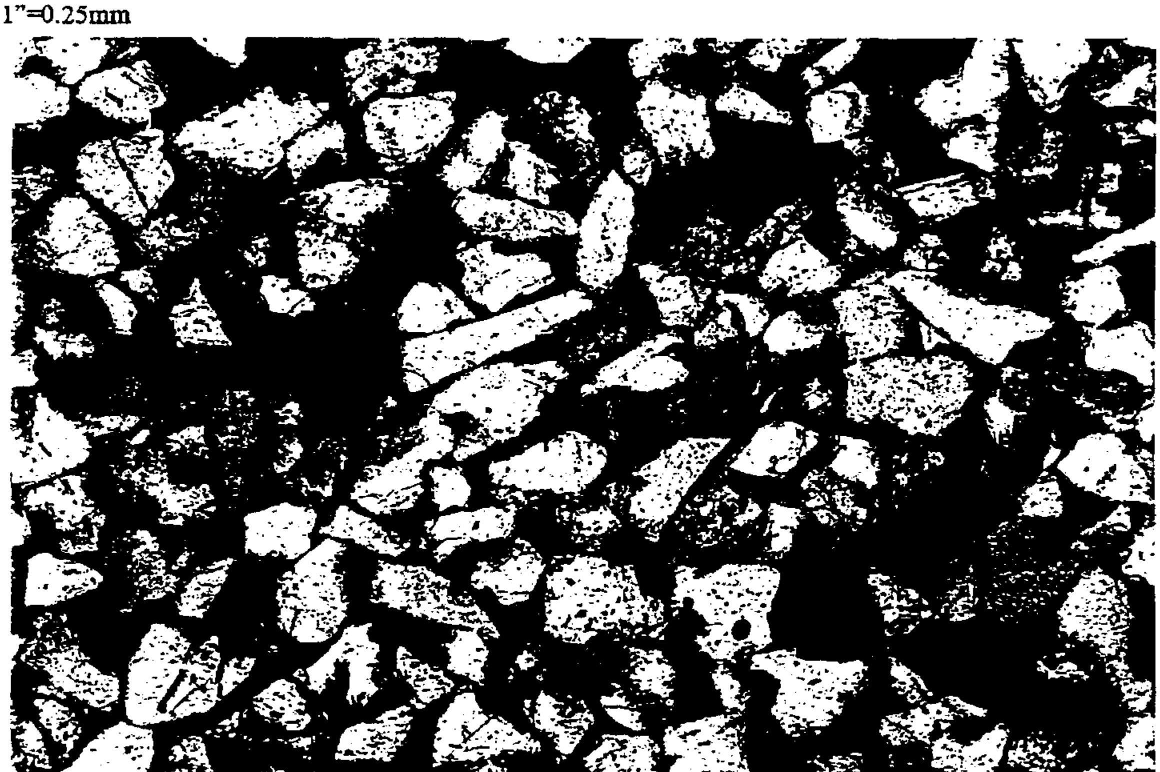


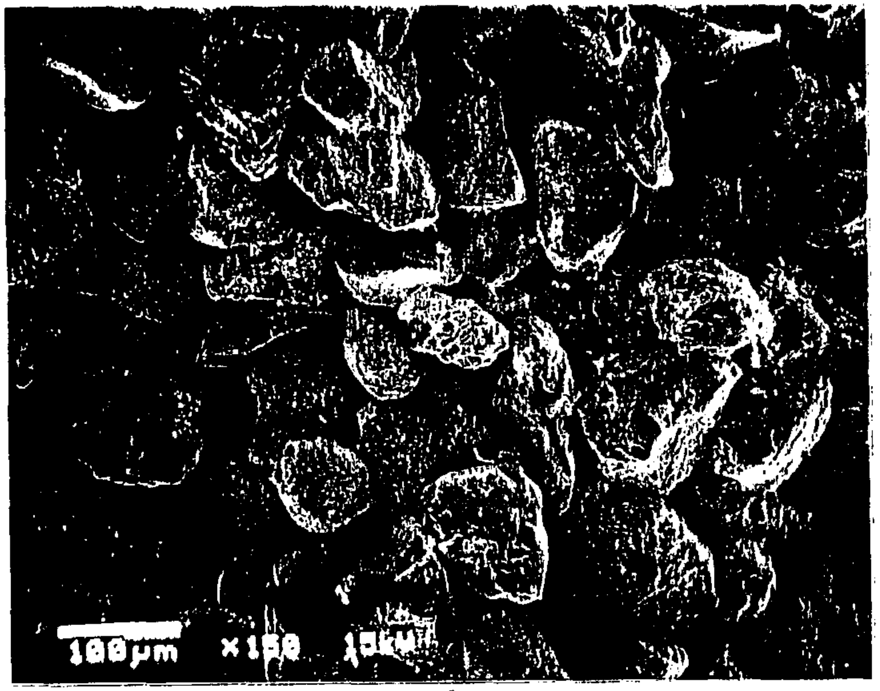
Figure A. This sandstone is described as a glauconitic, porous, sublitharenitic sandstone which displays lobe-shaped concentrations of infiltrated detrital clay (e.g., center). The black colored particles and mechanically deformed lenses are interpreted as organic matter which has been partially replaced with pyrite cement. The shape of the matrix-rich sandstone lobes is suggestive of in-filled burrow molds. 16X uncrossed nicols 1.25"=2.0mm

CH2M Hill, Inc.; Laredo ASR; TW-2A; Project # 118069; Core C-7; 401.3 ft.
Mineralogy, Inc. Job # 97-288-03

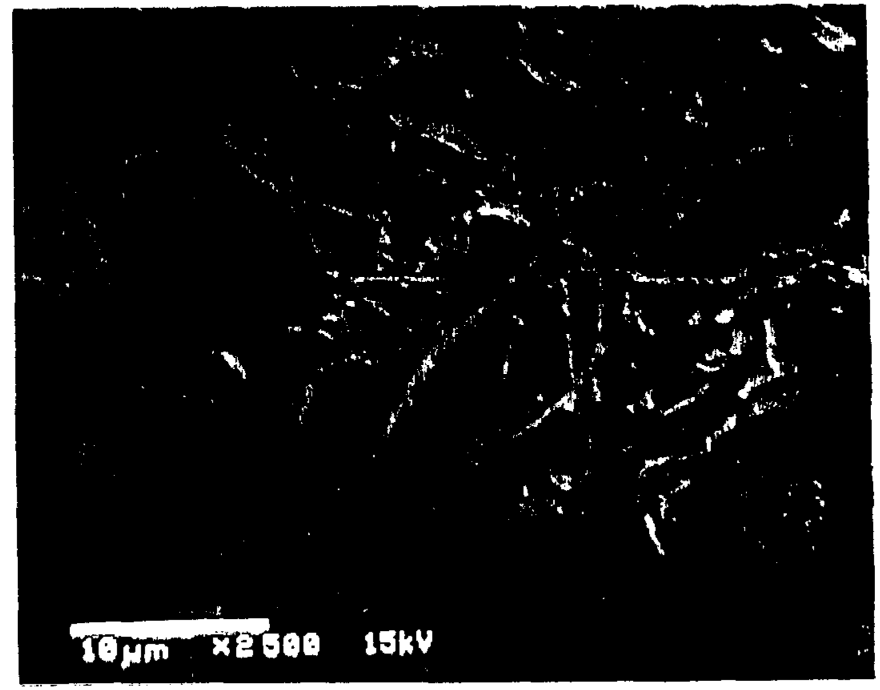
Figure B. As within the previously described sandstones from this aquifer, much of the clay matrix present in this core sample occurs as intragranular matrix within glauconite pellets (e.g., green; lower-right and top-center) and matrix-rich SRF's. Note the microporous authigenic clay encrusting the leached feldspar grain and choking the pore throat in the center of this photomicrograph. 100X uncrossed nicols 1"=0.25mm



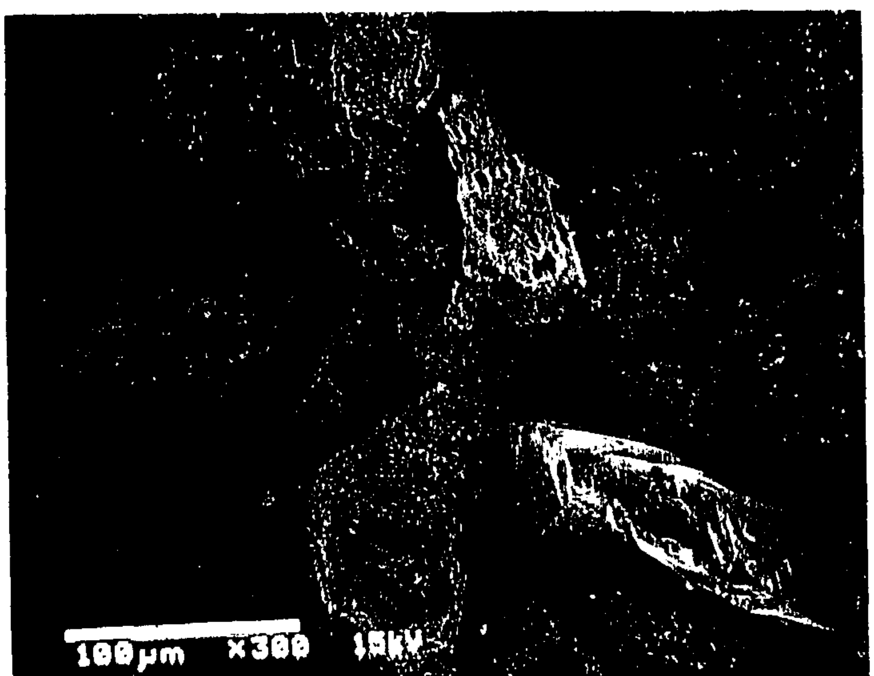
CH2M Hill, Inc.; Laredo ASR; TW-2A; Proj. #118069; Core # C-7 - 401.3 ft.; Mineralogy, Inc. # 97-288-03



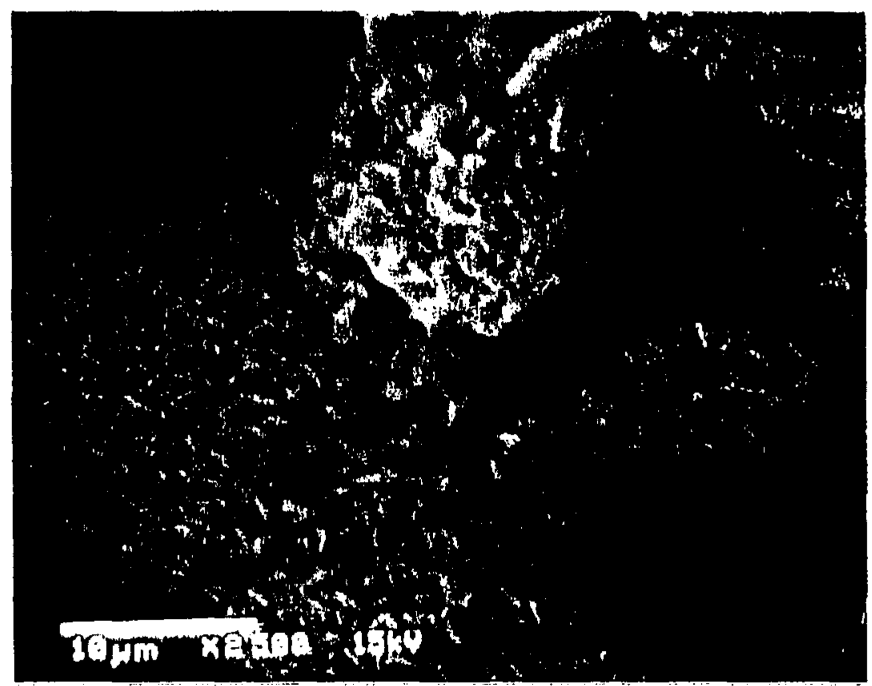
A.



B.



C.



D.

Mineralogy
Incorporated
3228 E. 15th Street
Tulsa, Okla. 74104

Particle Size Analysis

CH2M Hill, Inc.
Laredo ASR; TW-2A; Project No.: 118069 - Core C-7; 401.3 ft.
Mineralogy, Inc. Job # 97-288-03

Mesh Count	Phi Value	Inches	Millimeter	Microns	Inc. Percent	Cum. % Larger Than	Cum. % Smaller Than
18	0	0.0394	1.0000	1000	0.00	0.00	100.00
20	0.25	0.0331	0.8410	841	0.00	0.00	100.00
25	0.50	0.0278	0.7070	707	0.00	0.00	100.00
30	0.75	0.0234	0.5950	595	0.00	0.00	100.00
35	1.00	0.0197	0.5000	500	0.00	0.00	100.00
40	1.25	0.0165	0.4200	420	0.00	0:00	100.00
45	1.50	0.0139	0.3540	354	0	0.00	100.00
50	1.75	0.0117	0.2970	297	0.40	0.40	99.60
60	2.00	0.0098	0.2500	250	1.40	1.80	98.20
70	2.25	0.0083	0.2100	210	3.40	5.20	94.80
80	2.50	0.0070	0.1770	177	6.50	11.70	88.30
100	2.75	0.0059	0.1490	149	9.90	21.60	78.40
120	3.00	0.0049	0.1250	125	12.90	34.50	65.50
140	3.25	0.0041	0.1050	105	14.20	48.70	51.30
170	3.50	0.0035	0.0880	88	13.70	62.40	37.60
200	3.75	0.0029	0.0740	74	11.20	73.60	26.40
230	4.00	0.0025	0.0630	63	8.10	81.70	18.30
270	4.25	0.0021	0.0530	53	4.90	86.60	13.40
325	4.50	0.0017	0.0440	44	2.70	89.30	10.70
400	4.75	0.0015	0.0370	37	1.40	90.70	9.30
450	5.00	0.0012	0.0310	31	0.90	91.60	8.40
500	5.25	0.0010	0.0260	26	0.60	92.20	7.80
635	5.50	0.0009	0.0220	22	0.50	92.70	7.30
	5.75	0.0007	0.0190	19	0.40	93.10	6.90
	6.00	0.0006	0.0160	16	0.40	93.50	6.50
	6.25	0.0005	0.0130	13	0.40	93.90	6.10
	6.50	0.0004	0.0110	11	0.40	94.30	5.70
	6.75	0.0004	0.0093	9.3	0.40	94.70	5.30
	7.00	0.0003	0.0078	7.8	0.40	95.10	4.90
	7.25	0.0003	0.0065	6.5	0.40	95.50	4.50
	7.50	0.0002	0.0055	5.5	0.40	95.90	4.10
	7.75	0.0002	0.0046	4.6	0.40	96.30	3.70
	8.00	0.0002	0.0039	3.9	0.30	96.60	3.40
	8.25	0.0001	0.0033	3.3	0.30	96.90	3.10
	8.50	0.0001	0.0028	2.8	0.30	97.20	2.80
	8.75	0.0001	0.0023	2.3	0.30	97.50	2.50
	9.00	0.0001	0.0019	1.9	0.30	97.80	2.20
	9.25	0.0001	0.0016	1.6	0.30	98.10	1.90
	9.50	0.0001	0.0014	1.4	0.30	98.40	1.60
	9.75	0.0000	0.0012	1.2	0.30	98.70	1.30
	10.00	0.0000	0.0010	1	0.30	99.00	1.00
	10.25	0.0000	0.0008	0.8	0.30	99.30	0.70
	10.50	0.0000	0.0007	0.7	0.30	99.60	0.40
	10.75	0.0000	0.0006	0.6	0.20	99.80	0.20
	11.00	0.0000	0.0005	0.5	0.20	100.00	-0.00
	11.25	0.0000	0.0004	0.4	0.20	100.20	-0.20
	14.9	0.0000	0.0000	0.01	0.00	100.20	-0.20

Percent Larger Than	Phi	microns	mm	inches
5	2.24	212.4	0.2124	0.00836
10	2.43	185.0	0.1850	0.00728
16	2.61	164.0	0.1640	0.00646
25	2.82	142.0	0.1420	0.00559
50	3.27	103.4	0.1034	0.00407
75	3.79	72.1	0.0721	0.00284
84	4.12	57.6	0.0576	0.00227
90	4.62	40.5	0.0405	0.00160
95	6.94	8.2	0.0082	0.00032

	Phi	microns	mm	inches
Median Value	3.27	103.40	0.1034	0.00407
Primary Mode				
Secondary Mode				

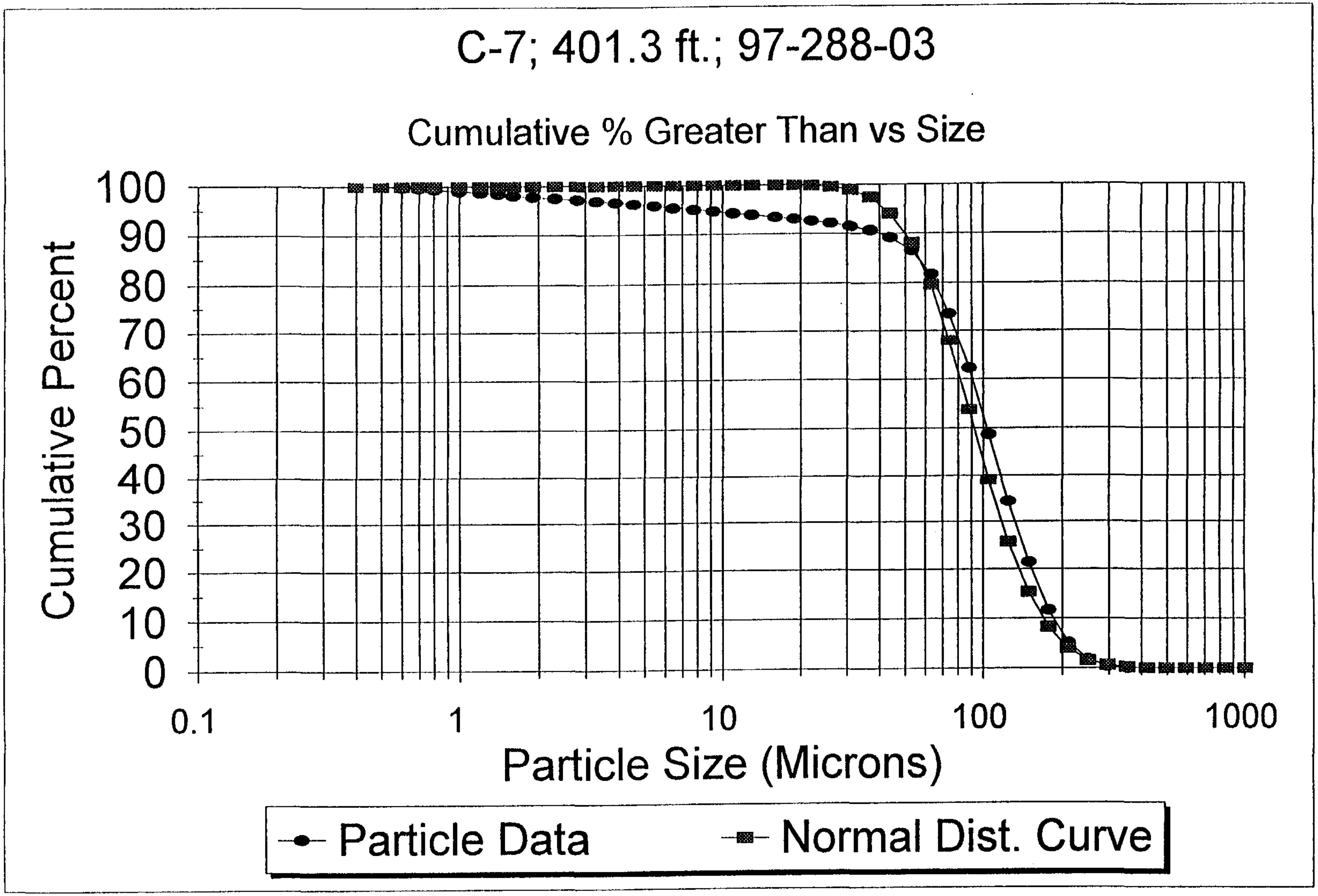
	Trask	Values	Folk	Values
	Phi	mm	Phi	mm
Mean		0.1031	3.333	0.10
Sorting		0.3992		0.4972
Skewness		0.5001	0.338	0.8
Kurtosis		0.1494	1.972	0.199

Moment Values (mm)	
Mean (First Moment)	0.0832
Std. Dev. (Second Moment	0.6119

Sand Contents	
% Coarse	0.00
% Medium	1.80
% Fine	32.70
% Very Fine	47.20
% Total Sand	81.70

Silt Contents	
% Coarse	9.90
% Medium	1.90
% Fine	1.60
% Very Fine	1.50
% Total Silt	14.90

Clay Content	
% Clay	3.40



C-7; 401.3 ft.; 97-288-03
Cumulative % Greater Than vs Size
Cumulative Percent
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
1000
Particle Size (Microns)
Particle Data
Normal Dist. Curve

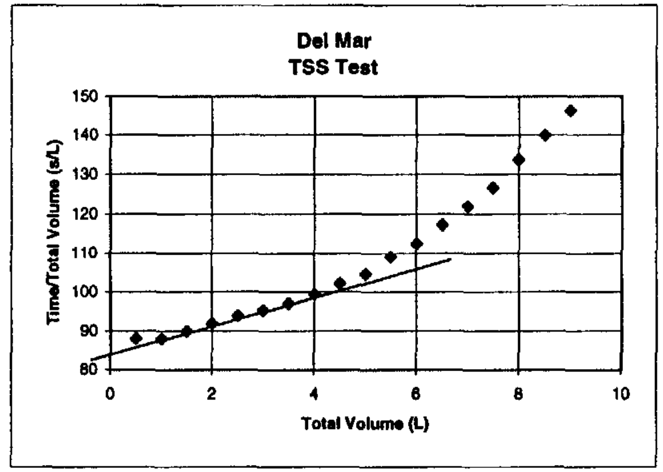
Appendix H
MFI Data

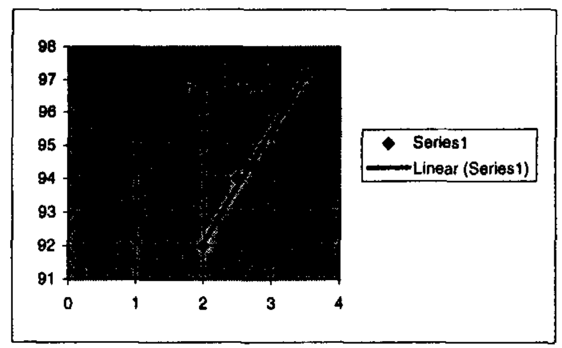
Attachment H-1

MFI Data-Del Mar Site

TOTAL SUSPENDED SOLIDS AND MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR (DS) FILTER END WT: 0.0778
7/11/97 (US) FILTER END WT: 0.0845
DEL MAR SITE
TEST 1 TEMPERATURE: 37 C
FILTERS # 59 (DS) AND #64 (US), STARTING WT 0.0831
Notes:no tears in filters

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	44	44	30	11	0.5	88
1000	88	44	30	11	1	88
1500	135	47	30	11	1.5	90
2000	184	49	30	11	2	92
2500	235	51	30	11	2.5	94
3000	286	51	30	10	3	95
3500	340	54	30	10	3.5	97
4000	398	58	30	10	4	100
4500	460	62	30	10	4.5	102
5000	523	63	30	10	5	105
5500	600	77	30	9	5.5	109
6000	675	75	30	9	6	113
6500	763	88	30	9	6.5	117
7000	854	179	30	8	7	122
7500	950	96	30	8	7.5	127
8000	1070	120	30	7	8	134
8500	1190	120	30	7	8.5	140
9000	1317	127	30	7	9	146





MFI= 3.35
TSS Correction 0.741
Temp Correction 1.43
actual MFI = 3.55

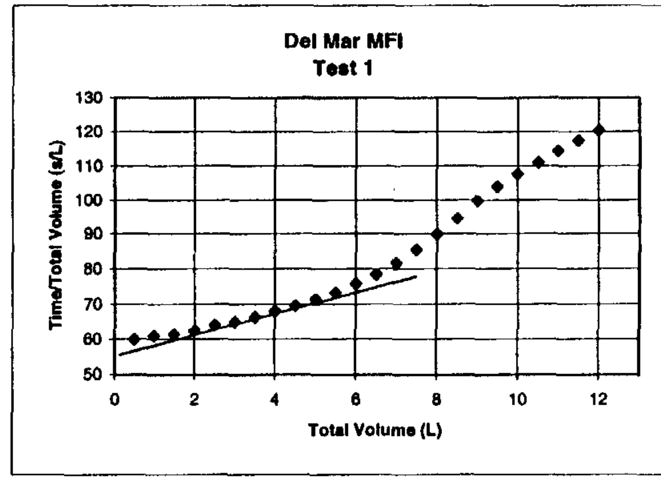
TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

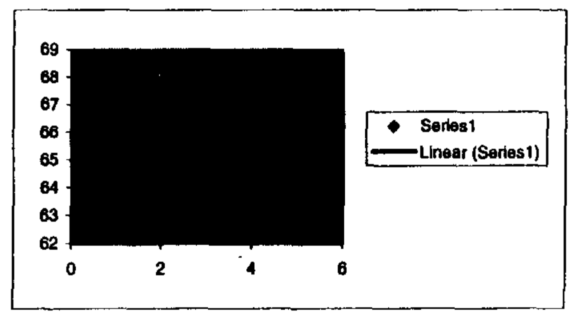
TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

TSS = 0.74 mg/L

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97 FILTER START WT: 0.0827
DEL MAR SITE FILTER END WT: 0.0846
TEST 1
FILTER # 51, WT 0.0827 TEMPERATURE: 37 C
Notes: Filter torn near end of test

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	30	30	30	17	0.5	60
1000	61	31	30	16	1	61
1500	92	31	30	16	1.5	61
2000	125	33	30	16	2	63
2500	160	35	30	16	2.5	64
3000	195	35	30	15	3	65
3500	232	37	30	15	3.5	66
4000	272	40	30	15	4	68
4500	313	41	30	14	4.5	70
5000	357	44	30	14	5	71
5500	403	46	30	14	5.5	73
6000	455	52	30	13	6	76
6500	510	55	30	13	6.5	78
7000	572	62	30	12	7	82
7500	641	69	30	12	7.5	85
8000	719	78	30	11	8	90
8500	804	85	30	11	8.5	95
9000	899	95	30	10	9	100
9500	988	89	30	10	9.5	104
10000	1076	88	30	9	10	108
10500	1166	90	30	9	10.5	111
11000	1258	92	30	9	11	114
11500	1352	94	30	9	11.5	118
12000	1446	94	30	8	12	121





MFI= 2.7
Temp Correction 1.43
actual MFI = 3.86

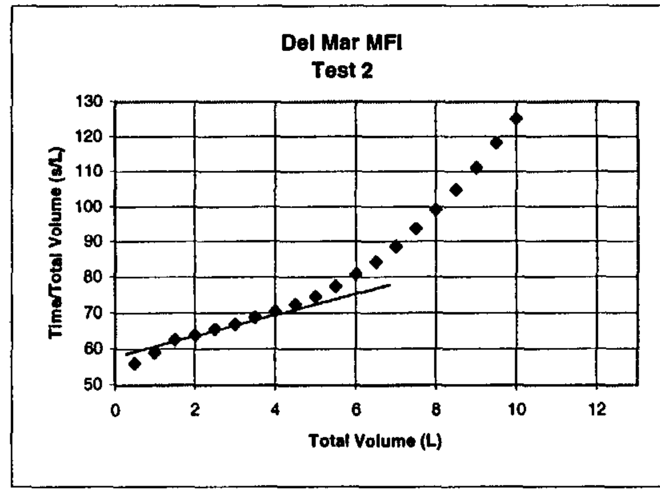
TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

TSS = 0.6 mg/L

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97 FILTER START WT: 0.083
DEL MAR SITE FILTER END WT: 0.0849
TEST 2
FILTER # 52, WT 0.0830 TEMPERATURE: 37 C
Notes:

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	28	28	30	18	0.5	56
1000	59	31	30	17	1	59
1500	94	35	30	16	1.5	63
2000	128	34	30	16	2	64
2500	164	36	30	15	2.5	66
3000	201	37	30	15	3	67
3500	241	40	30	15	3.5	69
4000	282	41	30	14	4	71
4500	326	44	30	14	4.5	72
5000	373	47	30	13	5	75
5500	426	53	30	13	5.5	77
6000	485	59	30	12	6	81
6500	548	63	30	12	6.5	84
7000	620	72	30	11	7	89
7500	704	84	30	11	7.5	94
8000	794	90	30	10	8	99
8500	892	98	30	10	8.5	105
9000	1001	109	30	9	9	111
9500	1123	122	30	8	9.5	118
10000	1252	129	30	8	10	125

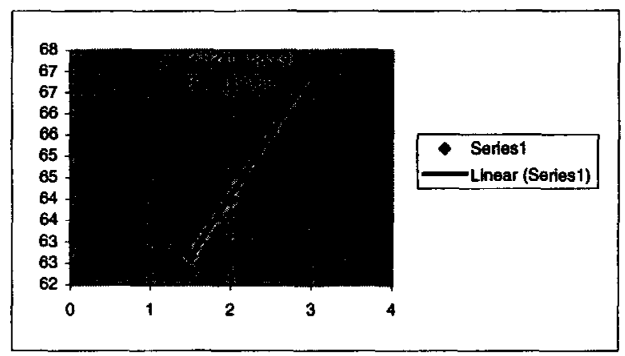


MFI= 2.92
Temp Correction 1.43
actual MFI = 4.18

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

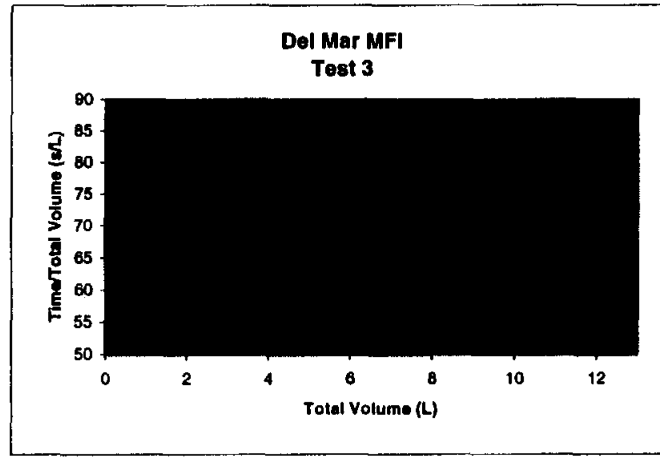
TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

TSS = 0.72 mg/L



MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97 FILTER START WT: 0.0831
DEL MAR SITE FILTER END WT: 0.0848
TEST 3
FILTER # 54, WT 0.0831 TEMPERATURE: 37 C
Notes: filter broken at end of test

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	28	28	30	18	0.5	56
1000	58	30	30	17	1	58
1500	89	31	30	17	1.5	59
2000	119	30	30	17	2	60
2500	153	34	30	16	2.5	61
3000	187	34	30	16	3	62
3500	225	38	30	16	3.5	64
4000	262	37	30	15	4	66
4500	300	38	30	15	4.5	67
5000	340	40	30	15	5	68
5500	382	42	30	14	5.5	69
6000	425	43	30	14	6	71
7000	477	52	30	15	7	68
7500	527	50	30	14	7.5	70
8000	584	57	30	14	8	73
8500	644	60	30	13	8.5	76
9000	710	66	30	13	9	79
9500	782	72	30	12	9.5	82
10500	866	84	30	12	10.5	82
11000	918	52	30	12	11	83



MFI= Not Calculated
Temp Correctio 1.43
actual MFI =

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

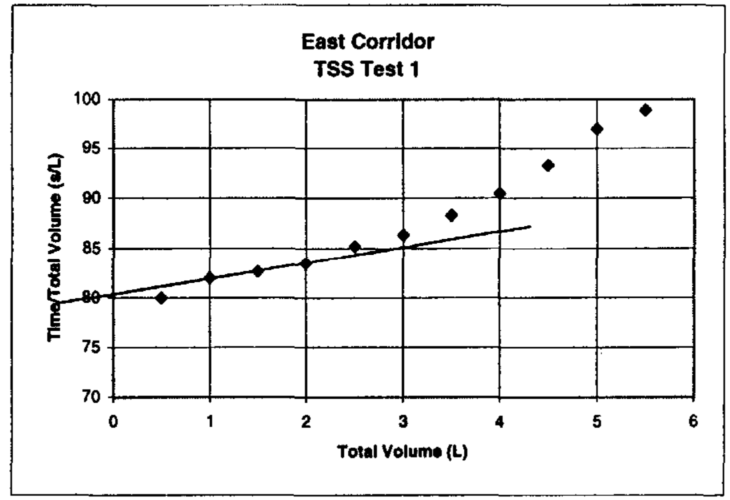
TSS = 0.7 mg/L

Attachment H-2

MFI Data-East corridor Site

TOTAL SUSPENDED SOLIDS AND MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR (DS) FILTER END WT: 0.0815
7/11/97 (US) FILTER END WT: 0.0827
EAST CORRIDOR SITE
TEST 1 TEMPERATURE: 32 C
FILTERS # 29(ds) AND #33 (us), STARTING WT: 0.0812
Notes: Both filters torn at end of test

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	40	40	30	13	0.5	80
1000	82	42	30	12	1	82
1500	124	42	30	12	1.5	83
2000	167	43	30	12	2	84
2500	213	46	30	12	2.5	85
3000	259	46	30	12	3	86
3500	309	50	30	11	3.5	88
4000	362	53	30	11	4	91
4500	420	58	30	11	4.5	93
5000	485	65	30	10	5	97
5500	544	59	30	10	5.5	99

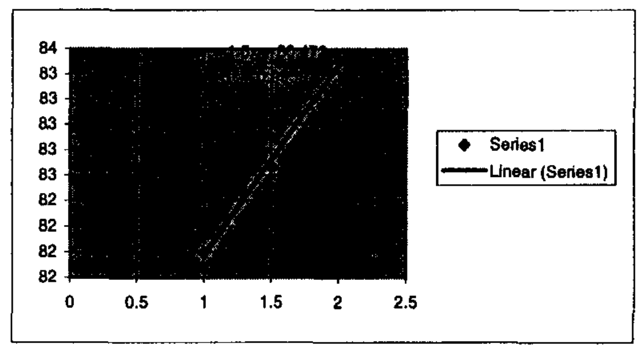


MFI=	1.5
TSS Correction	0.741
Temp Correctioı	1.28
actual MFI =	1.42

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter <u>gained</u> wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

TSS = 1.42 mg/L

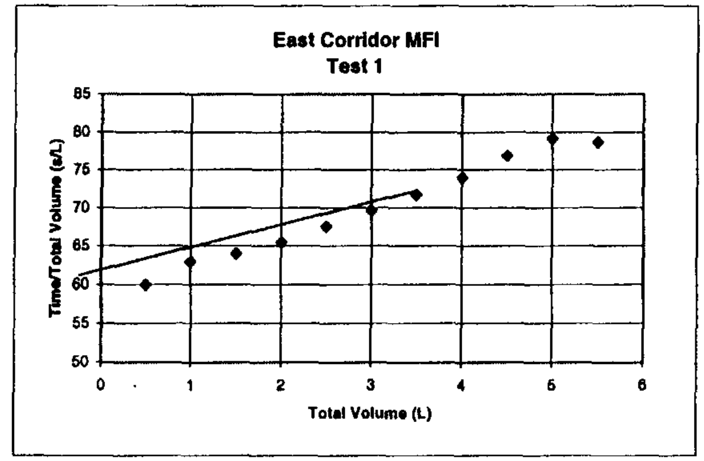


MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
EAST CORRIDOR SITE
TEST 1
FILTER # 45, WT 0.0771
Notes: Filter torn during test

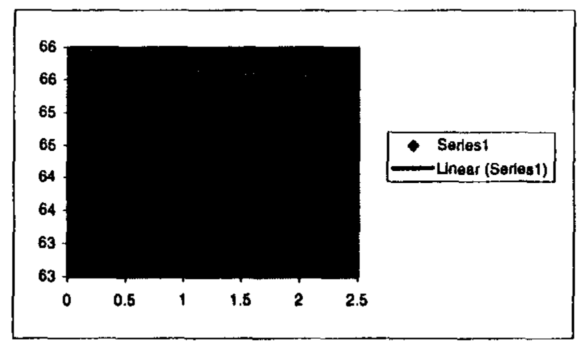
FILTER START WT: 0.0771
FILTER END WT: 0.0783

TEMPERATURE: 32 C

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	30	30	30	17	0.5	60
1000	63	33	30	16	1	63
1500	96	33	30	16	1.5	64
2000	131	35	30	15	2	66
2500	169	38	30	15	2.5	68
3000	209	40	30	14	3	70
3500	251	42	30	14	3.5	72
4000	296	45	30	14	4	74
4500	346	50	30	13	4.5	77
5000	396	50	30	13	5	79
5500	433	37	30	13	5.5	79
6000	470	37	30	13	6	78
7000	545	75	30	13	7	78
7500	582	37	30	13	7.5	78
8000	620	38	30	13	8	78



MFI= 2.5
Temp Correction 1.28
actual MFI = 3.2



TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

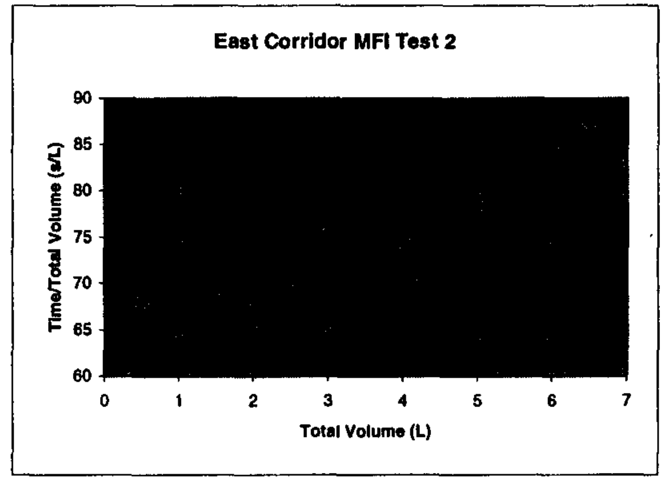
TSS = 1.3 mg/L

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
EAST CORRIDOR SITE
TEST 2
FILTER # 44, WT 0.0815
Notes: Filter torn during test after 6000 ml

FILTER START WT: 0.0815
FILTER END WT: 0.0829

TEMPERATURE: 32 C

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	34	34	30	15	0.5	68
1000	65	31	30	15	1	65
1500	104	39	30	14	1.5	69
2000	137	33	30	15	2	69
2500	176	39	30	14	2.5	70
3000	226	50	30	13	3	75
3500	256	30	30	14	3.5	73
4000	298	42	30	13	4	75
4500	342	44	30	13	4.5	76
5000	392	50	30	13	5	78
5500	447	55	30	12	5.5	81
6000	509	62	30	12	6	85
6500	568	59	30	11	6.5	87



MFI= Not Calculated
Temp Correction 1.28
actual MFI =

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

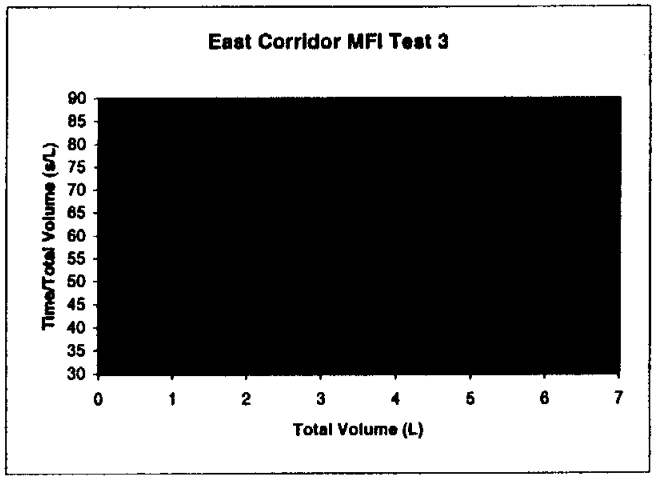
TSS = 1.12 mg/L

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
EAST CORRIDOR SITE
TEST 3
FILTER # 42, WT 0.0773
Notes: Filter torn during whole test

FILTER START WT: 0.0773
FILTER END WT: 0.0780

TEMPERATURE: 32 C

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	32	32	30	16	0.5	64
1000	63	31	30	16	1	63
1500	96	33	30	16	1.5	64
2000	131	35	30	15	2	66
2500	168	37	30	15	2.5	67
3000	202	34	30	15	3	67
3500	234	32	30	15	3.5	67
4000	266	32	30	15	4	67
4500	299	33	30	15	4.5	66
5000	331	32	30	15	5	66
5500	365	34	30	15	5.5	66
6000	408	43	30	15	6	68
6500	431	23	30	15	6.5	66



MFI= Not Calculated
Temp Correction 1.28
actual MFI =

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

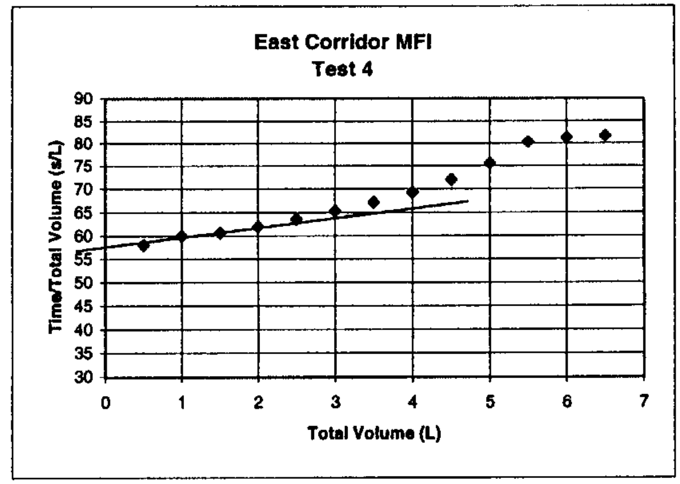
TSS = 0.92 mg/L

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
EAST CORRIDOR SITE
TEST 4
FILTER # 38, WT 0.0771
Notes: Filter torn towards end of test

FILTER START WT: 0.0771
FILTER END WT: 0.0784

TEMPERATURE: 32 C

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	29	29	30	17	0.5	58
1000	60	31	30	17	1	60
1500	91	31	30	16	1.5	61
2000	124	33	30	16	2	62
2500	159	35	30	16	2.5	64
3000	196	37	30	15	3	65
3500	235	39	30	15	3.5	67
4000	277	42	30	14	4	69
4500	324	47	30	14	4.5	72
5000	378	54	30	13	5	76
5500	442	64	30	12	5.5	80
6000	488	46	30	12	6	81
6500	531	43	30	12	6.5	82

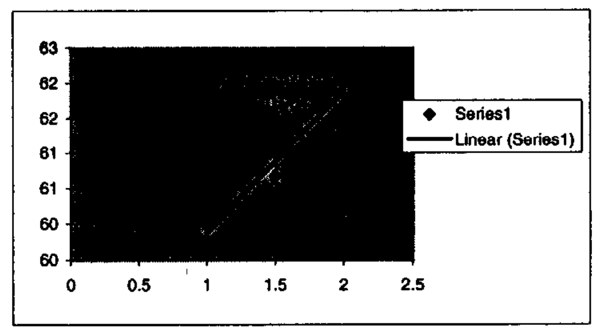


MFI=	2
Temp Correctior	1.28
actual MFI =	2.56

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

TSS = 1.2 mg/L



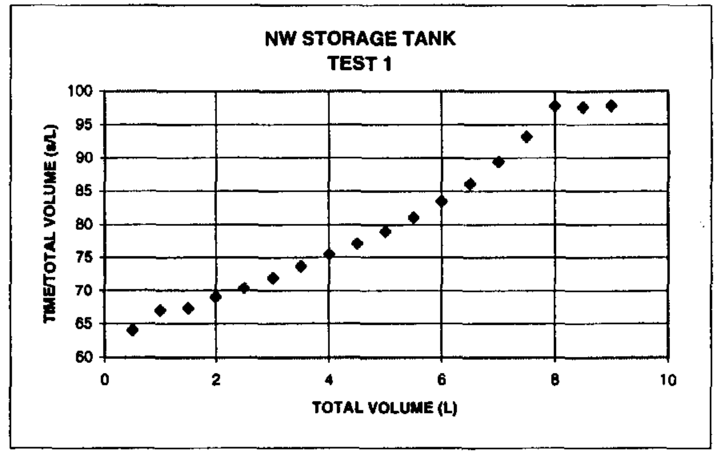
Attachment H-3

MFI Data-NW Storage Tank

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
NW STORAGE TANK
TEST 1
FILTER # 30, WT 0.0777
Notes: Filter torn near end of test

FILTER START WT: 0.0777
FILTER END WT: 0.0809
TEMPERATURE: 30 C

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	32	32	41	16	0.5	64
1000	67	35	41	15	1	67
1500	101	34	41	15	1.5	67
2000	138	37	41	14	2	69
2500	176	38	41	14	2.5	70
3000	216	40	41	14	3	72
3500	258	42	41	14	3.5	74
4000	302	44	41	13	4	76
4500	347	45	41	13	4.5	77
5000	395	48	41	13	5	79
5500	446	51	41	12	5.5	81
6000	501	55	41	12	6	84
6500	560	59	41	12	6.5	86
7000	626	66	41	11	7	89
7500	699	73	41	11	7.5	93
8000	782	83	41	10	8	98
8500	830	48	41	10	8.5	98
9000	881	51	41	10	9	98



MFI= Not Calculated
Temp Correctio 1.25
actual MFI =

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

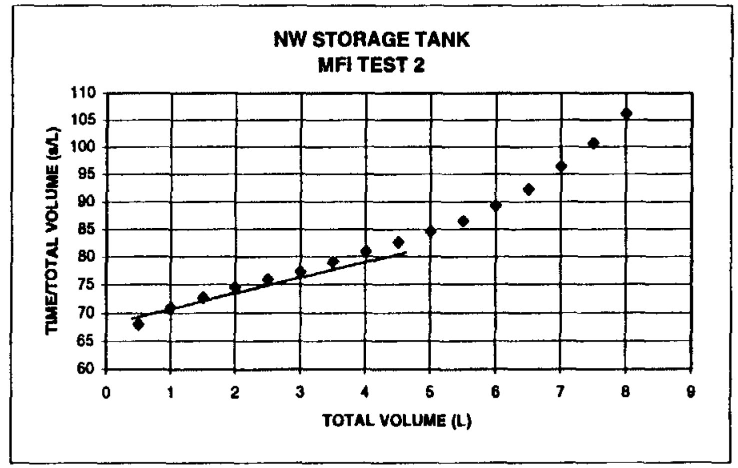
TSS = 0.94 mg/L

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
NW STORAGE TANK
TEST 2
FILTER # 36, WT 0.0816
Notes: Filter torn near end of test

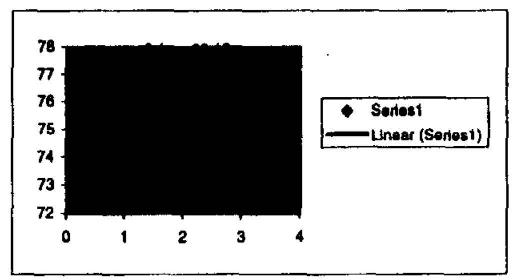
FILTER START WT: 0.0816
FILTER END WT: 0.0845

TEMPERATURE: 30 C

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	34	34	41	15	0.5	68
1000	71	37	41	14	1	71
1500	109	38	41	14	1.5	73
2000	149	40	41	13	2	75
2500	190	41	41	13	2.5	76
3000	232	42	41	13	3	77
3500	277	45	41	13	3.5	79
4000	324	47	41	12	4	81
4500	372	48	41	12	4.5	83
5000	423	51	41	12	5	85
5500	476	53	41	12	5.5	87
6000	536	60	41	11	6	89
6500	600	64	41	11	6.5	92
7000	675	75	41	10	7	96
7500	756	81	41	10	7.5	101
8000	850	94	41	9	8	106



MFI= 3.1
Temp Correctio 1.25
actual MFI = 3.88



TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

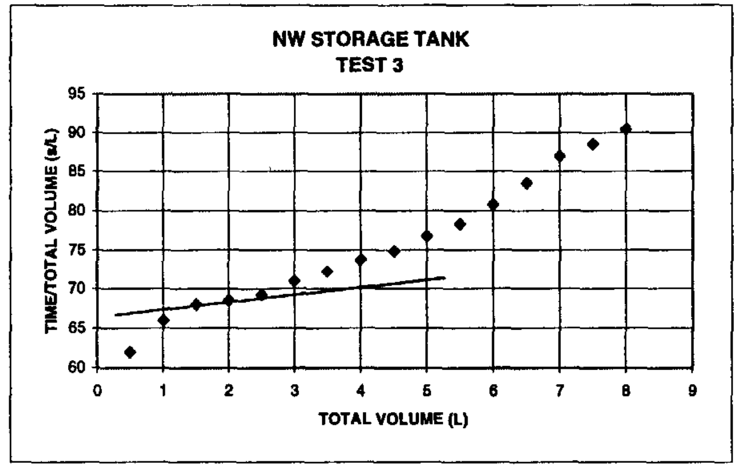
TSS = 1.03 mg/L

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
NW STORAGE TANK
TEST 3
FILTER # 27, WT 0.0773
Notes: Filter torn near end of test

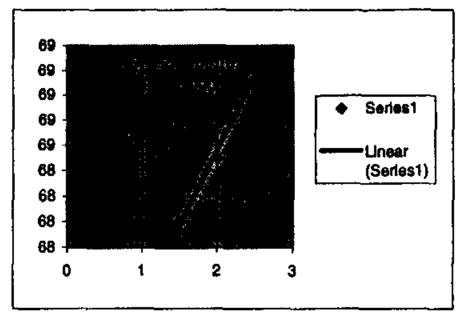
FILTER START WT: 0.0773
FILTER END WT: 0.0801

TEMPERATURE: 30 C

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	31	31	41	16	0.5	62
1000	66	35	41	15	1	66
1500	102	36	41	15	1.5	68
2000	137	35	41	15	2	69
2500	173	36	41	14	2.5	69
3000	213	40	41	14	3	71
3500	253	40	41	14	3.5	72
4000	295	42	41	14	4	74
4500	337	42	41	13	4.5	75
5000	384	47	41	13	5	77
5500	431	47	41	13	5.5	78
6000	485	54	41	12	6	81
6500	543	58	41	12	6.5	84
7000	609	66	41	11	7	87
7500	664	55	41	11	7.5	89
8000	724	60	41	11	8	91



MFI=	1.2
Temp Correctio	1.25
actual MFI =	1.50



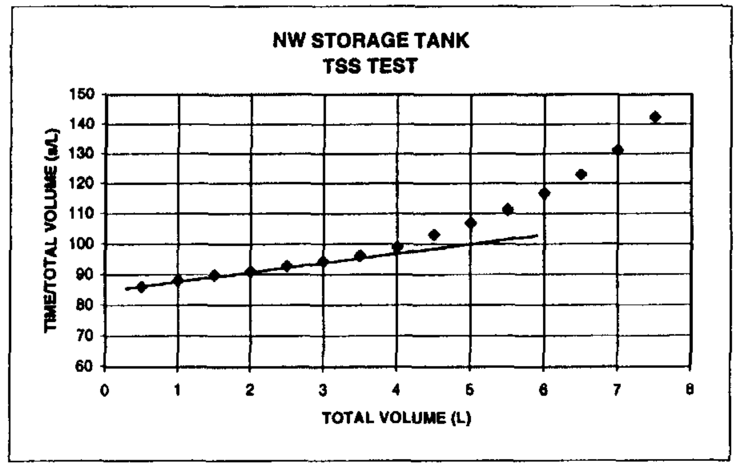
TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter <u>gained</u> wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

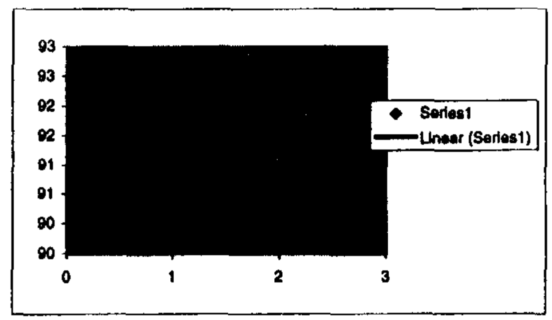
TSS = 1.01 mg/L

TOTAL SUSPENDED SOLIDS AND MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR (DS) FILTER END WT: 0.0777
7/11/97 (US) FILTER END WT: 0.0790
NW STORAGE TANK
TEST 1 TEMPERATURE: 30 C
FILTER # 32 (US) AND 25 (DS), STARTING WT 0.0771;
Notes: Filter torn near end of test

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	43	43	41	12	0.5	86
1000	88	45	41	11	1	88
1500	135	47	41	11	1.5	90
2000	182	47	41	11	2	91
2500	232	50	41	11	2.5	93
3000	283	51	41	11	3	94
3500	337	54	41	10	3.5	96
4000	396	59	41	10	4	99
4500	464	68	41	10	4.5	103
5000	535	71	41	9	5	107
5500	613	78	41	9	5.5	111
6000	701	88	41	9	6	117
6500	800	99	41	8	6.5	123
7000	919	119	41	8	7	131
7500	1069	150	41	7	7.5	143



MFI=	2.8
TSS Correction	0.741
Temp Correctioi	1.25
actual MFI =	2.59



TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

TSS = 1.04 mg/L

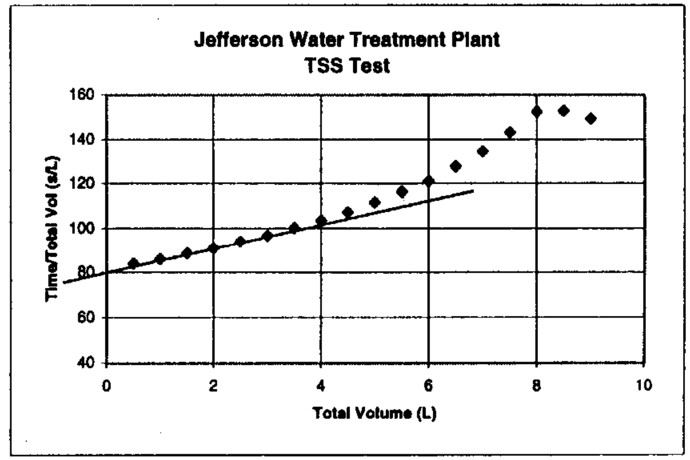
Attachment H-4

MFI Data-Jefferson Water Treatment Plant

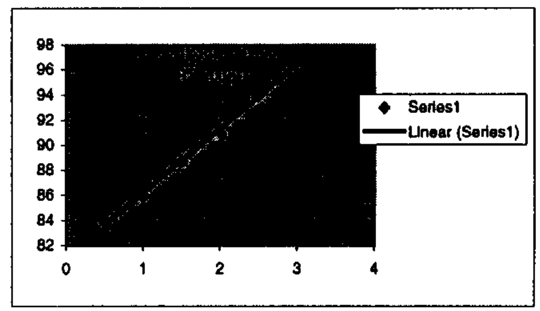
TOTAL SUSPENDED SOLIDS AND MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
JEFFERSON WATER TREATMENT PLANT (JWTP)
TSS TEST 1
FILTERS # 40 (ds) and 43 (us) STARTING WT 0.0772, ENDING WT :
Notes: both filters torn around o-ring at 8000 ML

FILTER #40 END WT: 0.0777
FILTER #43 END WT: 0.0772
TEMPERATURE: 30 C

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	42	42	30	12	0.5	84
1000	86	44	30	12	1	86
1500	133	47	30	11	1.5	89
2000	182	49	30	11	2	91
2500	235	53	30	11	2.5	94
3000	290	55	30	10	3	97
3500	351	61	30	10	3.5	100
4000	414	63	30	10	4	104
4500	483	69	30	9	4.5	107
5000	558	75	30	9	5	112
5500	640	82	30	9	5.5	116
6000	727	87	30	8	6	121
6500	831	104	30	8	6.5	128
7000	943	112	30	7	7	135
7500	1075	132	30	7	7.5	143
8000	1220	145	30	7	8	153
8500	1300	80	30	7	8.5	153
9000	1346	46	30	7	9	150



MFI=	5.12
TSS correction	x 0.741
Temp Correctioı	x 1.25
Actual MFI	4.7424



TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the upstream filter ending wt
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

TSS = 1.36 mg/L

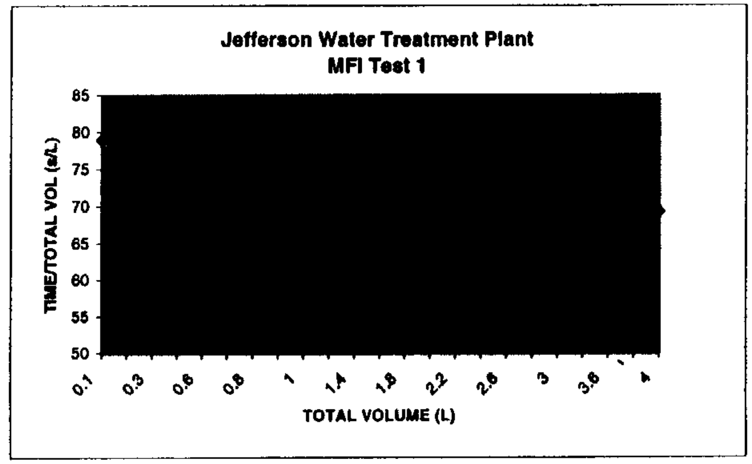
MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
JEFFERSON WATER TREATMENT PLANT (JWTP)
TEST 1
FILTER # 50, WT 0.0850

FILTER START WT: 0.085
FILTER END WT: 0.0853

TEMPERATURE: 30 C

Notes: filter not properly seated in O-ring, flow bypassing filter at some point in time

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
100	7.9	7.9	30	13	0.1	79
200	12	4.1	30	17	0.2	60
300	18.5	6.5	30	16	0.3	62
400	25.5	7	30	16	0.4	64
600	38.6	13.1	30	16	0.6	64
700	44.5	5.9	30	16	0.7	64
800	50.7	6.2	30	16	0.8	63
900	56	5.3	30	16	0.9	62
1000	62	6	30	16	1	62
1200	78	16	30	15	1.2	65
1400	90	12	30	16	1.4	64
1600	104	14	30	15	1.6	65
1800	117	13	30	15	1.8	65
2000	130	13	30	15	2	65
2200	145	15	30	15	2.2	66
2400	158	13	30	15	2.4	66
2600	173	15	30	15	2.6	67
2800	188	15	30	15	2.8	67
3000	202	14	30	15	3	67
3400	232	30	30	15	3.4	68
3600	245	13	30	15	3.6	68
3800	262	17	30	15	3.8	69
4000	277	15	30	14	4	69



MFI= Not Calculated
Temp Correction
actual MFI =

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter <u>gained</u> wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

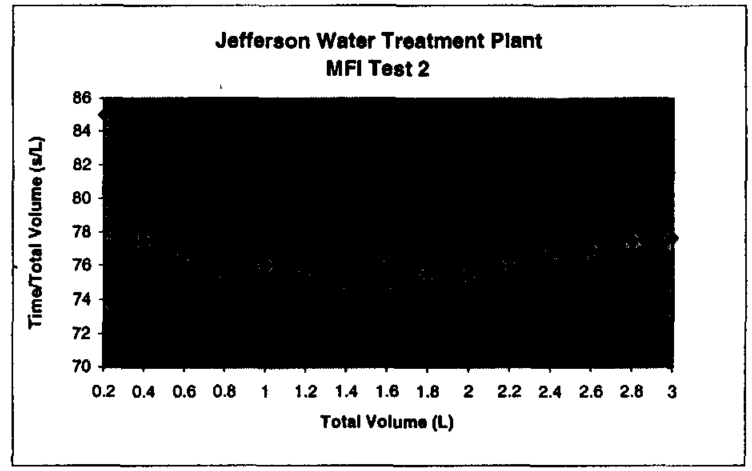
TSS = 1.4 mg/L

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
JEFFERSON WATER TREATMENT PLANT (JWTP)
TEST 2
FILTER # 48, WT 0.0848
Notes: test completed with filter intact

FILTER START WT: 0.0848
FILTER END WT: 0.0861

TEMPERATURE: 30 C

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
200	17	17	30	12	0.2	85
400	31	14	30	13	0.4	78
600	46	15	30	13	0.6	77
800	60	14	30	13	0.8	75
1000	76	16	30	13	1	76
1200	91	15	30	13	1.2	76
1400	105	14	30	13	1.4	75
1600	120	15	30	13	1.6	75
1800	136	16	30	13	1.8	76
2000	151	15	30	13	2	76
2200	168	17	30	13	2.2	76
2400	184	16	30	13	2.4	77
2600	200	16	30	13	2.6	77
2800	217	17	30	13	2.8	78
3000	233	16	30	13	3	78



MFI= Not Calculated
Temp Correction
actual MFI =

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter <u>gained</u> wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

TSS = 2.2 mg/L

MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
JEFFERSON WATER TREATMENT PLANT (JWTP)
TEST 3
FILTER # 46, WT 0.0772
Notes:

FILTER START WT: 0.0772
FILTER END WT: 0.0787

TEMPERATURE: 30 C

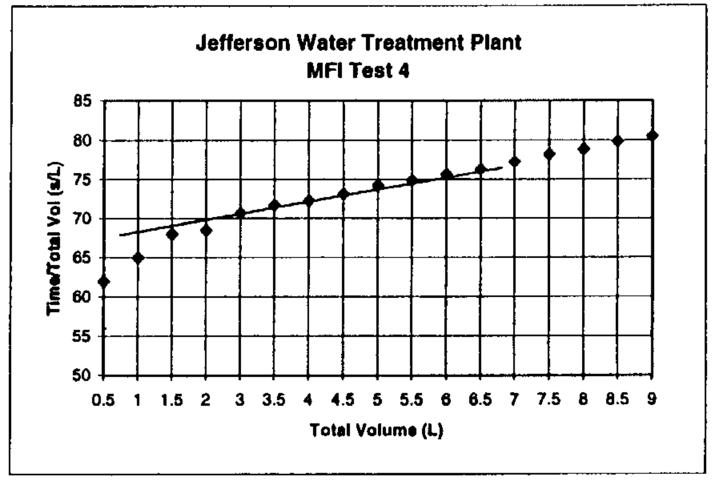
CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	31	31	30	16	0.5	62
1000	65	34	30	15	1	65
1500	102	37	30	15	1.5	68
2000	137	35	30	15	2	69
3000	212	75	30	14	3	71
3500	251	39	30	14	3.5	72
4000	289	38	30	14	4	72
4500	329	40	30	14	4.5	73
5000	371	42	30	13	5	74
5500	412	41	30	13	5.5	75
6000	454	42	30	13	6	76
6500	496	42	30	13	6.5	76
7000	541	45	30	13	7	77
7500	587	46	30	13	7.5	78
8000	631	44	30	13	8	79
8500	679	48	30	13	8.5	80
9000	725	46	30	12	9	81

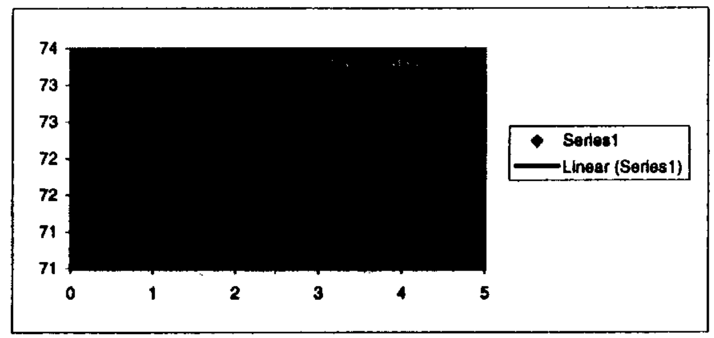
MFI= 1.57
Temp Correction 1.25
actual MFI = 1.96

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/L

TSS = 0.76





MODIFIED FOULING INDEX SPREADSHEET
LAREDO ASR
7/11/97
JEFFERSON WATER TREATMENT PLANT (JWTP)
TEST 3
FILTER # 47, WT 0.0891

FILTER START WT: 0.0891
FILTER END WT: 0.0909
TEMPERATURE: 30 C

Notes: filter tore all the way around o-ring between 7000mland 7500ml

CUMULATIVE VOULME (ml)	ELAPSED TIME (sec)	INTERVAL (sec)	PRESSURE (psi)	FLOW RATE (ml/sec)	TOTAL VOLUME (L)	TIME/TOTAL VOLUME (sec/L)
500	37	37	30	14	0.5	74
1000	75	38	30	13	1	75
1500	115	40	30	13	1.5	77
2000	155	40	30	13	2	78
2500	199	44	30	13	2.5	80
3000	242	43	30	12	3	81
3500	290	48	30	12	3.5	83
4000	339	49	30	12	4	85
4500	393	54	30	11	4.5	87
5000	452	59	30	11	5	90
5500	515	63	30	11	5.5	94
6000	582	67	30	10	6	97
6500	656	74	30	10	6.5	101
7000	730	74	30	10	7	104
7500	785	55	30	10	7.5	105
8000	842	57	30	10	8	105

MFI= 2.82
Temp Correction 1.25
actual MFI = 3.525

TSS calculation assumptions: Based on Del Mar test, assume all downstream filters lost 0.0053g.
If downstream filter gained wt, then add that wt gain to the top filter.
Calculate total volume only up to point where filter breaks (if applicable)

TSS = (ending wt - (starting wt - 0.0053))/vol (L) x 1000 mg/ in mg/L

TSS = 1.01 mg/L