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ANNUAL WATER QUALITY DATA REPORT

for the

WASTE ISOLATION PILOT PLANT

APRIL 1989

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MASTER

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPLANATION
AIS	Air Intake Shaft
AVG	Average
BGS	Below Ground Surface
BTOC	Below Top of Casing
C	Degrees Celsius
cc/l (STP)	cubic centimeters per liter at Standard Temperature and Pressure
CU	Color Units
EEG	Environmental Evaluation Group (State of New Mexico)
gph	gallons per hour
gpm	gallons per minute
ITAS	International Technology Analytical Services
LSI corrosivity	Langlier Saturation Index corrosivity (calcium carbonate saturation index)
MBAS	Methylene Blue Active Substances (surfactants)
meq/l	milliequivalents per liter
mg/l	milligram per liter
mg/l NO_3-N	milligram per liter Nitrate expressed as Nitrogen
mg/l T-PO4-P	milligram per liter Total Phosphate expressed as Phosphorous
MOC	Management Operating Contractor
MSL	Mean Sea Level
mV	millivolt
NA or N/A	Not Applicable or Not Analyzed
NTU	Nephelometric Turbidity Units

LIST OF ABBREVIATIONS
(CONTINUED)

ABBREVIATION	EXPLANATION
psi	pounds per square inch
SD	Standard Deviation (sample)
SHE	Standard Hydrogen Electrode
SNL	Sandia National Laboratory
T.O.N.	Threshold Odor Number
ug/l	micrograms per liter
umhos/cm	micromhos per centimeter
UNC	United Nuclear Corporation
WAESD	Westinghouse Advanced Energy Systems Division
WQSP	Water Quality Sampling Program

ANNUAL WATER QUALITY DATA REPORT
FOR THE WASTE ISOLATION PILOT PLANT

1.0 INTRODUCTION

This is the fourth Annual Water Quality Data Report for the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico (Figure 1.1). The WIPP project is operated by the United States Department of Energy (DOE) for the purpose of providing a research and development facility to demonstrate the safe disposal of transuranic radioactive wastes generated by the defense activities of the United States Government. This report presents water quality data collected from January 1988 through December 1988 from 16 designated pre-operational (WIPP facility) monitoring wells, two additional wells, and 10 privately-owned wells in the vicinity of the WIPP. Additionally, water samples were collected from the Air Intake Shaft during shaft construction activities at the WIPP. Table 1.1 lists pertinent information regarding the monitoring wells sampled, sampling zone, dates pumped, and types of samples collected during 1988. Figure 1.2 locates the wells sampled in the WIPP vicinity during 1988.

Of the 18 wells sampled in 1988, 11 were sampled for the third time, two were sampled for the second time, and three wells were sampled for the second and third times. In 1988, two wells were sampled for the first time by the WIPP Water Quality Sampling Program (WQSP). Comparative data from previous samplings of these wells can be found in several publications: Uhland and Randall (1986), Uhland et al. (1987), Randall et al. (1988), and in Section 2.0 of this report.

In addition to the regularly scheduled WQSP monitoring wells, ten privately-owned wells were sampled in 1988. Nine of these wells provide water for live-stock and one well provides water for human consumption. Of the ten private wells sampled in 1988, one well was sampled for the third time, eight wells were sampled for the second time, and one well was sampled for the first and second times. Comparative data from previous samplings of the private wells can be found in Uhland and Randall (1986), Uhland et al. (1987), Randall et al. (1988), and in Section 3.0 of this report.

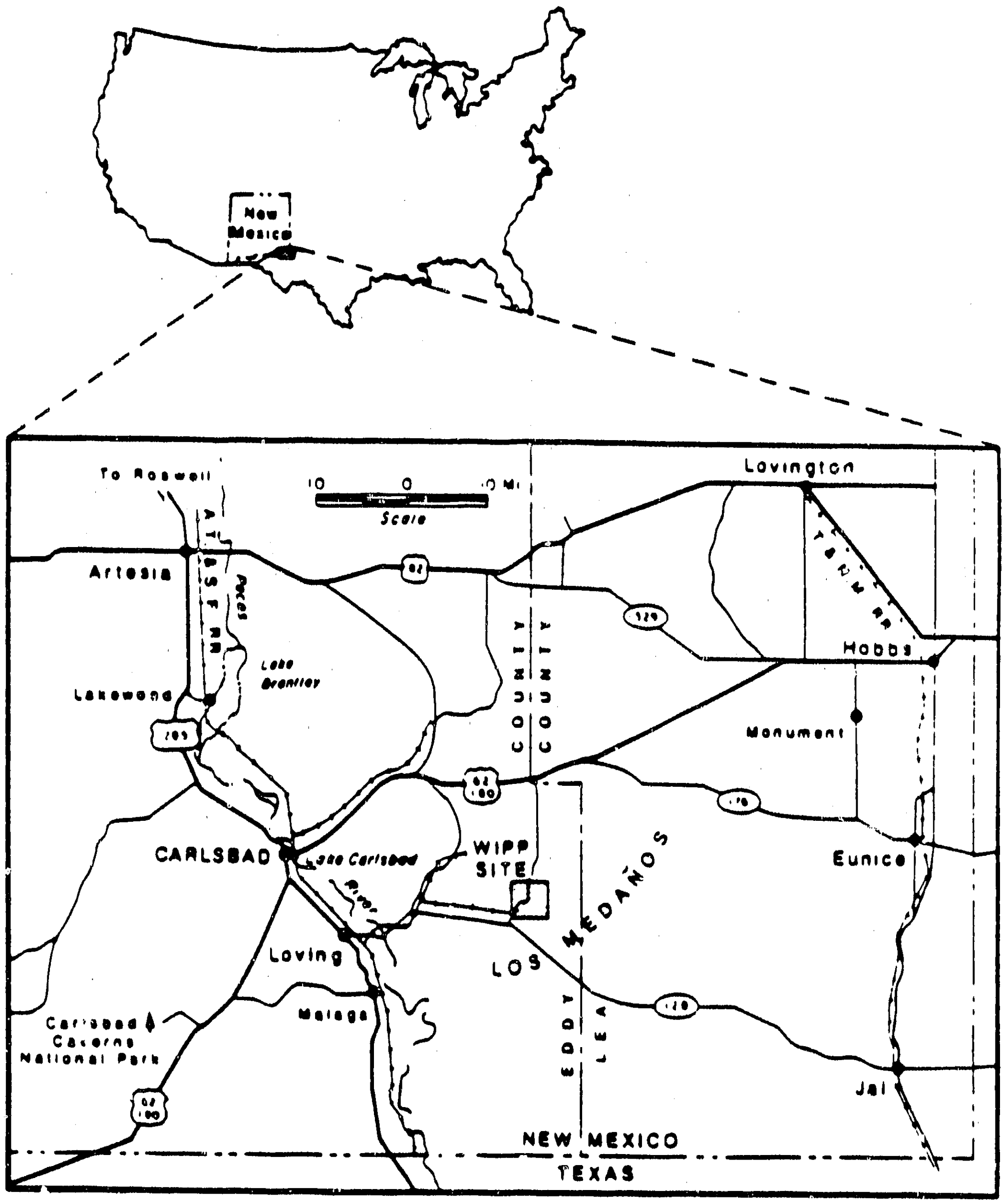


Figure 1.1. Location of the Waste Isolation Pilot Plant.

TABLE 1.1

1988 WELL SAMPLING LOG

WELL NAME	UNIT SAMPLED	ROUND	1988 DATES PUMPED	APPROXIMATE GALLONS PUMPED	FEET BTOC TO PUMP INTAKE	PUMP TYPE	SAMPLE TYPE
H-15	CULEBRA	2	01/07 - 01/13	1100	845	ADP	WQM/RBP/SNL (b)
H-14	CULEBRA	2	01/18 - 01/27	3000	535	ADP	WQM/RBP/SNL
WIPP-19	CULEBRA	2	01/26 - 02/12	3050	745	ADP	WQM/RBP/SNL
WIPP-30	CULEBRA	1	02/02 - 03/05 (a)	3000	612	ADP	SNL (c)
H-05b	CULEBRA	3	02/17 - 02/24	1450	875	ADP	WQM/RBP/SNL
H-05c	MAGENTA	2	02/24 - 03/03	1900	784	ADP	WQM/RBP/SNL
P-14	CULEBRA	3	03/08 - 03/16	5550	589	ADP	WQM/RBP/SNL
WIPP-25	CULEBRA	3	03/17 - 03/28	48000	433	ES	WQM/RBP/SNL
H-18	CULEBRA	2	02/26 - 04/07 (a)	33000	689	ES	WQM/RBP/SNL
WIPP-26	CULEBRA	3	04/05 - 04/14	9200	173	ADP	WQM/RBP/SNL (d)
H-07b1	CULEBRA	3	04/13 - 04/25	112400	198	ES	WQM/RBP/SNL (d)
DOE-2	CULEBRA	3	04/27 - 05/19	149000	821	ES	WQM/RBP/SNL (d)
H-08b	CULEBRA	3	06/01 - 06/08	4600	584	ADP	WQM/RBP/SNL
H-09b	CULEBRA	3	06/14 - 06/21	5150	634	ADP	WQM/RBP/SNL
H-04c	MAGENTA	3	07/12 - 07/19	700	358	ADP	WQM/RBP/SNL
H-06c	MAGENTA	3	07/19 - 07/26	2200	483	ADP	WQM/RBP/SNL
H-05c	MAGENTA	3	08/09 - 08/18	2500	759	ADP	WQM/RBP/SNL
WIPP-19	CULEBRA	3	08/17 - 08/29	5300	754	ADP	WQM/RBP/SNL
H-01	CULEBRA	1	09/19 - 10/07	5300	650	ADP	WQM (e)
AIS	CULEBRA		10/28		717		WQM/RBP/SNL (f)
H-15	CULEBRA	3	10/25 - 11/08	2200	850	ADP	WQM/RBP/SNL
H-12	CULEBRA	3	11/08 - 12/14	2900	808	ADP	WQM/RBP/SNL

Abbreviations:

- AIS Air intake shaft
- ADP Air driven piston
- BTOC Below top of casing
- ES Electric submersible
- RBP Radiologic Baseline Program
- SNL Sandia National Laboratories (Site Characterization Program)
- WQM Water quality monitoring

Notes:

(a) Pumping system operated by Sandia National Laboratories.
(b) No analyses for dissolved gases and redox couples.
(c) Serial sample field analyses and final sample analyses by SNL only.
(d) No analyses for dissolved gasses.
(e) Serial samples field analyses only.
(f) Values reflect date of sampling and depth location below ground surface.
Samples collected for general chemistry, inorganic constituents, and radionuclide analyses.
Samples also provided to SNL for analysis.

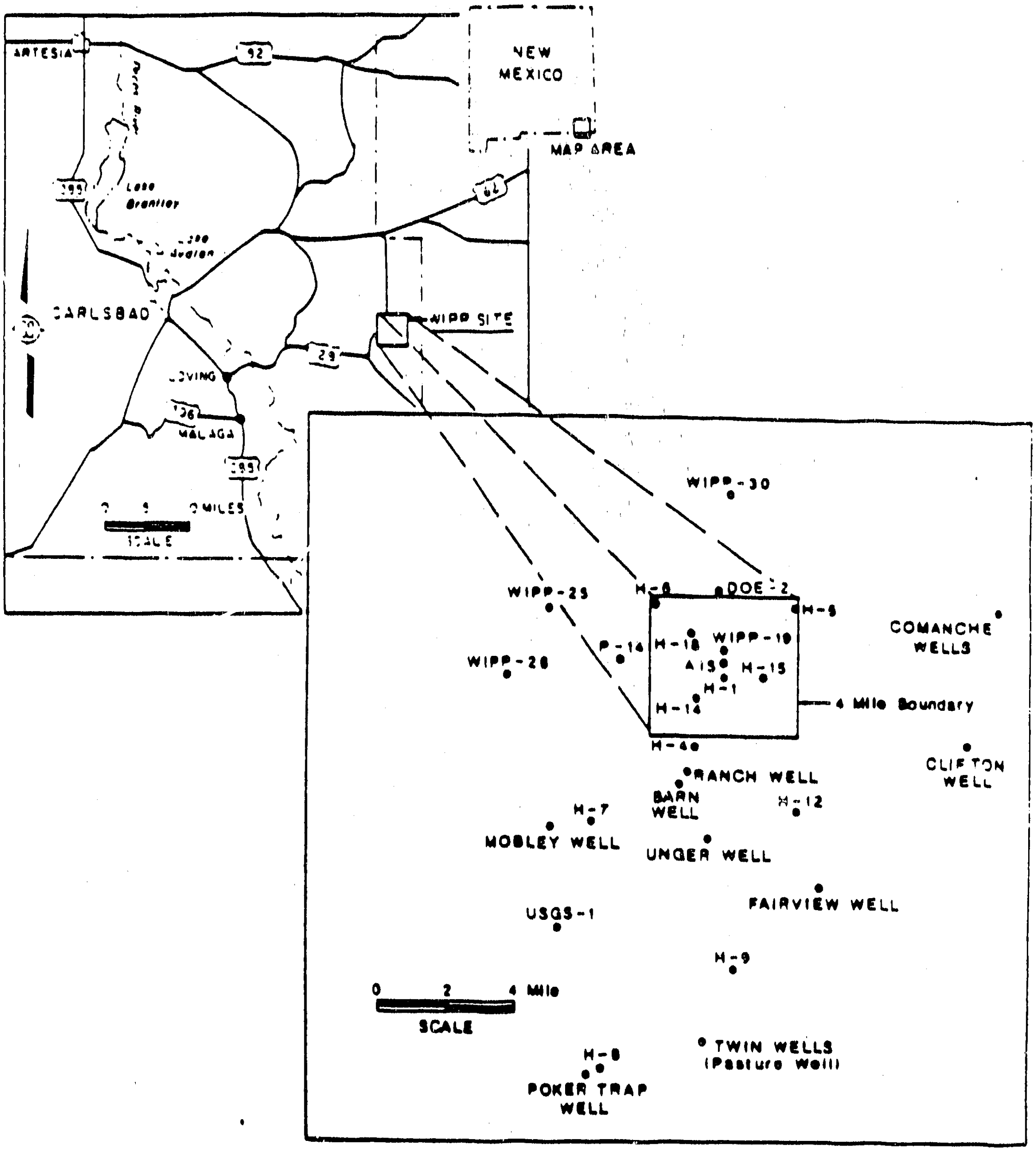


Figure 1.2. Locations of the wells near the Waste Isolation Pilot Plant that were sampled during 1988.

1.1 SAMPLING PROGRAM SCOPE

The WIPP Water Quality Sampling Program (WQSP) was initiated in January 1985. The program's goals are to collect reproducible and representative ground-water samples from water-bearing zones in the WIPP vicinity. The Waste Isolation Pilot Plant Water Quality Sampling Manual WP 7-2, Revision 1 (October 1987) was the governing document for the program in 1988. This manual details the WQSP wells to be sampled and lists the types of analyses required for the program. Procedures detailing sample collection techniques and methods for field analyses accompany WP 7-2 are located in the Waste Isolation Pilot Plant Geotechnical and Geosciences Procedure Manual.

The water quality analytical data obtained by the WQSP directly support four major programs at the WIPP. These programs include site characterization, performance assessment (compliance with 40 CFR 191), the Radiological Baseline Program, and the Ecological Monitoring Program. Additionally, the State of New Mexico Environmental Evaluation Group is provided with water samples from each sampling location for independent analysis. Each of these programs requires a unique set of analyses and data, but overlap of analytical needs does occur. The particular set of water sample analyses supporting a given program are defined by that program and not by the WQSP. A brief description of each program is given below to illustrate the role of the WQSP at the WIPP.

Site Characterization

A significant aspect of the site characterization activities conducted by Sandia National Laboratories (SNL) at the WIPP is to better understand the flow of ground water within the water-bearing units of the Rustler Formation. The WQSP provides samples to SNL for analysis of appropriate geochemical parameters to evaluate the flow regimes in the Culebra and Magenta Dolomite Members of the Rustler Formation. These rock units are considered to be the most feasible pathways for radionuclide transport in hypothetical repository breech scenarios. The understanding of the Rustler Formation is fundamentally relevant to the evaluation of the evaporite environment's ability to contain radionuclide waste for long periods of time.

Performance Assessment

The WIPP is required to comply with the Environmental Protection Agency's (EPA) Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High Level, and Transuranic Wastes (40 CFR 191). The WQSP supports this effort by providing water chemistry data which can be used for predictive modeling of the potential solubility and transport of radionuclides and nonradioactive waste components along potential flow pathways.

Radiological Baseline Program

The WQSP provides ground-water samples to the Westinghouse Advanced Energy Systems Division (WAESD) for a suite of radionuclide analyses as part of the Radiological Baseline Program at the WIPP. Results from these analyses for 1988 are published in the Annual Site Environmental Report for the Waste Isolation Pilot Plant (Flynn, 1989, in progress).

Ecological Monitoring Program

The WQSP gathers water quality data on key environmental parameters for ground water near the WIPP. The WQSP routinely has formation waters analyzed for general chemistry parameters, metals, and EPA listed organic hazardous substances. The volume of water quality data generated requires its reporting in Sections 2.0 and 3.0 of this report, although a summary of the WQSP participation in the Ecological Monitoring Program is also contained in Flynn (1989), in progress.

1.2 GEOLOGICAL SETTING

The WIPP is located within the Pecos Valley section of the Southern Great Plains physiographic province (Powers et al., 1978). Geologically, the WIPP is located in the northern portion of the Delaware Basin, the westernmost basin of the sedimentary basins collectively known as the Permian Basin.

The northern Delaware Basin is bounded by the Capitan Limestone, a Permian Age reef complex which is the only major source of potable ground water in the basin. Interior to the basin, and in the WIPP vicinity, eight rock units make up the stratigraphic column (Figure 1.3). These eight rock units are important to the hydrology at the WIPP. In ascending order, these units are the Delaware Mountain Group (consisting of the Brushy Canyon, Cherry Canyon, and

<table>
<tr><th>SYSTEM</th><th>SERIES</th><th>GROUP</th><th>FORMATION</th><th>MEMBER</th></tr>
<tr><td>RECENT</td><td>RECENT</td><td rowspan="3"></td><td>SURFICIAL DEPOSITS</td><td rowspan="3"></td></tr>
<tr><td rowspan="2">QUATERNARY</td><td rowspan="2">PLEISTOCENE</td><td>MESCALERO CALICHE</td></tr>
<tr><td>GATUNA</td></tr>
<tr><td>TRIASSIC</td><td></td><td>DOCKUM</td><td>UNDIVIDED</td><td></td></tr>
<tr><td rowspan="13">PERMIAN</td><td rowspan="10">OCHOAN</td><td rowspan="10"></td><td>DEWEY LAKE RED BEDS</td><td></td></tr>
<tr><td rowspan="5">RUSTLER</td><td>Forty-niner</td></tr>
<tr><td>Magenta</td></tr>
<tr><td>Tamarisk</td></tr>
<tr><td>Culebra</td></tr>
<tr><td>Unnamed</td></tr>
<tr><td rowspan="3">SALADO</td><td>Upper</td></tr>
<tr><td>McNutt</td></tr>
<tr><td>Lower</td></tr>
<tr><td>CASTILE</td><td></td></tr>
<tr><td rowspan="3">GUADALUPIAN</td><td rowspan="3">DELAWARE MOUNTAIN</td><td>BELL CANYON</td><td rowspan="3"></td></tr>
<tr><td>CHERRY CANYON</td></tr>
<tr><td>BRUSHY CANYON</td></tr>
</table>

Figure 1.3. Stratigraphic column at the Waste Isolation Pilot Plant.

Bell Canyon Formations), the Castile Formation, the Salado Formation, the Rustler Formation, the Dewey Lake Red Beds, and the Triassic Dockum Group. See Figure 1.4 for a generalized geologic cross section in the WIPP vicinity.

The formations producing sufficient water for sampling at some locations and that are of interest to the WQSP include, in descending order, the Dockum Group, the Dewey Lake Red Beds, the Magenta Dolomite, and the Culebra Dolomite. Fluids were collected from these formations by the WQSP in 1988, either via WQSP monitoring wells or privately-owned wells. A brief description of these geological formations and their hydrology follows below.

The Dockum Group is present east of the WIPP and consists of a fine- to coarse-grained sandstone with interbeds of siltstone and mudstone. Thickness of the formation varies up to 176 feet. Where it is present, the formation overlies the Dewey Lake Red Beds, is itself overlain by surface deposits or unsaturated Dockum Group sediments, and contains water under water table to confined conditions (Nicholson and Clebsch, 1961). The WQSP sampled two privately-owned wells believed to be completed in the Dockum Group during 1988.

The Dewey Lake Red Beds are composed of alternating thin, even beds of siltstone and mudstone with lenticular interbeds of fine-grained sandstone. Exploratory drilling did not identify a continuous zone of saturation within the Dewey Lake Red Beds; however, localized permeable zones were detected. A few private wells (Barn, Ranch, Fairview, Unger, and Twin) yield water from the Dewey Lake Red Beds, and those wells are thought to be completed in the thin lenticular sands where local ground-water recharge occurs (Mercer, 1983). The WQSP sampled several private wells producing from the Dewey Lake Red Beds in 1988.

The Rustler Formation underlies the Dewey Lake Red Beds. The Rustler Formation consists of interbedded anhydrite, gypsum, halite, polyhalite, dolomite, and limestone. The Rustler Formation is divided into five lithologic units. These units are, in descending order, the Forty-niner Member, the Magenta Dolomite Member, the Tamarisk Member, the Culebra Dolomite Member, and an unnamed lower member consisting of reddish-brown siltstone interbedded with

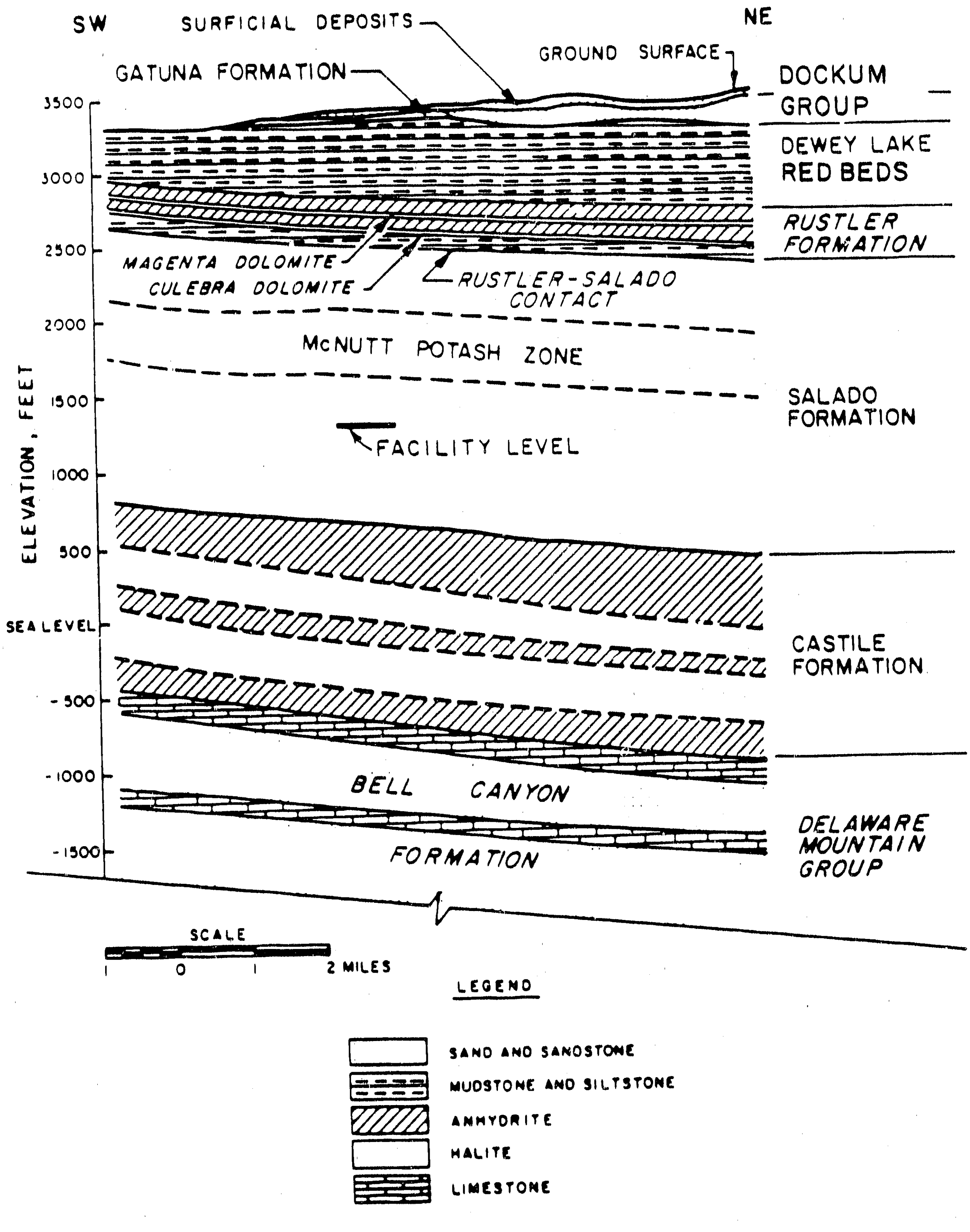


Figure 1.4. Generalized stratigraphic cross section Waste Isolation Pilot Plant vicinity.

gypsum or anhydrite, and halite. The Forty-niner and Tamarisk Members are primarily anhydrite, interbedded claystone, some halite, and potash minerals. The Magenta and Culebra Dolomites are areally extensive and are the significant water-bearing units in the WIPP vicinity. The majority of the WQSP water samples collected during 1988 were from the Culebra Dolomite, with some from the Magenta Dolomite.

The Magenta Dolomite is a clastic carbonate bed with thin laminae of anhydrite. The unit ranges in thickness from 20 to 30 feet in the WIPP vicinity. Water under confined conditions was sampled in three wells from the Magenta Dolomite by the WQSP in 1988.

The majority of the waters sampled by the WQSP in 1988 were from the Culebra Dolomite Member of the Rustler Formation. The Culebra Dolomite is the first continuous water-bearing unit above the Salado Formation (waste facility horizon) and is the most transmissive hydrologic unit in the WIPP area. In the WIPP vicinity, the Culebra Dolomite ranges from 25 to 30 feet in thickness and is a vuggy, finely crystalline dolomite (Mercer, 1983). The formation contains water of variable density ranging from brackish to brine under confined conditions. Testing has shown the Culebra Dolomite to be a heterogeneous, fractured unit with transmissivities varying locally from 7×10^{-2} to greater than 1000 feet^2 per day (Mercer, 1983). The greater transmissivity values in the Culebra have been reported from well locations south and west of the WIPP. In this area, the Culebra fluids exhibit relatively low concentrations of total dissolved solids. In areas lying east of the WIPP, transmissivities in the Culebra are quite low and fluid samples show high concentrations of total dissolved solids. Crawley, 1988 utilized a potentiometric contour map, derived from measured formation pressures in WIPP vicinity wells, to plot regional ground-water flow directions over a 12 x 18 mile area surrounding the WIPP. Crawley estimated these regional flow directions to be towards the south and southeast in the Culebra Dolomite. However, since the water flow in the Culebra Dolomite is affected by fractures, variable fluid densities, and heterogeneity of the rock, the regional flow directions may have little if any relationship to localized flow paths (Crawley, 1988). Numerous reports have presented chemical data for waters from the Magenta and Culebra Dolomites including Mercer (1983), Uhland and Randall (1986), Uhland et al. (1987), Robinson (1988), and Randall et al. (1988). This report continues with the presentation of chemical water quality data for the Magenta and Culebra Dolomites from numerous wells, some having been sampled for the third time in 1988.

1.3 SAMPLING PROGRAM DESCRIPTION

The WQSP has identified approximately 23 wells for repeated sampling during the pre-operational baseline establishment period at the WIPP Additional wells have been sampled occasionally upon request of various WIPP programs. Three rounds of sampling on the 23 wells were completed by early 1989. Data from the three rounds will establish a pre-operational water quality baseline for the WIPP.

The WQSP water sampling protocol is defined by the Waste Isolation Pilot Plant Water Quality Sampling Manual WP 7-2, Revision 1 (October 1987). The sampling procedure consists of two types of sampling: serial sampling and final sampling. Serial sampling is the sequential sampling and field analysis of representative water quality parameters while the well is being continuously pumped. Serial sampling is performed to ascertain when steady-state conditions, in regard to the water quality parameters, are reached. Ideally, serial sampling leads to the collection of water samples representing the actual undisturbed formation water at a particular location. In practice, serial sampling leads to the collection of water samples with reproducible chemistries allowing for alterations to the local ground water by factors associated with the physical well installation and operations of downhole pumping and sampling systems At the WIPP, serial sample parameters are generally monitored on a daily frequency in a mobile field laboratory which is transported to the well location during pumping operations. The parameters most useful in identifying a steady-state condition of the water chemistry include chloride, divalent cations (hardness), and alkalinity, which are analyzed by classic wet chemistry bench methods (titrations). Also useful are determinations for total and ferrous iron content, which are made by spectrophotometric comparisons with a standard concentrations curve. Other serial sampling parameters analyzed in the field include measurements of pH, Eh, temperature, specific conductance, and specific gravity. After field analyses of the serial sampling parameters indicates that steady-state conditions are present, final samples are collected and forwarded to the contracted analytical laboratories for analysis.

Contracted laboratories which analyze the final samples for WQSP include International Technology Analytical Services (ITAS), United Nuclear Corporation (UNC) (which is contracted by both the WQSP and Sandia National Laboratories to perform analyses), and Westinghouse Advanced Energy Systems Division (WAESD). See Table 1.2 for a listing of contract laboratories and the analyses they perform. Samples from each well are also provided to the State of New Mexico Environmental Evaluation Group (EEG) for independent analysis. Results from the 1988 serial and final sampling analyses by the WQSP and contract laboratories follow in Sections 2.0 and 3.0 of this report.

TABLE 1.2

CONTRACTED ANALYTICAL LABORATORIES
WATER QUALITY ANALYSES

INTERNATIONAL TECHNOLOGY ANALYTICAL SERVICES		SANDIA NATIONAL LABORATORIES	UNITED NUCLEAR CORPORATION	ENVIRONMENTAL EVALUATION GROUP	WESTINGHOUSE ADVANCED ENERGY SYSTEMS DIVISION
GENERAL CHEMISTRY	METALS	ISOTOPES	DISSOLVED GASES	GENERAL CHEMISTRY	RADIONUCLIDES
		RADIOCARBON		RADIONUCLIDES	
ALKALINITY	ALUMINUM	MAJOR IONS	ARGON		Am-241
BROMIDE	ANTIMONY	TRACE ELEMENTS	OXYGEN		Am-243
CHLORIDE	ARSENIC		NITROGEN		Cm-244
CYANIDE	BARIUM		CARBON MONOXIDE		Co-60
FLUORIDE	BERYLLIUM		CARBON DIOXIDE		Cs-137
IODIDE	BORON		METHANE		H-3
NITRATE	CADMIUM		ETHANE		K-40
pH	CALCIUM		C-3		Np-237
PHENOLICS	CESIUM		C-4		Pu-238
PHOSPHATE, TOTAL	CHROMIUM		C-5		Pu-239/Pu-240
FILTERABLE RESIDUE	COBALT		C-6		Pu-241
NONFILTERABLE RESIDUE	COPPER		SUM OF CO2		Pu-242
SPECIFIC CONDUCTANCE	IRON		TOTAL GAS		Ra-226
SULFATE	LEAD				Ra-228
TOTAL ORGANIC CARBON	LITHIUM		REDOX COUPLES		Sr-90/Yt-90
TOTAL ORGANIC HALOGEN	MAGNESIUM				Th-228
	MERCURY		AMMONIA		Th-230
ORGANIC COUMPOUNDS	MOLYBDENUM		NITRATE		Th-232
	NICKEL		TOTAL IRON		U-233
VOLATILE HAZARDOUS	POTASSIUM		FERROUS IRON		U-234
SUBSTANCE LIST	SELENIUM		ARSENIC III		U-235
SEMIVOLATILE HAZARDOUS	SILICA		TOTAL ARSENIC		U-238
SUBSTANCE LIST	SILVER		SELENIUM IV		
PCB	SODIUM		TOTAL SELENIUM		
	STRONTIUM		IODIDE		
	THALLIUM		IODATE		
	TITANIUM				
	VANADIUM				
	ZINC				

2.0 WATER QUALITY DATA

Data from 18 wells (21 sampling episodes) plus data from samples collected in the WIPP Air Intake Shaft are presented in this section. A subsection for each well or sampling episode includes a summary of the sampling period, tabulation of serial sample or field chemistry data, final sample analytical data, hydrologic response to the sampling event, and figures depicting characteristics of the water chemistry and response to sampling.

The summary for each sampling period includes a description of the well characteristics, sampling process, field chemistry, physical parameter measurements, final sample collection, general observations, and field parameter comparisons with previous sampling episodes, where applicable. Serial sample data are presented in tabular format, Table 2.X.1, and include field chemical and physical parameter analyses. Final sample data are presented in tabular form, Table 2.X.2 or 2.X.3, and include chemical analyses from ITAS and UNC laboratories. Data not presented in this report include analyses by SNL or their contractors, the EEG, or radiological analyses by WAESD. Radiological analyses for WIPP vicinity ground water can be found in Flynn, ed., 1989. Table 2.X.4 lists flow rate, downhole pressures, and time measurements collected while continuously pumping the wells. Table numbers can vary because some wells have an incomplete data set due to problems encountered during the sampling episodes.

Figures in each subsection detail the water chemistry response to pumping for the serial field parameters alkalinity, chloride, divalent cations, and total and ferrous iron. These plots also depict the analytical precision of serial sampling analytical results by showing the average, sample value, and sample duplicate value for each day at each well. The final figure in each subsection graphically depicts the general water quality at each location through Stiff, pie, and Piper trilinear diagrams. The Stiff, pie, and Piper diagrams were plotted with software from Earthware, Inc. (formerly Hall Ground Water Consultants, Inc.) copyright 1985.

2.1 SUMMARY OF CULEBRA WELL H-15, ROUND TWO

Well Characteristics

Well H-15 is located approximately one mile east of the center of the WIPP site at an elevation of 3,482 feet above MSL, to the top of the casing (Gonzales, 1989). The well is completed to a depth of 900 feet BGS, with casing installed to a depth of 853 feet BGS. The bottom 47 feet of the well are completed open hole. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 861 to 883 feet BGS (Beauheim, 1987).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. The pump intake was located at 845 feet BTOC.

Pumping began on 01/07/88 and ceased on 01/13/88. Serial sampling began on 01/11/88 after approximately 900 gallons of water had been pumped from the well. The average flow rate was initially 10 gph until the morning of 01/11/88 when problems developed with the pump. Careful monitoring and adjustments to the pumping system allowed serial sampling to continue although several interruptions in pumping occurred. One serial sample was collected daily for three consecutive days. After serial sampling on 01/13/88 the pump appeared to be approaching complete failure. Consequently, final samples were collected in bulk quantity and processed for shipment the following day. Approximately 1,100 gallons of water had been pumped from the well prior to final sampling.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analyses showed alkalinity remaining between 40 and 42 mg/l (Figure 2.1.1).

Chloride content was stable at approximately 134,000 mg/l (Figure 2.1.1).

Divalent cations varied between 293 and 300 meq/l (Figure 2.1.2).

Total iron concentrations ranged from 2.99 to 3.65 mg/l over the entire sampling period. Ferrous iron concentrations increased from approximately 2.7 to 3.2 mg/l (Figure 2.1.2).

The water pH ranged between 6.9 and 7.0 SU during serial sampling.

Physical Parameters

Values for Eh ranged between 108 and 134 mV, relative to the SHE, exhibiting no distinct trend.

The water temperature varied between 14.2 and 20.4°C probably caused by the low flow rate and temperature fluctuations at the ground surface.

The water had a specific gravity of 1.153 at 21.4°C on the final day of serial sampling.

Specific conductance was reported at 225,000 umhos/cm at 25°C on the final day of serial sampling.

Final Sample Collection

Final sample collection deviated slightly from the routine procedures outlined in the WIPP Geotechnical and Geosciences Procedures Manual WP 07-230. The anticipated pump failure forced the collection of bulk samples which were then processed and prepared for shipment the following day.

Samples were collected and sent to ITAS, Sandia National Laboratories, and the EEG. Samples for full suite radionuclide analysis were sent to WAESD. Samples for dissolved gasses and redox couple analyses, usually sent to UNC analytical laboratory, were not collected. Archival samples were collected for the WIPP project.

General Observations

The water from this well was effervescent.

Some fine-grained particulate matter was observed on the 0.45-um filters employed during sampling. The amount of particulates decreased as pumping progressed.

Tabular data are presented in Tables 2.1.1, 2.1.2, and 2.1.3. These tables list results from serial sampling, ITAS laboratory analyses, and pressure versus flow data, respectively.

Figures 2.1.1 and 2.1.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.1.3 illustrates the general water quality at well H-15 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds exist below the Culebra Dolomite Member within the Rustler Formation in the vicinity of H-15 (Lappin, 1988).

<u>Serial Parameter Comparisons with the Previous Round</u>

During the round one sampling 5,300 gallons were pumped prior to final sampling compared to 1,100 gallons during round two. Problems with pumping were experienced during both rounds of sampling.

The data gathered during this round two test interval agree favorably with the previous round's serial sampling data. Most chemical parameters in round two are reported at levels identical to, or from one to four percent greater than, the round one results. Values for iron are approximately 0.5 mg/l greater for round two than for round one. Generally, most chemical parameters exhibit increasing values since the initial serial sampling during round one.

TABLE 2.1.1

SERIAL SAMPLE CHEMISTRY
H-15 CULEBRA ROUND TWO

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	40.0	40.7	mg/l	900	01/11/88
2	ALKALINITY	40.0	40.5	mg/l	1000	01/12/88
3	ALKALINITY	41.5	41.0	mg/l	1100	01/13/88
1	CHLORIDE	134000	134000	mg/l	900	01/11/88
2	CHLORIDE	134000	134000	mg/l	1000	01/12/88
3	CHLORIDE	134000	134000	mg/l	1100	01/13/88
1	DIVALENT CATIONS	298	296	meq/l	900	01/11/88
2	DIVALENT CATIONS	295	293	meq/l	1000	01/12/88
3	DIVALENT CATIONS	298	300	meq/l	1100	01/13/88
1	TOTAL IRON	3.20	2.99	mg/l	900	01/11/88
2	TOTAL IRON	3.41	3.60	mg/l	1000	01/12/88
3	TOTAL IRON	3.65	3.54	mg/l	1100	01/13/88
1	FERROUS IRON	2.74	2.65	mg/l	900	01/11/88
2	FERROUS IRON	3.08	3.13	mg/l	1000	01/12/88
3	FERROUS IRON	3.14	3.24	mg/l	1100	01/13/88
1	pH	7.0			900	01/11/88
2	pH	6.9			1000	01/12/88
3	pH	7.0			1100	01/13/88
1	Eh	121		mV	900	01/11/88
2	Eh	134		mV	1000	01/12/88
3	Eh	108		mV	1100	01/13/88
1	TEMPERATURE	18.8		C	900	01/11/88
2	TEMPERATURE	20.4		C	1000	01/12/88
3	TEMPERATURE	14.2		C	1100	01/13/88

TABLE 2.1.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	SPECIFIC GRAVITY	1.152		@ 20.2 C	900	01/11/88
3	SPECIFIC GRAVITY	1.153		@ 21.4 C	1100	01/13/88
1	SPECIFIC CONDUCTANCE	204000	@ 25 C	umhos/cm	900	01/11/88
3	SPECIFIC CONDUCTANCE	225000	@ 25 C	umhos/cm	1100	01/13/88

TABLE 2.1.2

ITAS LABORATORY RESULTS
H-15 CULEBRA ROUND TWO

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	32		mg/l	01/13/88
ALKALINITY (CO3)	0		mg/l	01/13/88
BROMIDE	99	100	mg/l	01/13/88
CHLORIDE	134000		mg/l	01/13/88
CYANIDE, TOTAL	< 0.02		mg/l	01/13/88
FLUORIDE	0.7		mg/l	01/13/88
IODIDE	< 2.0		mg/l	01/13/88
NITRATE	< 0.02		mg/l NO3-N	01/13/88
pH	6.80			01/13/88
PHENOLICS	0.039		mg/l	01/13/88
PHOSPHATE, TOTAL	< 0.01		mg/l T-PO4-P	01/13/88
RESIDUE, FILTERABLE @180 C	230000	232000	mg/l	01/13/88
RESIDUE, NONFILTERABLE @105 C	54	68	mg/l	01/13/88
SPECIFIC CONDUCTANCE	410000	405000	umhos/cm@25C	01/13/88
SULFATE	7500		mg/l	01/13/88
TOTAL ORGANIC CARBON	2.0	1.0	mg/l	01/13/88
TOTAL ORGANIC HALOGEN	2.50	2.80	mg/l	01/13/88

TABLE 2.1.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 10	< 10	< 0.1	< 0.1	mg/l	01/13/88
ANTIMONY	< 5.0	< 5.0	< 0.05	< 0.05	mg/l	01/13/88
ARSENIC	< 1.0	< 1.0	< 0.005	< 0.005	mg/l	01/13/88
BARIUM	< 0.50	< 0.50	< 0.005	< 0.005	mg/l	01/13/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	01/13/88
BORON	44	44	< 0.01	< 0.01	mg/l	01/13/88
CADMIUM	< 0.50	< 0.50	< 0.005	< 0.005	mg/l	01/13/88
CALCIUM	1400	1400			mg/l	01/13/88
CESIUM	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	01/13/88
CHROMIUM	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	01/13/88
COBALT	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	01/13/88
COPPER	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	01/13/88
IRON	3.0	3.0	< 0.01	< 0.01	mg/l	01/13/88
LEAD	< 5.0	< 5.0	< 0.05	< 0.05	mg/l	01/13/88
LITHIUM	0.80	0.80	< 0.01	< 0.01	mg/l	01/13/88
MAGNESIUM	2600	2600			mg/l	01/13/88
MANGANESE	0.60	0.60	< 0.005	< 0.005	mg/l	01/13/88
MERCURY	< 0.0020		< 0.0002	< 0.0002	mg/l	01/13/88
MOLYBDENUM	0.52	0.52	0.02	0.01	mg/l	01/13/88
NICKEL	< 3.0	< 3.0	< 0.03	< 0.03	mg/l	01/13/88
POTASSIUM	1800	1800			mg/l	01/13/88
SELENIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	01/13/88
SILICA	< 21	< 21	< 0.2	< 0.2	mg/l	01/13/88
SILVER	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	01/13/88
SODIUM	78900	78900			mg/l	01/13/88
STRONTIUM	30	31	< 0.01	< 0.01	mg/l	01/13/88
THALLIUM	< 5.0	< 5.0	< 0.005	< 0.005	mg/l	01/13/88
TITANIUM	< 3.0	< 3.0	< 0.03	< 0.03	mg/l	01/13/88
VANADIUM	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	01/13/88
ZINC	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	01/13/88

TABLE 2.1.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10		ug/l	01/13/88
BENZENE	< 5.0		< 5.0		ug/l	01/13/88
2-BUTANONE	< 10		< 10		ug/l	01/13/88
BROMOFORM	< 5.0		< 5.0		ug/l	01/13/88
CARBON DISULFIDE	< 5.0		< 5.0		ug/l	01/13/88
CARBON TETRACHLORIDE	< 5.0		< 5.0		ug/l	01/13/88
CHLOROBENZENE	< 5.0		< 5.0		ug/l	01/13/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0		ug/l	01/13/88
CHLOROETHANE	< 10		< 10		ug/l	01/13/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10		ug/l	01/13/88
CHLOROFORM	< 5.0		< 5.0		ug/l	01/13/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	01/13/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0		ug/l	01/13/88
1,1-DICHLOROETHANE	< 5.0		< 5.0		ug/l	01/13/88
1,2-DICHLOROETHANE	< 5.0		< 5.0		ug/l	01/13/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	01/13/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0		ug/l	01/13/88
ETHYLBENZENE	< 5.0		< 5.0		ug/l	01/13/88
2-HEXANONE	< 10		< 10		ug/l	01/13/88
METHYL BROMIDE	< 10		< 10		ug/l	01/13/88
METHYL CHLORIDE	< 10		< 10		ug/l	01/13/88
4-METHYL-2-PENTANONE	< 10		< 10		ug/l	01/13/88
METHYLENE CHLORIDE	< 5.0		< 5.0		ug/l	01/13/88
STYRENE	< 5.0		< 5.0		ug/l	01/13/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0		ug/l	01/13/88
TETRACHLOROETHYLENE	< 5.0		< 5.0		ug/l	01/13/88
TOLUENE	< 5.0		< 5.0		ug/l	01/13/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	01/13/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	01/13/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	01/13/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	01/13/88
TRICHLOROETHYLENE	< 5.0		< 5.0		ug/l	01/13/88
VINYL ACETATE	< 10		< 10		ug/l	01/13/88
VINYL CHLORIDE	< 10		< 10		ug/l	01/13/88
TOTAL XYLENES	< 5.0		< 5.0		ug/l	01/13/88

TABLE 2.1.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	01/13/88
ACENAPHTHYLENE	< 10		ug/l	01/13/88
ANTHRACENE	< 10		ug/l	01/13/88
BENZO(A)ANTHRACENE	< 10		ug/l	01/13/88
BENZO(A)PYRENE	< 10		ug/l	01/13/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	01/13/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	01/13/88
BENZOIC ACID	< 50		ug/l	01/13/88
BENZO(K)FLUORANTHENE	< 10		ug/l	01/13/88
BENZYL ALCOHOL	< 10		ug/l	01/13/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	01/13/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	01/13/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	01/13/88
BIS(2-ETHYLHEXYL)PHTHALATE	22		ug/l	01/13/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	01/13/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	01/13/88
4-CHLOROANILINE	< 10		ug/l	01/13/88
2-CHLORONAPHTHALENE	< 10		ug/l	01/13/88
2-CHLOROPHENOL	< 10		ug/l	01/13/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	01/13/88
CHRYSENE	< 10		ug/l	01/13/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	01/13/88
DIBENZOFURAN	< 10		ug/l	01/13/88
1,2-DICHLOROBENZENE	< 10		ug/l	01/13/88
1,3-DICHLOROBENZENE	< 10		ug/l	01/13/88
1,4-DICHLOROBENZENE	< 10		ug/l	01/13/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	01/13/88
2,4-DICHLOROPHENOL	< 10		ug/l	01/13/88
DIETHYL PHTHALATE	< 10		ug/l	01/13/88
2,4-DIMETHYLPHENOL	< 10		ug/l	01/13/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	01/13/88
2,4-DINITROPHENOL	< 50		ug/l	01/13/88
DIMETHYL PHTHALATE	< 10		ug/l	01/13/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	01/13/88
2,4-DINITROTOLUENE	< 10		ug/l	01/13/88
2,6-DINITROTOLUENE	< 10		ug/l	01/13/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	01/13/88

TABLE 2.1.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	(10		ug/l	01/13/88
FLUORENE	(10		ug/l	01/13/88
HEXACHLOROBENZENE	(10		ug/l	01/13/88
HEXACHLOROBUTADIENE	(10		ug/l	01/13/88
HEXACHLOROCYCLOPENTADIENE	(10		ug/l	01/13/88
HEXACHLOROETHANE	(10		ug/l	01/13/88
INDENO(1,2,3-CD)PYRENE	(10		ug/l	01/13/88
ISOPHORONE	(10		ug/l	01/13/88
2-METHYLNAPHTHALENE	(10		ug/l	01/13/88
2-METHYLPHENOL	(10		ug/l	01/13/88
4-METHYLPHENOL	(10		ug/l	01/13/88
NAPHTHALENE	(10		ug/l	01/13/88
2-NITROANILINE	(50		ug/l	01/13/88
3-NITROANILINE	(50		ug/l	01/13/88
4-NITROANILINE	(50		ug/l	01/13/88
NITROBENZENE	(10		ug/l	01/13/88
2-NITROPHENOL	(10		ug/l	01/13/88
4-NITROPHENOL	(50		ug/l	01/13/88
N-NITROSODI-N-PROPYLAMINE	(10		ug/l	01/13/88
N-NITROSODIPHENYLAMINE	(10		ug/l	01/13/88
P-CHLORO-M-CRESOL	(10		ug/l	01/13/88
PENTACHLOROPHENOL	(50		ug/l	01/13/88
PHENANTHRENE	(10		ug/l	01/13/88
PHENOL	(10		ug/l	01/13/88
PYRENE	(10		ug/l	01/13/88
1,2,4-TRICHLOROBENZENE	(10		ug/l	01/13/88
2,4,5-TRICHLOROPHENOL	(50		ug/l	01/13/88
2,4,6-TRICHLOROPHENOL	(10		ug/l	01/13/88

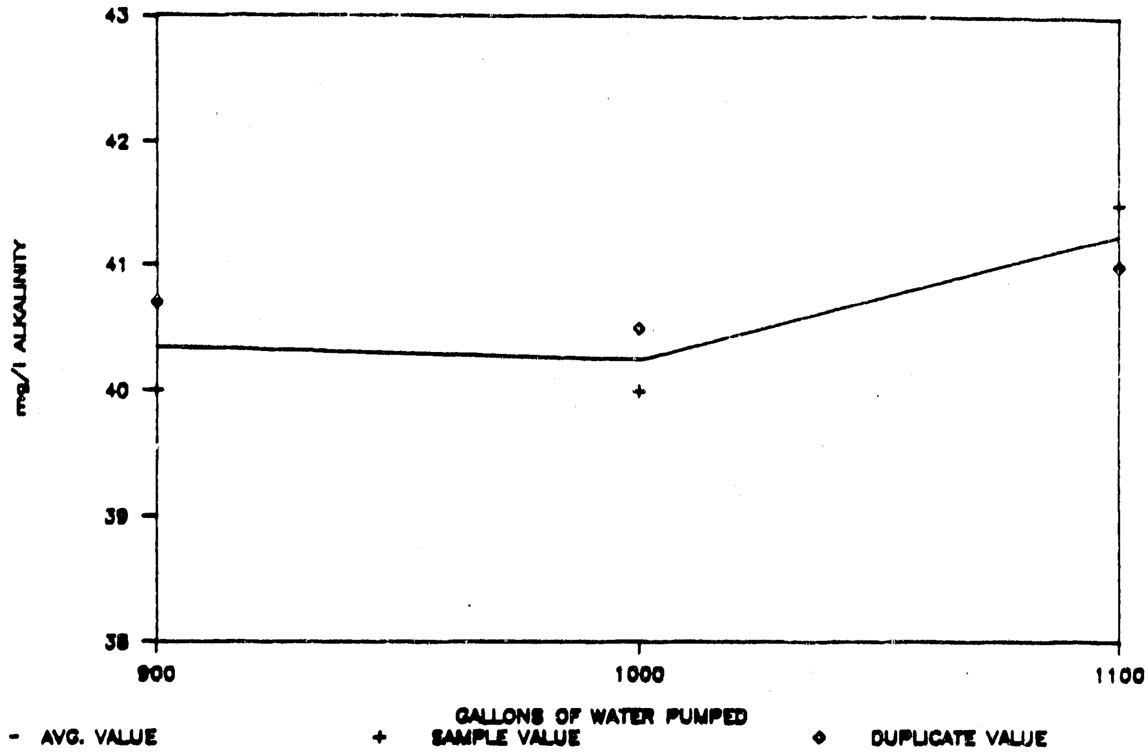
POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	(1	ug/l	01/13/88

TABLE 2.1.3

PRESSURE AND FLOW
H-15 CULEBRA ROUND TWO

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
01/07/88	14:44	136	163	00	PUMP OFF/PACKER DEFLATED
01/07/88	14:59	137	158	00	PACKER INFLATED/PUMP OFF
01/07/88	15:07	136	135	30	PUMP STARTED 15:05
01/07/88	15:09	137	117	28	
01/07/88	15:17	136	85	17	FLOW DECREASED 15:12
01/07/88	15:22	136	75	15	
01/07/88	15:27	136	67	14	
01/07/88	15:33	136	49	12	REDUCE FLOW RATE
01/07/88	15:39	136	58	10	REDUCE FLOW RATE
01/07/88	15:43	136	73	08	INCREASE FLOW RATE
01/07/88	15:45	136	67	10	
01/07/88	15:55	136	61	10	
01/07/88	16:04	136	44	10	
01/07/88	16:30	136	60	10	
01/07/88	17:30	136	58	10	
01/08/88	07:30	135	43	09	
01/08/88	12:00	135	20	11	
01/08/88	14:00	135	08	10	REDUCE FLOW 08 GPH
01/08/88	15:30	135	47	08	
01/09/88	10:00	135	38	08	
01/09/88	18:30	135	53	08	
01/10/88	08:00	135	49	07	
01/10/88	17:30	134	31	08	
01/11/88	07:15	134	45	08	
01/11/88	08:57	134	62	10	FLOW RATE LOST 08:35
01/11/88	14:30	134	54	07	
01/11/88	15:30	134	46	07	
01/12/88	07:45	134	101	12	FLOW RATE RESTORED 07:33
01/12/88	08:35	134	30	09	
01/12/88	14:00	134	28	08	
01/12/88	15:30	134	44	08	
01/13/88	07:45	134	141	15	FLOW RATE RESTORED 07:40
01/13/88	08:05	134	58	11	
01/13/88	08:45	134	78	12	FLOW RATE RESTORED
01/13/88	09:03	134	93	15	FLOW RATE RESTORED
01/13/88	10:03	134	110	12	FLOW RESTORED
01/13/88	15:30	134	132	00	FLOW INTERMITTANT
01/13/88	17:30	134	11	10	PUMP OFF 17:45
01/14/88	08:20	134	144	00	LOGGING OFF 08:21



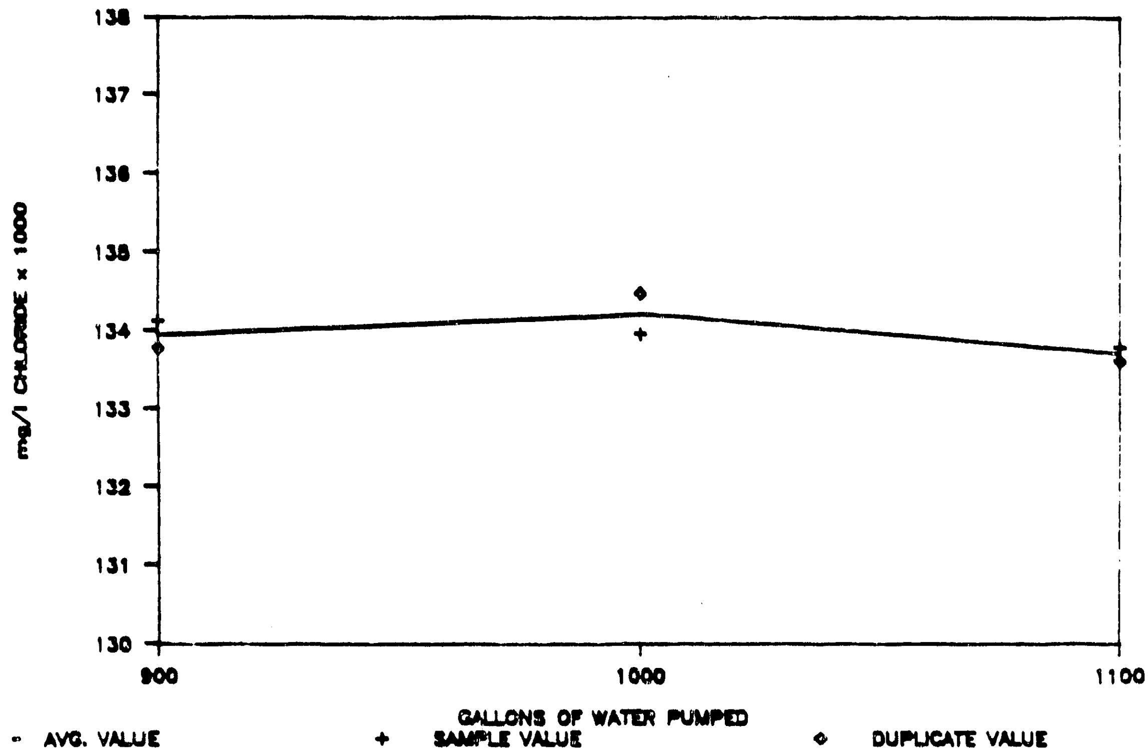
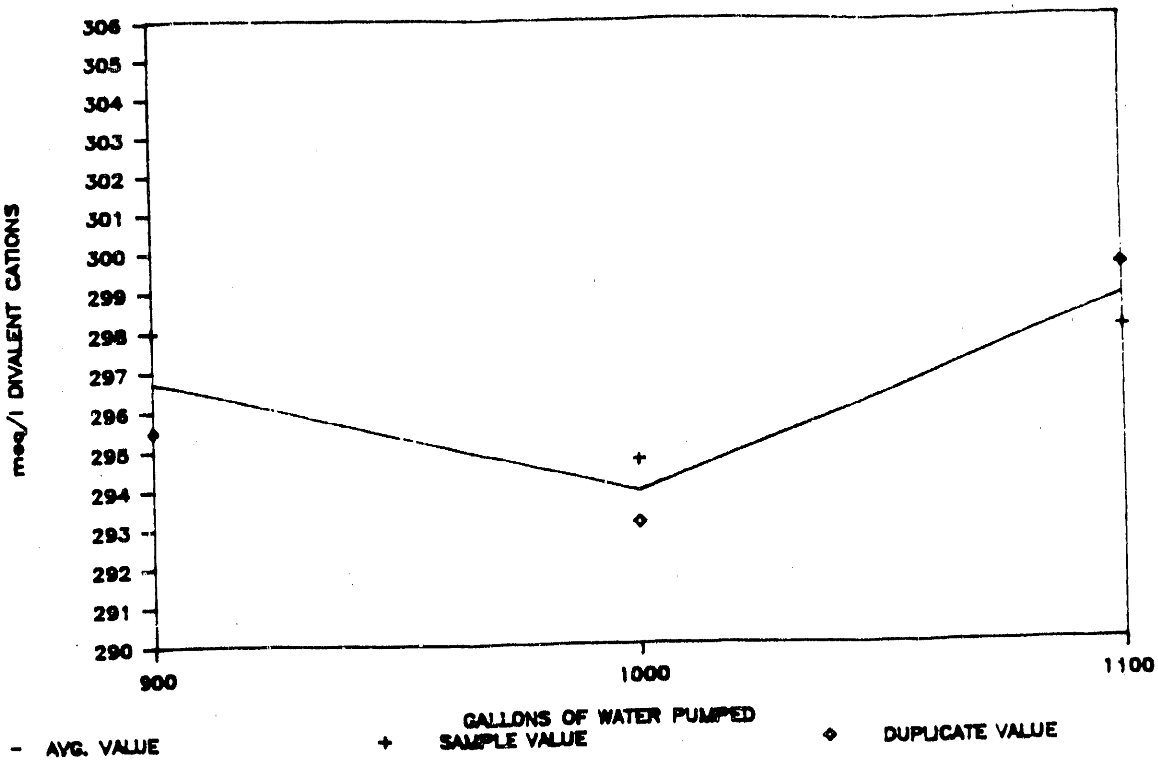


Figure 2.1.1. Graphs of alkalinity and chloride from second round serial sampling at well H-15 Culebra.



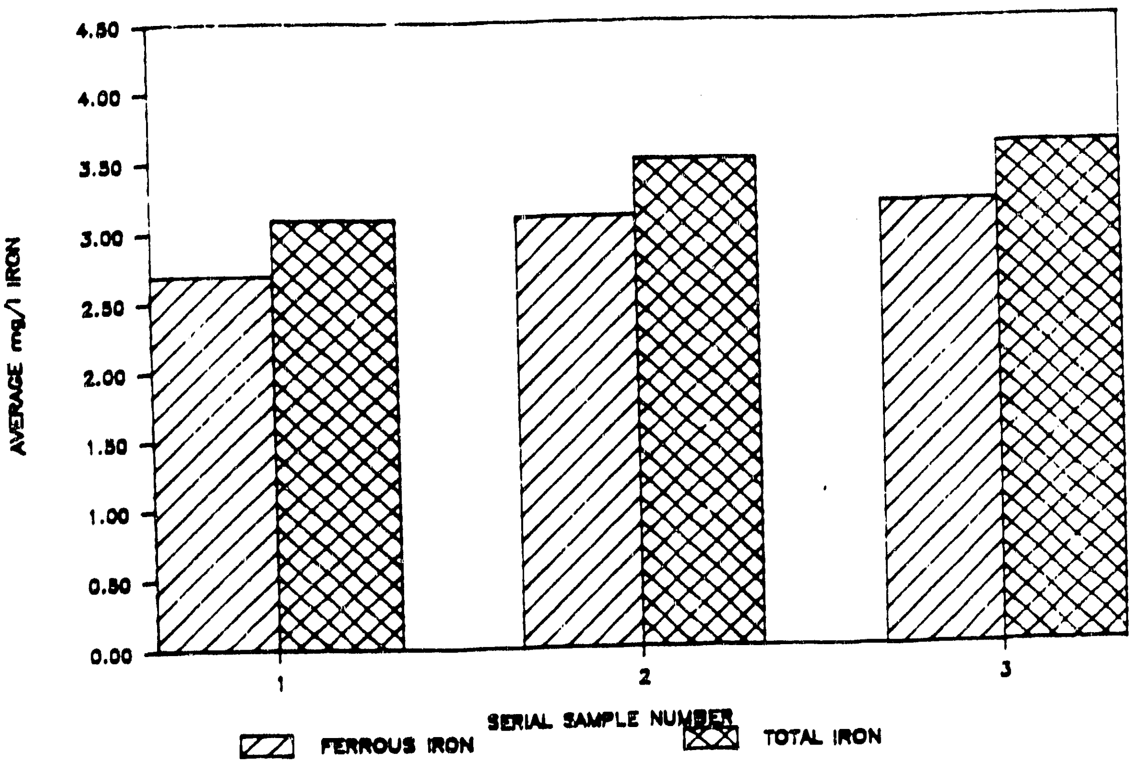


Figure 2.1.2. Graphs of divalent cations and iron from second round serial sampling at well H-15 Culebra.

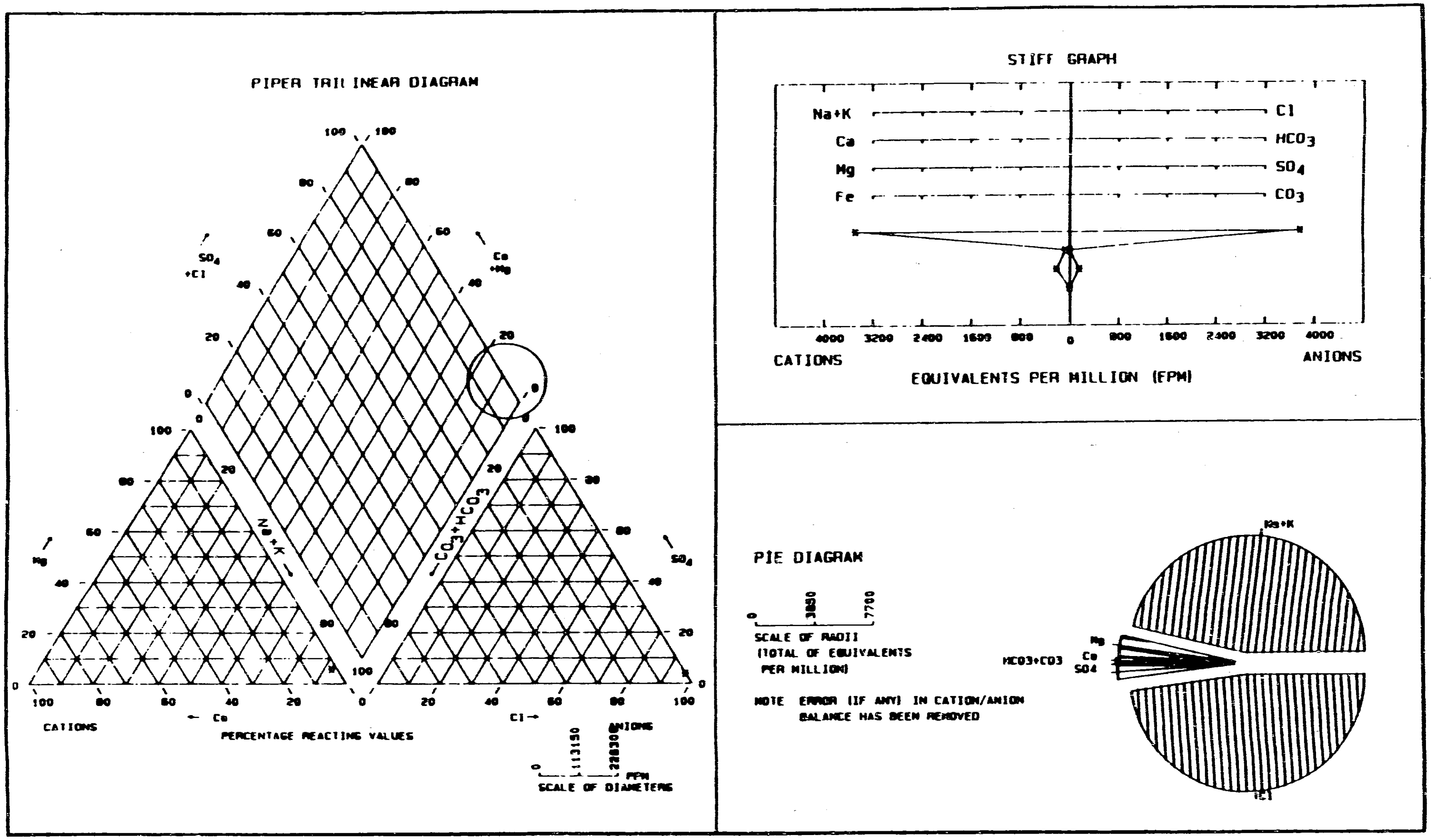


Figure 2.1.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from second round serial sampling at well H-15 Culebra.

2.2 SUMMARY OF CULEBRA WELL H-14, ROUND TWO

Well Characteristics

Well H-14 is located approximately 1.3 miles southwest of the center of the WIPP site at an elevation of 3,347 feet above MSL, to the top of the casing (Gonzales, 1989). The well is completed to a depth of 589 feet BGS, with casing extending 532 feet BGS. The remaining 57 feet are open hole. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 545 to 571 feet BGS (Beauheim, 1987).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. The pump intake was set at a depth of 535 feet BTOC.

Pumping began on 01/18/88 and ceased on 01/27/88. The average flow rate was approximately 14 gph for the sampling period. Serial sampling began on 01/21/88 after approximately 1,000 gallons of water had been pumped from the well. One serial sample was taken daily for seven consecutive days. Serial sampling ended and final samples were collected on 01/27/88, after pumping approximately 3,000 gallons of water.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analyses showed alkalinity decreasing slightly from approximately 39 to 37 mg/l (Figure 2.2.1).

Chloride content was reported between 8,700 and 8,500 mg/l (Figure 2.2.1).

Divalent cations concentrations were nearly constant at approximately 130 meq/l (Figure 2.2.2).

Total iron concentration decreased gradually from approximately 0.3 to 0.2 mg/l over the sampling period. Ferrous iron followed a trend similar to total iron (Figure 2.2.2).

The water pH varied from 7.8 down to 7.5 SU.

Physical Parameters

The water Eh value varied between 162 and 192 mV relative to the SHE.

The average water temperature was 20.7°C.

Specific gravity was 1.012 at 19.7°C on the final day of serial sampling.

Specific conductance was approximately 27,000 umhos/cm at 25°C during the sampling period.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were taken following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from this well was only slightly effervescent.

Some fine-grained particulate matter was observed on the 0.45-um filters employed during sampling. The amount of particulates decreased as pumping progressed.

Tabular data are presented in Tables 2.2.1, 2.2.2, 2.2.3, and 2.2.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.2.1 and 2.2.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.2.3 illustrates the general water quality at well H-14 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds exist below the Culebra Dolomite within the Rustler Formation in the vicinity of well H-14 (Lappin, 1988).

No problems were encountered during the sampling of well H-14.

Serial Parameter Comparisons With The Previous Round

Selected serial sampling data from round one are closely reproduced by the round two sampling results. Analytical results for alkalinity, chloride, and divalent cations are within a few percent of agreement for the final day of sampling during each round. Values for total and ferrous iron are lower in round two. Eh values are significantly greater for round two, approximately 190 versus 70 mV relative to the SHE, than for round one. All other measured parameters remained virtually unchanged.

The volume of water pumped during this round two sampling episode was 400 gallons greater than that for round one. Flow rates varied slightly between the rounds, averaging 14 gph for round two and 16 gph during round one.

TABLE 2.2.1

SERIAL SAMPLE CHEMISTRY
H-14 CULEBRA ROUND TWO

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	39.3	39.1	mg/l	1000	01/21/88
2	ALKALINITY	38.1	38.6	mg/l	1300	01/22/88
3	ALKALINITY	38.8	38.1	mg/l	1600	01/23/88
4	ALKALINITY	37.0	36.7	mg/l	1950	01/24/88
5	ALKALINITY	37.2	36.9	mg/l	2350	01/25/88
6	ALKALINITY	37.6	37.8	mg/l	2700	01/26/88
7	ALKALINITY	36.9	37.1	mg/l	3000	01/27/88
1	CHLORIDE	8680	8660	mg/l	1000	01/21/88
2	CHLORIDE	8610	8640	mg/l	1300	01/22/88
3	CHLORIDE	8680	8690	mg/l	1600	01/23/88
4	CHLORIDE	8620	8590	mg/l	1950	01/24/88
5	CHLORIDE	8590	8590	mg/l	2350	01/25/88
6	CHLORIDE	8570	8640	mg/l	2700	01/26/88
7	CHLORIDE	8520	8500	mg/l	3000	01/27/88
1	DIVALENT CATIONS	129	130	meq/l	1000	01/21/88
2	DIVALENT CATIONS	130	129	meq/l	1300	01/22/88
3	DIVALENT CATIONS	129	130	meq/l	1600	01/23/88
4	DIVALENT CATIONS	130	129	meq/l	1950	01/24/88
5	DIVALENT CATIONS	130	129	meq/l	2350	01/25/88
6	DIVALENT CATIONS	129	129	meq/l	2700	01/26/88
7	DIVALENT CATIONS	129	130	meq/l	3000	01/27/88
1	TOTAL IRON	0.33	0.32	mg/l	1000	01/21/88
2	TOTAL IRON	0.28	0.30	mg/l	1300	01/22/88
3	TOTAL IRON	0.25	0.23	mg/l	1600	01/23/88
4	TOTAL IRON	0.19	0.18	mg/l	1950	01/24/88
5	TOTAL IRON	0.16	0.14	mg/l	2350	01/25/88
6	TOTAL IRON	0.11	0.11	mg/l	2700	01/26/88
7	TOTAL IRON	0.16	0.16	mg/l	3000	01/27/88
1	FERROUS IRON	0.25	0.24	mg/l	1000	01/21/88
2	FERROUS IRON	0.21	0.21	mg/l	1300	01/22/88
3	FERROUS IRON	0.19	0.16	mg/l	1600	01/23/88
4	FERROUS IRON	0.16	0.16	mg/l	1950	01/24/88
5	FERROUS IRON	0.10	0.11	mg/l	2350	01/25/88
6	FERROUS IRON	0.08	0.09	mg/l	2700	01/26/88
7	FERROUS IRON	0.09	0.09	mg/l	3000	01/27/88

TABLE 2.2.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	7.8			1000	01/21/88
2	pH	7.7			1300	01/22/88
4	pH	7.5			1950	01/24/88
5	pH	7.6			2350	01/25/88
6	pH	7.6			2700	01/26/88
7	pH	7.6			3000	01/27/88
1	Eh	167		mV	1000	01/21/88
2	Eh	162		mV	1300	01/22/88
4	Eh	175		mV	1950	01/24/88
5	Eh	181		mV	2350	01/25/88
6	Eh	190		mV	2700	01/26/88
7	Eh	192		mV	3000	01/27/88
1	TEMPERATURE	20.5		C	1000	01/21/88
2	TEMPERATURE	20.5		C	1300	01/22/88
4	TEMPERATURE	20.4		C	1950	01/24/88
5	TEMPERATURE	20.7		C	2350	01/25/88
6	TEMPERATURE	21.0		C	2700	01/26/88
7	TEMPERATURE	20.8		C	3000	01/27/88
1	SPECIFIC GRAVITY	1.012		@ 18.8 C	1000	01/21/88
3	SPECIFIC GRAVITY	1.012		@ 19.9 C	1600	01/23/88
7	SPECIFIC GRAVITY	1.012		@ 19.7 C	3000	01/27/88
1	SPECIFIC CONDUCTANCE	27500	@ 25 C	umhos/cm	1000	01/21/88
7	SPECIFIC CONDUCTANCE	27200	@ 25 C	umhos/cm	3000	01/27/88

TABLE 2.2.2

ITAS LABORATORY RESULTS
H-14 CULEBRA ROUND TWO

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	39		mg/l	01/27/88
ALKALINITY (CO3)	0		mg/l	01/27/88
BROMIDE	11	11	mg/l	01/27/88
CHLORIDE	7900		mg/l	01/27/88
CYANIDE, TOTAL	< 0.02		mg/l	01/27/88
FLUORIDE	1.6		mg/l	01/27/88
IODIDE	< 2.0	< 2.0	mg/l	01/27/88
NITRATE	< 0.02		mg/l NO3-N	01/27/88
pH	6.54	6.65		01/27/88
PHENOLICS	0.090		mg/l	01/27/88
PHOSPHATE, TOTAL	< 0.01		mg/l T-PO4-P	01/27/88
RESIDUE, FILTERABLE @180 C	17200	17200	mg/l	01/27/88
RESIDUE, NONFILTERABLE @105 C	62	60	mg/l	01/27/88
SPECIFIC CONDUCTANCE	27700	28200	umhos/cm@25C	01/27/88
SULFATE	1900		mg/l	01/27/88
TOTAL ORGANIC CARBON	2.0	2.0	mg/l	01/27/88
TOTAL ORGANIC HALOGEN	1.20	0.98	mg/l	01/27/88

TABLE 2.2.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	01/27/88
ANTIMONY	0.60	0.60	< 0.05	< 0.05	mg/l	01/27/88
ARSENIC	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	01/27/88
BARIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	01/27/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	01/27/88
BORON	11	11	< 0.01	< 0.01	mg/l	01/27/88
CADMIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	01/27/88
CALCIUM	1700	1700			mg/l	01/27/88
CESIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	01/27/88
CHROMIUM	0.30	0.30	0.01	0.02	mg/l	01/27/88
COBALT	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	01/27/88
COPPER	0.10	0.10	< 0.01	< 0.01	mg/l	01/27/88
IRON	0.30	0.30	< 0.01	< 0.01	mg/l	01/27/88
LEAD	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	01/27/88
LITHIUM	0.44	0.44	< 0.01	< 0.01	mg/l	01/27/88
MAGNESIUM	500	500			mg/l	01/27/88
MANGANESE	0.090	0.090	< 0.005	< 0.005	mg/l	01/27/88
MERCURY	< 0.0002		< 0.0002	< 0.0002	mg/l	01/27/88
MOLYBDENUM	0.070	0.070	< 0.01	< 0.01	mg/l	01/27/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	01/27/88
POTASSIUM	240	240			mg/l	01/27/88
SELENIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	01/27/88
SILICA	14	14	< 0.2	< 0.2	mg/l	01/27/88
SILVER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	01/27/88
SODIUM	3300	3300			mg/l	01/27/88
STRONTIUM	33	33	< 0.01	< 0.01	mg/l	01/27/88
THALLIUM	< 5.0	< 5.0	< 0.005	< 0.005	mg/l	01/27/88
TITANIUM	0.50	0.50	< 0.03	< 0.03	mg/l	01/27/88
VANADIUM	0.20	0.10	< 0.01	< 0.01	mg/l	01/27/88
ZINC	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	01/27/88

TABLE 2.2.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	(10		(10		ug/l	01/27/88
BENZENE	(5.0		(5.0		ug/l	01/27/88
2-BUTANONE	(10		(10		ug/l	01/27/88
BROMOFORM	(5.0		(5.0		ug/l	01/27/88
CARBON DISULFIDE	(5.0		(5.0		ug/l	01/27/88
CARBON TETRACHLORIDE	(5.0		(5.0		ug/l	01/27/88
CHLOROBENZENE	(5.0		(5.0		ug/l	01/27/88
CHLORODIBROMOMETHANE	(5.0		(5.0		ug/l	01/27/88
CHLOROETHANE	(10		(10		ug/l	01/27/88
2-CHLOROETHYLVINYL ETHER	(10		(10		ug/l	01/27/88
CHLOROFORM	(5.0		(5.0		ug/l	01/27/88
CIS-1,3-DICHLOROPROPENE	(5.0		(5.0		ug/l	01/27/88
DICHLOROBROMOMETHANE	(5.0		(5.0		ug/l	01/27/88
1,1-DICHLOROETHANE	(5.0		(5.0		ug/l	01/27/88
1,2-DICHLOROETHANE	(5.0		(5.0		ug/l	01/27/88
1,1-DICHLOROETHYLENE	(5.0		(5.0		ug/l	01/27/88
1,2-DICHLOROPROPANE	(5.0		(5.0		ug/l	01/27/88
ETHYLBENZENE	(5.0		(5.0		ug/l	01/27/88
2-HEXANONE	(10		(10		ug/l	01/27/88
METHYL BROMIDE	(10		(10		ug/l	01/27/88
METHYL CHLORIDE	(10		(10		ug/l	01/27/88
4-METHYL-2-PENTANONE	(10		(10		ug/l	01/27/88
METHYLENE CHLORIDE	(5.0		(5.0		ug/l	01/27/88
STYRENE	(5.0		(5.0		ug/l	01/27/88
1,1,2,2-TETRACHLOROETHANE	(5.0		(5.0		ug/l	01/27/88
TETRACHLOROETHYLENE	(5.0		(5.0		ug/l	01/27/88
TOLUENE	(5.0		(5.0		ug/l	01/27/88
TRANS-1,2-DICHLOROETHYLENE	(5.0		(5.0		ug/l	01/27/88
TRANS-1,3-DICHLOROPROPENE	(5.0		(5.0		ug/l	01/27/88
1,1,1-TRICHLOROETHANE	(5.0		(5.0		ug/l	01/27/88
1,1,2-TRICHLOROETHANE	(5.0		(5.0		ug/l	01/27/88
TRICHLOROETHYLENE	(5.0		(5.0		ug/l	01/27/88
VINYL ACETATE	(10		(10		ug/l	01/27/88
VINYL CHLORIDE	(10		(10		ug/l	01/27/88
TOTAL XYLENES	(5.0		(5.0		ug/l	01/27/88

TABLE 2.2.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	01/27/88
ACENAPHTHYLENE	< 10		ug/l	01/27/88
ANTHRACENE	< 10		ug/l	01/27/88
BENZO(A)ANTHRACENE	< 10		ug/l	01/27/88
BENZO(A)PYRENE	< 10		ug/l	01/27/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	01/27/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	01/27/88
BENZOIC ACID	< 50		ug/l	01/27/88
BENZO(K)FLUORANTHENE	< 10		ug/l	01/27/88
BENZYL ALCOHOL	< 10		ug/l	01/27/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	01/27/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	01/27/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	01/27/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	01/27/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	01/27/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	01/27/88
4-CHLOROANILINE	< 10		ug/l	01/27/88
2-CHLORONAPHTHALENE	< 10		ug/l	01/27/88
2-CHLOROPHENOL	< 10		ug/l	01/27/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	01/27/88
CHRYSENE	< 10		ug/l	01/27/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	01/27/88
DIBENZOFURAN	< 10		ug/l	01/27/88
1,2-DICHLOROBENZENE	< 10		ug/l	01/27/88
1,3-DICHLOROBENZENE	< 10		ug/l	01/27/88
1,4-DICHLOROBENZENE	< 10		ug/l	01/27/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	01/27/88
2,4-DICHLOROPHENOL	< 10		ug/l	01/27/88
DIETHYL PHTHALATE	< 10		ug/l	01/27/88
2,4-DIMETHYLPHENOL	< 10		ug/l	01/27/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	01/27/88
2,4-DINITROPHENOL	< 50		ug/l	01/27/88
DIMETHYL PHTHALATE	< 10		ug/l	01/27/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	01/27/88
2,4-DINITROTOLUENE	< 10		ug/l	01/27/88
2,6-DINITROTOLUENE	< 10		ug/l	01/27/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	01/27/88

TABLE 2.2.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	01/27/88
FLUORENE	< 10		ug/l	01/27/88
HEXACHLOROBENZENE	< 10		ug/l	01/27/88
HEXACHLOROBUTADIENE	< 10		ug/l	01/27/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	01/27/88
HEXACHLOROETHANE	< 10		ug/l	01/27/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	01/27/88
ISOPHORONE	< 10		ug/l	01/27/88
2-METHYLNAPHTHALENE	< 10		ug/l	01/27/88
2-METHYLPHENOL	< 10		ug/l	01/27/88
4-METHYLPHENOL	< 10		ug/l	01/27/88
NAPHTHALENE	< 10		ug/l	01/27/88
2-NITROANILINE	< 50		ug/l	01/27/88
3-NITROANILINE	< 50		ug/l	01/27/88
4-NITROANILINE	< 50		ug/l	01/27/88
NITROBENZENE	< 10		ug/l	01/27/88
2-NITROPHENOL	< 10		ug/l	01/27/88
4-NITROPHENOL	< 10		ug/l	01/27/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	01/27/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	01/27/88
P-CHLORO-M-CRESOL	< 10		ug/l	01/27/88
PENTACHLOROPHENOL	< 50		ug/l	01/27/88
PHENANTHRENE	< 10		ug/l	01/27/88
PHENOL	< 10		ug/l	01/27/88
PYRENE	< 10		ug/l	01/27/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	01/27/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	01/27/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	01/27/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	01/27/88

TABLE 2.2.3

UNC LABORATORY ANALYSIS
H-14 CULEBRA ROUND TWO

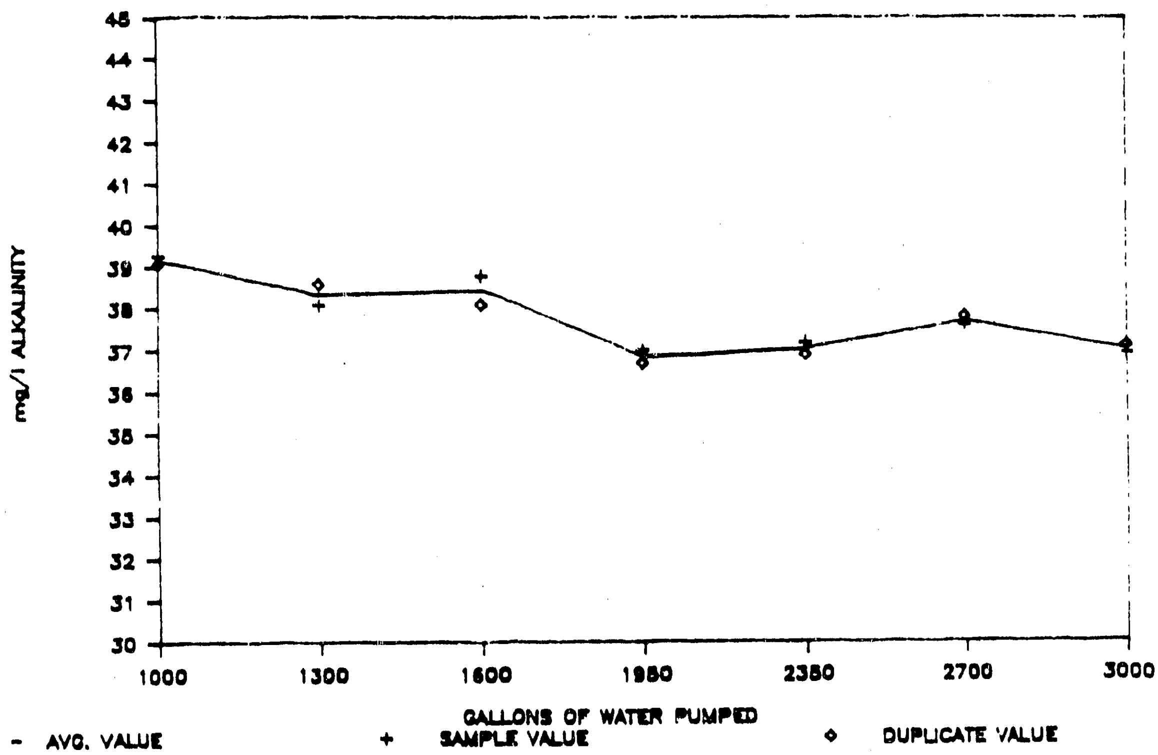
DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	0.25		cc/l (STP)	01/27/88
OXYGEN	< 0.05		cc/l (STP)	01/27/88
NITROGEN	25.94		cc/l (STP)	01/27/88
CARBON MONOXIDE	< 0.001		cc/l (STP)	01/27/88
CARBON DIOXIDE	2.780		cc/l (STP)	01/27/88
METHANE	0.130		cc/l (STP)	01/27/88
ETHANE	< 0.001		cc/l (STP)	01/27/88
C-3	< 0.001		cc/l (STP)	01/27/88
C-4	< 0.001		cc/l (STP)	01/27/88
C-5	< 0.001		cc/l (STP)	01/27/88
C-6	< 0.001		cc/l (STP)	01/27/88
SUM OF CO2	18.33		cc/l (STP)	01/27/88
TOTAL GAS	29.100		cc/l (STP)	01/27/88
AMMONIA	0.26		mg/l	01/27/88
NITRATE	< 1.00		mg/l	01/27/88
TOTAL IRON	0.250		mg/l	01/27/88
FERROUS IRON	0.20	0.20	mg/l	01/27/88
TOTAL ARSENIC	0.0030		mg/l	01/27/88
ARSENIC III	0.0020		mg/l	01/27/88
TOTAL SELENIUM	< 0.001		mg/l	01/27/88
IODIDE	70	70	ug/l	01/27/88
IODATE	< 15		ug/l	01/27/88

TABLE 2.2.4

PRESSURE AND FLOW
H-14 CULEBRA ROUND TWO

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
01/18/88	13:48	78	84	00	PACKER DEFLATED
01/18/88	14:10	78	81	00	PACKER INFLATED
01/18/88	14:12	78	34	26	PUMP ON 14:10
01/18/88	14:18	78	27	26	
01/18/88	14:22	78	32	16	FLOW RATE REDUCED
01/18/88	14:25	78	35	18	
01/18/88	15:00	78	32	15	
01/19/88	07:30	77	21	13	
01/19/88	12:30	77	20	15	
01/19/88	14:30	77	19	15	
01/20/88	08:37	77	17	15	FLOW RATE 07:50
01/20/88	15:00	77	16	15	
01/21/88	07:30	77	16	13	
01/21/88	10:00	77	19	14	FLOW RATE 09:50
01/21/88	13:30	76	21	13	FLOW RATE 13:25
01/21/88	15:00	76	20	13	
01/22/88	08:00	76	18	12	
01/22/88	15:00	76	14	14	
01/23/88	10:00	76	14	14	
01/23/88	20:35	76	13	15	PSI 20:30
01/24/88	08:00	76	13	15	
01/24/88	18:00	76	13	14	
01/25/88	07:00	75	12	14	
01/25/88	12:30	75	12	14	
01/25/88	15:30	75	13	14	
01/26/88	07:00	75	12	14	
01/26/88	12:00	75	13	14	
01/26/88	14:30	75	13	14	
01/27/88	07:00	75	13	14	
01/27/88	14:50	74	13	14	PSI 14:30
01/27/88	15:00	74	20	00	PUMP OFF 14:55
01/28/38	09:15	74	72	00	LOGGING OFF 09:20



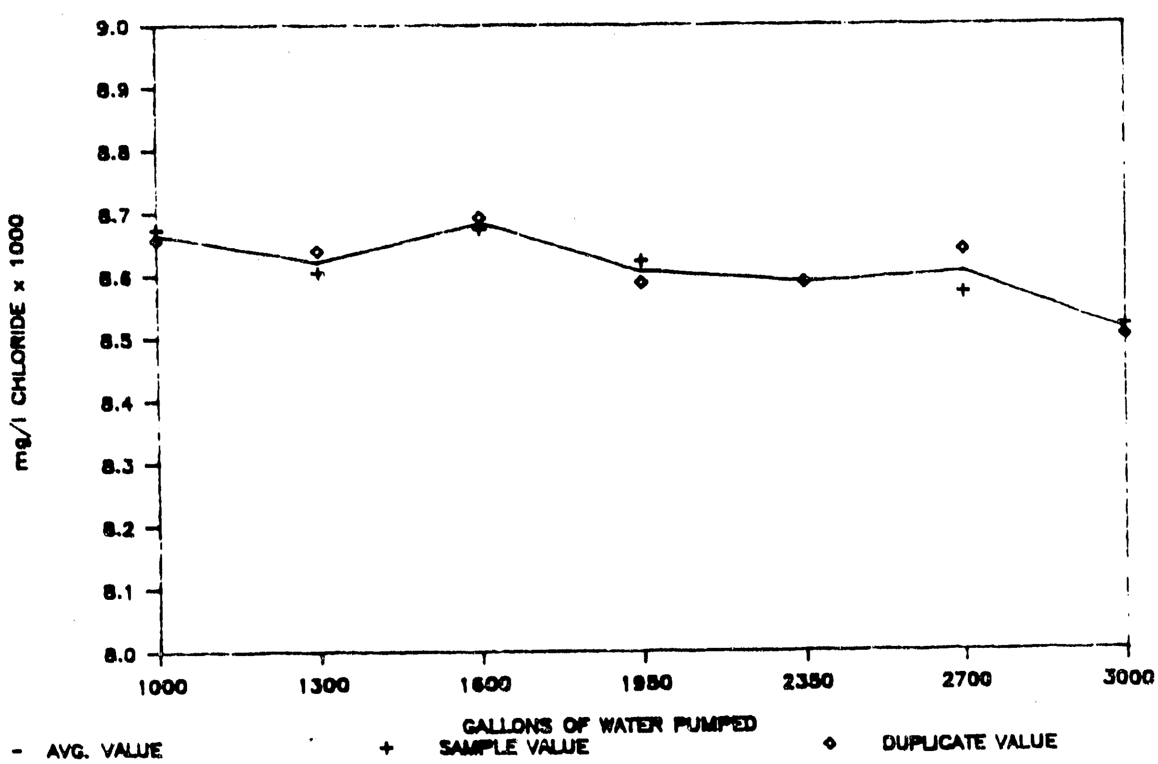


Figure 2.2.1. Graphs of alkalinity and chloride from second round serial sampling at well H-14 Culebra.

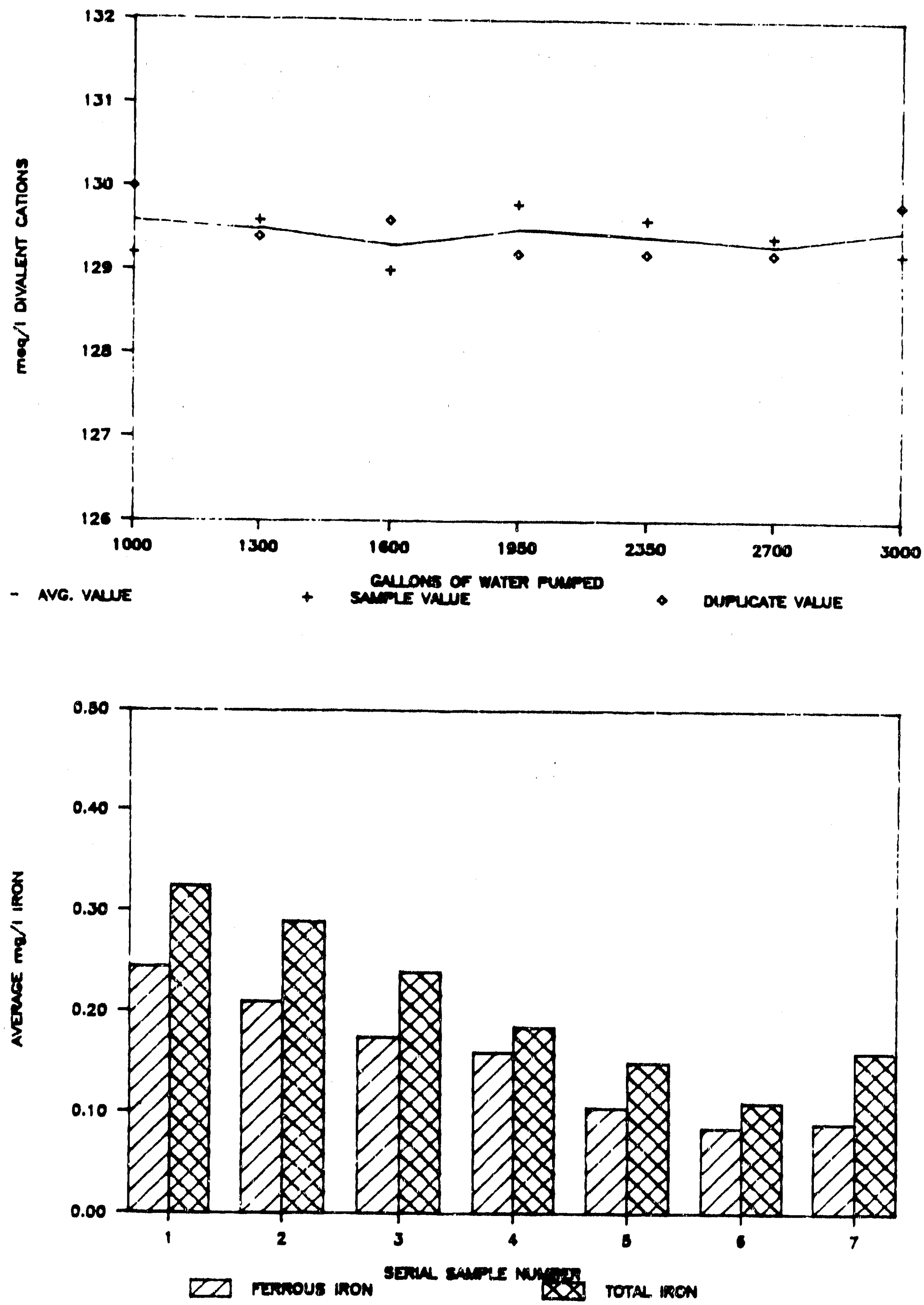


Figure 2.2.2. Graphs of divalent cations and iron from second round serial sampling at well H-14 Culebra.

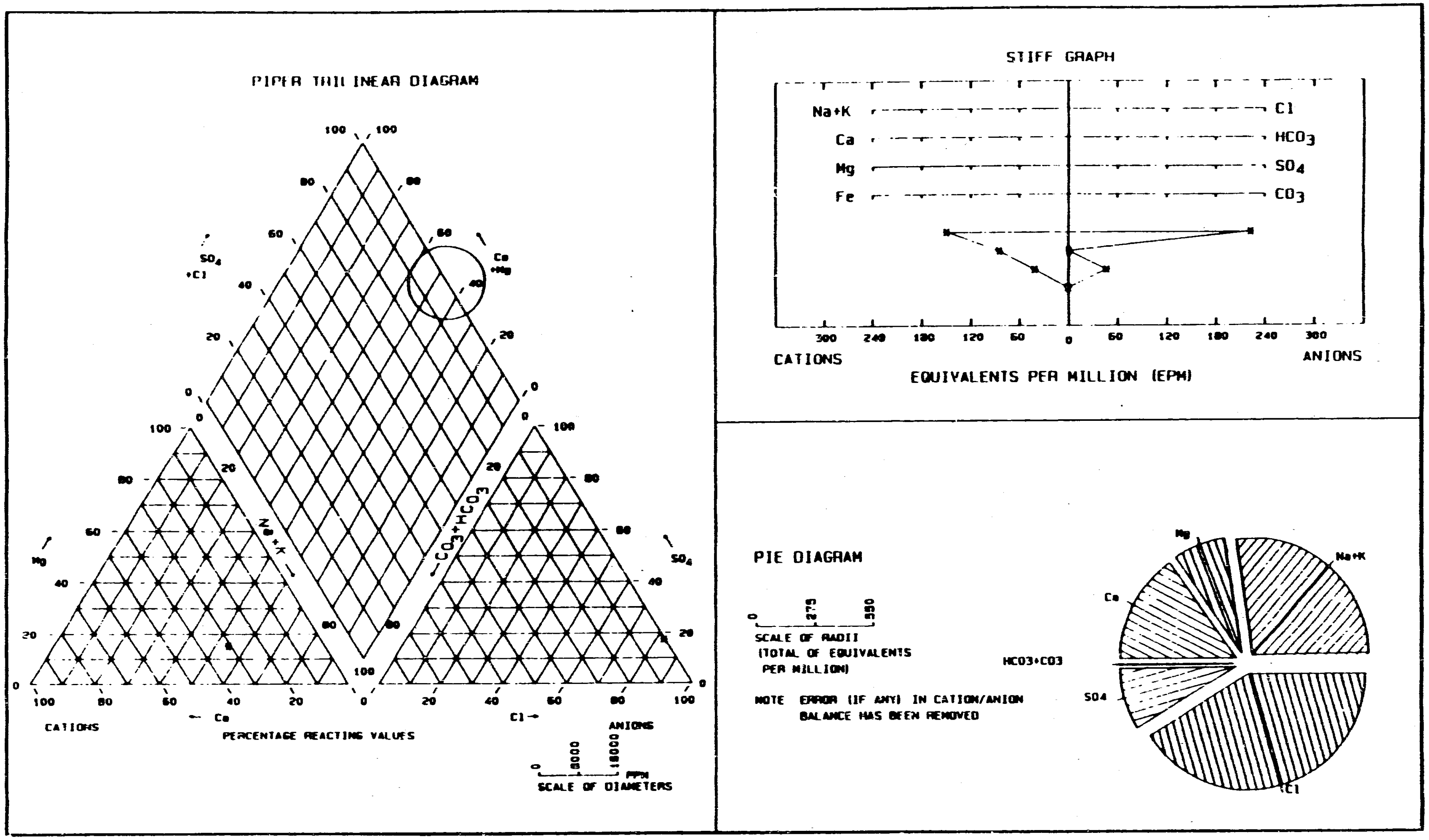


Figure 2.2.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from second round serial sampling at well H-14 Culebra.

2.3 SUMMARY OF CULEBRA WELL WIPP-19, ROUND TWO

Well Characteristics

Well WIPP-19 is located approximately 0.6 miles north of the center of the WIPP site at an elevation of 3,435 feet above MSL, to the top of the casing (Gonzales, 1989). The total depth of the drilled hole is 1,038 feet BGS. Casing is in place to a depth of 1,037 feet BGS. The casing is perforated in only one interval. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation, which occurs here at a depth interval from 756 to 779 feet BGS (Sandia Laboratories and U.S. Geological Survey, 1980a).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. The pump intake was located at 745 feet BTOC.

Pumping began on 01/26/88 and ceased on 02/12/88. Problems were experienced with the Bennett pump and tubing bundle which resulted in numerous pumping interruptions. Problems were finally resolved on 02/04/88. Steady pumping of WIPP-19 began on 02/04/88 with an average flow rate of 16.5 gph. Serial sampling began on 02/08/88 after approximately 1,550 gallons of water had been pumped from the well. One serial sample was taken each day for five consecutive days. Serial sampling ended and final samples were collected on 02/12/88 after approximately 3,050 gallons had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analyses showed alkalinity ranging between approximately 72 and 66 mg/l during the sampling period (Figure 2.3.1).

Chloride concentrations decreased slightly from approximately 50,000 to 49,000 mg/l during the serial sampling period (Figure 2.3.1).

Divalent cations averaged approximately 242 meq/l (Figure 2.3.2).

Total iron decreased from 1.67 to 1.30 mg/l during the sampling period. Ferrous iron followed a trend similar to total iron (Figure 2.3.2).

The water pH was measured between 7.1 and 7.2 SU.

Physical Parameters

Values for Eh ranged from 75 to 112 mV relative to the SHE.

The water temperature ranged from 21.1 to 21.7°C.

The specific gravity of the water decreased slightly from 1.062, at 20.6°C, to 1.061, at 21.1°C.

Specific conductance decreased slightly from 119,000 umhos/cm at 25°C on the first day, to 113,000 umhos/cm at 25°C on the final day.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were collected following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from this well was very effervescent.

Fine-grained particulate matter deposited on the 0.45-um filters employed during sampling. The filters were frequently changed.

Tabular data are presented in Tables 2.3.1, 2.3.2, 2.3.3, and 2.3.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data respectively. Figures

2.3.1 and 2.3.2 graphically depict serial sampling results and the degree of stabilization achieved.

Figure 2.3.3 illustrates the general water quality at well WIPP-19 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds occur below the Culebra Dolomite Member within the Rustler Formation at WIPP-19 (Sandia Laboratories and U.S. Geological Survey, 1980a).

Initially there were numerous problems with the sampling equipment at well WIPP-19. After establishing steady flow conditions, serial sampling proceeded and no further problems were encountered.

Serial Parameter Comparisons With The Previous Round

Concentration values for the serial sampling parameters alkalinity, chloride, divalent cations, total iron, and ferrous iron all decreased significantly between rounds one and two. For alkalinity and chloride the decrease was approximately 20%, while divalent cations decreased approximately 15 percent. Iron values decreased significantly but remained above one mg/l. Values for Eh, specific gravity, and specific conductance also decreased between rounds one and two. The water pH showed a slight increase between rounds. This change in the water quality serial parameters was accompanied by the apparent development of the well.

During round two an average flow rate of approximately 16.5 gph was maintained, while during round one an average flow rate of only 7.4 gph was maintainable. The volume of water removed from the well during round two was greater than during round one, 3,050 versus 2,400 gallons.

TABLE 2.3.1

SERIAL SAMPLE CHEMISTRY
WIPP-19 CULEBRA ROUND TWO

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	72.1	71.1	mg/l	1550	02/08/88
2	ALKALINITY	66.5	66.0	mg/l	1950	02/09/88
3	ALKALINITY	71.8	70.6	mg/l	2350	02/10/88
4	ALKALINITY	68.7	69.4	mg/l	2700	02/11/88
5	ALKALINITY	68.4	67.9	mg/l	3050	02/12/88
1	CHLORIDE	50000	49900	mg/l	1550	02/08/88
2	CHLORIDE	49500	49600	mg/l	1950	02/09/88
3	CHLORIDE	49100	49000	mg/l	2350	02/10/88
4	CHLORIDE	49200	49000	mg/l	2700	02/11/88
5	CHLORIDE	48700	48900	mg/l	3050	02/12/88
1	DIVALENT CATIONS	242	239	meq/l	1550	02/08/88
2	DIVALENT CATIONS	243	242	meq/l	1950	02/09/88
3	DIVALENT CATIONS	244	243	meq/l	2350	02/10/88
4	DIVALENT CATIONS	242	242	meq/l	2700	02/11/88
5	DIVALENT CATIONS	241	240	meq/l	3050	02/12/88
1	TOTAL IRON	1.66	1.67	mg/l	1550	02/08/88
2	TOTAL IRON	1.40	1.46	mg/l	1950	02/09/88
3	TOTAL IRON	1.65	1.55	mg/l	2350	02/10/88
4	TOTAL IRON	1.52	1.45	mg/l	2700	02/11/88
5	TOTAL IRON	1.30	1.32	mg/l	3050	02/12/88
1	FERROUS IRON	1.25	1.38	mg/l	1550	02/08/88
2	FERROUS IRON	1.32	1.29	mg/l	1950	02/09/88
3	FERROUS IRON	1.24	1.27	mg/l	2350	02/10/88
4	FERROUS IRON	1.14	1.19	mg/l	2700	02/11/88
5	FERROUS IRON	1.11	1.09	mg/l	3050	02/12/88
1	pH	7.1			1550	02/08/88
2	pH	7.1			1950	02/09/88
3	pH	7.2			2350	02/10/88
4	pH	7.1			2700	02/11/88
5	pH	7.2			3050	02/12/88

TABLE 2.3.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	Eh	92		mV	1550	02/08/88
2	Eh	75		mV	1950	02/09/88
3	Eh	92		mV	2350	02/10/88
4	Eh	97		mV	2700	02/11/88
5	Eh	112		mV	3050	02/12/88
1	TEMPERATURE	21.7		C	1550	02/08/88
2	TEMPERATURE	21.1		C	1950	02/09/88
3	TEMPERATURE	21.2		C	2350	02/10/88
4	TEMPERATURE	21.3		C	2700	02/11/88
5	TEMPERATURE	21.1		C	3050	02/12/88
1	SPECIFIC GRAVITY	1.062		@ 20.6 C	1550	02/08/88
5	SPECIFIC GRAVITY	1.061		@ 21.1 C	3050	02/12/88
1	SPECIFIC CONDUCTANCE	119000	@ 25 C	umhos/cm	1550	02/08/88
5	SPECIFIC CONDUCTANCE	113000	@ 25 C	umhos/cm	3050	02/12/88

TABLE 2.3.2

ITAS LABORATORY RESULTS
WIPP-19 CULEBRA ROUND TWO

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	58		mg/l	02/12/88
ALKALINITY (CO3)	0		mg/l	02/12/88
BROMIDE	95	94	mg/l	02/12/88
CHLORIDE	46100		mg/l	02/12/88
CYANIDE, TOTAL	< 0.01		mg/l	02/12/88
FLUORIDE	0.9		mg/l	02/12/88
IODIDE	< 2.0	< 2.0	mg/l	02/12/88
NITRATE	0.11	0.12	mg/l NO3-N	02/12/88
pH	6.67	6.76		02/12/88
PHENOLICS	< 0.005		mg/l	02/12/88
PHOSPHATE, TOTAL	< 0.01		mg/l T-PO4-P	02/12/88
RESIDUE, FILTERABLE @180 C	85400		mg/l	02/12/88
RESIDUE, NONFILTERABLE @105 C	59		mg/l	02/12/88
SPECIFIC CONDUCTANCE	158000	159000	umhos/cm@25C	02/12/88
SULFATE	5700		mg/l	02/12/88
TOTAL ORGANIC CARBON	7.0	7.0	mg/l	02/12/88
TOTAL ORGANIC HALOGEN	1.10	1.60	mg/l	02/12/88

TABLE 2.3.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 10	< 10	< 0.1	< 0.1	mg/l	02/12/88
ANTIMONY	< 5.0	< 5.0	< 0.05	< 0.05	mg/l	02/12/88
ARSENIC	< 0.50	< 0.50	< 0.005	< 0.005	mg/l	02/12/88
BARIUM	< 0.50	< 0.50	< 0.005	< 0.005	mg/l	02/12/88
BERYLLIUM	< 0.50	< 0.50	< 0.005	< 0.005	mg/l	02/12/88
BORON	30	30	< 0.01	< 0.01	mg/l	02/12/88
CADMIUM	< 0.50	< 0.50	< 0.005	< 0.005	mg/l	02/12/88
CALCIUM	1600	1600			mg/l	02/12/88
CESIUM	< 0.50	< 0.50	< 0.01	< 0.01	mg/l	02/12/88
CHROMIUM	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	02/12/88
COBALT	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	02/12/88
COPPER	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	02/12/88
IRON	1.0	1.0	< 0.01	< 0.01	mg/l	02/12/88
LEAD	1.3	1.2	< 0.01	< 0.01	mg/l	02/12/88
LITHIUM	1.0	1.0	< 0.01	< 0.01	mg/l	02/12/88
MAGNESIUM	1700	1700			mg/l	02/12/88
MANGANESE	3.1	3.1	< 0.005	< 0.005	mg/l	02/12/88
MERCURY	< 0.0002		< 0.0002	< 0.0002	mg/l	02/12/88
MOLYBDENUM	0.17	0.17	< 0.01	< 0.01	mg/l	02/12/88
NICKEL	< 3.0	< 3.0	< 0.03	< 0.03	mg/l	02/12/88
POTASSIUM	910	890			mg/l	02/12/88
SELENIUM	< 0.50	< 0.50	< 0.005	< 0.005	mg/l	02/12/88
SILICA	< 4.2				mg/l	02/12/88
SILVER	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	02/12/88
SODIUM	26500	26500			mg/l	02/12/88
STRONTIUM	35	36	< 0.01	< 0.01	mg/l	02/12/88
THALLIUM	< 0.050		< 0.005	< 0.005	mg/l	02/12/88
TITANIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	02/12/88
VANADIUM	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	02/12/88
ZINC	3.0	1.0	< 0.01	< 0.01	mg/l	02/12/88

TABLE 2.3.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	18.0		< 10		ug/l	02/12/88
BENZENE	< 5.0		< 5.0		ug/l	02/12/88
2-BUTANONE	< 10		< 10		ug/l	02/12/88
BROMOFORM	< 5.0		< 5.0		ug/l	02/12/88
CARBON DISULFIDE	< 5.0		< 5.0		ug/l	02/12/88
CARBON TETRACHLORIDE	< 5.0		< 5.0		ug/l	02/12/88
CHLOROBENZENE	< 5.0		< 5.0		ug/l	02/12/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0		ug/l	02/12/88
CHLOROETHANE	< 10		< 10		ug/l	02/12/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10		ug/l	02/12/88
CHLOROFORM	< 5.0		< 5.0		ug/l	02/12/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	02/12/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0		ug/l	02/12/88
1,1-DICHLOROETHANE	< 5.0		< 5.0		ug/l	02/12/88
1,2-DICHLOROETHANE	< 5.0		< 5.0		ug/l	02/12/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	02/12/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0		ug/l	02/12/88
ETHYLBENZENE	< 5.0		< 5.0		ug/l	02/12/88
2-HEXANONE	< 10		< 10		ug/l	02/12/88
METHYL BROMIDE	< 10		< 10		ug/l	02/12/88
METHYL CHLORIDE	< 10		< 10		ug/l	02/12/88
4-METHYL-2-PENTANONE	< 10		< 10		ug/l	02/12/88
METHYLENE CHLORIDE	< 5.0		< 5.0		ug/l	02/12/88
STYRENE	< 5.0		< 5.0		ug/l	02/12/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0		ug/l	02/12/88
TETRACHLOROETHYLENE	< 5.0		< 5.0		ug/l	02/12/88
TOLUENE	< 5.0		< 5.0		ug/l	02/12/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	02/12/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	02/12/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	02/12/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	02/12/88
TRICHLOROETHYLENE	< 5.0		< 5.0		ug/l	02/12/88
VINYL ACETATE	< 10		< 10		ug/l	02/12/88
VINYL CHLORIDE	< 10		< 10		ug/l	02/12/88
TOTAL XYLENES	< 5.0		< 5.0		ug/l	02/12/88

TABLE 2.3.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	(10	(10	ug/l	02/12/88
ACENAPHTHYLENE	(10	(10	ug/l	02/12/88
ANTHRACENE	(10	(10	ug/l	02/12/88
BENZO(A)ANTHRACENE	(10	(10	ug/l	02/12/88
BENZO(A)PYRENE	(10	(10	ug/l	02/12/88
3,4-BENZOFLUORANTHENE	(10	(10	ug/l	02/12/88
BENZO(G,H,I)PERYLENE	(10	(10	ug/l	02/12/88
BENZOIC ACID	(50	(50	ug/l	02/12/88
BENZO(K)FLUORANTHENE	(10	(10	ug/l	02/12/88
BENZYL ALCOHOL	(10	(10	ug/l	02/12/88
BIS(2-CHLOROETHOXY)METHANE	(10	(10	ug/l	02/12/88
BIS(2-CHLOROETHYL)ETHER	(10	(10	ug/l	02/12/88
BIS(2-CHLOROISOPROPYL)ETHER	(10	(10	ug/l	02/12/88
BIS(2-ETHYLHEXYL)PHTHALATE	(10	(10	ug/l	02/12/88
4-BROMOPHENYL PHENYL ETHER	(10	(10	ug/l	02/12/88
BUTYL BENZYL PHTHALATE	(10	(10	ug/l	02/12/88
4-CHLOROANILINE	(10	(10	ug/l	02/12/88
2-CHLORONAPHTHALENE	(10	(10	ug/l	02/12/88
2-CHLOROPHENOL	(10	(10	ug/l	02/12/88
4-CHLOROPHENYL PHENYL ETHER	(10	(10	ug/l	02/12/88
CHRYSENE	(10	(10	ug/l	02/12/88
DIBENZO(A,H)ANTHRACENE	(10	(10	ug/l	02/12/88
DIBENZOFURAN	(10	(10	ug/l	02/12/88
1,2-DICHLOROBENZENE	(10	(10	ug/l	02/12/88
1,3-DICHLOROBENZENE	(10	(10	ug/l	02/12/88
1,4-DICHLOROBENZENE	(10	(10	ug/l	02/12/88
3,3'-DICHLOROBENZIDINE	(20	(20	ug/l	02/12/88
2,4-DICHLOROPHENOL	(10	(10	ug/l	02/12/88
DIETHYL PHTHALATE	(10	(10	ug/l	02/12/88
2,4-DIMETHYLPHENOL	(10	(10	ug/l	02/12/88
4,6-DINITRO-O-CRESOL	(50	(50	ug/l	02/12/88
2,4-DINITROPHENOL	(50	(50	ug/l	02/12/88
DIMETHYL PHTHALATE	(10	(10	ug/l	02/12/88
DI-N-BUTYL PHTHALATE	(10	(10	ug/l	02/12/88
2,4-DINITROTOLUENE	(10	(10	ug/l	02/12/88
2,6-DINITROTOLUENE	(10	(10	ug/l	02/12/88
DI-N-OCTYL PHTHALATE	(10	(10	ug/l	02/12/88

TABLE 2.3.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10	< 10	ug/l	02/12/88
FLUORENE	< 10	< 10	ug/l	02/12/88
HEXACHLOROBENZENE	< 10	< 10	ug/l	02/12/88
HEXACHLOROBUTADIENE	< 10	< 10	ug/l	02/12/88
HEXACHLOROCYCLOPENTADIENE	< 10	< 10	ug/l	02/12/88
HEXACHLOROETHANE	< 10	< 10	ug/l	02/12/88
INDENO(1,2,3-CD)PYRENE	< 10	< 10	ug/l	02/12/88
ISOPHORONE	< 10	< 10	ug/l	02/12/88
2-METHYLNAPHTHALENE	< 10	< 10	ug/l	02/12/88
2-METHYLPHENOL	< 10	< 10	ug/l	02/12/88
4-METHYLPHENOL	< 10	< 10	ug/l	02/12/88
NAPHTHALENE	< 10	< 10	ug/l	02/12/88
2-NITROANILINE	< 50	< 50	ug/l	02/12/88
3-NITROANILINE	< 50	< 50	ug/l	02/12/88
4-NITROANILINE	< 50	< 50	ug/l	02/12/88
NITROBENZENE	< 10	< 10	ug/l	02/12/88
2-NITROPHENOL	< 10	< 10	ug/l	02/12/88
4-NITROPHENOL	< 50	< 50	ug/l	02/12/88
N-NITROSODI-N-PROPYLAMINE	< 10	< 10	ug/l	02/12/88
N-NITROSODIPHENYLAMINE	< 10	< 10	ug/l	02/12/88
P-CHLORO-M-CRESOL	< 10	< 10	ug/l	02/12/88
PENTACHLOROPHENOL	< 50	< 50	ug/l	02/12/88
PHENANTHRENE	< 10	< 10	ug/l	02/12/88
PHENOL	< 10	< 10	ug/l	02/12/88
PYRENE	< 10	< 10	ug/l	02/12/88
1,2,4-TRICHLOROBENZENE	< 10	< 10	ug/l	02/12/88
2,4,5-TRICHLOROPHENOL	< 50	< 50	ug/l	02/12/88
2,4,6-TRICHLOROPHENOL	< 10	< 10	ug/l	02/12/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	02/12/88

TABLE 2.3.3

UNC LABORATORY ANALYSIS
WIPP-19 CULEBRA ROUND TWO

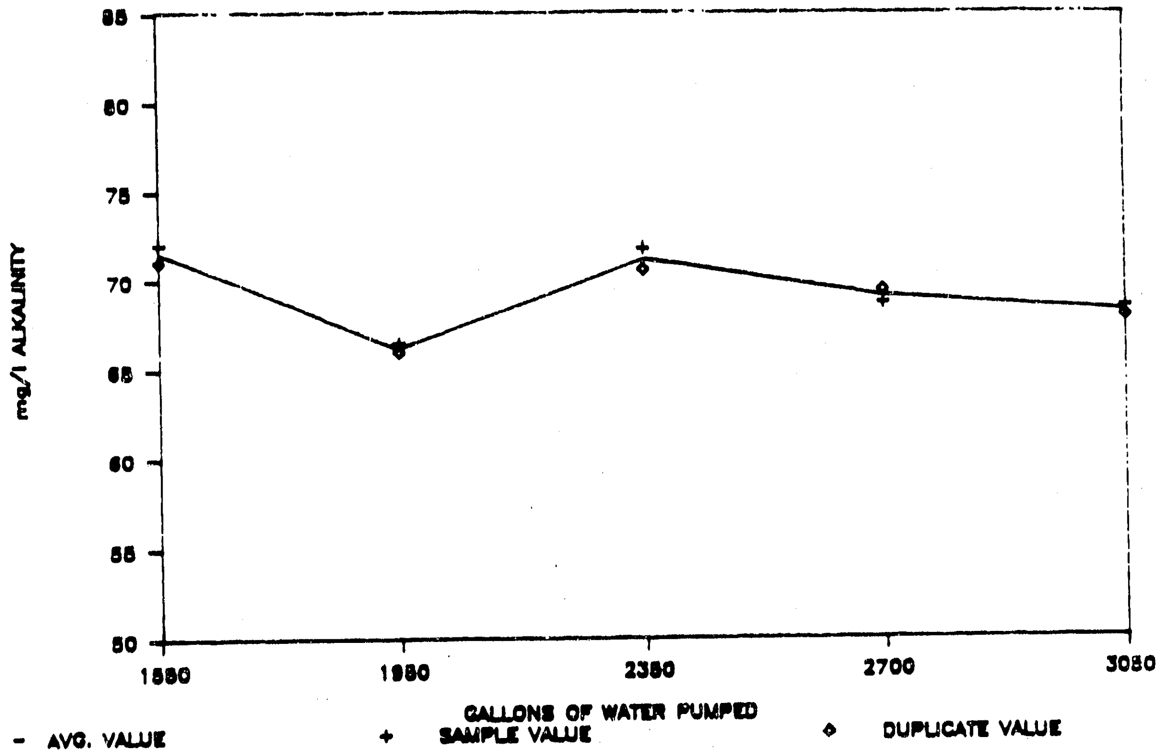
DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	< 0.05		cc/l (STP)	02/12/88
OXYGEN	< 0.05		cc/l (STP)	02/12/88
NITROGEN	18.50		cc/l (STP)	02/12/88
CARBON MONOXIDE	0.070		cc/l (STP)	02/12/88
CARBON DIOXIDE	1.980		cc/l (STP)	02/12/88
METHANE	0.090		cc/l (STP)	02/12/88
ETHANE	< 0.001		cc/l (STP)	02/12/88
C-3	< 0.001		cc/l (STP)	02/12/88
C-4	< 0.001		cc/l (STP)	02/12/88
C-5	< 0.001		cc/l (STP)	02/12/88
C-6	< 0.001		cc/l (STP)	02/12/88
SUM OF CO2	24.43		cc/l (STP)	02/12/88
TOTAL GAS	20.570		cc/l (STP)	02/12/88
AMMONIA	1.70		mg/l	02/12/88
NITRATE	< 2.00		mg/l	02/12/88
TOTAL IRON	2.780		mg/l	02/12/88
FERROUS IRON	2.64	2.66	mg/l	02/12/88
TOTAL ARSENIC	0.0024		mg/l	02/12/88
ARSENIC III	0.0016		mg/l	02/12/88
TOTAL SELENIUM	< 0.001		mg/l	02/12/88
IODIDE	240	240	ug/l	02/12/88
IODATE	< 15	< 15	ug/l	02/12/88

TABLE 2.3.4

PRESSURE AND FLOW
WIPP-19 CULEBRA ROUND TWO

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
01/26/88	12:24	145	157	00	PUMP OFF
01/26/88	12:56	145	152	00	PACKER INFLATED
01/26/88	13:00	145	138	00	PUMP ON NO DISCHARGE
01/26/88	13:03	145	123	12	DISCHARGE TO SURFACE
01/26/88	13:15	145	111	12	
01/26/88	13:30	145	103	12	
01/26/88	13:45	146	101	12	
01/26/88	14:00	146	100	12	
01/26/88	15:00	147	96	13	
01/27/88	07:30	163	89	12	
01/27/88	15:20	170	91	10	PSI 15:00
01/27/88	15:30	170	91	10	FLOW RATE 15:40
01/28/88	08:00	184	98	09	
01/28/88	15:00	186	99	09	
01/29/88	07:50	193	131	01	PUMP FAILURE
01/29/88	08:05	193	126	04	PSI #1 RISING
01/29/88	09:10	NA	NA	NA	PULL PUMP/REPLACE
02/01/88	16:37	148	103	00	PACKER INFLATED
02/01/88	16:50	150	114	06	UNSTABLE FLOW RATE
02/02/88	14:00	150	138	00	PUMP FAILURE/PUMP OFF
02/04/88	13:45	NA	NA	NA	RESTART WQSP
02/04/88	14:11	145	153	00	PUMP OFF
02/04/88	14:17	145	154	00	PACKER INFLATED
02/04/88	14:20	145	142	00	PUMP TURNED ON
02/04/88	14:21	145	128	NA	DISCHARGE TO SURFACE
02/04/88	14:29	145	100	18	
02/04/88	14:40	145	100	16	
02/04/88	15:00	143	98	16	
02/04/88	15:30	145	95	16	
02/05/88	07:00	145	82	19	
02/05/88	15:00	145	66	20	
02/06/88	08:30	146	62	18	
02/06/88	17:00	144	61	18	
02/07/88	12:30	144	60	18	
02/08/88	07:30	144	61	18	
02/08/88	16:30	143	56	16	
02/09/88	07:00	144	53	16	
02/09/88	16:00	143	55	16	
02/10/88	07:00	144	56	17	
02/10/88	16:00	142	57	16	
02/11/88	07:00	142	60	16	
02/11/88	16:00	142	60	17	
02/12/88	10:30	142	63	16	
02/12/88	11:00	143	69	00	PUMP OFF



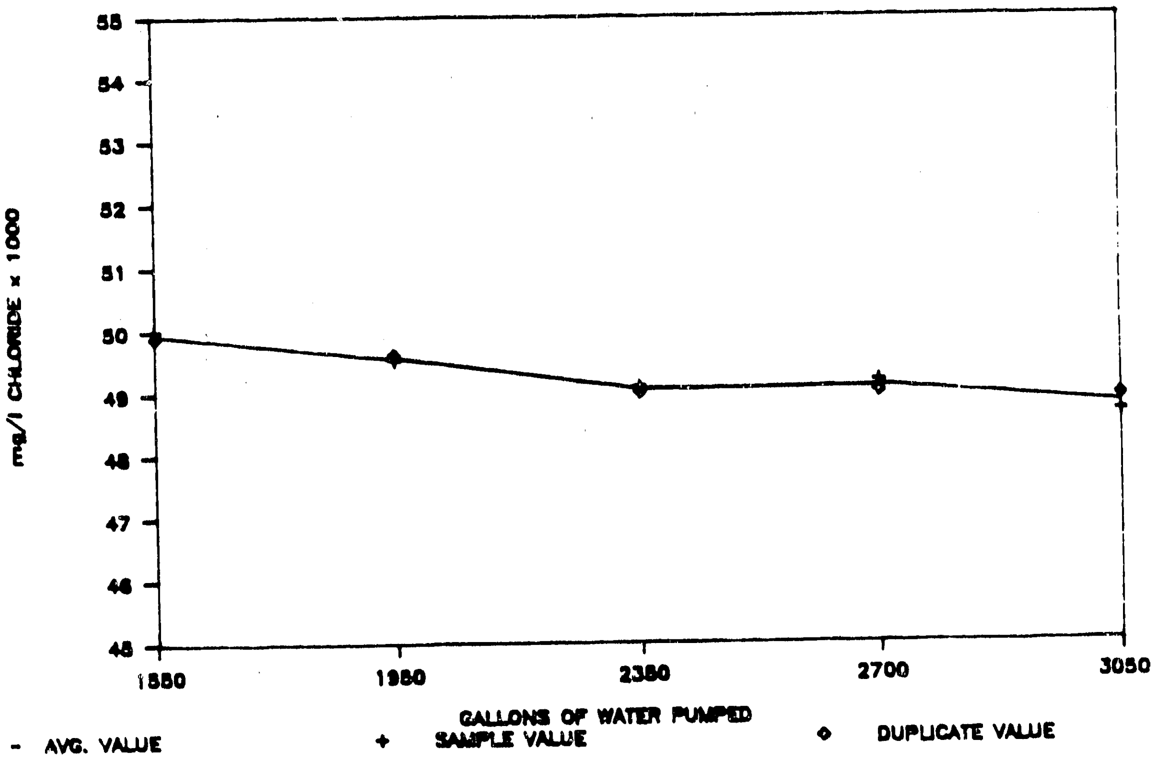
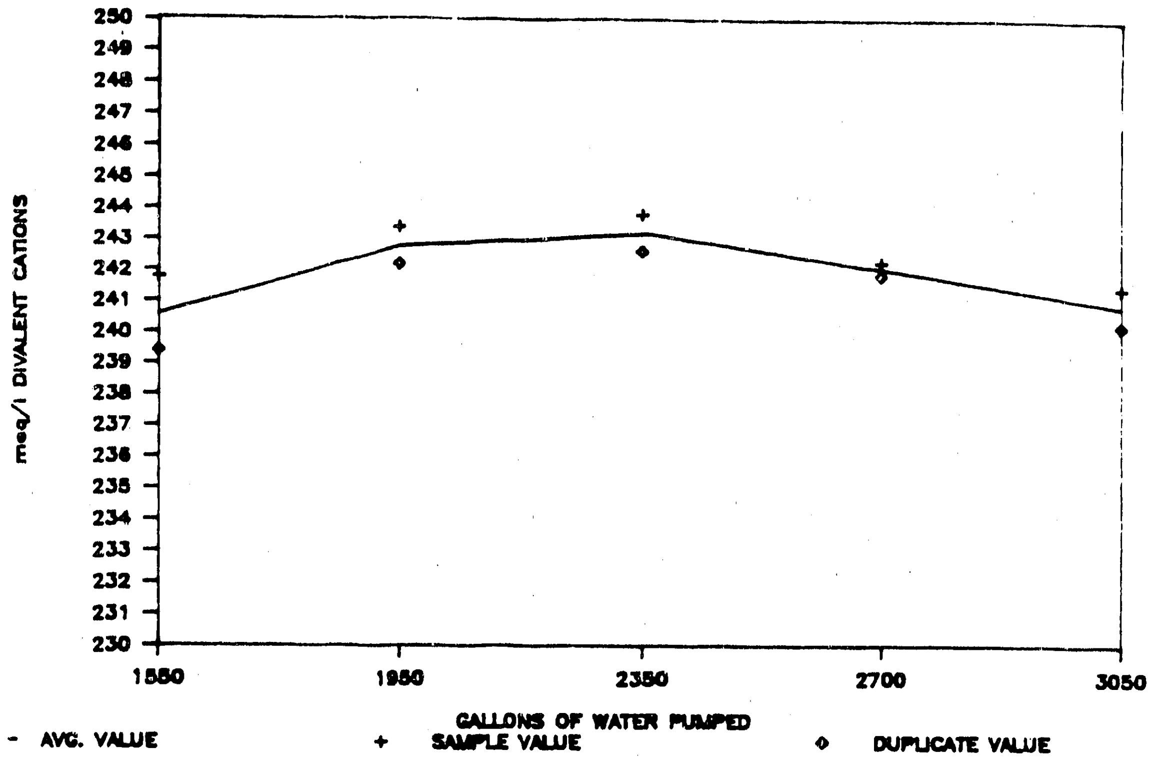


Figure 2.3.1. Graphs of alkalinity and chloride from second round serial sampling at well WIPP-19 Culebra.



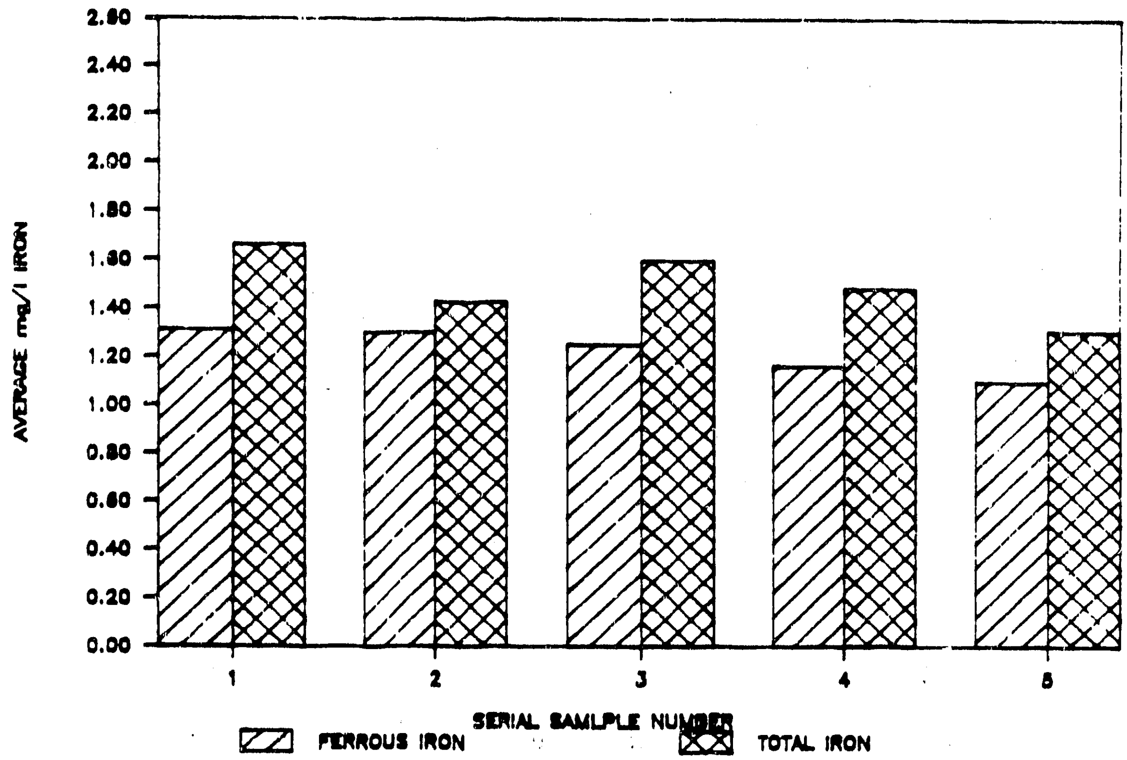


Figure 2.3.2. Graphs of divalent cations and iron from second round serial sampling at well WIPP-19 Culebra.

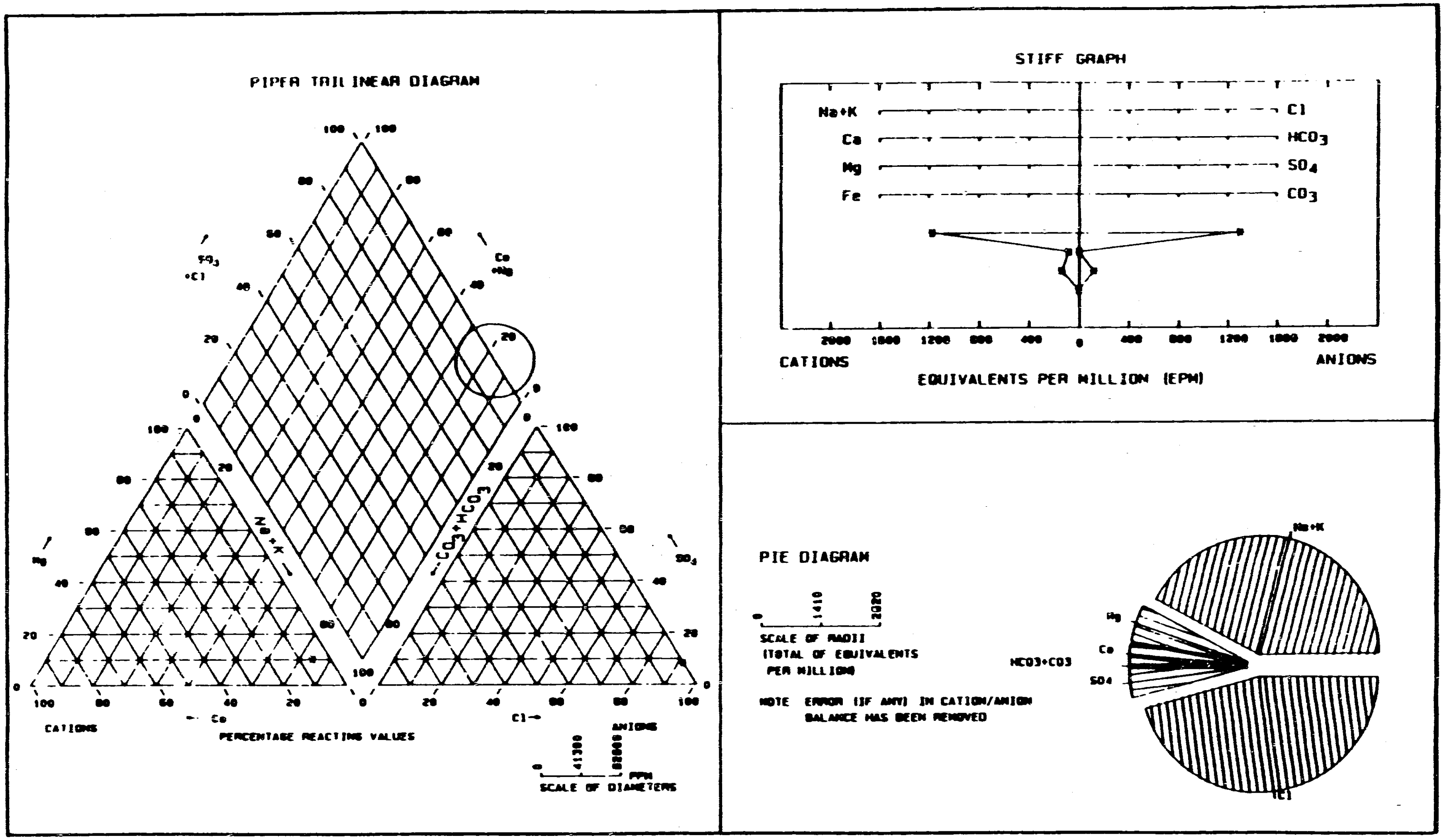


Figure 2.3.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from second round serial sampling at well WIPP-19 Culebra.

2.4 SUMMARY OF CULEBRA WELL WIPP-30, ROUND ONE

Well Characteristics

Well WIPP-30 is located approximately 4.9 miles north of the center of the WIPP site at an elevation of 3,429 feet above MSL, to the top of casing (Gonzales, 1989). The total depth of the drilled hole was 913 feet BGS. The well is cased to a depth of 912 feet BGS. The bottom one foot of the hole is plugged with cement. The casing is perforated in three intervals accessing the Magenta Dolomite, the Culebra Dolomite, and the base of the Rustler Formation. Currently, a bridge plug is installed at 701 feet BGS so that only the Magenta and Culebra Dolomites are accessible. A retrievable production-injection packer (PIP) is installed at approximately 590 feet BTOC to prevent mixing of Magenta and Culebra fluids (Stensrud et al., 1988). The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 631 to 653 feet BGS (Sandia Laboratories and USGS, 1980b).

Sampling Process

This well is not a regularly scheduled well in the WIPP Water Quality Sampling Program. WIPP-30 was sampled at the request of, and in cooperation with, Sandia National Laboratories and their subcontractor, INTERA Technologies. Removal and emplacement of the PIP, installation of the pump and pressure monitoring equipment, and monitoring of flow rates and volumes were activities of Sandia National Laboratories and INTERA Technologies personnel.

WIPP-30 was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from the Magenta Dolomite and fluid in the well bore. The pump intake was set at an approximate depth of 612 feet BTOC.

Pumping began on 02/02/88. The pump operated for 12 days and then failed on 02/13/88. The pump was removed, and the Baski inflatable packer reinstalled to prevent fluids from the Magenta and Culebra Dolomites from mixing. After being repaired, the pump was reinstalled on 02/25/88. The pump operated for 10 more days before failing again on 03/05/88. At this point the operation was terminated.

Serial sampling began on 02/05/88 after 450 gallons of water had been pumped from the well. Flow rates varied during the pumping episode from approximately 7.5 to less than two gallons per hour. A total of six serial samples were collected from WIPP-30, four during the first pumping episode and two during the second. Serial samples were collected at two day intervals while pumping was in progress. Serial samples were collected at the well head and transported to the field laboratory trailer located a short distance away. Serial sampling ended on 03/04/88 after approximately 3,000 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the serial sampling field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity decreasing from approximately 40 to 37 mg/l during the serial sampling period (Figure 2.4.1).

Chloride concentration decreased from approximately 21,800 down to 13,300 mg/l (Figure 2.4.1).

Divalent cations varied between 102 and 96 meq/l (Figure 2.4.2).

Total iron concentration decreased from approximately 4.6 mg/l on the first day to 1.8 mg/l before the pump failed during the first pumping episode. Total iron values then ranged between 1.0 and 2.6 mg/l. Ferrous iron concentrations followed a trend similar to total iron (Figure 2.4.2).

The water pH varied between 7.9 to 7.6 SU.

Physical Parameters

Specific gravity was 1.020 at 19.1°C on the final day of sampling.

Specific conductance was reported as 48,300 umhos/cm at 25°C for the fourth serial sample. Specific conductance was not measured on the final day of pumping.

Final Sample Collection

A complete final sample suite was not collected from well WIPP-30. At the time of the second pump failure, on 03/05/88, samples were only collected for analysis by Sandia National Laboratories. Field parameters did not appear to have stabilized at the end of the sampling episode.

General Observations

As this well was sampled in conjunction with Sandia National Laboratories on-going hydrology program, standard operating procedures of the Water Quality Sampling Program were not strictly adhered to. Every effort was made to preserve the integrity of the chemical analyses during serial sampling, but some transient physical parameters such as Eh and temperature were not measured.

Tabular data are presented in Table 2.4.1. This tables list results from serial sampling. No listing of pressure versus flow data is presented as the WQSP did not collect this data.

Figures 2.4.1 and 2.4.2 graphically depict serial sampling results and the degree of stabilization achieved.

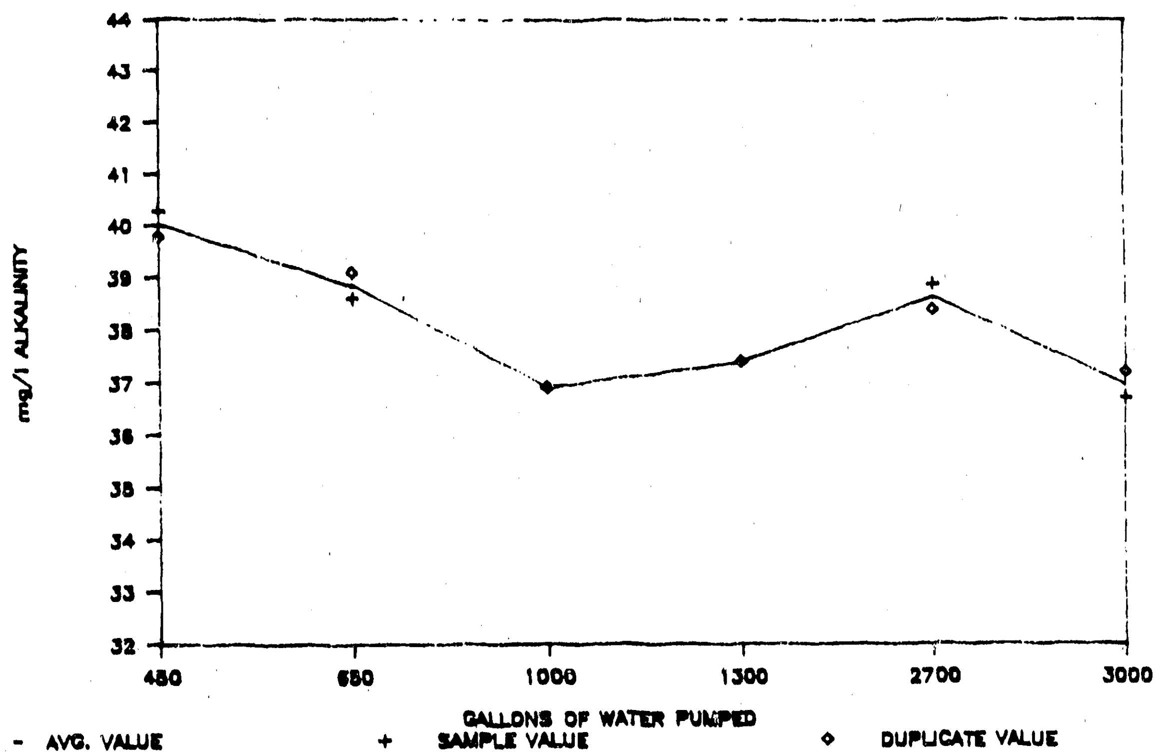
TABLE 2.4.1

SERIAL SAMPLE CHEMISTRY
WIPP-30 CULEBRA ROUND ONE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	40.3	39.8	mg/l	450	02/05/88
2	ALKALINITY	38.6	39.1	mg/l	650	02/07/88
3	ALKALINITY	36.9	36.9	mg/l	1000	02/09/88
4	ALKALINITY	37.4	37.4	mg/l	1300	02/11/88
5	ALKALINITY	38.9	38.4	mg/l	2700	03/02/88
6	ALKALINITY	36.7	37.2	mg/l	3000	03/04/88
1	CHLORIDE	21700	21900	mg/l	450	02/05/88
2	CHLORIDE	19700	19600	mg/l	650	02/07/88
3	CHLORIDE	17700	17600	mg/l	1000	02/09/88
4	CHLORIDE	16100	16000	mg/l	1300	02/11/88
5	CHLORIDE	13800	13700	mg/l	2700	03/02/88
6	CHLORIDE	13300	13200	mg/l	3000	03/04/88
1	DIVALENT CATIONS	101	101	meq/l	450	02/05/88
2	DIVALENT CATIONS	99.4	98.8	meq/l	650	02/07/88
3	DIVALENT CATIONS	102	102	meq/l	1000	02/09/88
4	DIVALENT CATIONS	102	102	meq/l	1300	02/11/88
5	DIVALENT CATIONS	96.3	97.0	meq/l	2700	03/02/88
6	DIVALENT CATIONS	96.0	95.7	meq/l	3000	03/04/88
1	TOTAL IRON	4.59	4.71	mg/l	450	02/05/88
2	TOTAL IRON	2.69	2.74	mg/l	650	02/07/88
3	TOTAL IRON	1.82	1.75	mg/l	1000	02/09/88
4	TOTAL IRON	1.05	1.01	mg/l	1300	02/11/88
5	TOTAL IRON	2.62	2.61	mg/l	2700	03/02/88
6	TOTAL IRON	2.16	2.22	mg/l	3000	03/04/88
1	FERROUS IRON	3.73	3.85	mg/l	450	02/05/88
2	FERROUS IRON	2.33	2.38	mg/l	650	02/07/88
3	FERROUS IRON	1.01	1.02	mg/l	1000	02/09/88
4	FERROUS IRON	0.78	0.82	mg/l	1300	02/11/88
5	FERROUS IRON	1.38	1.51	mg/l	2700	03/02/88
6	FERROUS IRON	1.57	1.62	mg/l	3000	03/04/88

TABLE 2.4.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	7.8			450	02/05/88
2	pH	7.9			650	02/07/88
3	pH	7.7			1000	02/09/88
4	pH	7.6			1300	02/11/88
5	pH	7.6			2700	03/02/88
6	pH	7.7			3000	03/04/88
1	SPECIFIC GRAVITY	1.032		@ 13.8 C	450	02/05/88
2	SPECIFIC GRAVITY	1.031		@ 14.9 C	650	02/07/88
3	SPECIFIC GRAVITY	1.026		@ 18.6 C	1000	02/09/88
4	SPECIFIC GRAVITY	1.024		@ 20.3 C	1300	02/11/88
5	SPECIFIC GRAVITY	1.020		@ 23.0 C	2700	03/02/88
6	SPECIFIC GRAVITY	1.020		@ 19.1 C	3000	03/04/88
1	SPECIFIC CONDUCTANCE	64800	@ 25 C	umhos/cm	450	02/05/88
2	SPECIFIC CONDUCTANCE	60200	@ 25 C	umhos/cm	650	02/07/88
4	SPECIFIC CONDUCTANCE	48300	@ 25 C	umhos/cm	1300	02/11/88



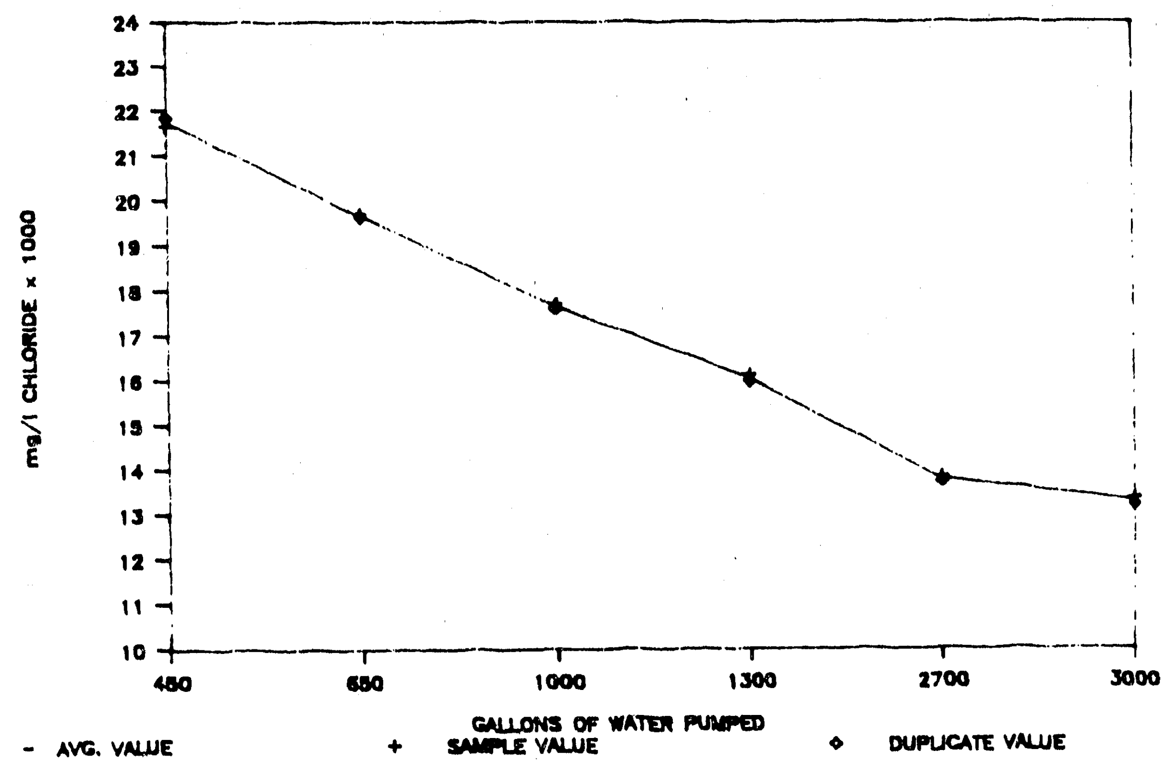


Figure 2.4.1. Graphs of alkalinity and chloride from second round serial sampling at well WIPP-30 Culebra.

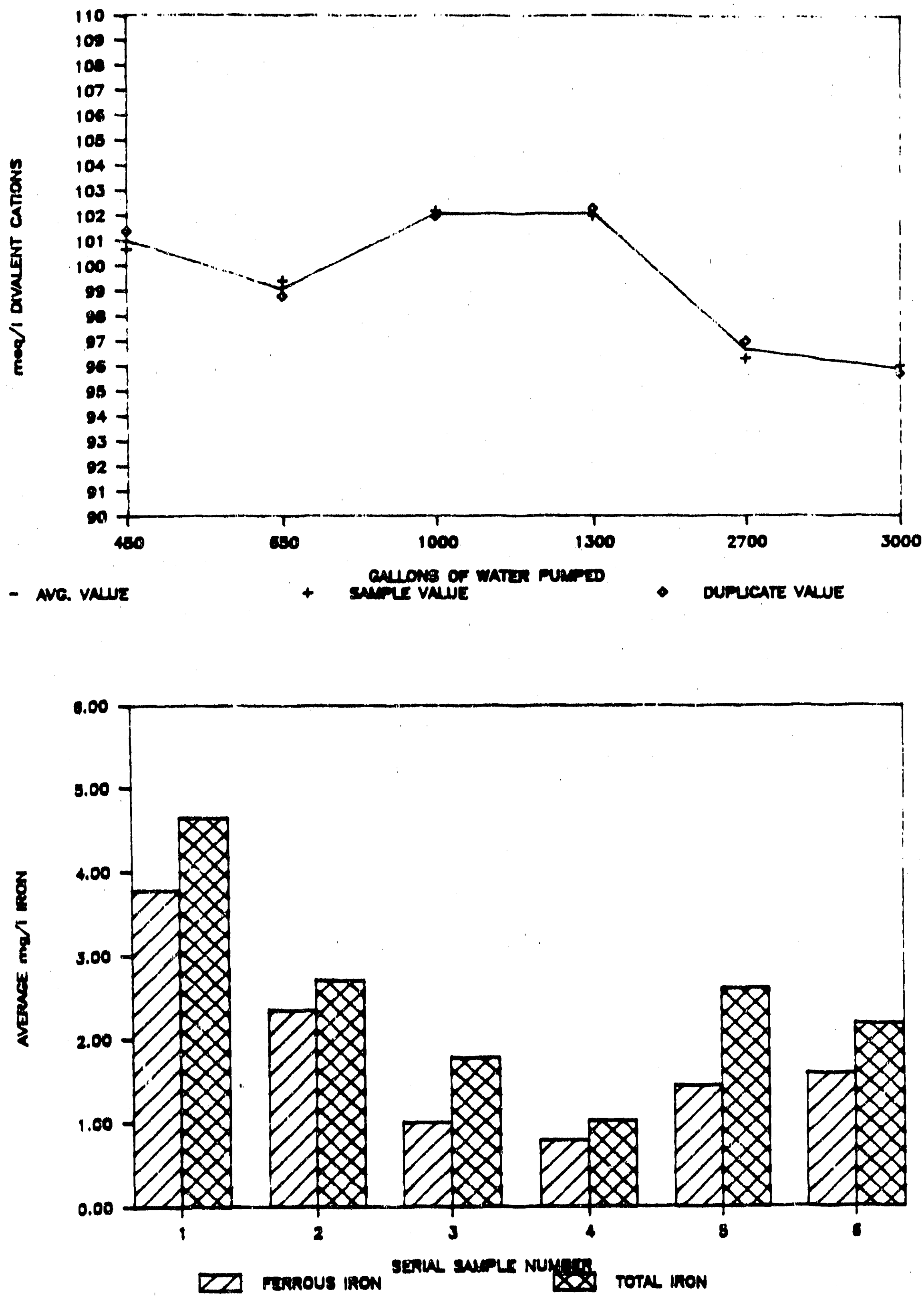


Figure 2.4.2. Graphs of divalent cations and iron from second round serial sampling at well WIPP-30 Culebra.

2.5 SUMMARY OF CULEBRA WELL H-05b, ROUND THREE

Well Characteristics

Well H-05b is located approximately 2.7 miles northeast of the center of the WIPP site at an elevation of 3,506 feet above MSL, to the top of casing (Gonzales, 1989). The total depth of the hole is 925 feet BGS. The well is cased to a depth of 881 feet BGS and completed open hole. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 897 to 920 feet BGS (Mercer and Orr, 1979).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. The pump intake was set at a depth of 875 feet BTOC.

Pumping began on 02/17/88 and ceased on 02/24/88. The average flow rate was approximately nine gph. Serial sampling began on 02/19/88 after 400 gallons of water had been pumped from the well. One serial sample was taken daily for six consecutive days. Serial sampling ended and final samples were collected on 02/24/88, after approximately 1,450 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity ranging between approximately 51 and 46 mg/l during the serial sampling period (Figure 2.5.1).

Chloride content remained between approximately 85,000 and 86,000 mg/l (Figure 2.5.1).

Divalent cations remained between 255 and 259 meq/l (Figure 2.5.2).

Total iron concentrations dropped from approximately 3.3 to 2.2 mg/l, while ferrous iron dropped from approximately 2.7 to 2.0 mg/l, during the course of serial sampling (Figure 2.5.2).

The water pH was between 7.2 and 7.3 SU.

Physical Parameters

Eh values ranged from 91 to 112 mV relative to the SHE.

The water temperature varied between 19 and 21°C.

Specific gravity was 1.102 at 19.3°C on the final day of sampling.

Specific conductance remained at approximately 172,000 umhos/cm at 25°C over the course of the sampling period.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were collected following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from well H-05b was slightly effervescent.

Some small particles were observed on the 0.45-um filters after sampling each day but the amount decreased as pumping progressed.

There were no problems encountered in sampling well H-05b.

Tabular data are presented in Tables 2.5.1, 2.5.2, 2.5.3, and 2.5.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.5.1 and 2.5.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.5.3 illustrates the general water quality at well H-05b utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds exist below the Culebra Dolomite Member within the Rustler Formation in the vicinity of H-05b (Mercer, 1983).

Serial Parameter Comparisons With The Previous Rounds

Data from serial sampling field analyses compare favorably over the past three rounds. With the exception of total iron, ferrous iron, and Eh values, all the physical and chemical parameters measured in the field are in good agreement.

Flow rates and purge volumes varied considerably between round one and rounds two and three. Round one had an average flow rate of eight gph resulting in a purge volume of 950 gallons. Average flow rates of six and 9.5 gph, with purge volumes of 2,000 and 1,450 gallons, were recorded for rounds two and three respectively.

TABLE 2.5.1

SERIAL SAMPLE CHEMISTRY
H-05b CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	49.1	50.3	mg/l	400	02/19/88
2	ALKALINITY	50.5	51.3	mg/l	550	02/20/88
3	ALKALINITY	47.0	46.4	mg/l	800	02/21/88
4	ALKALINITY	45.9	46.9	mg/l	1050	02/22/88
5	ALKALINITY	47.8	48.3	mg/l	1250	02/23/88
6	ALKALINITY	47.8	47.4	mg/l	1450	02/24/88
1	CHLORIDE	85500	85200	mg/l	400	02/19/88
2	CHLORIDE	85200	85000	mg/l	550	02/20/88
3	CHLORIDE	84700	84500	mg/l	800	02/21/88
4	CHLORIDE	84900	84900	mg/l	1050	02/22/88
5	CHLORIDE	85000	85400	mg/l	1250	02/23/88
6	CHLORIDE	85500	85700	mg/l	1450	02/24/88
1	DIVALENT CATIONS	259	257	meq/l	400	02/19/88
2	DIVALENT CATIONS	257	257	meq/l	550	02/20/88
3	DIVALENT CATIONS	256	255	meq/l	800	02/21/88
4	DIVALENT CATIONS	259	259	meq/l	1050	02/22/88
5	DIVALENT CATIONS	257	256	meq/l	1250	02/23/88
6	DIVALENT CATIONS	259	259	meq/l	1450	02/24/88
1	TOTAL IRON	3.26	3.27	mg/l	400	02/19/88
2	TOTAL IRON	3.18	3.24	mg/l	550	02/20/88
3	TOTAL IRON	2.55	2.55	mg/l	800	02/21/88
4	TOTAL IRON	2.37	2.59	mg/l	1050	02/22/88
5	TOTAL IRON	2.41	2.55	mg/l	1250	02/23/88
6	TOTAL IRON	2.13	2.16	mg/l	1450	02/24/88
1	FERROUS IRON	2.58	2.73	mg/l	400	02/19/88
2	FERROUS IRON	2.53	2.60	mg/l	550	02/20/88
3	FERROUS IRON	2.45	2.46	mg/l	800	02/21/88
4	FERROUS IRON	2.27	2.28	mg/l	1050	02/22/88
5	FERROUS IRON	2.27	2.29	mg/l	1250	02/23/88
6	FERROUS IRON	1.93	1.95	mg/l	1450	02/24/88

TABLE 2.5.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	7.3			400	02/19/88
3	pH	7.3			800	02/21/88
4	pH	7.2			1050	02/22/88
5	pH	7.2			1250	02/23/88
6	pH	7.3			1450	02/24/88
1	Eh	91		mV	400	02/19/88
3	Eh	106		mV	800	02/21/88
4	Eh	108		mV	1050	02/22/88
5	Eh	105		mV	1250	02/23/88
6	Eh	112		mV	1450	02/24/88
1	TEMPERATURE	19.2		C	400	02/19/88
3	TEMPERATURE	19.8		C	800	02/21/88
4	TEMPERATURE	20.5		C	1050	02/22/88
5	TEMPERATURE	20.4		C	1250	02/23/88
6	TEMPERATURE	19.1		C	1450	02/24/88
1	SPECIFIC GRAVITY	1.102		@ 19.7 C	400	02/19/88
6	SPECIFIC GRAVITY	1.102		@ 19.3 C	1450	02/24/88
1	SPECIFIC CONDUCTANCE	173000	@ 25 C	umhos/cm	400	02/19/88
6	SPECIFIC CONDUCTANCE	172000	@ 25 C	umhos/cm	1450	02/24/88

TABLE 2.5.2

ITAS LABORATORY RESULTS
H-05b CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	42	42	mg/l	02/24/88
ALKALINITY (CO3)	0	0	mg/l	02/24/88
BROMIDE	73	73	mg/l	02/24/88
CHLORIDE	84100		mg/l	02/24/88
CYANIDE, TOTAL	< 0.02		mg/l	02/24/88
FLUORIDE	0.9		mg/l	02/24/88
IODIDE	< 2.0	< 2.0	mg/l	02/24/88
NITRATE	0.04		mg/l NO3-N	02/24/88
pH	7.03	7.03		02/24/88
PHENOLICS	0.051		mg/l	02/24/88
PHOSPHATE, TOTAL	0.02		mg/l T-PO4-P	02/24/88
RESIDUE, FILTERABLE @180 C	153000	154000	mg/l	02/24/88
RESIDUE, NONFILTERABLE @105 C	760	640	mg/l	02/24/88
SPECIFIC CONDUCTANCE	242000	241000	umhos/cm@25C	02/24/88
SULFATE	7000		mg/l	02/24/88
TOTAL ORGANIC CARBON	4.0	3.0	mg/l	02/24/88
TOTAL ORGANIC HALOGEN	8.20	7.00	mg/l	02/24/88

TABLE 2.5.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	02/24/88
ANTIMONY *	0.77				mg/l	02/24/88
ARSENIC *	< 0.024				mg/l	02/24/88
BARIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	02/24/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	02/24/88
BORON	35	35	< 0.01	< 0.01	mg/l	02/24/88
CADMIUM *	< 0.0040				mg/l	02/24/88
CALCIUM	1500	1500			mg/l	02/24/88
CESIUM *	< 0.28				mg/l	02/24/88
CHROMIUM *	0.016				mg/l	02/24/88
COBALT *	< 0.010				mg/l	02/24/88
COPPER *	< 0.010				mg/l	02/24/88
IRON	2.3	2.3	0.01	< 0.01	mg/l	02/24/88
LEAD *	< 0.040				mg/l	02/24/88
LITHIUM *	0.75				mg/l	02/24/88
MAGNESIUM	1800	1800			mg/l	02/24/88
MANGANESE	0.21	0.21	< 0.005	< 0.005	mg/l	02/24/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	02/24/88
MOLYBDENUM *	0.030				mg/l	02/24/88
NICKEL *	< 0.010				mg/l	02/24/88
POTASSIUM	1340	1340			mg/l	02/24/88
SELENIUM *	< 0.024				mg/l	02/24/88
SILICA	2.8				mg/l	02/24/88
SILVER *	0.090				mg/l	02/24/88
SODIUM	52000	52000			mg/l	02/24/88
STRONTIUM	34	34	< 0.01	< 0.01	mg/l	02/24/88
THALLIUM	< 0.050		< 0.005	< 0.005	mg/l	02/24/88
TITANIUM *	< 0.010				mg/l	02/24/88
VANADIUM	0.20	0.20	< 0.01	< 0.01	mg/l	02/24/88
ZINC *	0.030				mg/l	02/24/88

* Sample analysis by ion exchange separation method. See section 4.0.

TABLE 2.5.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10	43	ug/l	02/24/88
BENZENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
2-BUTANONE	< 10		< 10	< 10	ug/l	02/24/88
BROMOFORM	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
CARBON DISULFIDE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
CARBON TETRACHLORIDE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
CHLOROBENZENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
CHLOROETHANE	< 10		< 10	< 10	ug/l	02/24/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10	< 10	ug/l	02/24/88
CHLOROFORM	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
1,1-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
1,2-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
ETHYLBENZENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
2-HEXANONE	< 10		< 10	< 10	ug/l	02/24/88
METHYL BROMIDE	< 10		< 10	< 10	ug/l	02/24/88
METHYL CHLORIDE	< 10		< 10	< 10	ug/l	02/24/88
4-METHYL-2-PENTANONE	< 10		< 10	< 10	ug/l	02/24/88
METHYLENE CHLORIDE	< 5.0		85	110	ug/l	02/24/88
STYRENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
TETRACHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
TOLUENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
TRICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	02/24/88
VINYL ACETATE	< 10		< 10	< 10	ug/l	02/24/88
VINYL CHLORIDE	< 10		< 10	< 10	ug/l	02/24/88
TOTAL XYLENES	< 5.0		< 5.0	< 5.0	ug/l	02/24/88

TABLE 2.5.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	02/24/88
ACENAPHTHYLENE	< 10		ug/l	02/24/88
ANTHRACENE	< 10		ug/l	02/24/88
BENZO(A)ANTHRACENE	< 10		ug/l	02/24/88
BENZO(A)PYRENE	< 10		ug/l	02/24/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	02/24/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	02/24/88
BENZOIC ACID	< 50		ug/l	02/24/88
BENZO(K)FLUORANTHENE	< 10		ug/l	02/24/88
BENZYL ALCOHOL	< 10		ug/l	02/24/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	02/24/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	02/24/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	02/24/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	02/24/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	02/24/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	02/24/88
4-CHLOROANILINE	< 10		ug/l	02/24/88
2-CHLORONAPHTHALENE	< 10		ug/l	02/24/88
2-CHLOROPHENOL	< 10		ug/l	02/24/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	02/24/88
CHRYSENE	< 10		ug/l	02/24/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	02/24/88
DIBENZOFURAN	< 10		ug/l	02/24/88
1,2-DICHLOROBENZENE	< 10		ug/l	02/24/88
1,3-DICHLOROBENZENE	< 10		ug/l	02/24/88
1,4-DICHLOROBENZENE	< 10		ug/l	02/24/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	02/24/88
2,4-DICHLOROPHENOL	< 10		ug/l	02/24/88
DIETHYL PHTHALATE	< 10		ug/l	02/24/88
2,4-DIMETHYLPHENOL	< 10		ug/l	02/24/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	02/24/88
2,4-DINITROPHENOL	< 50		ug/l	02/24/88
DIMETHYL PHTHALATE	< 10		ug/l	02/24/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	02/24/88
2,4-DINITROTOLUENE	< 10		ug/l	02/24/88
2,6-DINITROTOLUENE	< 10		ug/l	02/24/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	02/24/88

TABLE 2.5.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	02/24/88
FLUORENE	< 10		ug/l	02/24/88
HEXACHLOROBENZENE	< 10		ug/l	02/24/88
HEXACHLOROBUTADIENE	< 10		ug/l	02/24/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	02/24/88
HEXACHLOROETHANE	< 10		ug/l	02/24/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	02/24/88
ISOPHORONE	< 10		ug/l	02/24/88
2-METHYLNAPHTHALENE	< 10		ug/l	02/24/88
2-METHYLPHENOL	< 10		ug/l	02/24/88
4-METHYLPHENOL	< 10		ug/l	02/24/88
NAPHTHALENE	< 10		ug/l	02/24/88
2-NITROANILINE	< 50		ug/l	02/24/88
3-NITROANILINE	< 50		ug/l	02/24/88
4-NITROANILINE	< 50		ug/l	02/24/88
NITROBENZENE	< 10		ug/l	02/24/88
2-NITROPHENOL	< 10		ug/l	02/24/88
4-NITROPHENOL	< 50		ug/l	02/24/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	02/24/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	02/24/88
P-CHLORO-M-CRESOL	< 10		ug/l	02/24/88
PENTACHLOROPHENOL	< 50		ug/l	02/24/88
PHENANTHRENE	< 10		ug/l	02/24/88
PHENOL	< 10		ug/l	02/24/88
PYRENE	< 10		ug/l	02/24/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	02/24/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	02/24/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	02/24/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	02/24/88

TABLE 2.5.3

UNC LABORATORY ANALYSIS
H-05b CULEBRA ROUND THREE

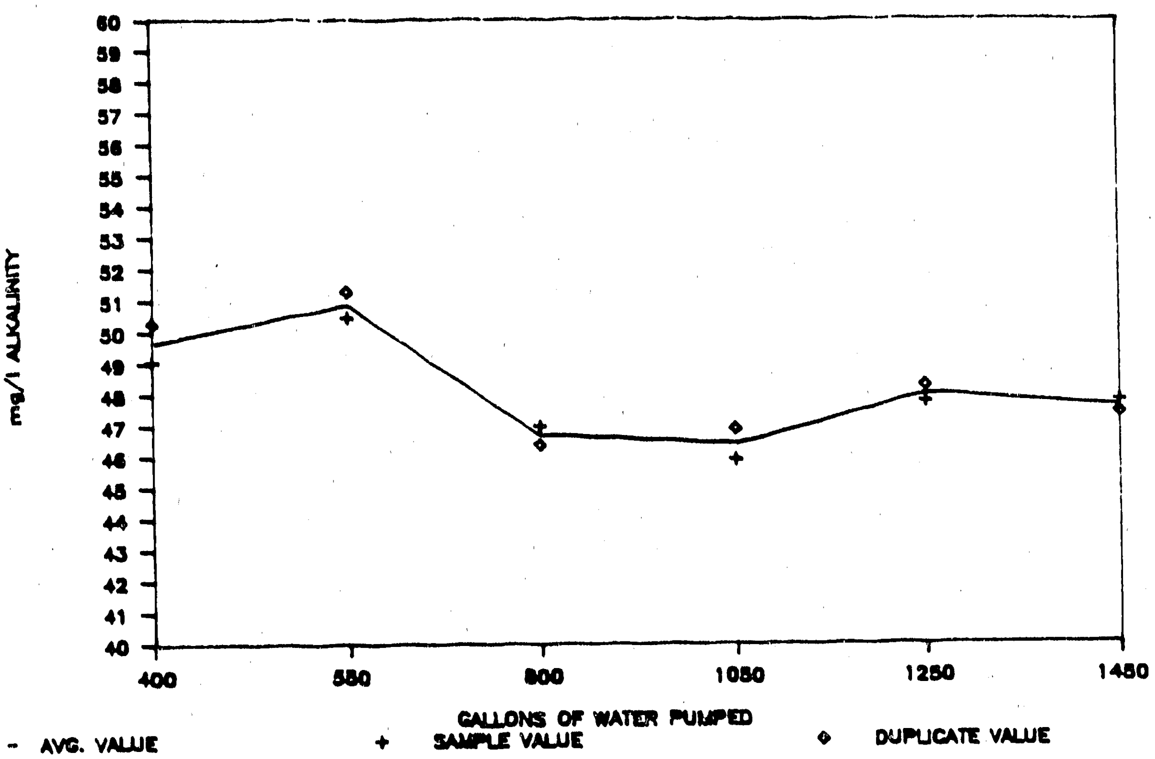
DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	< 0.05		cc/l (STP)	02/24/88
OXYGEN	< 0.05		cc/l (STP)	02/24/88
NITROGEN	10.43		cc/l (STP)	02/24/88
CARBON DIOXIDE	0.950		cc/l (STP)	02/24/88
METHANE	< 0.001		cc/l (STP)	02/24/88
ETHANE	< 0.001		cc/l (STP)	02/24/88
C-3	< 0.001		cc/l (STP)	02/24/88
C-4	< 0.001		cc/l (STP)	02/24/88
C-5	< 0.001		cc/l (STP)	02/24/88
C-6	< 0.001		cc/l (STP)	02/24/88
SUM OF CO2	52.62		cc/l (STP)	02/24/88
TOTAL GAS	11.378		cc/l (STP)	02/24/88
AMMONIA	1.26		mg/l	02/24/88
NITRATE	< 4.00		mg/l	02/24/88
TOTAL IRON	2.160		mg/l	02/24/88
FERROUS IRON	1.99	1.99	mg/l	02/24/88
TOTAL ARSENIC	0.0022		mg/l	02/24/88
ARSENIC III	0.0014		mg/l	02/24/88
TOTAL SELENIUM	< 0.001		mg/l	02/24/88
IODIDE	150	150	ug/l	02/24/88
IODATE	< 15		ug/l	02/24/88

TABLE 2.5.4

PRESSURE AND FLOW
H-05b CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
02/17/88	13:13	118	193	00	PUMP OFF
02/17/88	13:31	119	193	00	PUMP ON 13:45
02/17/88	13:48	118	194	20	
02/17/88	14:00	117	166	18	
02/17/88	14:10	117	104	18	
02/17/88	14:30	114	105	17	
02/17/88	14:45	114	113	13	DECREASE FLOW 14:40
02/17/88	15:00	114	111	13	
02/18/88	07:30	114	99	10	
02/18/88	15:30	114	105	09	
02/19/88	08:00	113	103	10	
02/19/88	14:00	113	100	10	
02/20/88	08:00	113	97	09	
02/20/88	15:30	113	96	10	
02/21/88	07:00	113	99	09	
02/21/88	18:00	113	100	09	
02/22/88	07:30	113	99	09	
02/22/88	15:30	112	102	09	
02/23/88	07:30	113	101	09	
02/23/88	15:00	113	102	09	
02/24/88	07:30	113	100	08	
02/24/88	13:30	113	104	08	
02/24/88	14:05	112	104	00	PUMP OFF
02/25/88	08:00	112	237	00	PSI #2 SUSPECT
02/25/88	08:05	NA	NA	00	LOGGING OFF



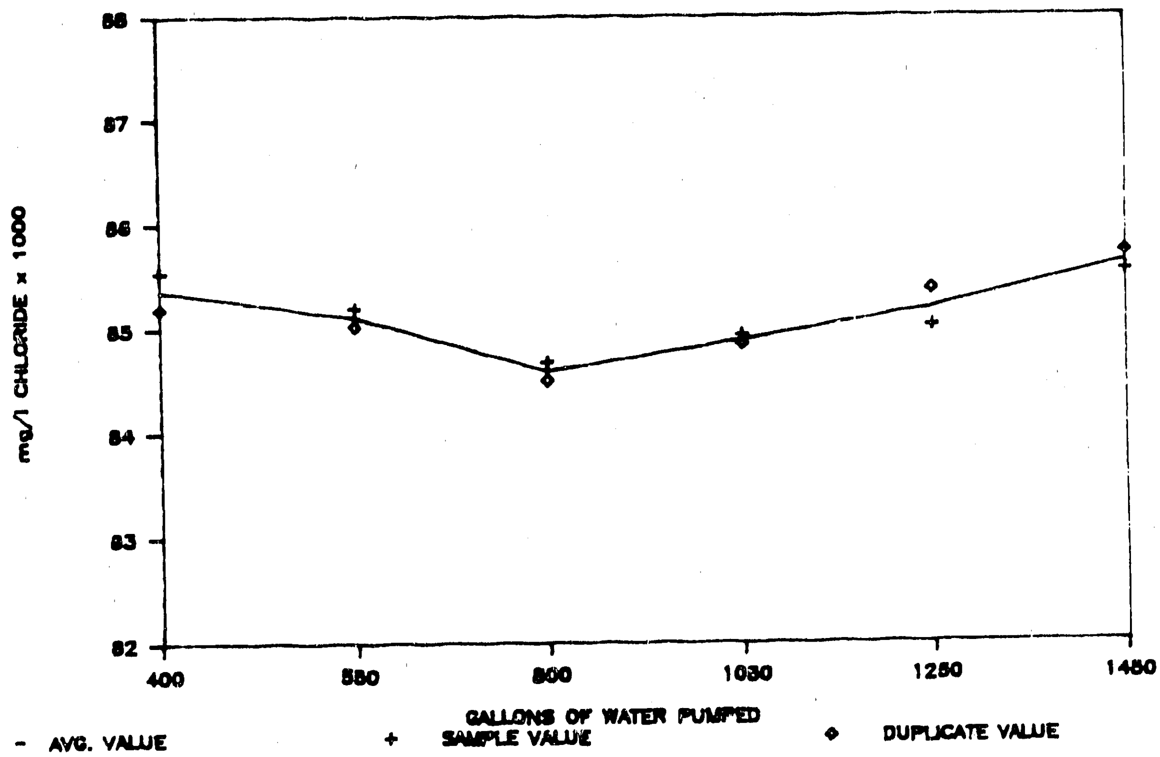
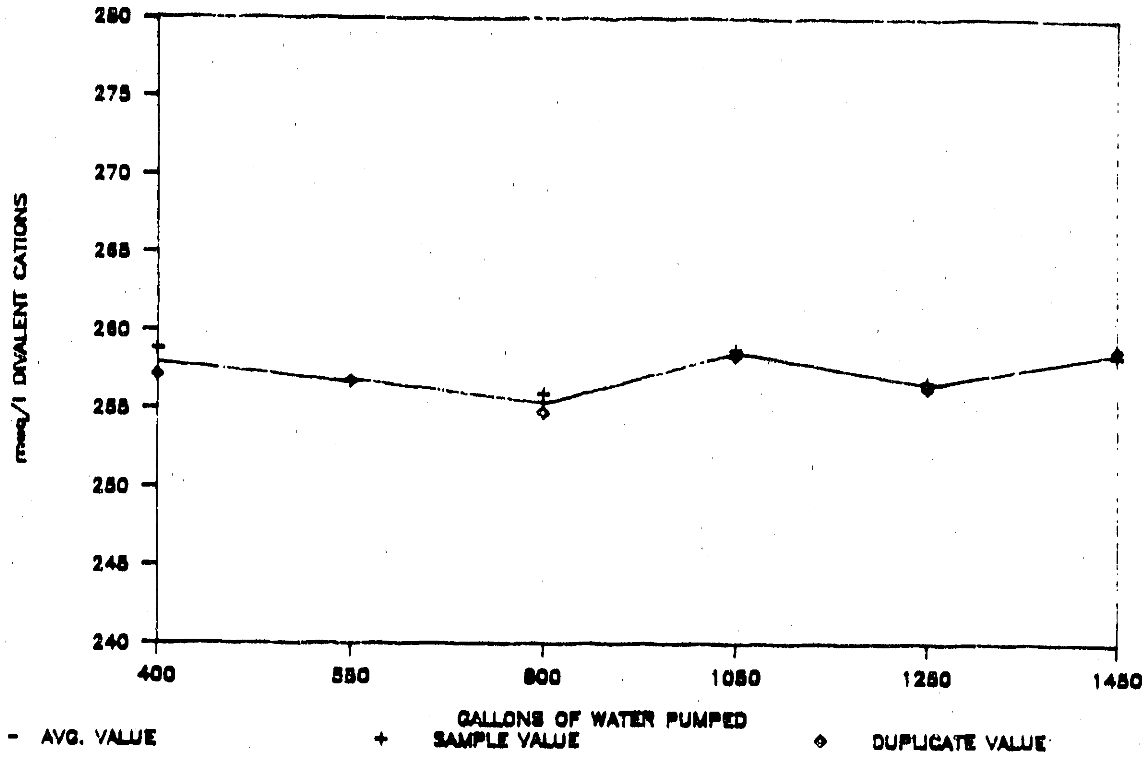


Figure 2.5.1. Graphs of alkalinity and chloride from second round serial sampling at well H-05b Culebra.



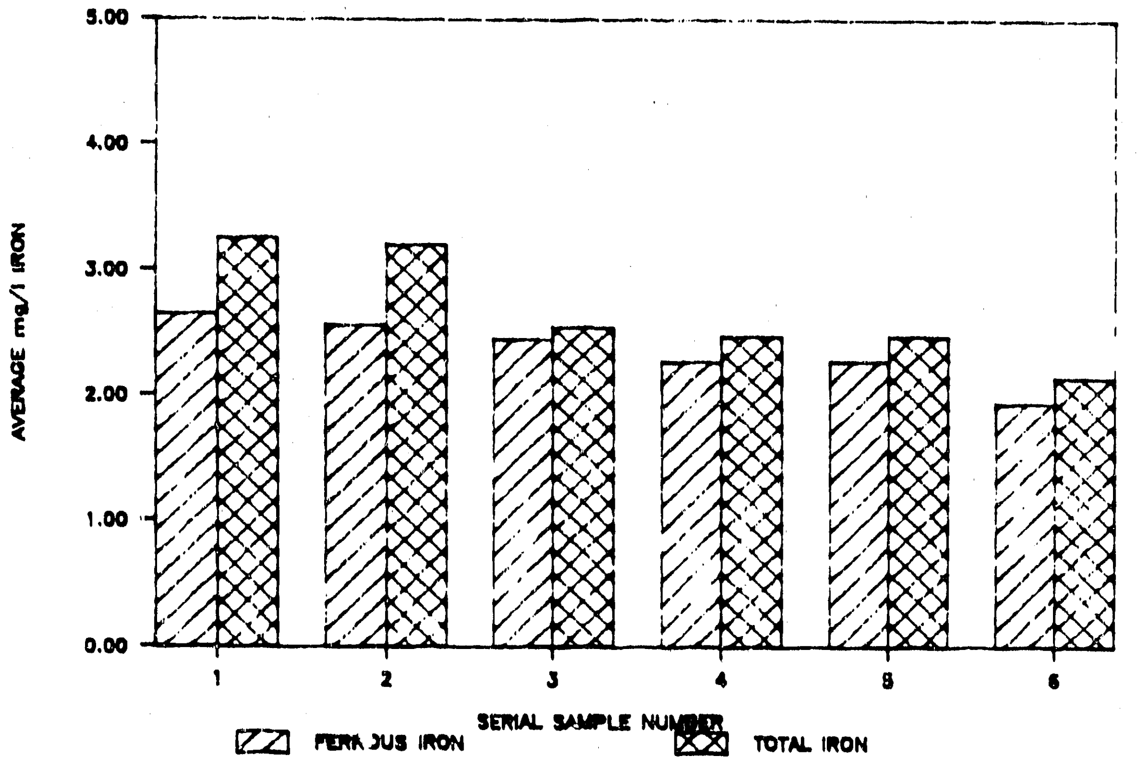


Figure 2.5.2. Graphs of divalent cations and iron from second round serial sampling at well H-05b Culebra.

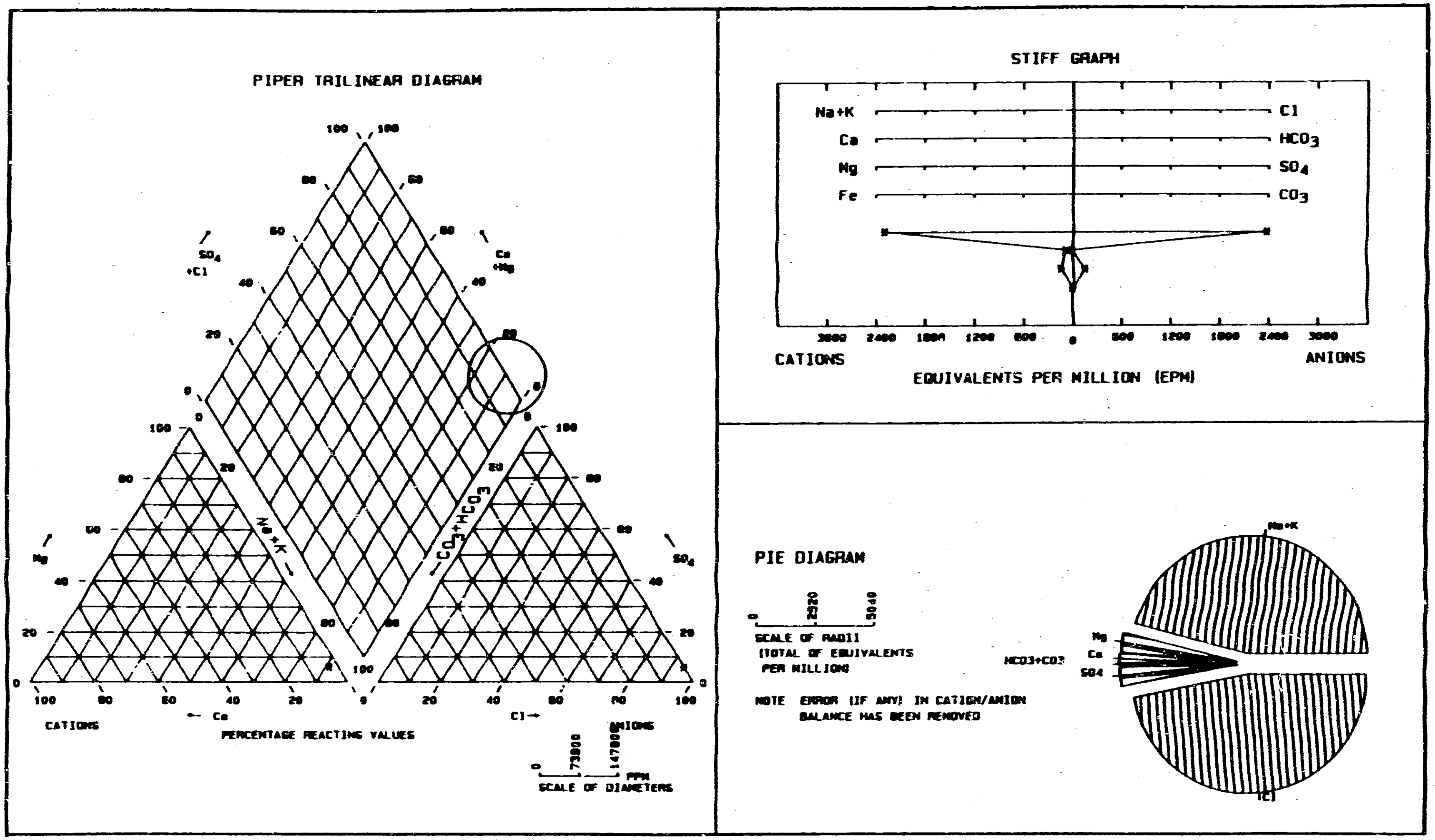


Figure 2.5.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well H-05b Culebra.

2.6 SUMMARY OF MAGENTA WELL H-05c, ROUND TWO

Well Characteristics

Well H-05c is located approximately 2.7 miles northeast of the center of the WIPP site at an elevation of 3,506 feet above MSL, to the top of the casing (Gonzales, 1989). Total depth of the drilled hole is 1,076 feet BGS. The hole is cased to a depth of 1,024 feet BGS. Below the casing the well is completed open hole, and the casing is perforated at two intervals accessing the Magenta Dolomite and the Culebra Dolomite. Bridge plugs have been set below the Magenta Dolomite at 837 feet BTOC and below the Culebra Dolomite at 935 feet BTOC. Currently only the Magenta Dolomite is accessible. The source of water sampled from this well is the Magenta Dolomite Member of the Rustler Formation, located at depths of 788 to 812 feet BGS (Stensrud, 1986).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. The pump intake was set at a depth of 784 feet BTOC.

Pumping began on 02/24/88 and ceased on 03/03/88. The average flow rate was approximately 10 gph. Serial sampling began on 02/29/88 after 1,150 gallons of water had been pumped from the well. One serial sample was taken daily for four consecutive days. Serial sampling ended and final samples were collected on 03/03/88, after approximately 1,900 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity values ranging between approximately 56 and 58 mg/l (Figure 2.6.1).

Chloride content remained fairly constant ranging between 1,050 and 1,040 mg/l (Figure 2.6.1).

Divalent cations remained between 41 and 42 meq/l (Figure 2.6.2).

Total iron concentrations decreased from the first day high of approximately 0.4 mg/l to approximately 0.3 mg/l on the second day. Ferrous iron values followed the same general trend as total iron. Iron values were generally stable during the last three days of sampling (Figure 2.6.2).

The water pH ranged between 7.9 and 8.0 SU over the course of serial sampling.

Physical Parameters

Eh values ranged from 40 to 57 mV relative to the SHE.

The water temperature varied between 18.8 and 21.2°C.

Specific gravity was 1.008 at 18.1°C on the final day of sampling.

Specific conductance remained at approximately 9,200 umhos/cm at 25°C over the course of the sampling period.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were collected following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from well H-05c was slightly effervescent.

Very few particulates were observed on the 0.45-um filters after sampling each day.

Tabular data are presented in Tables 2.6.1, 2.6.2, 2.6.3, and 2.6.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.6.1 and 2.6.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.6.3 illustrates the general water quality at well H-05c utilizing Stiff, pie, and Piper trilinear diagrams.

Serial Parameter Comparisons With The Previous Round

Serial sampling data from round two tended to exhibit greater stability than data from round one. Generally, most parameters are in good agreement between the two rounds of sampling.

Average purge volumes and flow rates were 1,900 gallons and 10 gph during round two and 5,800 gallons and 13 gph during round one.

TABLE 2.6.1

SERIAL SAMPLE CHEMISTRY
H-05c MAGENTA ROUND TWO

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	55.8	56.3	mg/l	1150	02/29/88
2	ALKALINITY	58.2	57.5	mg/l	1400	03/01/88
3	ALKALINITY	56.5	57.0	mg/l	1650	03/02/88
4	ALKALINITY	57.0	57.3	mg/l	1900	03/03/88
1	CHLORIDE	1050	1050	mg/l	1150	02/29/88
2	CHLORIDE	1040	1040	mg/l	1400	03/01/88
3	CHLORIDE	1040	1040	mg/l	1650	03/02/88
4	CHLORIDE	1040	1040	mg/l	1900	03/03/88
1	DIVALENT CATIONS	41.3	41.2	meq/l	1150	02/29/88
2	DIVALENT CATIONS	41.2	41.5	meq/l	1400	03/01/88
3	DIVALENT CATIONS	41.1	41.1	meq/l	1650	03/02/88
4	DIVALENT CATIONS	41.6	41.3	meq/l	1900	03/03/88
1	TOTAL IRON	0.42	0.41	mg/l	1150	02/29/88
2	TOTAL IRON	0.29	0.31	mg/l	1400	03/01/88
3	TOTAL IRON	0.31	0.31	mg/l	1650	03/02/88
4	TOTAL IRON	0.29	0.28	mg/l	1900	03/03/88
1	FERROUS IRON	0.29	0.32	mg/l	1150	02/29/88
2	FERROUS IRON	0.25	0.25	mg/l	1400	03/01/88
3	FERROUS IRON	0.26	0.27	mg/l	1650	03/02/88
4	FERROUS IRON	0.23	0.26	mg/l	1900	03/03/88
1	pH	8.0			1150	02/29/88
2	pH	7.9			1400	03/01/88
3	pH	7.9			1650	03/02/88
4	pH	7.9			1900	03/03/88
2	Eh	40		mV	1400	03/01/88
3	Eh	57		mV	1650	03/02/88
4	Eh	46		mV	1900	03/03/88

TABLE 2.6.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	TEMPERATURE	21.2		C	1150	02/29/88
2	TEMPERATURE	21.1		C	1400	03/01/88
3	TEMPERATURE	21.0		C	1650	03/02/88
4	TEMPERATURE	18.8		C	1900	03/03/88
1	SPECIFIC GRAVITY	1.019		@ 20.4 C	1150	02/29/88
4	SPECIFIC GRAVITY	1.008		@ 18.1 C	1900	03/03/88
1	SPECIFIC CONDUCTANCE	9100	@ 25 C	umhos/cm	1150	02/29/88
4	SPECIFIC CONDUCTANCE	9220	@ 25 C	umhos/cm	1900	03/03/88

TABLE 2.6.2

ITAS LABORATORY RESULTS
H-05c MAGENTA ROUND TWO

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	55		mg/l	03/03/88
ALKALINITY (CO3)	0		mg/l	03/03/88
BROMIDE	2.5	2.5	mg/l	03/03/88
CHLORIDE	1000		mg/l	03/03/88
CYANIDE, TOTAL	< 0.01		mg/l	03/03/88
FLUORIDE	2.8		mg/l	03/03/88
IODIDE	< 2.0	< 2.0	mg/l	03/03/88
NITRATE	0.02		mg/l NO3-N	03/03/88
pH	7.84	7.86		03/03/88
PHENOLICS	0.010		mg/l	03/03/88
PHOSPHATE, TOTAL	< 0.01		mg/l T-PO4-P	03/03/88
RESIDUE, FILTERABLE @180 C	6900	7400	mg/l	03/03/88
RESIDUE, NONFILTERABLE @105 C	< 4	< 4	mg/l	03/03/88
SPECIFIC CONDUCTANCE	9000	9050	umhos/cm@25C	03/03/88
SULFATE	3800		mg/l	03/03/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	03/03/88
TOTAL ORGANIC HALOGEN	< 0.05	0.06	mg/l	03/03/88

TABLE 2.6.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	03/03/88
ANTIMONY	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	03/03/88
ARSENIC	< 0.0050		< 0.005	< 0.005	mg/l	03/03/88
BARIUM	< 0.010	< 0.010	< 0.005	< 0.005	mg/l	03/03/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/03/88
BORON	12		< 0.01	< 0.01	mg/l	03/03/88
CADMIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/03/88
CALCIUM	560	560			mg/l	03/03/88
CESIUM	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	03/03/88
CHROMIUM	0.20	0.20	0.02	0.02	mg/l	03/03/88
COBALT	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/03/88
COPPER	< 0.10	< 0.10	0.01	0.02	mg/l	03/03/88
IRON	0.30	0.30	0.02	< 0.01	mg/l	03/03/88
LEAD	0.18	0.18	< 0.01	< 0.01	mg/l	03/03/88
LITHIUM	0.22	0.22	< 0.01	< 0.01	mg/l	03/03/88
MAGNESIUM	180	180			mg/l	03/03/88
MANGANESE	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/03/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	03/03/88
MOLYBDENUM	0.050	0.050	0.01	0.01	mg/l	03/03/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	03/03/88
POTASSIUM	38	40			mg/l	03/03/88
SELENIUM	< 0.50		< 0.005	< 0.005	mg/l	03/03/88
SILICA	5.0				mg/l	03/03/88
SILVER	0.020	0.020	< 0.01	< 0.01	mg/l	03/03/88
SODIUM	1420	1420			mg/l	03/03/88
STRONTIUM	9.5	9.7	< 0.01	< 0.01	mg/l	03/03/88
THALLIUM	< 0.0050		< 0.005	< 0.005	mg/l	03/03/88
TITANIUM	0.40	0.40	0.03	0.03	mg/l	03/03/88
VANADIUM	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	03/03/88
ZINC	< 0.010		< 0.01	< 0.01	mg/l	03/03/88

TABLE 2.6.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10	< 10	ug/l	03/03/88
BENZENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
2-BUTANONE	< 10		< 10	< 10	ug/l	03/03/88
BROMOFORM	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
CARBON DISULFIDE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
CARBON TETRACHLORIDE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
CHLOROBENZENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
CHLOROETHANE	< 10		< 10	< 10	ug/l	03/03/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10	< 10	ug/l	03/03/88
CHLOROFORM	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
1,1-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
1,2-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
ETHYLBENZENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
2-HEXANONE	< 10		< 10	< 10	ug/l	03/03/88
METHYL BROMIDE	< 10		< 10	< 10	ug/l	03/03/88
METHYL CHLORIDE	< 10		< 10	< 10	ug/l	03/03/88
4-METHYL-2-PENTANONE	< 10		< 10	< 10	ug/l	03/03/88
METHYLENE CHLORIDE	< 5.0		81	72	ug/l	03/03/88
STYRENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
TETRACHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
TOLUENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
TRICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	03/03/88
VINYL ACETATE	< 10		< 10	< 10	ug/l	03/03/88
VINYL CHLORIDE	< 10		< 10	< 10	ug/l	03/03/88
TOTAL XYLENES	< 5.0		< 5.0	< 5.0	ug/l	03/03/88

TABLE 2.6.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	03/03/88
ACENAPHTHYLENE	< 10		ug/l	03/03/88
ANTHRACENE	< 10		ug/l	03/03/88
BENZO(A)ANTHRACENE	< 10		ug/l	03/03/88
BENZO(A)PYRENE	< 10		ug/l	03/03/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	03/03/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	03/03/88
BENZOIC ACID	< 50		ug/l	03/03/88
BENZO(K)FLUORANTHENE	< 10		ug/l	03/03/88
BENZYL ALCOHOL	< 10		ug/l	03/03/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	03/03/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	03/03/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	03/03/88
BIS(2-ETHYLHEXYL)PHTHALATE	10		ug/l	03/03/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	03/03/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	03/03/88
4-CHLOROANILINE	< 10		ug/l	03/03/88
2-CHLORONAPHTHALENE	< 10		ug/l	03/03/88
2-CHLOROPHENOL	< 10		ug/l	03/03/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	03/03/88
CHRYSENE	< 10		ug/l	03/03/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	03/03/88
DIBENZOFURAN	< 10		ug/l	03/03/88
1,2-DICHLOROBENZENE	< 10		ug/l	03/03/88
1,3-DICHLOROBENZENE	< 10		ug/l	03/03/88
1,4-DICHLOROBENZENE	< 10		ug/l	03/03/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	03/03/88
2,4-DICHLOROPHENOL	< 10		ug/l	03/03/88
DIETHYL PHTHALATE	< 10		ug/l	03/03/88
2,4-DIMETHYLPHENOL	< 10		ug/l	03/03/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	03/03/88
2,4-DINITROPHENOL	< 50		ug/l	03/03/88
DIMETHYL PHTHALATE	< 10		ug/l	03/03/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	03/03/88
2,4-DINITROTOLUENE	< 10		ug/l	03/03/88
2,6-DINITROTOLUENE	< 10		ug/l	03/03/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	03/03/88

TABLE 2.6.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	03/03/88
FLUORENE	< 10		ug/l	03/03/88
HEXACHLOROBENZENE	< 10		ug/l	03/03/88
HEXACHLOROBUTADIENE	< 10		ug/l	03/03/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	03/03/88
HEXACHLOROETHANE	< 10		ug/l	03/03/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	03/03/88
ISOPHORONE	< 10		ug/l	03/03/88
2-METHYLNAPHTHALENE	< 10		ug/l	03/03/88
2-METHYLPHENOL	< 10		ug/l	03/03/88
4-METHYLPHENOL	< 10		ug/l	03/03/88
NAPHTHALENE	< 10		ug/l	03/03/88
2-NITROANILINE	< 50		ug/l	03/03/88
3-NITROANILINE	< 50		ug/l	03/03/88
4-NITROANILINE	< 50		ug/l	03/03/88
NITROBENZENE	< 10		ug/l	03/03/88
2-NITROPHENOL	< 10		ug/l	03/03/88
4-NITROPHENOL	< 50		ug/l	03/03/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	03/03/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	03/03/88
P-CHLORO-M-CRESOL	< 10		ug/l	03/03/88
PENTACHLOROPHENOL	< 50		ug/l	03/03/88
PHENANTHRENE	< 10		ug/l	03/03/88
PHENOL	< 10		ug/l	03/03/88
PYRENE	< 10		ug/l	03/03/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	03/03/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	03/03/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	03/03/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	03/03/88

TABLE 2.6.3

UNC LABORATORY ANALYSIS
H-05c MAGENTA ROUND TWO

DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	1.28		cc/l (STP)	03/03/88
OXYGEN	< 0.05		cc/l (STP)	03/03/88
NITROGEN	15.20		cc/l (STP)	03/03/88
CARBON DIOXIDE	0.469		cc/l (STP)	03/03/88
METHANE	0.222		cc/l (STP)	03/03/88
ETHANE	0.002		cc/l (STP)	03/03/88
C-3	< 0.001		cc/l (STP)	03/03/88
C-4	< 0.001		cc/l (STP)	03/03/88
C-5	< 0.001		cc/l (STP)	03/03/88
C-6	< 0.001		cc/l (STP)	03/03/88
SUM OF CO2	17.00		cc/l (STP)	03/03/88
TOTAL GAS	17.200		cc/l (STP)	03/03/88
AMMONIA	0.92	0.91	mg/l	03/03/88
NITRATE	0.80	0.80	mg/l	03/03/88
TOTAL IRON	0.860		mg/l	03/03/88
FERROUS IRON	0.72	0.72	mg/l	03/03/88
TOTAL ARSENIC	0.0010		mg/l	03/03/88
ARSENIC III	< 0.0010		mg/l	03/03/88
TOTAL SELENIUM	< 0.001		mg/l	03/03/88
IODIDE	290		ug/l	03/03/88
IODATE	17	19	ug/l	03/03/88

TABLE 2.6.4

PRESSURE AND FLOW
H-05c MAGENTA ROUND TWO

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
02/24/88	15:25	103	186	00	PUMP NOT TURNED ON
02/24/88	15:40	104	78	21	PUMP ON 15:30
02/24/88	15:45	33	101	14	FLOW REDUCED
02/24/88	15:50	103	105	14	
02/24/88	15:55	103	105	14	
02/24/88	16:00	103	102	14	
02/25/88	08:30	102	81	13	FLOW REDUCED 08:45
02/25/88	14:30	102	105	09	
02/26/88	08:10	101	103	09	
02/26/88	14:00	102	110	07	
02/27/88	06:50	102	109	08	
02/27/88	10:30	102	88	09	FLOW/PSI #2 10:35
02/27/88	17:35	101	97	09	
02/28/88	09:30	101	86	10	
02/28/88	17:30	101	76	11	
02/29/88	07:30	101	67	11	
02/29/88	15:30	101	71	11	
03/01/88	07:30	101	65	11	
03/01/88	17:30	100	76	09	
03/02/88	06:30	100	79	09	
03/02/88	18:30	101	76	10	
03/03/88	07:30	101	75	10	
03/03/88	12:30	101	76	10	PUMP OFF 12:33

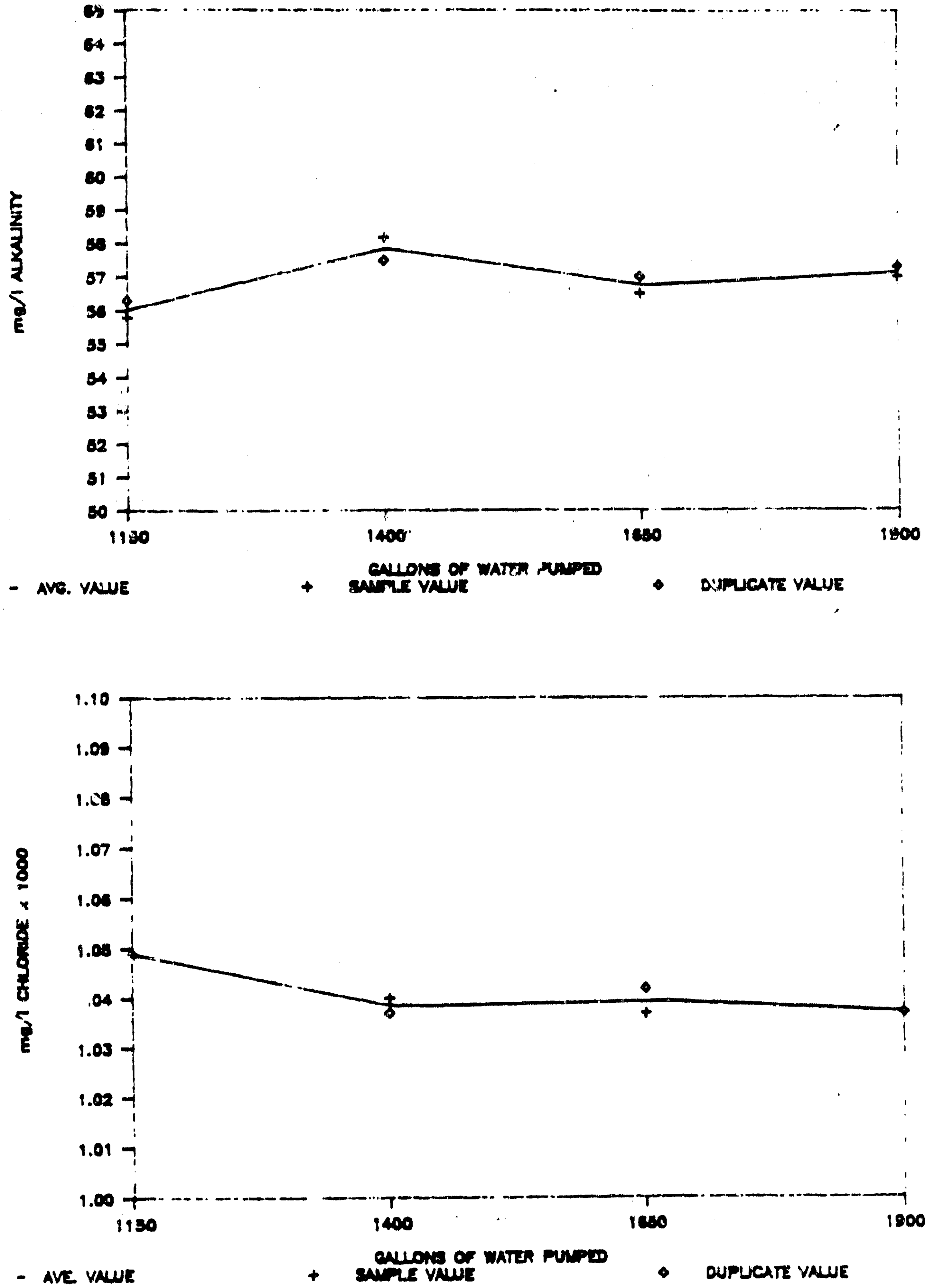
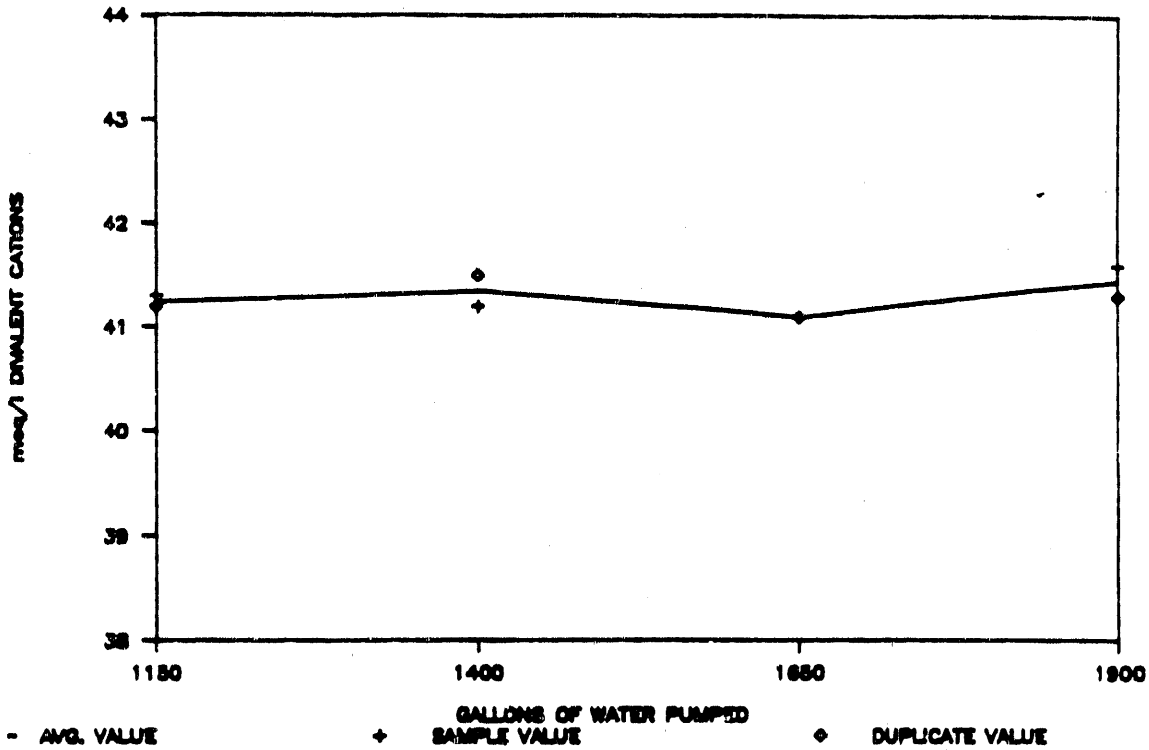


Figure 2.6.1. Graphs of alkalinity and chloride from second round serial sampling at well H-05c Culebra.



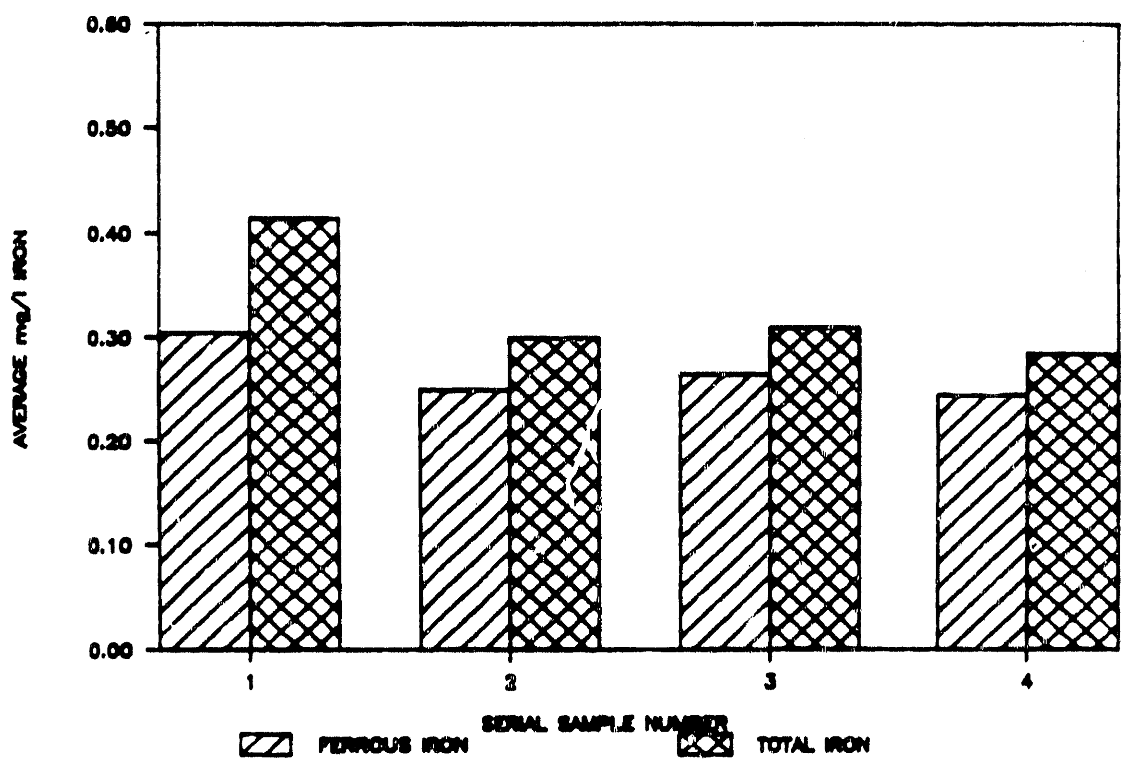


Figure 2.6.2. Graphs of divalent cations and iron from second round serial sampling at well H-05c Culebra.

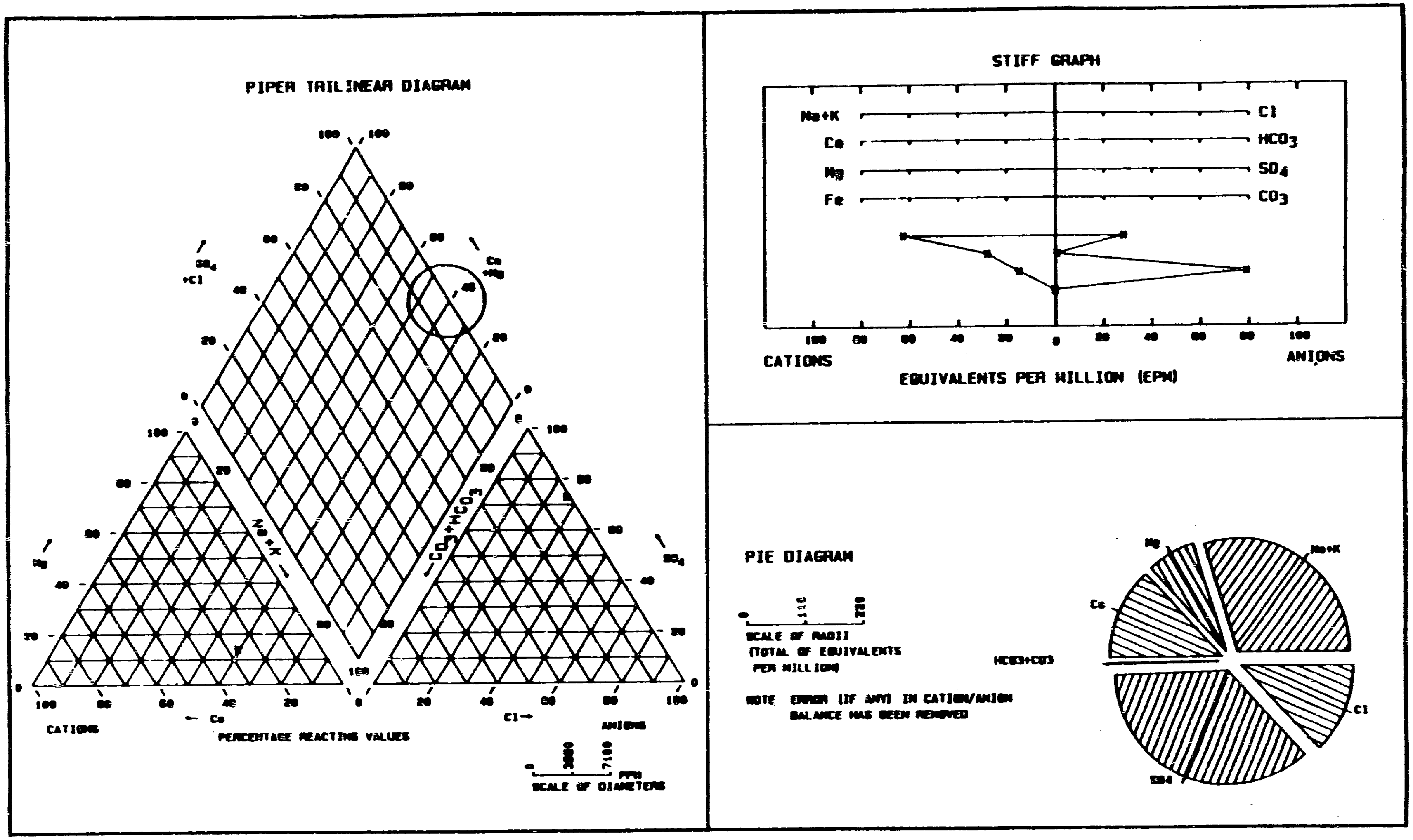


Figure 2.6.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from second round serial sampling at well H-05c Magenta.

2.7 SUMMARY OF CULEBRA WELL P-14, ROUND THREE

Well Characteristics

Well P-14 is located approximately 2.5 miles west of the center of the WIPP site at an elevation of 3,361 feet above MSL, to the top of the casing (Gonzales, 1989). Total depth of the drilled hole was 1,545 feet BGS. The well is cased to a depth of 775 feet BGS and plugged back to a depth of 759 feet BGS. The well is perforated in two intervals accessing the Culebra Dolomite and the base of the Rustler Formation. A bridge plug is set at 652 feet BGS. Consequently, only the Culebra Dolomite is presently accessible. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 573 to 595 feet BGS (Jones, 1978).

Sampling Process

This well was sampled using a Bennett model piston pump. An inflatable packer was not set in the well. The pump intake was set at a depth of 589 feet BTOC.

Pumping began on 03/08/88 and ceased on 03/16/88. The average flow rate was approximately 30 gph during the sampling period. Serial sampling began on 03/11/88 after approximately 2,100 gallons of water had been pumped from the well. Five serial samples were collected and analyzed. Serial samples were taken consecutively except for a one-day hiatus on 03/14/88 when an air compressor failed and had to be replaced. Pumping stopped for approximately 5 hours while work on the compressor was in progress. Serial sampling ended and final samples were collected on 03/16/88, after approximately 5,550 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity remaining fairly constant between 105 and 108 mg/l (Figure 2.7.1).

Chloride values remained nearly constant between 14,000 and 15,000 mg/l (Figure 2.7.1).

Divalent cations were stable between 254 and 257 meq/l (Figure 2.7.2).

Total iron concentrations varied slightly from approximately 2.1 to 1.6 mg/1 over the course of the sampling period. Ferrous iron values ranged between approximately 2.0 and 1.5 mg/1 (Figure 2.7.2).

The water pH value was 6.9 SU on the final day of serial sampling.

Physical Parameters

The water Eh value ranged between 168 and 182 mV relative to the SHE.

The average water temperature was 21.5°C.

Specific gravity was stable at 1.020 at 21.0°C.

Specific conductance remained at approximately 39,500 umhos/cm at 25°C over the course of the sampling period.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were collected following the procedures outlined in the WIPP Geotechnical and Geosciences Procedures Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD

General Observations

The water from this well was slightly effervescent.

Some fine-grained particulate matter was observed on the 0.45-um filters employed during the sampling.

Tabular data are presented in Tables 2.7.1, 2.7.2, 2.7.3, and 2.7.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data respectively.

Figures 2.7.1 and 2.7.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.7.3 illustrates the general water quality at well P-14 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds are not present in the Rustler Formation, neither above nor below the Culebra Dolomite, in the vicinity of well P-14 (Mercer, 1983).

<u>Serial Parameter Comparisons With The Previous Rounds</u>

Data from the round three serial sampling episode agree favorably with data from the previous rounds. Eh values for round three are comparable to the round one data, which ranged from 150 to 185 mV relative to the SHE, but differ from the round two data which ranged from approximately 40 to 100 mV relative to the SHE. Values for total and ferrous iron were slightly lower for round three than for round one, and approximately 20% less than the round two data. Analytical results for all other field parameters have been reproducible during all three rounds of sampling.

Pump flow rates and purge volumes have varied between the three sampling episodes. The round one flow rate averaged 34 gph, round two, 18 gph, and round three was 30 gph. Purge volumes were 6,450, 3,300, and 5,550 gallons for rounds one, two, and three respectively. Serial sampling during the round one and three episodes did not utilize an inflatable packer, while a packer was utilized in the well during round two.

TABLE 2.7.1

SERIAL SAMPLE CHEMISTRY
P-14 CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	108	106	mg/l	2100	03/11/88
2	ALKALINITY	106	106	mg/l	2750	03/12/88
3	ALKALINITY	105	105	mg/l	3450	03/13/88
4	ALKALINITY	108	107	mg/l	4800	03/15/88
5	ALKALINITY	107	107	mg/l	5550	03/16/88
1	CHLORIDE	14400	14500	mg/l	2100	03/11/88
2	CHLORIDE	14400	14300	mg/l	2750	03/12/88
3	CHLORIDE	14700	14600	mg/l	3450	03/13/88
4	CHLORIDE	14600	14500	mg/l	4800	03/15/88
5	CHLORIDE	14700	14600	mg/l	5550	03/16/88
1	DIVALENT CATIONS	254	255	meq/l	2100	03/11/88
2	DIVALENT CATIONS	256	256	meq/l	2750	03/12/88
3	DIVALENT CATIONS	254	256	meq/l	3450	03/13/88
4	DIVALENT CATIONS	257	256	meq/l	4800	03/15/88
5	DIVALENT CATIONS	256	256	meq/l	5550	03/16/88
1	TOTAL IRON	2.13	2.12	mg/l	2100	03/11/88
2	TOTAL IRON	1.65	1.66	mg/l	2750	03/12/88
3	TOTAL IRON	1.99	1.96	mg/l	3450	03/13/88
4	TOTAL IRON	1.91	1.93	mg/l	4800	03/15/88
5	TOTAL IRON	2.04	1.95	mg/l	5550	03/16/88
1	FERROUS IRON	1.95	1.99	mg/l	2100	03/11/88
2	FERROUS IRON	1.48	1.52	mg/l	2750	03/12/88
3	FERROUS IRON	1.89	1.91	mg/l	3450	03/13/88
4	FERROUS IRON	1.85	1.81	mg/l	4800	03/15/88
5	FERROUS IRON	1.88	1.88	mg/l	5550	03/16/88
1	pH	6.9			2100	03/11/88
3	pH	7.0			3450	03/13/88
4	pH	6.9			4800	03/15/88
5	pH	6.9			5550	03/16/88

TABLE 2.7.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	Eh	168		mV	2100	03/11/88
3	Eh	168		mV	3450	03/13/88
4	Eh	176		mV	4800	03/15/88
5	Eh	182		mV	5550	03/16/88
1	TEMPERATURE	21.7		C	2100	03/11/88
3	TEMPERATURE	21.2		C	3450	03/13/88
4	TEMPERATURE	21.4		C	4800	03/15/88
5	TEMPERATURE	21.8		C	5550	03/16/88
1	SPECIFIC GRAVITY	1.020		@ 22.0 C	2100	03/11/88
5	SPECIFIC GRAVITY	1.020		@ 21.0 C	5550	03/16/88
1	SPECIFIC CONDUCTANCE	39600	@ 25 C	umhos/cm	2100	03/11/88
5	SPECIFIC CONDUCTANCE	39500	@ 25 C	umhos/cm	5550	03/16/88

TABLE 2.7.2

ITAS LABORATORY RESULTS
P-14 CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	100		mg/l	03/16/88
ALKALINITY (CO3)	0		mg/l	03/16/88
BROMIDE	16		mg/l	03/16/88
CHLORIDE	14300		mg/l	03/16/88
CYANIDE, TOTAL	< 0.02		mg/l	03/16/88
FLUORIDE	1.2		mg/l	03/16/88
IODIDE	< 2.0	< 2.0	mg/l	03/16/88
NITRATE	0.03		mg/l NO3-N	03/16/88
pH	6.68	6.72		03/16/88
PHENOLICS	< 0.005		mg/l	03/16/88
PHOSPHATE, TOTAL	< 0.02	< 0.02	mg/l T-PO4-P	03/16/88
RESIDUE, FILTERABLE @180 C	29400	28800	mg/l	03/16/88
RESIDUE, NONFILTERABLE @105 C	< 4	< 4	mg/l	03/16/88
SPECIFIC CONDUCTANCE	36000	36000	umhos/cm@25C	03/16/88
SULFATE	1600		mg/l	03/16/88
TOTAL ORGANIC CARBON	2.0	1.0	mg/l	03/16/88
TOTAL ORGANIC HALOGEN	0.25	0.41	mg/l	03/16/88

TABLE 2.7.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	03/16/88
ANTIMONY	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	03/16/88
ARSENIC	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/16/88
BARIUM	< 0.10	< 0.010	0.01	0.01	mg/l	03/16/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/16/88
BORON	0.70	0.70	< 0.01	< 0.01	mg/l	03/16/88
CADMIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/16/88
CALCIUM	3400	3400			mg/l	03/16/88
CESIUM	< 0.020	< 0.020	< 0.01	< 0.01	mg/l	03/16/88
CHROMIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/16/88
COBALT	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/16/88
COPPER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/16/88
IRON	1.7	1.8	< 0.01	< 0.01	mg/l	03/16/88
LEAD	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	03/16/88
LITHIUM	0.50	0.51	< 0.01	< 0.01	mg/l	03/16/88
MAGNESIUM	880	870			mg/l	03/16/88
MANGANESE	0.31	0.30	< 0.005	< 0.005	mg/l	03/16/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	03/16/88
MOLYBDENUM	0.080	0.070	0.01	0.01	mg/l	03/16/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	03/16/88
POTASSIUM	48	48			mg/l	03/16/88
SELENIUM	< 0.50	< 0.50	< 0.005	< 0.005	mg/l	03/16/88
SILICA	14	14			mg/l	03/16/88
SILVER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/16/88
SODIUM	4600	4600			mg/l	03/16/88
STRONTIUM	55	55	< 0.01	< 0.01	mg/l	03/16/88
THALLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/16/88
TITANIUM	0.50	0.60	< 0.03	< 0.03	mg/l	03/16/88
VANADIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/16/88
ZINC	0.20	0.10	< 0.01	< 0.01	mg/l	03/16/88

TABLE 2.7.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10	< 10	ug/l	03/16/88
BENZENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
2-BUTANONE	< 10		< 10	< 10	ug/l	03/16/88
BROMOFORM	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
CARBON DISULFIDE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
CARBON TETRACHLORIDE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
CHLOROBENZENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
CHLOROETHANE	< 10		< 10	< 10	ug/l	03/16/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10	< 10	ug/l	03/16/88
CHLOROFORM	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
1,1-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
1,2-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
ETHYLBENZENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
2-HEXANONE	< 10		< 10	< 10	ug/l	03/16/88
METHYL BROMIDE	< 10		< 10	< 10	ug/l	03/16/88
METHYL CHLORIDE	< 10		< 10	< 10	ug/l	03/16/88
4-METHYL-2-PENTANONE	< 10		< 10	< 10	ug/l	03/16/88
METHYLENE CHLORIDE	< 5.0		31	32	ug/l	03/16/88
STYRENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
TETRACHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
TOLUENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
TRICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	03/16/88
VINYL ACETATE	< 10		< 10	< 10	ug/l	03/16/88
VINYL CHLORIDE	< 10		< 10	< 10	ug/l	03/16/88
TOTAL XYLENES	< 5.0		< 5.0	< 5.0	ug/l	03/16/88

TABLE 2.7.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	03/16/88
ACENAPHTHYLENE	< 10		ug/l	03/16/88
ANTHRACENE	< 10		ug/l	03/16/88
BENZO(A)ANTHRACENE	< 10		ug/l	03/16/88
BENZO(A)PYRENE	< 10		ug/l	03/16/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	03/16/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	03/16/88
BENZOIC ACID	< 50		ug/l	03/16/88
BENZO(K)FLUORANTHENE	< 10		ug/l	03/16/88
BENZYL ALCOHOL	< 10		ug/l	03/16/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	03/16/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	03/16/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	03/16/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	03/16/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	03/16/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	03/16/88
4-CHLOROANILINE	< 10		ug/l	03/16/88
2-CHLORONAPHTHALENE	< 10		ug/l	03/16/88
2-CHLOROPHENOL	< 10		ug/l	03/16/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	03/16/88
CHRYSENE	< 10		ug/l	03/16/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	03/16/88
DIBENZOFURAN	< 10		ug/l	03/16/88
1,2-DICHLOROBENZENE	< 10		ug/l	03/16/88
1,3-DICHLOROBENZENE	< 10		ug/l	03/16/88
1,4-DICHLOROBENZENE	< 10		ug/l	03/16/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	03/16/88
2,4-DICHLOROPHENOL	< 10		ug/l	03/16/88
DIETHYL PHTHALATE	< 10		ug/l	03/16/88
2,4-DIMETHYLPHENOL	< 10		ug/l	03/16/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	03/16/88
2,4-DINITROPHENOL	< 50		ug/l	03/16/88
DIMETHYL PHTHALATE	< 10		ug/l	03/16/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	03/16/88
2,4-DINITROTOLUENE	< 10		ug/l	03/16/88
2,6-DINITROTOLUENE	< 10		ug/l	03/16/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	03/16/88

TABLE 2.7.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	03/16/88
FLUORENE	< 10		ug/l	03/16/88
HEXACHLOROBENZENE	< 10		ug/l	03/16/88
HEXACHLOROBUTADIENE	< 10		ug/l	03/16/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	03/16/88
HEXACHLOROETHANE	< 10		ug/l	03/16/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	03/16/88
ISOPHORONE	< 10		ug/l	03/16/88
2-METHYLNAPHTHALENE	< 10		ug/l	03/16/88
2-METHYLPHENOL	< 10		ug/l	03/16/88
4-METHYLPHENOL	< 10		ug/l	03/16/88
NAPHTHALENE	< 10		ug/l	03/16/88
2-NITROANILINE	< 50		ug/l	03/16/88
3-NITROANILINE	< 50		ug/l	03/16/88
4-NITROANILINE	< 50		ug/l	03/16/88
NITROBENZENE	< 10		ug/l	03/16/88
2-NITROPHENOL	< 10		ug/l	03/16/88
4-NITROPHENOL	< 50		ug/l	03/16/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	03/16/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	03/16/88
P-CHLORO-M-CRESOL	< 10		ug/l	03/16/88
PENTACHLOROPHENOL	< 50		ug/l	03/16/88
PHENANTHRENE	< 10		ug/l	03/16/88
PHENOL	< 10		ug/l	03/16/88
PYRENE	< 10		ug/l	03/16/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	03/16/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	03/16/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	03/16/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	03/16/88

TABLE 2.7.3

UNC LABORATORY ANALYSIS
P-14 CULEBRA ROUND THREE

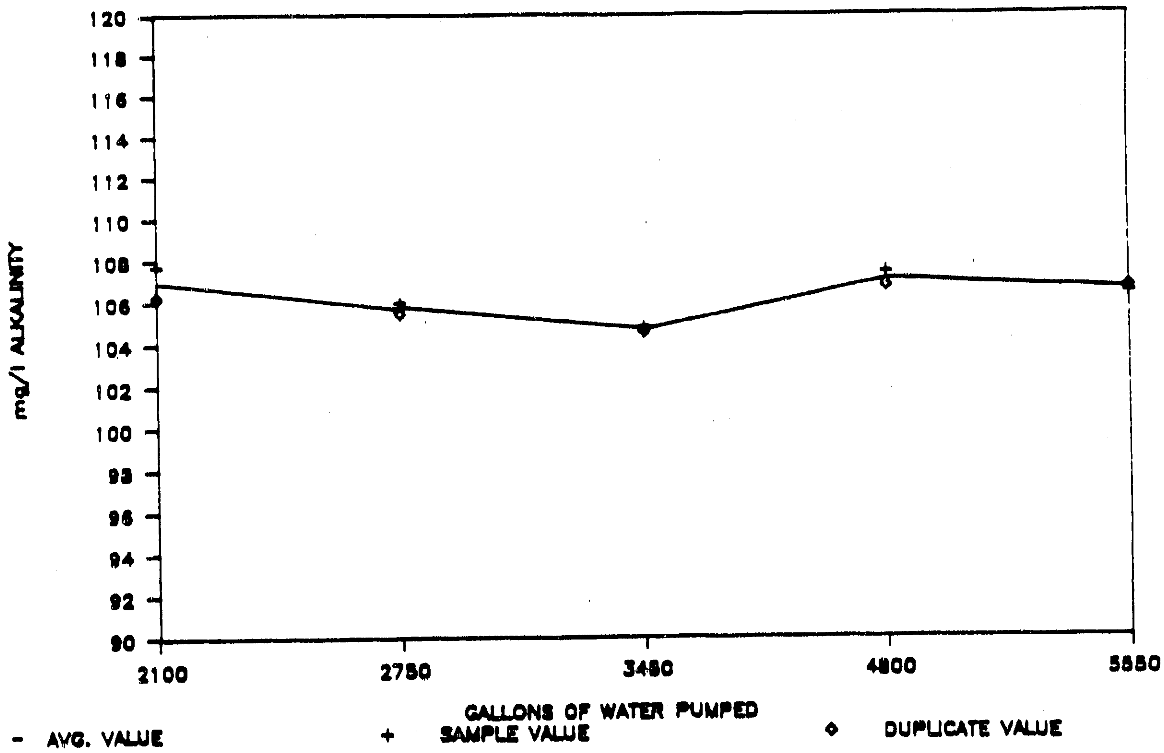
DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	< 0.05		cc/l (STP)	03/16/88
OXYGEN	< 0.05		cc/l (STP)	03/16/88
NITROGEN	11.80		cc/l (STP)	03/16/88
CARBON MONOXIDE	< 0.001		cc/l (STP)	03/16/88
CARBON DIOXIDE	5.570		cc/l (STP)	03/16/88
METHANE	0.321		cc/l (STP)	03/16/88
ETHANE	< 0.001		cc/l (STP)	03/16/88
C-3	< 0.001		cc/l (STP)	03/16/88
C-4	< 0.001		cc/l (STP)	03/16/88
C-5	< 0.001		cc/l (STP)	03/16/88
C-6	< 0.001		cc/l (STP)	03/16/88
SUM OF CO2	45.30		cc/l (STP)	03/16/88
TOTAL GAS	17.700		cc/l (STP)	03/16/88
AMMONIA	0.35	0.39	mg/l	03/16/88
NITRATE	< 1.00	< 1.00	mg/l	03/16/88
TOTAL IRON	2.460		mg/l	03/16/88
FERROUS IRON	2.35	2.37	mg/l	03/16/88
TOTAL ARSENIC	0.0010		mg/l	03/16/88
ARSENIC III	< 0.0010		mg/l	03/16/88
TOTAL SELENIUM	< 0.001		mg/l	03/16/88
IODIDE	570		ug/l	03/16/88
IODATE	< 15		ug/l	03/16/88

TABLE 2.7.4

PRESSURE AND FLOW
P-14 CULEBRA ROUND THREE

DATE	TIME	PSI TOP OF PUMP	GPH FLOW RATE	COMMENTS
03/08/88	10:00	117	00	PUMP OFF
03/08/88	10:15	99	30	PUMP ON 10:05
03/08/88	10:30	83	30	
03/08/88	10:45	70	32	
03/08/88	11:00	61	31	
03/08/88	19:00	109	31	BUBBLER REPAIRED
03/09/88	07:00	109	00	FROZEN AIRLINE
03/09/88	07:48	110	29	PUMP ON
03/09/88	08:00	109	28	
03/09/88	14:00	110	29	
03/10/88	07:30	109	29	
03/10/88	16:00	110	30	
03/11/88	08:00	109	29	
03/11/88	15:30	110	30	
03/12/88	06:00	109	30	
03/12/88	16:00	110	30	
03/13/88	09:45	110	29	
03/13/88	17:45	110	29	
03/14/88	07:30	109	28	
03/14/88	16:30	110	31	
03/15/88	07:30	109	31	
03/15/88	14:30	110	30	
03/16/88	07:00	109	29	
03/16/88	12:00	110	33	PUMP OFF 12:05



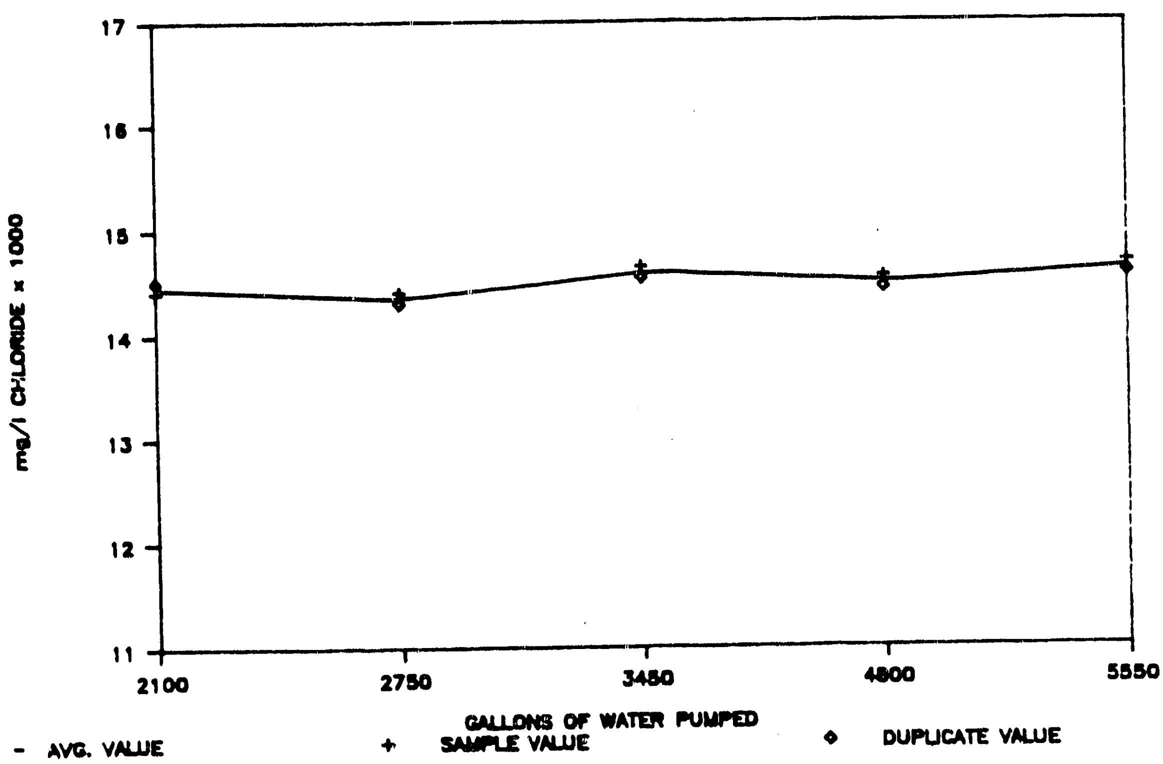
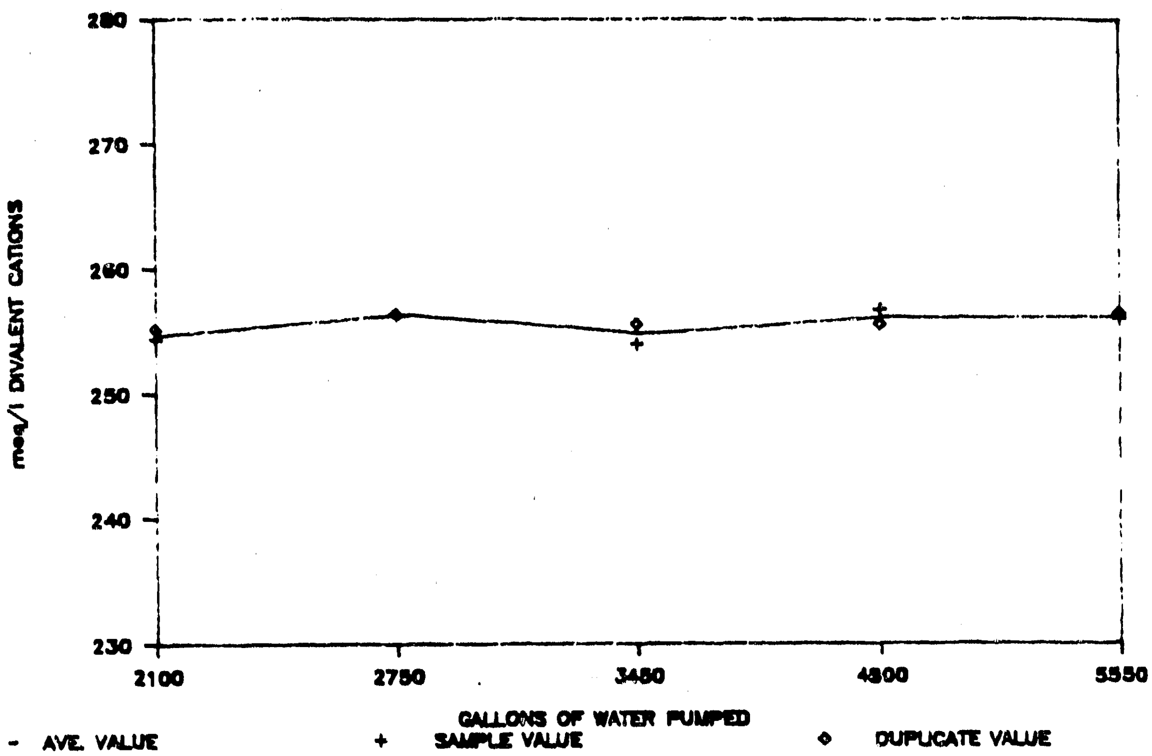


Figure 2.7.1. Graphs of alkalinity and chloride from second round serial sampling at well P-14 Culebra.



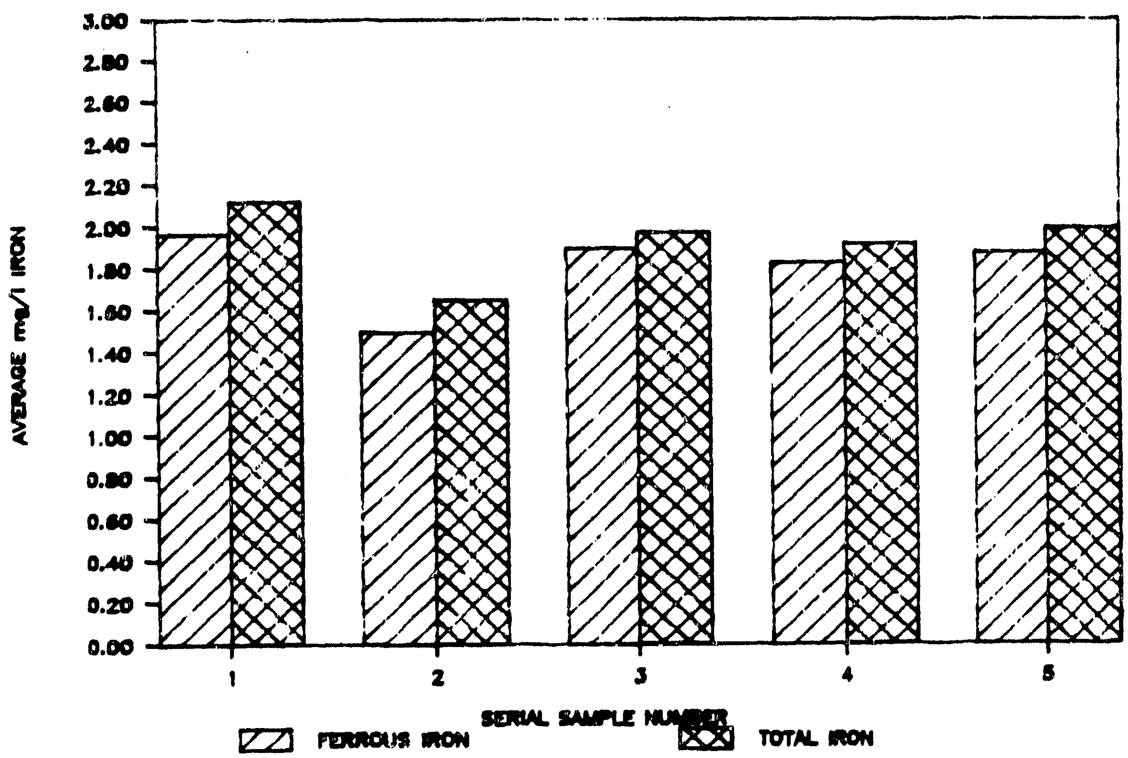


Figure 2.7.2. Graphs of divalent cations and iron from second round serial sampling at well P-14 Culebra.

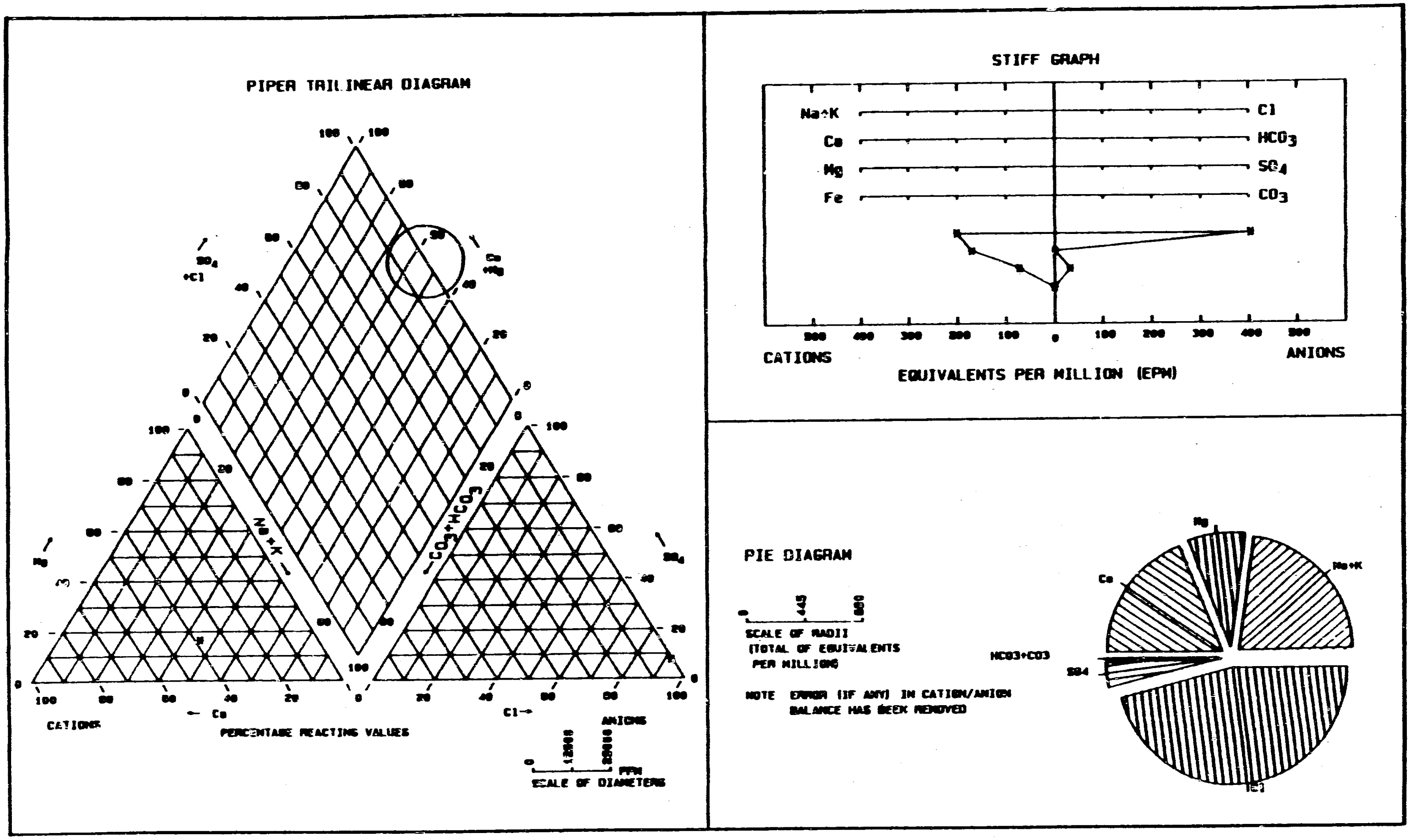


Figure 2.7.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well P-14 Culebra.

2.8 SUMMARY OF CULEBRA WELL WIPP-25, ROUND THREE

Well Characteristics

Well WIPP-25 is located approximately 4.8 miles northwest of the center of the WIPP site at an elevation of 3,214 feet above MSL, to the top of the casing (Gonzales, 1989). Total depth of the drilled hole was 651 feet BGS. The hole is cased to a depth of 648 feet BGS with the remaining three feet being plugged off. The casing is perforated in three zones accessing the Magenta and Culebra Dolomites, and the base of the Rustler Formation. A bridge plug is installed at 573 feet BGS. Consequently, only the Magenta and Culebra Dolomites are presently accessible. A retrievable production-injection packer (PIP) is installed at 359 feet BGS to prevent mixing of Magenta and Culebra fluids. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 447 to 472 feet BGS (Sandia Laboratories and U.S. Geological Survey, 1979a).

Sampling Process

This well was sampled using an electric submersible pump. A Baski inflatable packer was installed, after removal of the PIP, isolating the pump intake from the overlying Magenta Dolomite and stagnant water in the well bore. The pump intake was set at a depth of 433 feet BTOC.

Pumping began on 03/17/88 and ceased on 03/28/88. The average flow rate for the first five days of pumping was approximately 4.1 gpm. The pump flow rate was decreased and serial sampling began on 03/22/88, after approximately 25,000 gallons of water had been pumped from the well. The average flow rate during the sampling episode was approximately 2.7 gpm. One serial sample was taken each day for seven consecutive days. Serial sampling ended and final samples were collected on 03/28/88 after approximately 48,000 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity remaining fairly constant between 124 and 126 mg/l (Figure 2.8.1).

Chloride content was nearly constant ending at approximately 6,400 mg/l (Figure 2.8.1).

Divalent cations fluctuated between approximately 80 and 90 meq/l (Figure 2.8.2).

Total iron concentrations remained between approximately 0.6 and 0.8 mg/l for the entire sampling period. Ferrous iron remained between approximately 0.4 and 0.7 mg/l (Figure 2.8.2).

The water pH was 7.2 SU on the final day of sampling.

Physical Parameters

The Eh measurements ranged between 164 and 175 mV relative to the SHE.

The average water temperature was 23.2°C.

Specific gravity was reported as 1.010 at 22.0°C on the final day of serial sampling.

Specific conductance was approximately 21,000 umhos/cm at 25°C during the course of serial sampling.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were taken following procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sardia National Laboratories, and the EEG. Samples collected for radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from this well was not effervescent.

Some fine-grained particulate matter was observed on the 0.45-um filters employed during sampling. The amount of particulates decreased as pumping progressed.

Tabular data are presented in Tables 2.8.1, 2.8.2, 2.8.3, and 2.8.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.8.1 and 2.8.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.8.3 illustrates the general water quality at well WIPP-25 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds are not present in the Rustler Formation, neither above nor below the Culebra Dolomite, in the vicinity of well WIPP-25 (Mercer, 1983).

No problems were encountered while sampling well WIPP-25.

Serial Parameter Comparisons With The Previous Rounds

Comparisons of the round three data with data from the previous rounds of sampling agree favorably with regards to most parameters. Total iron was slightly variable and showed an increase during the third round as compared to rounds two and one. All other parameters were nearly identical on the last day of sampling for all three rounds.

During the round one sampling the average flow rate was 7.1 gpm. The round two sampling averaged 5.4 gpm. And during this round three sampling the flow rate averaged 2.8 gpm during the sampling episode. Prior to final sampling, the total volume purged from the well was approximately 164,500 gallons for round one, 53,500 gallons for round two, and 48,000 gallons for round three.

TABLE 2.8.1

SERIAL SAMPLE CHEMISTRY
WIPP-25 CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	125	125	mg/l	25000	03/22/88
2	ALKALINITY	125	126	mg/l	29000	03/23/88
3	ALKALINITY	124	124	mg/l	33000	03/24/88
4	ALKALINITY	125	125	mg/l	37000	03/25/88
5	ALKALINITY	126	126	mg/l	40000	03/26/88
6	ALKALINITY	124	124	mg/l	44000	03/27/88
7	ALKALINITY	124	125	mg/l	48000	03/28/88
1	CHLORIDE	6410	6450	mg/l	25000	03/22/88
2	CHLORIDE	6410	6390	mg/l	29000	03/23/88
3	CHLORIDE	6500	6500	mg/l	33000	03/24/88
4	CHLORIDE	6410	6440	mg/l	37000	03/25/88
5	CHLORIDE	6420	6390	mg/l	40000	03/26/88
6	CHLORIDE	6420	6390	mg/l	44000	03/27/88
7	CHLORIDE	6410	6400	mg/l	48000	03/28/88
1	DIVALENT CATIONS	82.4	82.1	meq/l	25000	03/22/88
2	DIVALENT CATIONS	82.2	82.1	meq/l	29000	03/23/88
3	DIVALENT CATIONS	88.8	88.2	meq/l	33000	03/24/88
4	DIVALENT CATIONS	82.7	83.6	meq/l	37000	03/25/88
5	DIVALENT CATIONS	82.1	82.1	meq/l	40000	03/26/88
6	DIVALENT CATIONS	84.0	83.6	meq/l	44000	03/27/88
7	DIVALENT CATIONS	83.1	82.4	meq/l	48000	03/28/88
1	TOTAL IRON	0.61	0.59	mg/l	25000	03/22/88
2	TOTAL IRON	0.68	0.73	mg/l	29000	03/23/88
3	TOTAL IRON	0.65	0.66	mg/l	33000	03/24/88
4	TOTAL IRON	0.65	0.64	mg/l	37000	03/25/88
5	TOTAL IRON	0.61	0.63	mg/l	40000	03/26/88
6	TOTAL IRON	0.73	0.72	mg/l	44000	03/27/88
7	TOTAL IRON	0.72	0.73	mg/l	48000	03/28/88
1	FERROUS IRON	0.50	0.51	mg/l	25000	03/22/88
2	FERROUS IRON	0.61	0.65	mg/l	29000	03/23/88
3	FERROUS IRON	0.64	0.63	mg/l	33000	03/24/88
4	FERROUS IRON	0.61	0.56	mg/l	37000	03/25/88
5	FERROUS IRON	0.56	0.56	mg/l	40000	03/26/88
6	FERROUS IRON	0.44	0.44	mg/l	44000	03/27/88
7	FERROUS IRON	0.68	0.70	mg/l	48000	03/28/88

TABLE 2.8.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	7.2			25000	03/22/88
2	pH	7.2			29000	03/23/88
3	pH	7.2			33000	03/24/88
4	pH	7.2			37000	03/25/88
6	pH	7.2			44000	03/27/88
7	pH	7.2			48000	03/28/88
1	Eh	175		mV	25000	03/22/88
2	Eh	174		mV	29000	03/23/88
3	Eh	174		mV	33000	03/24/88
4	Eh	164		mV	37000	03/25/88
6	Eh	173		mV	44000	03/27/88
7	Eh	169		mV	48000	03/28/88
1	TEMPERATURE	23.5		C	25000	03/22/88
2	TEMPERATURE	23.3		C	29000	03/23/88
3	TEMPERATURE	23.5		C	33000	03/24/88
4	TEMPERATURE	23.2		C	37000	03/25/88
6	TEMPERATURE	22.7		C	44000	03/27/88
7	TEMPERATURE	23.2		C	48000	03/28/88
1	SPECIFIC GRAVITY	1.010		@ 22.1 C	25000	03/22/88
5	SPECIFIC GRAVITY	1.010		@ 18.4 C	40000	03/26/88
7	SPECIFIC GRAVITY	1.010		@ 22.0 C	48000	03/28/88
1	SPECIFIC CONDUCTANCE	20900	@ 25 C	umhos/cm	25000	03/22/88
7	SPECIFIC CONDUCTANCE	21400	@ 25 C	umhos/cm	48000	03/28/88

TABLE 2.8.2

ITAS LABORATORY RESULTS
WIPP-25 CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	130		mg/l	03/28/88
ALKALINITY (CO3)	0		mg/l	03/28/88
BROMIDE	4	4	mg/l	03/28/88
CHLORIDE	6500		mg/l	03/28/88
CYANIDE, TOTAL	< 0.02		mg/l	03/28/88
FLUORIDE	1.5		mg/l	03/28/88
IODIDE	< 2.0		mg/l	03/28/88
NITRATE	2.60		mg/l NO3-N	03/28/88
pH	7.00	7.04		03/28/88
PHENOLICS	0.106		mg/l	03/28/88
PHOSPHATE, TOTAL	0.03		mg/l T-PO4-P	03/28/88
RESIDUE, FILTERABLE @180 C	14800		mg/l	03/28/88
RESIDUE, NONFILTERABLE @105 C	29	24	mg/l	03/28/88
SPECIFIC CONDUCTANCE	21900	22000	umhos/cm@25C	03/28/88
SULFATE	2600		mg/l	03/28/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	03/28/88
TOTAL ORGANIC HALOGEN	< 0.05	< 0.05	mg/l	03/28/88

TABLE 2.8.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	03/28/88
ANTIMONY	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	03/28/88
ARSENIC	< 0.0050		< 0.005	< 0.005	mg/l	03/28/88
BARIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/28/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/28/88
BORON	1.8	1.8	< 0.01	< 0.01	mg/l	03/28/88
CADMIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	03/28/88
CALCIUM	1100	1100			mg/l	03/28/88
CESIUM	0.010	0.010	< 0.01	< 0.01	mg/l	03/28/88
CHROMIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/28/88
COBALT	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/28/88
COPPER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/28/88
IRON	0.80	0.80	< 0.01	< 0.01	mg/l	03/28/88
LEAD	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	03/28/88
LITHIUM	0.26	0.26	< 0.01	< 0.01	mg/l	03/28/88
MAGNESIUM	330	330			mg/l	03/28/88
MANGANESE	0.13	0.13	< 0.005	< 0.005	mg/l	03/28/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	03/28/88
MOLYBDENUM	< 1.0	< 1.0	< 0.01	< 0.01	mg/l	03/28/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	03/28/88
POTASSIUM	150	150			mg/l	03/28/88
SELENIUM	< 0.50		< 0.005	< 0.005	mg/l	03/28/88
SILICA	13	13			mg/l	03/28/88
SILVER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/28/88
SODIUM	3300	3300			mg/l	03/28/88
STRONTIUM	19	19	< 0.01	< 0.01	mg/l	03/28/88
THALLIUM	< 5.0		< 0.005	< 0.005	mg/l	03/28/88
TITANIUM	0.30	0.30	< 0.03	< 0.03	mg/l	03/28/88
VANADIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/28/88
ZINC	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	03/28/88

TABLE 2.8.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	(10		(10	(10	ug/l	03/28/88
BENZENE	(5.0		(5.0	(5.0	ug/l	03/28/88
2-BUTANONE	(10		(10	(10	ug/l	03/28/88
BROMOFORM	(5.0		(5.0	(5.0	ug/l	03/28/88
CARBON DISULFIDE	(5.0		(5.0	(5.0	ug/l	03/28/88
CARBON TETRACHLORIDE	(5.0		(5.0	(5.0	ug/l	03/28/88
CHLOROBENZENE	(5.0		(5.0	(5.0	ug/l	03/28/88
CHLORODIBROMOMETHANE	(5.0		(5.0	(5.0	ug/l	03/28/88
CHLOROETHANE	(10		(10	(10	ug/l	03/28/88
2-CHLOROETHYLVINYL ETHER	(10		(10	(10	ug/l	03/28/88
CHLOROFORM	(5.0		(5.0	(5.0	ug/l	03/28/88
CIS-1,3-DICHLOROPROPENE	(5.0		(5.0	(5.0	ug/l	03/28/88
DICHLOROBROMOMETHANE	(5.0		(5.0	(5.0	ug/l	03/28/88
1,1-DICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	03/28/88
1,2-DICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	03/28/88
1,1-DICHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	03/28/88
1,2-DICHLOROPROPANE	(5.0		(5.0	(5.0	ug/l	03/28/88
ETHYLBENZENE	(5.0		(5.0	(5.0	ug/l	03/28/88
2-HEXANONE	(10		(10	(10	ug/l	03/28/88
METHYL BROMIDE	(10		(10	(10	ug/l	03/28/88
METHYL CHLORIDE	(10		(10	(10	ug/l	03/28/88
4-METHYL-2-PENTANONE	(10		(10	(10	ug/l	03/28/88
METHYLENE CHLORIDE	(5.0		41	35	ug/l	03/28/88
STYRENE	(5.0		(5.0	(5.0	ug/l	03/28/88
1,1,2,2-TETRACHLOROETHANE	(5.0		(5.0	(5.0	ug/l	03/28/88
TETRACHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	03/28/88
TOLUENE	(5.0		(5.0	(5.0	ug/l	03/28/88
TRANS-1,2-DICHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	03/28/88
TRANS-1,3-DICHLOROPROPENE	(5.0		(5.0	(5.0	ug/l	03/28/88
1,1,1-TRICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	03/28/88
1,1,2-TRICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	03/28/88
TRICHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	03/28/88
VINYL ACETATE	(10		(10	(10	ug/l	03/28/88
VINYL CHLORIDE	(10		(10	(10	ug/l	03/28/88
TOTAL XYLENES	(5.0		(5.0	(5.0	ug/l	03/28/88

TABLE 2.8.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	03/28/88
ACENAPHTHYLENE	< 10		ug/l	03/28/88
ANTHRACENE	< 10		ug/l	03/28/88
BENZO(A)ANTHRACENE	< 10		ug/l	03/28/88
BENZO(A)PYRENE	< 10		ug/l	03/28/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	03/28/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	03/28/88
BENZOIC ACID	< 50		ug/l	03/28/88
BENZO(K)FLUORANTHENE	< 10		ug/l	03/28/88
BENZYL ALCOHOL	< 10		ug/l	03/28/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	03/28/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	03/28/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	03/28/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	03/28/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	03/28/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	03/28/88
4-CHLOROANILINE	< 10		ug/l	03/28/88
2-CHLORONAPHTHALENE	< 10		ug/l	03/28/88
2-CHLOROPHENOL	< 10		ug/l	03/28/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	03/28/88
CHRYSENE	< 10		ug/l	03/28/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	03/28/88
DIBENZOFURAN	< 10		ug/l	03/28/88
1,2-DICHLOROBENZENE	< 10		ug/l	03/28/88
1,3-DICHLOROBENZENE	< 10		ug/l	03/28/88
1,4-DICHLOROBENZENE	< 10		ug/l	03/28/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	03/28/88
2,4-DICHLOROPHENOL	< 10		ug/l	03/28/88
DIETHYL PHTHALATE	< 10		ug/l	03/28/88
2,4-DIMETHYLPHENOL	< 10		ug/l	03/28/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	03/28/88
2,4-DINITROPHENOL	< 50		ug/l	03/28/88
DIMETHYL PHTHALATE	< 10		ug/l	03/28/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	03/28/88
2,4-DINITROTOLUENE	< 10		ug/l	03/28/88
2,6-DINITROTOLUENE	< 10		ug/l	03/28/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	03/28/88

TABLE 2.8.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	03/28/88
FLUORENE	< 10		ug/l	03/28/88
HEXACHLOROBENZENE	< 10		ug/l	03/28/88
HEXACHLOROBUTADIENE	< 10		ug/l	03/28/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	03/28/88
HEXACHLOROETHANE	< 10		ug/l	03/28/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	03/28/88
ISOPHORONE	< 10		ug/l	03/28/88
2-METHYLNAPHTHALENE	< 10		ug/l	03/28/88
2-METHYLPHENOL	< 10		ug/l	03/28/88
4-METHYLPHENOL	< 10		ug/l	03/28/88
NAPHTHALENE	< 10		ug/l	03/28/88
2-NITROANILINE	< 50		ug/l	03/28/88
3-NITROANILINE	< 50		ug/l	03/28/88
4-NITROANILINE	< 50		ug/l	03/28/88
NITROBENZENE	< 10		ug/l	03/28/88
2-NITROPHENOL	< 10		ug/l	03/28/88
4-NITROPHENOL	< 50		ug/l	03/28/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	03/28/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	03/28/88
P-CHLORO-M-CRESOL	< 10		ug/l	03/28/88
PENTACHLOROPHENOL	< 50		ug/l	03/28/88
PHENANTHRENE	< 10		ug/l	03/28/88
PHENOL	< 10		ug/l	03/28/88
PYRENE	< 10		ug/l	03/28/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	03/28/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	03/28/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	03/28/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	03/28/88

TABLE 2.8.3

UNC LABORATORY ANALYSIS
WIPP-25 CULEBRA ROUND THREE

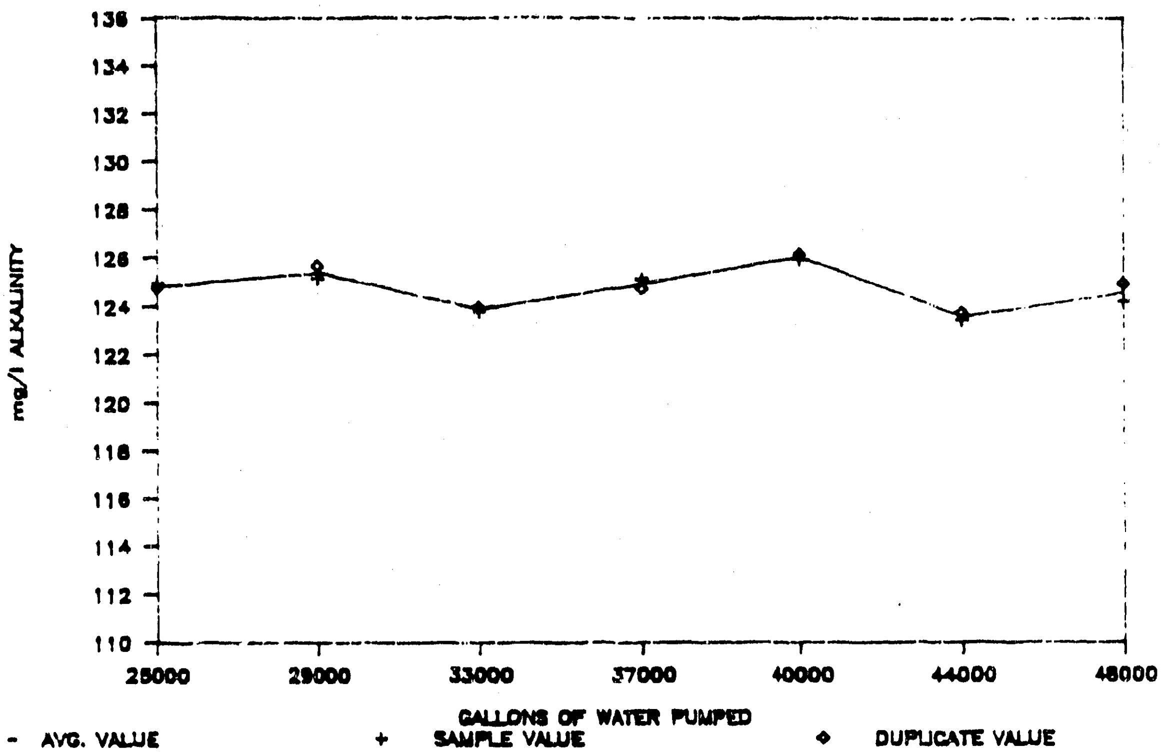
DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	< 0.05		cc/l (STP)	03/28/88
OXYGEN	< 0.05		cc/l (STP)	03/28/88
NITROGEN	3.22		cc/l (STP)	03/28/88
CARBON DIOXIDE	5.050		cc/l (STP)	03/28/88
METHANE	0.077		cc/l (STP)	03/28/88
ETHANE	< 0.001		cc/l (STP)	03/28/88
C-3	< 0.001		cc/l (STP)	03/28/88
C-4	< 0.001		cc/l (STP)	03/28/88
C-5	< 0.001		cc/l (STP)	03/28/88
C-6	< 0.001		cc/l (STP)	03/28/88
SUM OF CO2	95.50		cc/l (STP)	03/28/88
TOTAL GAS	8.340		cc/l (STP)	03/28/88
AMMONIA	0.02	0.05	mg/l	03/28/88
NITRATE	13.1	13.0	mg/l	03/28/88
TOTAL IRON	0.800		mg/l	03/28/88
FERROUS IRON	0.72	0.72	mg/l	03/28/88
TOTAL ARSENIC	0.0025		mg/l	03/28/88
ARSENIC III	< 0.0010		mg/l	03/28/88
TOTAL SELENIUM	0.018		mg/l	03/28/88
SELENIUM IV	0.002		mg/l	03/28/88
IODIDE	120		ug/l	03/28/88
IODATE	25		ug/l	03/28/88

TABLE 2.8.4

PRESSURE AND FLOW
WIPP-25 CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPM FLOW RATE	COMMENTS
03/17/88	17:35	100	110	0.00	PUMP TURNED ON
03/17/88	17:44	100	109	4.05	
03/17/88	18:00	100	109	4.25	
03/18/88	07:00	99	108	4.29	
03/18/88	15:00	99	108	4.25	
03/19/88	07:00	99	108	4.27	
03/19/88	16:30	99	106	4.10	
03/20/88	07:30	99	106	4.14	
03/20/88	16:30	98	107	4.10	
03/21/88	07:00	98	107	4.10	
03/21/88	15:30	99	108	2.60	FLOW REDUCED 10:45
03/22/88	07:00	99	105	2.68	
03/22/88	15:30	99	108	2.64	
03/23/88	07:00	99	108	2.69	
03/23/88	15:30	99	108	2.73	
03/24/88	07:00	98	106	2.68	
03/24/88	14:30	99	108	2.60	
03/25/88	07:00	99	108	2.66	
03/25/88	14:30	98	108	2.60	
03/26/88	07:00	99	108	2.66	
03/26/88	18:30	98	108	2.62	
03/27/88	09:30	99	108	2.63	FLOW RATE 09:15
03/27/88	14:00	98	108	2.56	
03/28/88	07:00	98	108	2.63	
03/28/88	13:30	99	108	2.58	PUMP OFF 13:35
03/29/88	07:30	100	109	0.00	LOGGING OFF



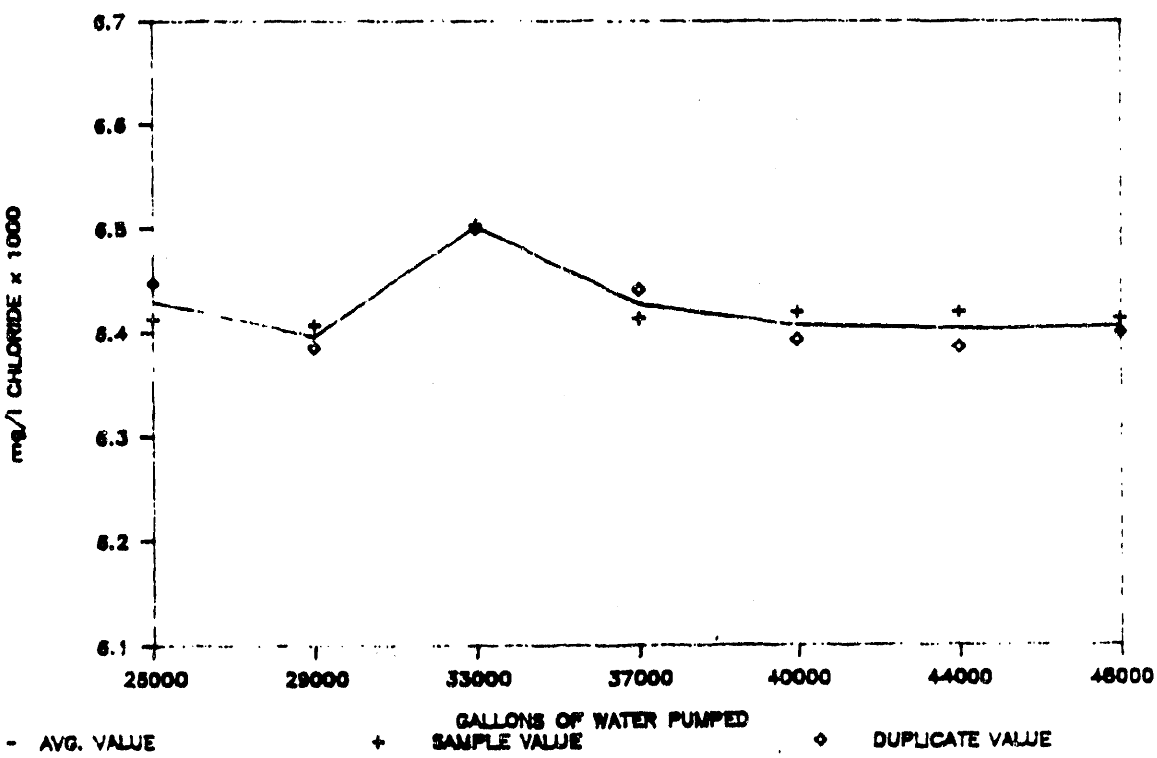
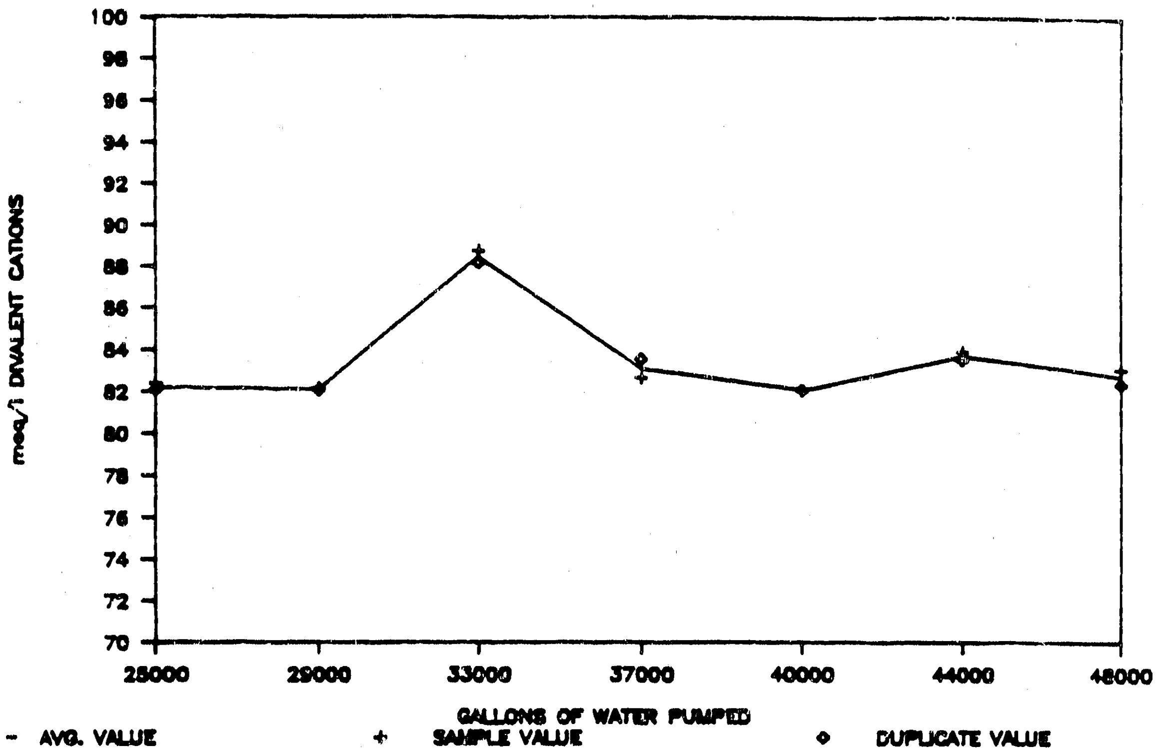


Figure 2.8.1. Graphs of alkalinity and chloride from third round serial sampling at well WIPP-25 Culebra.



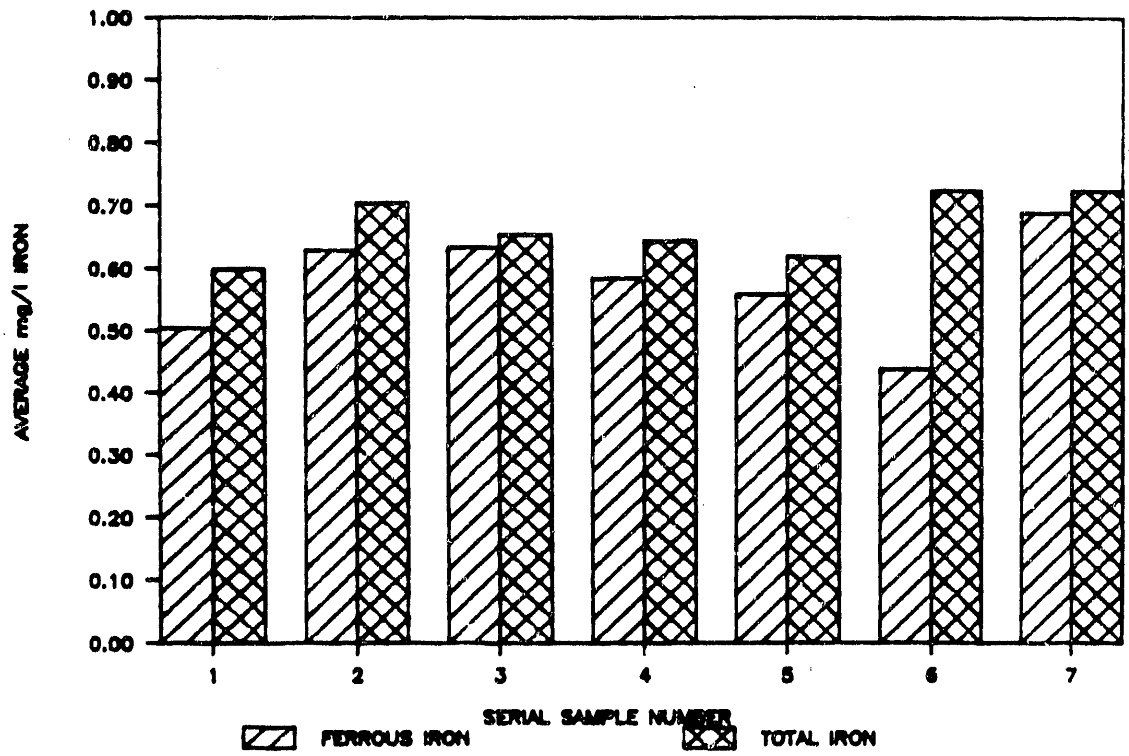


Figure 2.8.2. Graphs of divalent cations and iron from third round serial sampling at well WIPP-25 Culebra.

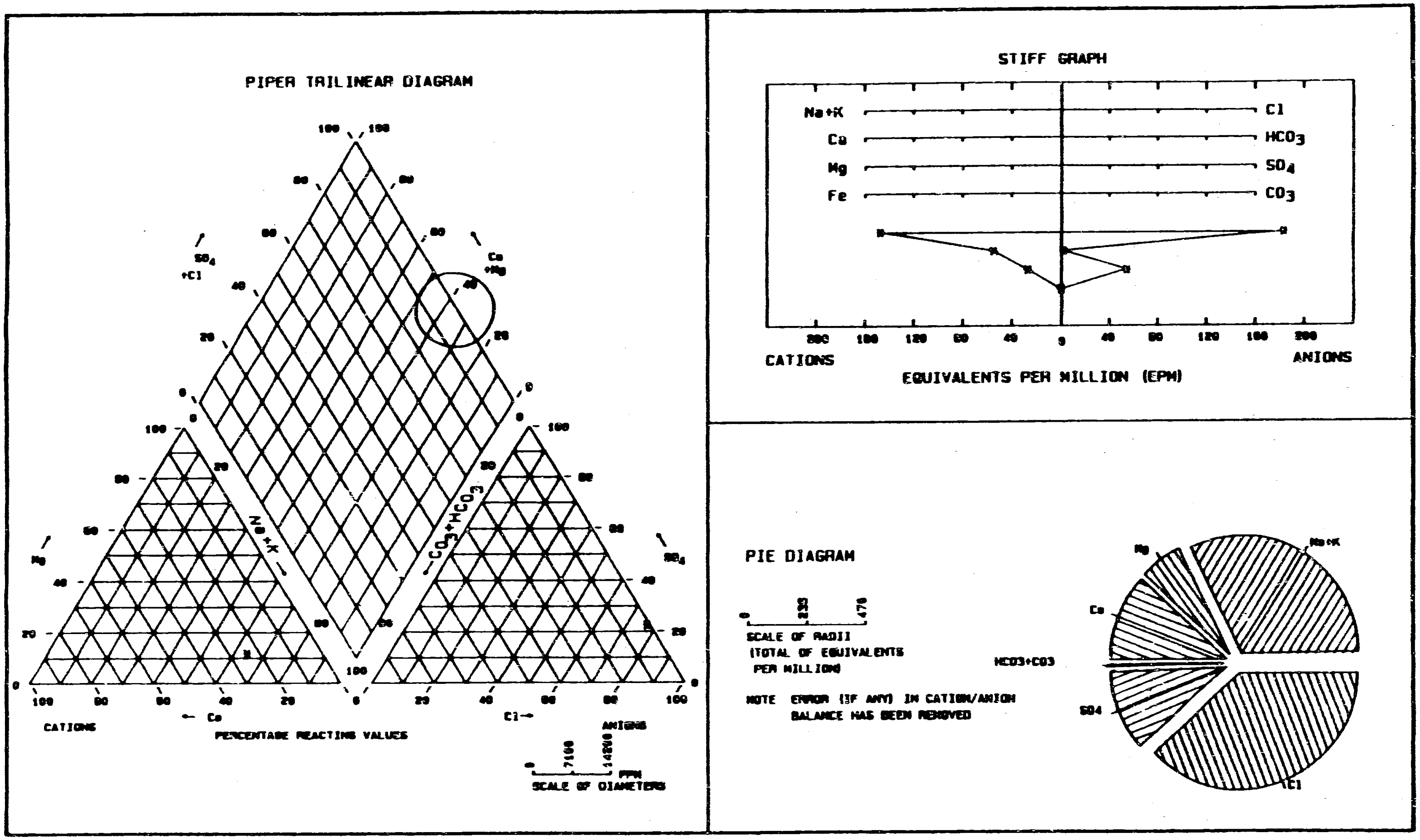


Figure 2.8.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well WIPP-25 Culebra.

2.9 SUMMARY OF CULEBRA WELL H-18, ROUND TWO

Well Characteristics

Well H-18 is located approximately 1.2 miles northwest of the center of the WIPP site at an elevation of 3,414 feet above MSL, to the top of casing (Gonzales, 1989). The total depth of the drilled hole was 831 feet BGS, but the hole has been plugged back to 766 feet BGS. The well is cased to a depth of 673 feet BGS and completed open hole. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 689 to 713 feet BGS (Beauheim, 1987).

Sampling Process

This well was sampled in conjunction with Sandia National Laboratories' on-going hydrologic activities. Installation of the pump, pressure monitoring equipment, and monitoring of the flow rates and pump volumes were activities of Sandia National Laboratories and INTERA Technologies personnel.

In November of 1987 well H-18 was sampled for the first time. This round one sampling occurred during drilling operations. Since the well was completed in late 1987, drilling fluid composed of concentrated sodium chloride brine remained in the well. In late February 1988, hydrologic testing was conducted at well H-18. Round two water quality sampling at H-18 began immediately following the hydrologic testing, and utilized the same pump and packer configuration.

Well H-18 was sampled using a Red Jacket model submersible pump. A Baski inflatable packer isolated the pump intake from fluid above it in the well bore. The pump intake was set at a depth of 689 feet BTOC.

Pumping for hydrologic testing began on 02/26/88. Pumping finally ceased after collection of final samples on 04/07/88. Pump operation and flow rates were variable during hydrologic testing, but a steady flow rate of approximately one gallon per minute was established on 03/19/88 in preparation for serial sampling.

Serial sampling began on 03/21/88 after approximately 9,600 gallons of water had been removed from the well. Generally, serial samples were collected at two to three day intervals and transported to the field laboratory located a short distance away. The final three serial samples were collected daily. Serial sampling ended and final samples were collected on 04/07/88 after approximately 33,000 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity decreasing from approximately 55 to 50 mg/l during the serial sampling period (Figure 2.9.1).

Chloride concentration decreased from approximately 16,800 to 12,100 mg/l over the first five serial samples. Chloride then increased in concentration to approximately 13,000 mg/l where it remained until final sampling (Figure 2.9.1).

Divalent cations ranged from approximately 104 down to 90 meq/l (Figure 2.9.2).

Total iron concentration varied between approximately 0.8 mg/l on the first day down to 0.3 mg/l. Ferrous iron followed the the same general trend as did total iron, except for sample number 4 when ferrous iron was equivalent to total iron (Figure 2.9.2).

The water pH varied between 7.5 and 7.4 SU.

Physical Parameters

Specific gravity was 1.020 at 20.2°C on the final day of sampling.

Specific conductance was reported as 38,200 umhos/cm at 25°C on the final day of sampling.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were taken following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Collected samples were sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

As this well was sampled in conjunction with Sandia National Laboratories on-going hydrology program, standard operating procedures of the Water Quality Sampling Program were not strictly adhered to. Samples were collected at the well site and transported a short distance away to the field laboratory trailer. Every effort was made to preserve the integrity of the chemical analyses during serial sampling, but some transient physical parameters such as Eh and temperature were not measured.

Tabular data are presented in Tables 2.9.1, 2.9.2, and 2.9.3. These tables list results from serial sampling, ITAS laboratory analyses, and UNC laboratory analyses, respectively. No listing of pressure versus flow data is presented as the WQSP did not collect this data.

Figures 2.9.1 and 2.9.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.9.3 depicts the general water quality at H-18 utilizing Stiff, pie, and Piper trilinear diagrams.

Serial Parameter Comparison with the Previous Round

Analytical results from the final day of serial sampling between rounds one and two are comparable with slight differences. Chloride concentration was approximately 1000 mg/l greater at the end of the round two sampling than at the end of round one. Total iron increased from 0.15 to 0.28 mg/l, on the average, from round one to two. Ferrous iron values more than doubled, from 0.1 to 0.25 mg/l. The parameters alkalinity, divalent cations, pH, specific conductance, and specific gravity exhibited slight variations between each round on the final day of sampling.

Pump flow rates are comparable between the two rounds of sampling, ranging from 0.9 to one gpm during both sampling periods. Purge volumes varied with approximately 9,000 gallons being pumped prior to final sampling in round one and approximately 33,000 gallons being removed from the well in round two.

TABLE 2.9.1

SERIAL SAMPLE CHEMISTRY
H-18 CULEBRA ROUND TWO

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	55.4	55.1	mg/l	9600	03/21/88
2	ALKALINITY	54.9	54.4	mg/l	12600	03/23/88
3	ALKALINITY	53.9	53.2	mg/l	15800	03/25/88
4	ALKALINITY	52.7	52.5	mg/l	20800	03/28/88
5	ALKALINITY	51.7	51.2	mg/l	23700	03/30/88
6	ALKALINITY	51.8	51.7	mg/l	26700	04/01/88
7	ALKALINITY	51.2	51.5	mg/l	30200	04/04/88
8	ALKALINITY	51.1	50.5	mg/l	32700	04/05/88
9	ALKALINITY	50.2	50.7	mg/l	33000	04/07/88
1	CHLORIDE	16800	16700	mg/l	9600	03/21/88
2	CHLORIDE	16700	16600	mg/l	12600	03/23/88
3	CHLORIDE	14200	14300	mg/l	15800	03/25/88
4	CHLORIDE	13700	13600	mg/l	20800	03/28/88
5	CHLORIDE	12100	12200	mg/l	23700	03/30/88
6	CHLORIDE	13200	13200	mg/l	26700	04/01/88
7	CHLORIDE	13000	13000	mg/l	30200	04/04/88
8	CHLORIDE	13000	13000	mg/l	32700	04/05/88
9	CHLORIDE	13000	13000	mg/l	33000	04/07/88
1	DIVALENT CATIONS	104	104	meq/l	9600	03/21/88
2	DIVALENT CATIONS	104	104	meq/l	12600	03/23/88
3	DIVALENT CATIONS	103	103	meq/l	15800	03/25/88
4	DIVALENT CATIONS	104	103	meq/l	20800	03/28/88
5	DIVALENT CATIONS	89.4	90.3	meq/l	23700	03/30/88
6	DIVALENT CATIONS	101	101	meq/l	26700	04/01/88
7	DIVALENT CATIONS	100	101	meq/l	30200	04/04/88
8	DIVALENT CATIONS	100	101	meq/l	32700	04/05/88
9	DIVALENT CATIONS	101	102	meq/l	33000	04/07/88
2	TOTAL IRON	0.83	0.84	mg/l	12600	03/23/88
3	TOTAL IRON	0.36	0.36	mg/l	15800	03/25/88
4	TOTAL IRON	0.35	0.36	mg/l	20800	03/28/88
5	TOTAL IRON	0.60	0.61	mg/l	23700	03/30/88
6	TOTAL IRON	0.33	0.33	mg/l	26700	04/01/88
7	TOTAL IRON	0.27	0.28	mg/l	30200	04/04/88
8	TOTAL IRON	0.29	0.28	mg/l	32700	04/05/88
9	TOTAL IRON	0.27	0.29	mg/l	33000	04/07/88

TABLE 2.9.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
2	FERROUS IRON	0.80	0.80	mg/l	12600	03/23/88
3	FERROUS IRON	0.30	0.30	mg/l	15800	03/25/88
4	FERROUS IRON	0.35	0.35	mg/l	20800	03/28/88
5	FERROUS IRON	0.51	0.53	mg/l	23700	03/30/88
6	FERROUS IRON	0.31	0.30	mg/l	26700	04/01/88
7	FERROUS IRON	0.26	0.26	mg/l	30200	04/04/88
8	FERROUS IRON	0.27	0.27	mg/l	32700	04/05/88
9	FERROUS IRON	0.25	0.25	mg/l	33000	04/07/88
1	pH	7.5			9600	03/21/88
2	pH	7.5			12600	03/23/88
3	pH	7.5			15800	03/25/88
4	pH	7.5			20800	03/28/88
5	pH	7.4			23700	03/30/88
6	pH	7.5			26700	04/01/88
7	pH	7.5			30200	04/04/88
8	pH	7.5			32700	04/05/88
9	pH	7.5			33000	04/07/88
1	SPECIFIC GRAVITY	1.027		@ 26.1 C	9600	03/21/88
2	SPECIFIC GRAVITY	1.022		@ 20.6 C	12600	03/23/88
3	SPECIFIC GRAVITY	1.022		@ 20.0 C	15800	03/25/88
4	SPECIFIC GRAVITY	1.020		@ 20.5 C	20800	03/28/88
5	SPECIFIC GRAVITY	1.020		@ 20.1 C	23700	03/30/88
6	SPECIFIC GRAVITY	1.020		@ 20.5 C	26700	04/01/88
7	SPECIFIC GRAVITY	1.020		@ 22.3 C	30200	04/04/88
8	SPECIFIC GRAVITY	1.020		@ 22.7 C	32700	04/05/88
9	SPECIFIC GRAVITY	1.020		@ 20.2 C	33000	04/07/88
1	SPECIFIC CONDUCTANCE	47000	@ 25 C	umhos/cm	9600	03/21/88
2	SPECIFIC CONDUCTANCE	46800	@ 25 C	umhos/cm	12600	03/23/88
3	SPECIFIC CONDUCTANCE	41300	@ 25 C	umhos/cm	15800	03/25/88
4	SPECIFIC CONDUCTANCE	39800	@ 25 C	umhos/cm	20800	03/28/88
5	SPECIFIC CONDUCTANCE	35500	@ 25 C	umhos/cm	23700	03/30/88
6	SPECIFIC CONDUCTANCE	38900	@ 25 C	umhos/cm	26700	04/01/88
7	SPECIFIC CONDUCTANCE	38500	@ 25 C	umhos/cm	30200	04/04/88
8	SPECIFIC CONDUCTANCE	38200	@ 25 C	umhos/cm	32700	04/05/88
9	SPECIFIC CONDUCTANCE	38200	@ 25 C	umhos/cm	33000	04/07/88

TABLE 2.9.2

ITAS LABORATORY RESULTS
H-18 CULEBRA ROUND TWO

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	50		mg/l	04/07/88
ALKALINITY (CO3)	0		mg/l	04/07/88
BROMIDE	14		mg/l	04/07/88
CHLORIDE	12500		mg/l	04/07/88
CYANIDE, TOTAL	< 0.02		mg/l	04/07/88
FLUORIDE	1.6		mg/l	04/07/88
IODIDE	< 2.0		mg/l	04/07/88
NITRATE	< 0.02		mg/l NO3-N	04/07/88
pH	7.16	7.20		04/07/88
PHENOLICS	< 0.005		mg/l	04/07/88
PHOSPHATE, TOTAL	< 0.01		mg/l T-PO4-P	04/07/88
RESIDUE, FILTERABLE @180 C	27900		mg/l	04/07/88
RESIDUE, NONFILTERABLE @105 C	6		mg/l	04/07/88
SPECIFIC CONDUCTANCE	39200	39600	umhos/cm@25C	04/07/88
SULFATE	3800		mg/l	04/07/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	04/07/88
TOTAL ORGANIC HALOGEN	< 0.05	< 0.05	mg/l	04/07/88

TABLE 2.9.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	04/07/88
ANTIMONY	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	04/07/88
ARSENIC	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/07/88
BARIUM	< 0.050	< 0.050	0.005	< 0.005	mg/l	04/07/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	04/07/88
BORON	17	17	0.01	0.01	mg/l	04/07/88
CADMIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	04/07/88
CALCIUM	1100	1100			mg/l	04/07/88
CESIUM	< 0.050	< 0.050	< 0.01	< 0.01	mg/l	04/07/88
CHROMIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/07/88
COBALT	< 0.10	< 0.10	0.02	0.02	mg/l	04/07/88
COPPER	0.10	0.20	< 0.01	< 0.01	mg/l	04/07/88
IRON	0.30	0.40	< 0.01	< 0.01	mg/l	04/07/88
LEAD	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	04/07/88
LITHIUM	0.31	0.31	< 0.01	< 0.01	mg/l	04/07/88
MAGNESIUM	480	480			mg/l	04/07/88
MANGANESE	0.18	0.18	< 0.005	< 0.005	mg/l	04/07/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	04/07/88
MOLYBDENUM	< 2.0	< 2.0	< 0.01	< 0.01	mg/l	04/07/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	04/07/88
POTASSIUM	220	230			mg/l	04/07/88
SELENIUM	< 0.50	< 0.50	< 0.005	< 0.005	mg/l	04/07/88
SILICA	5.3	5.3			mg/l	04/07/88
SILVER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/07/88
SODIUM	8000	8000			mg/l	04/07/88
STRONTIUM	16	16	< 0.01	< 0.01	mg/l	04/07/88
THALLIUM	< 5.0	< 5.0	< 0.005	< 0.005	mg/l	04/07/88
TITANIUM	0.60	0.60	< 0.03	< 0.03	mg/l	04/07/88
VANADIUM	0.10	0.20	< 0.01	< 0.01	mg/l	04/07/88
ZINC	< 0.10	0.10	< 0.01	< 0.01	mg/l	04/07/88

TABLE 2.9.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		12		ug/l	04/07/88
BENZENE	< 5.0		< 5.0		ug/l	04/07/88
2-BUTANONE	< 10		< 10		ug/l	04/07/88
BROMOFORM	< 5.0		< 5.0		ug/l	04/07/88
CARBON DISULFIDE	< 5.0		< 5.0		ug/l	04/07/88
CARBON TETRACHLORIDE	< 5.0		< 5.0		ug/l	04/07/88
CHLOROBENZENE	< 5.0		< 5.0		ug/l	04/07/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0		ug/l	04/07/88
CHLOROETHANE	< 10		< 10		ug/l	04/07/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10		ug/l	04/07/88
CHLOROFORM	< 5.0		< 5.0		ug/l	04/07/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	04/07/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0		ug/l	04/07/88
1,1-DICHLOROETHANE	< 5.0		< 5.0		ug/l	04/07/88
1,2-DICHLOROETHANE	< 5.0		< 5.0		ug/l	04/07/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/07/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0		ug/l	04/07/88
ETHYLBENZENE	< 5.0		< 5.0		ug/l	04/07/88
2-HEXANONE	< 10		< 10		ug/l	04/07/88
METHYL BROMIDE	< 10		< 10		ug/l	04/07/88
METHYL CHLORIDE	< 10		< 10		ug/l	04/07/88
4-METHYL-2-PENTANONE	< 10		< 10		ug/l	04/07/88
METHYLENE CHLORIDE	5.5		5.7		ug/l	04/07/88
STYRENE	< 5.0		< 5.0		ug/l	04/07/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0		ug/l	04/07/88
TETRACHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/07/88
TOLUENE	< 5.0		< 5.0		ug/l	04/07/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/07/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	04/07/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	04/07/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	04/07/88
TRICHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/07/88
VINYL ACETATE	< 10		< 10		ug/l	04/07/88
VINYL CHLORIDE	< 10		< 10		ug/l	04/07/88
TOTAL XYLENES	< 5.0		< 5.0		ug/l	04/07/88

TABLE 2.9.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	04/07/88
ACENAPHTHYLENE	< 10		ug/l	04/07/88
ANTHRACENE	< 10		ug/l	04/07/88
BENZO(A)ANTHRACENE	< 10		ug/l	04/07/88
BENZO(A)PYRENE	< 10		ug/l	04/07/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	04/07/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	04/07/88
BENZOIC ACID	< 50		ug/l	04/07/88
BENZO(K)FLUORANTHENE	< 10		ug/l	04/07/88
BENZYL ALCOHOL	< 10		ug/l	04/07/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	04/07/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	04/07/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	04/07/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	04/07/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	04/07/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	04/07/88
4-CHLOROANILINE	< 10		ug/l	04/07/88
2-CHLORONAPHTHALENE	< 10		ug/l	04/07/88
2-CHLOROPHENOL	< 10		ug/l	04/07/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	04/07/88
CHRYSENE	< 10		ug/l	04/07/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	04/07/88
DIBENZOFURAN	< 10		ug/l	04/07/88
1,2-DICHLOROBENZENE	< 10		ug/l	04/07/88
1,3-DICHLOROBENZENE	< 10		ug/l	04/07/88
1,4-DICHLOROBENZENE	< 10		ug/l	04/07/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	04/07/88
2,4-DICHLOROPHENOL	< 10		ug/l	04/07/88
DIETHYL PHTHALATE	< 10		ug/l	04/07/88
2,4-DIMETHYLPHENOL	< 10		ug/l	04/07/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	04/07/88
2,4-DINITROPHENOL	< 50		ug/l	04/07/88
DIMETHYL PHTHALATE	< 10		ug/l	04/07/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	04/07/88
2,4-DINITROTOLUENE	< 10		ug/l	04/07/88
2,6-DINITROTOLUENE	< 10		ug/l	04/07/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	04/07/88

TABLE 2.9.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	04/07/88
FLUORENE	< 10		ug/l	04/07/88
HEXACHLOROBENZENE	< 10		ug/l	04/07/88
HEXACHLOROBUTADIENE	< 10		ug/l	04/07/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	04/07/88
HEXACHLOROETHANE	< 10		ug/l	04/07/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	04/07/88
ISOPHORONE	< 10		ug/l	04/07/88
2-METHYLNAPHTHALENE	< 10		ug/l	04/07/88
2-METHYLPHENOL	< 10		ug/l	04/07/88
4-METHYLPHENOL	< 10		ug/l	04/07/88
NAPHTHALENE	< 10		ug/l	04/07/88
2-NITROANILINE	< 50		ug/l	04/07/88
3-NITROANILINE	< 50		ug/l	04/07/88
4-NITROANILINE	< 50		ug/l	04/07/88
NITROBENZENE	< 10		ug/l	04/07/88
2-NITROPHENOL	< 10		ug/l	04/07/88
4-NITROPHENOL	< 50		ug/l	04/07/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	04/07/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	04/07/88
P-CHLORO-M-CRESOL	< 10		ug/l	04/07/88
PENTACHLOROPHENOL	< 50		ug/l	04/07/88
PHENANTHRENE	< 10		ug/l	04/07/88
PHENOL	< 10		ug/l	04/07/88
PYRENE	< 10		ug/l	04/07/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	04/07/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	04/07/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	04/07/88

POLYCHLORINATED BIPHENYLS

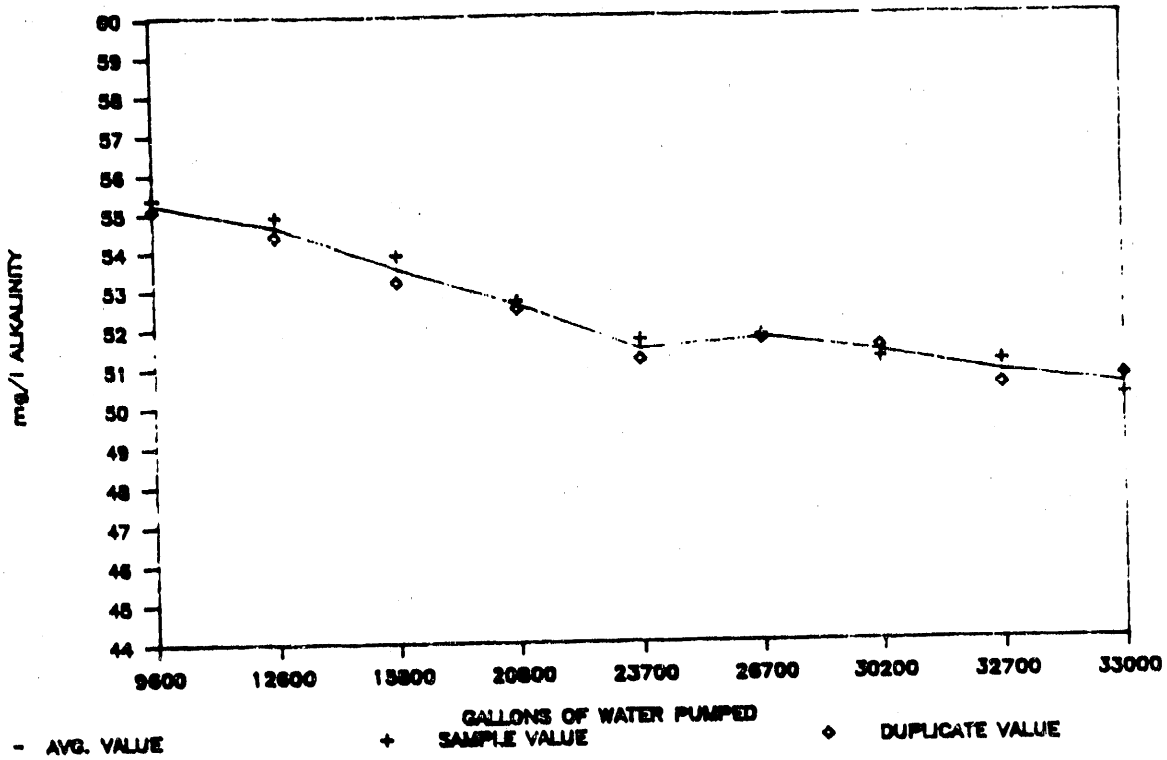
PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	04/07/88

TABLE 2.9.3

UNC LABORATORY ANALYSIS
H-18 CULEBRA ROUND TWO

DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	< 0.05		cc/l (STP)	04/07/88
OXYGEN	< 0.05		cc/l (STP)	04/07/88
NITROGEN	4.84		cc/l (STP)	04/07/88
CARBON DIOXIDE	2.180		cc/l (STP)	04/07/88
METHANE	0.010		cc/l (STP)	04/07/88
ETHANE	< 0.001		cc/l (STP)	04/07/88
C-3	< 0.001		cc/l (STP)	04/07/88
C-4	< 0.001		cc/l (STP)	04/07/88
C-5	< 0.001		cc/l (STP)	04/07/88
C-6	< 0.001		cc/l (STP)	04/07/88
SUM OF CO2	27.70		cc/l (STP)	04/07/88
TOTAL GAS	7.030		cc/l (STP)	04/07/88
AMMONIA	< 0.10	< 0.10	mg/l	04/07/88
NITRATE	< 0.50	< 0.50	mg/l	04/07/88
TOTAL IRON	0.430	0.430	mg/l	04/07/88
FERROUS IRON	0.40	0.40	mg/l	04/07/88
TOTAL ARSENIC	< 0.0010	< 0.0010	mg/l	04/07/88
TOTAL SELENIUM	< 0.001	< 0.001	mg/l	04/07/88
IODIDE	80	70	ug/l	04/07/88
IODATE	< 20	< 20	ug/l	04/07/88



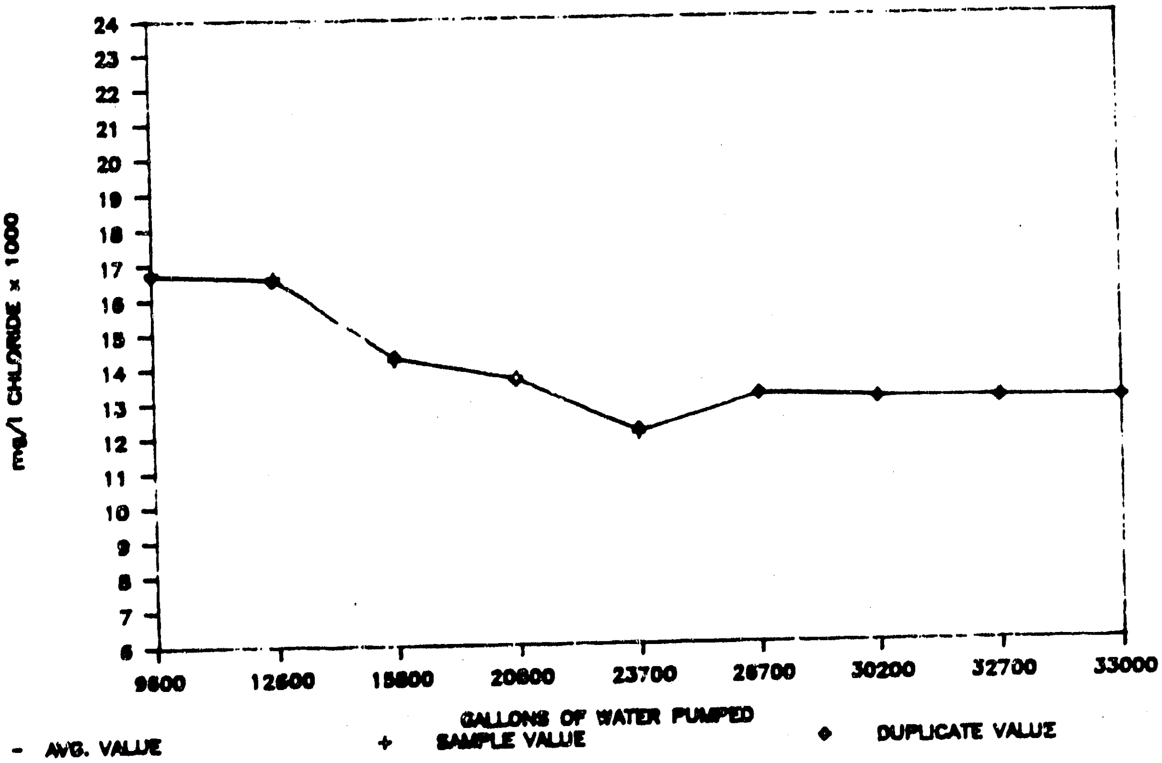
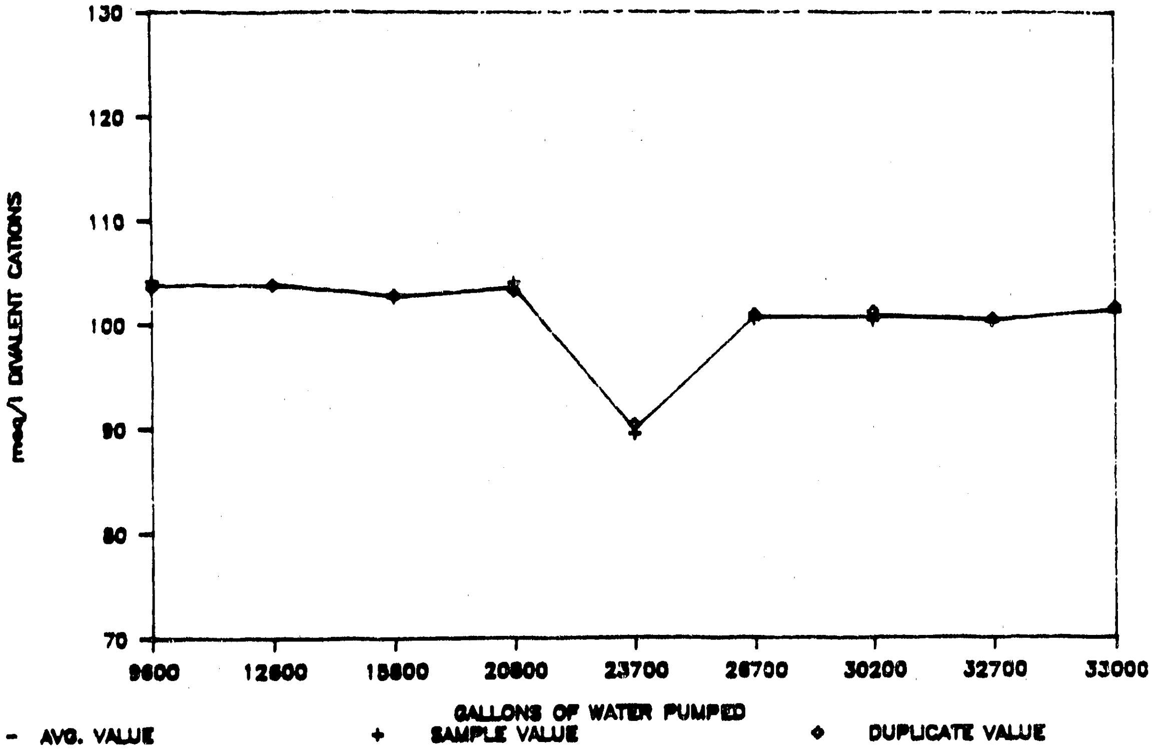


Figure 2.9.1. Graphs of alkalinity and chloride from second round serial sampling at well H-18 Culebra.



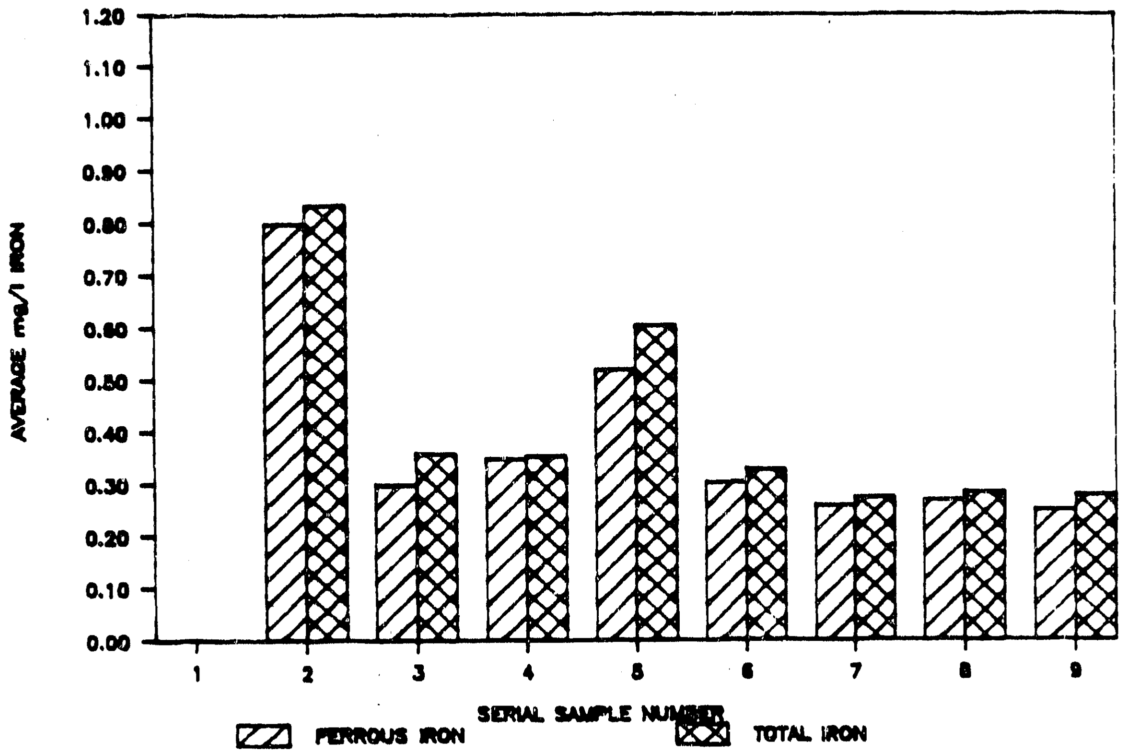


Figure 2.9.2. Graphs of divalent cations and iron from second round serial sampling at well H-18 Culebra.

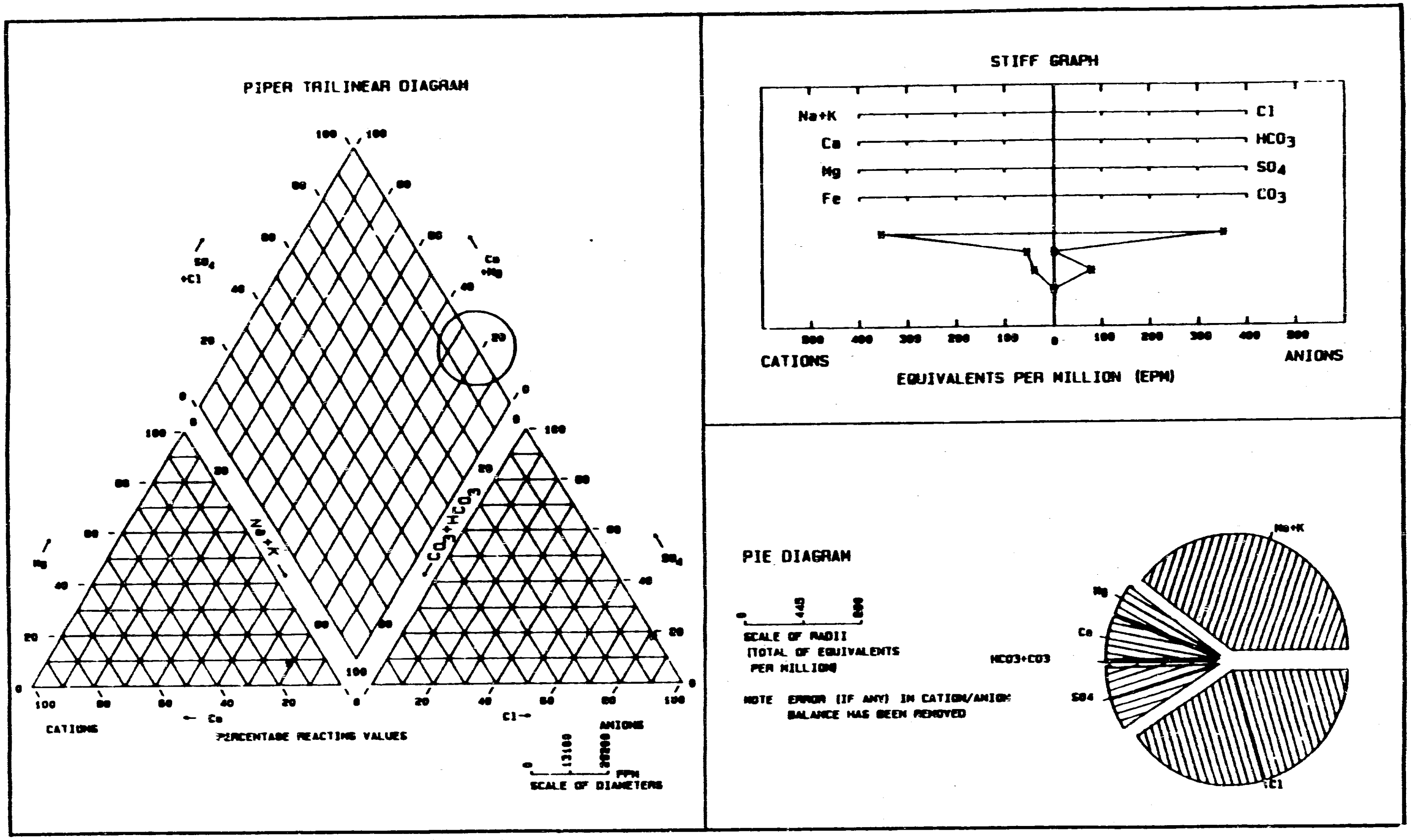


Figure 2.9.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from second round serial sampling at well H-18 Culebra.

2.10 SUMMARY OF CULEBRA WELL WIPP-26, ROUND THREE

Well Characteristics

Well WIPP-26 is located approximately six miles west of the center of the WIPP site at an elevation of 3,153 feet above MSL, to the top of the casing (Gonzales, 1989). Total depth of the drilled hole is 503 feet BGS, with casing in place down to 502 feet BGS. The casing is perforated in three intervals, accessing the Magenta and Culebra Dolomites and the base of the Rustler Formation. The Magenta Dolomite does not yield water at this location. A bridge plug is set at 269 feet BGS separating the Culebra Dolomite from the base of the Rustler Formation. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation, located at a depth interval of 186 to 209 feet BGS (Sandia Laboratories and U.S. Geological Survey, 1979b).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. The pump intake was located at a depth of 173 feet BTOC.

Pumping began on 04/05/88 and ceased on 04/14/88. The average flow rate was approximately 53 gph for three days prior to initiating serial sampling. The flow rate was decreased to approximately 39 gph two days prior to the sampling period. Serial sampling began on 04/10/88 after approximately 5,400 gallons of water had been pumped from the well. One serial sample was taken each day for five consecutive days. Serial sampling ended and final samples were collected on 04/14/88 after 9,200 gallons of water were pumped.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity nearly constant between 111 and 114 mg/l (Figure 2.10.1).

Chloride content remained between 5,600 and 5,800 mg/l (Figure 2.10.1).

Eighty-five to 87 meq/l was the approximate range for divalent cations during the sampling period (Figure 2.10.2).

Total iron decreased from 0.06 mg/l on the first day to 0.03 mg/l during the sampling period. Ferrous iron was below the detection limit (<0.02 mg/l) during the entire sampling period (Figure 2.10.2).

The water pH varied slightly between 7.0 and 7.1 SU.

Physical Parameters

Eh values ranged between 300 and 400 mV relative to the SHE during the entire sampling period.

The water temperature ranged between 21.1 and 21.4°C.

The specific gravity of the water was 1.009 at 21.3°C on the final day of sampling.

Specific conductance increased from 17,700 to 18,500 umhos/cm at 25°C over the course of the sampling period.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were collected following procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

The collected samples were sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from this well was slightly effervescent.

A relatively small quantity of fine-grained particulate matter was observed on the 0.45-um filters after sampling each day.

Tabular data are presented in Tables 2.10.1, 2.10.2, 2.10.3, and 2.10.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.10.1 and 2.10.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.10.3 illustrates the general water quality at well WIPP-26 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds are not present in the Rustler Formation, neither above nor below the Culebra Dolomite, in the vicinity of WIPP-26 (Mercer, 1983).

No problems were encountered during sampling at well WIPP-26.

Serial Parameter Comparisons With The Previous Rounds

Approximately 61,000 gallons of water were pumped from the well during the round one sampling. The rounds two and three samplings pumped approximately 9,000 gallons each. Data generated during the round two and round three serial sampling episodes are nearly identical with respect to all parameters. Round one data, however, reported some variations in the water chemistry relative to the subsequent rounds of sampling. Most notably, the round one chloride values were approximately 3,000 mg/l greater than chloride values obtained during rounds two and three.

TABLE 2.10.1

SERIAL SAMPLE CHEMISTRY
WIPP-26 CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	111	112	mg/l	5400	04/10/88
2	ALKALINITY	114	113	mg/l	6400	04/11/88
3	ALKALINITY	114	113	mg/l	7300	04/12/88
4	ALKALINITY	114	114	mg/l	8300	04/13/88
5	ALKALINITY	114	114	mg/l	9200	04/14/88
1	CHLORIDE	5700	5670	mg/l	5400	04/10/88
2	CHLORIDE	5720	5690	mg/l	6400	04/11/88
3	CHLORIDE	5690	5700	mg/l	7300	04/12/88
4	CHLORIDE	5760	5720	mg/l	8300	04/13/88
5	CHLORIDE	5670	5720	mg/l	9200	04/14/88
1	DIVALENT CATIONS	84.8	84.8	meq/l	5400	04/10/88
2	DIVALENT CATIONS	86.3	86.6	meq/l	6400	04/11/88
3	DIVALENT CATIONS	86.9	86.3	meq/l	7300	04/12/88
4	DIVALENT CATIONS	87.1	87.4	meq/l	8300	04/13/88
5	DIVALENT CATIONS	87.4	87.1	meq/l	9200	04/14/88
1	TOTAL IRON	0.06	0.06	mg/l	5400	04/10/88
2	TOTAL IRON	0.03	0.03	mg/l	6400	04/11/88
3	TOTAL IRON	0.03	0.03	mg/l	7300	04/12/88
4	TOTAL IRON	0.03	0.03	mg/l	8300	04/13/88
5	TOTAL IRON	0.04	0.04	mg/l	9200	04/14/88
1	FERROUS IRON	< 0.02	< 0.02	mg/l	5400	04/10/88
2	FERROUS IRON	< 0.02	< 0.02	mg/l	6400	04/11/88
3	FERROUS IRON	< 0.02	< 0.02	mg/l	7300	04/12/88
4	FERROUS IRON	< 0.02	< 0.02	mg/l	8300	04/13/88
5	FERROUS IRON	< 0.02	< 0.02	mg/l	9200	04/14/88
1	pH	7.1			5400	04/10/88
2	pH	7.1			6400	04/11/88
3	pH	7.1			7300	04/12/88
4	pH	7.0			8300	04/13/88
5	pH	7.1			9200	04/14/88

TABLE 2.10.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
2	Eh	413		mV	6400	04/11/88
3	Eh	308		mV	7300	04/12/88
4	Eh	405		mV	8300	04/13/88
5	Eh	428		mV	9200	04/14/88
1	TEMPERATURE	21.1		C	5400	04/10/88
2	TEMPERATURE	21.3		C	6400	04/11/88
3	TEMPERATURE	21.4		C	7300	04/12/88
4	TEMPERATURE	21.3		C	8300	04/13/88
5	TEMPERATURE	21.1		C	9200	04/14/88
1	SPECIFIC GRAVITY	1.010		@ 18.6 C	5400	04/10/88
5	SPECIFIC GRAVITY	1.009		@ 21.3 C	9200	04/14/88
1	SPECIFIC CONDUCTANCE	17700	@ 25 C	umhos/cm	5400	04/10/88
5	SPECIFIC CONDUCTANCE	18500	@ 25 C	umhos/cm	9200	04/14/88

TABLE 2.10.2

ITAS LABORATORY RESULTS
WIPP-26 CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	110		mg/l	04/14/88
ALKALINITY (CO3)	0		mg/l	04/14/88
BROMIDE	7	7	mg/l	04/14/88
CHLORIDE	5500		mg/l	04/14/88
CYANIDE, TOTAL	< 0.02		mg/l	04/14/88
FLUORIDE	1.6		mg/l	04/14/88
IODIDE	< 2.0	< 2.0	mg/l	04/14/88
NITRATE	3.60		mg/l NO3-N	04/14/88
pH	6.87	6.90		04/14/88
PHENOLICS	0.012		mg/l	04/14/88
PHOSPHATE, TOTAL	0.04		mg/l T-PO4-P	04/14/88
RESIDUE, FILTERABLE @180 C	12800	12900	mg/l	04/14/88
RESIDUE, NONFILTERABLE @105 C	29	30	mg/l	04/14/88
SPECIFIC CONDUCTANCE	19400	19500	umhos/cm@25C	04/14/88
SULFATE	2500	2300	mg/l	04/14/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	04/14/88
TOTAL ORGANIC HALOGEN	< 0.05	< 0.05	mg/l	04/14/88

TABLE 2.10.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	04/14/88
ANTIMONY	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	04/14/88
ARSENIC	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/14/88
BARIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	04/14/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	04/14/88
BORON	1.3	1.3	< 0.01	< 0.01	mg/l	04/14/88
CADMIUM	0.050	< 0.050	< 0.005	< 0.005	mg/l	04/14/88
CALCIUM	1200	1100			mg/l	04/14/88
CESIUM	< 0.020	< 0.020	< 0.01	< 0.01	mg/l	04/14/88
CHROMIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/14/88
COBALT	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/14/88
COPPER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/14/88
IRON	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/14/88
LEAD	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	04/14/88
LITHIUM	0.26	0.27	< 0.01	< 0.01	mg/l	04/14/88
MAGNESIUM	330	330			mg/l	04/14/88
MANGANESE	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	04/14/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	04/14/88
MOLYBDENUM	< 2.0	< 2.0	< 0.01	< 0.01	mg/l	04/14/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	04/14/88
POTASSIUM	189	190			mg/l	04/14/88
SELENIUM	0.022		< 0.005	< 0.005	mg/l	04/14/88
SILICA	15				mg/l	04/14/88
SILVER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/14/88
SODIUM	2600	2600			mg/l	04/14/88
STRONTIUM	18	19	< 0.01	< 0.01	mg/l	04/14/88
THALLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	04/14/88
TITANIUM	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	04/14/88
VANADIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/14/88
ZINC	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/14/88

TABLE 2.10.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10		ug/l	04/14/88
BENZENE	< 5.0		< 5.0		ug/l	04/14/88
2-BUTANONE	< 10		< 10		ug/l	04/14/88
BROMOFORM	< 5.0		< 5.0		ug/l	04/14/88
CARBON DISULFIDE	< 5.0		< 5.0		ug/l	04/14/88
CARBON TETRACHLORIDE	< 5.0		< 5.0		ug/l	04/14/88
CHLOROBENZENE	< 5.0		< 5.0		ug/l	04/14/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0		ug/l	04/14/88
CHLOROETHANE	< 10		< 10		ug/l	04/14/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10		ug/l	04/14/88
CHLOROFORM	< 5.0		< 5.0		ug/l	04/14/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	04/14/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0		ug/l	04/14/88
1,1-DICHLOROETHANE	< 5.0		< 5.0		ug/l	04/14/88
1,2-DICHLOROETHANE	< 5.0		< 5.0		ug/l	04/14/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/14/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0		ug/l	04/14/88
ETHYLBENZENE	< 5.0		< 5.0		ug/l	04/14/88
2-HEXANONE	< 10		< 10		ug/l	04/14/88
METHYL BROMIDE	< 10		< 10		ug/l	04/14/88
METHYL CHLORIDE	< 10		< 10		ug/l	04/14/88
4-METHYL-2-PENTANONE	< 10		< 10		ug/l	04/14/88
METHYLENE CHLORIDE	< 5.0		41		ug/l	04/14/88
STYRENE	< 5.0		< 5.0		ug/l	04/14/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0		ug/l	04/14/88
TETRACHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/14/88
TOLUENE	< 5.0		< 5.0		ug/l	04/14/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/14/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	04/14/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	04/14/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	04/14/88
TRICHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/14/88
VINYL ACETATE	< 10		< 10		ug/l	04/14/88
VINYL CHLORIDE	< 10		< 10		ug/l	04/14/88
TOTAL XYLENES	< 5.0		< 5.0		ug/l	04/14/88

TABLE 2.10.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	04/14/88
ACENAPHTHYLENE	< 10		ug/l	04/14/88
ANTHRACENE	< 10		ug/l	04/14/88
BENZO(A)ANTHRACENE	< 10		ug/l	04/14/88
BENZO(A)PYRENE	< 10		ug/l	04/14/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	04/14/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	04/14/88
BENZOIC ACID	< 50		ug/l	04/14/88
BENZO(K)FLUORANTHENE	< 10		ug/l	04/14/88
BENZYL ALCOHOL	< 10		ug/l	04/14/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	04/14/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	04/14/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	04/14/88
BIS(2-ETHYLHEXYL)PHTHALATE	14		ug/l	04/14/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	04/14/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	04/14/88
4-CHLOROANILINE	< 10		ug/l	04/14/88
2-CHLORONAPHTHALENE	< 10		ug/l	04/14/88
2-CHLOROPHENOL	< 10		ug/l	04/14/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	04/14/88
CHRYSENE	< 10		ug/l	04/14/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	04/14/88
DIBENZOFURAN	< 10		ug/l	04/14/88
1,2-DICHLOROBENZENE	< 10		ug/l	04/14/88
1,3-DICHLOROBENZENE	< 10		ug/l	04/14/88
1,4-DICHLOROBENZENE	< 10		ug/l	04/14/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	04/14/88
2,4-DICHLOROPHENOL	< 10		ug/l	04/14/88
DIETHYL PHTHALATE	< 10		ug/l	04/14/88
2,4-DIMETHYLPHENOL	< 10		ug/l	04/14/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	04/14/88
2,4-DINITROPHENOL	< 50		ug/l	04/14/88
DIMETHYL PHTHALATE	< 10		ug/l	04/14/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	04/14/88
2,4-DINITROTOLUENE	< 10		ug/l	04/14/88
2,6-DINITROTOLUENE	< 10		ug/l	04/14/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	04/14/88

TABLE 2.10.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	04/14/88
FLUORENE	< 10		ug/l	04/14/88
HEXACHLOROBENZENE	< 10		ug/l	04/14/88
HEXACHLOROBUTADIENE	< 10		ug/l	04/14/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	04/14/88
HEXACHLOROETHANE	< 10		ug/l	04/14/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	04/14/88
ISOPHORONE	< 10		ug/l	04/14/88
2-METHYLNAPHTHALENE	< 10		ug/l	04/14/88
2-METHYLPHENOL	< 10		ug/l	04/14/88
4-METHYLPHENOL	< 10		ug/l	04/14/88
NAPHTHALENE	< 10		ug/l	04/14/88
2-NITROANILINE	< 50		ug/l	04/14/88
3-NITROANILINE	< 50		ug/l	04/14/88
4-NITROANILINE	< 50		ug/l	04/14/88
NITROBENZENE	< 10		ug/l	04/14/88
2-NITROPHENOL	< 10		ug/l	04/14/88
4-NITROPHENOL	< 50		ug/l	04/14/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	04/14/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	04/14/88
P-CHLORO-M-CRESOL	< 10		ug/l	04/14/88
PENTACHLOROPHENOL	< 50		ug/l	04/14/88
PHENANTHRENE	< 10		ug/l	04/14/88
PHENOL	< 10		ug/l	04/14/88
PYRENE	< 10		ug/l	04/14/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	04/14/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	04/14/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	04/14/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	04/14/88

TABLE 2.10.3

UNC LABORATORY ANALYSIS
WIPP-26 CULEBRA ROUND THREE

REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
AMMONIA	< 0.10	< 0.10	mg/l	04/14/88
NITRATE	13.3	13.6	mg/l	04/14/88
TOTAL IRON	< 0.030	< 0.030	mg/l	04/14/88
FERROUS IRON	< 0.03	< 0.03	mg/l	04/14/88
TOTAL ARSENIC	0.0010	0.0010	mg/l	04/14/88
TOTAL SELENIUM	0.019	0.018	mg/l	04/14/88
SELENIUM IV	< 0.001		mg/l	04/14/88
IODIDE	60	60	ug/l	04/14/88
IODATE	< 20		ug/l	04/14/88

TABLE 2.10.4

PRESSURE AND FLOW
WIPP-26 CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
04/05/88	15:35	07	14	00	PUMP OFF
04/05/88	15:50	07	14	00	PACKER INFLATED
04/05/88	16:00	07	14	55	PUMP ON 15:55
04/05/88	16:15	07	14	54	
04/06/88	07:00	06	14	53	
04/06/88	19:00	07	14	52	
04/07/88	06:00	08	14	54	
04/07/88	17:00	07	14	55	
04/08/88	07:00	07	14	53	
04/08/88	14:30	06	13	56	
04/08/88	15:00	06	13	36	FLOW REDUCED 14:40
04/09/88	08:30	07	13	38	
04/09/88	17:30	07	14	38	FLOW RATE 17:35
04/10/88	07:00	07	14	39	
04/10/88	19:00	07	14	39	
04/11/88	07:00	06	13	37	
04/11/88	16:00	07	14	38	
04/12/88	07:00	07	14	41	
04/12/88	17:30	06	14	39	
04/13/88	06:00	06	14	41	
04/13/88	15:00	07	14	40	
04/14/88	07:00	07	14	38	
04/14/88	12:00	07	14	37	PUMP OFF 12:05

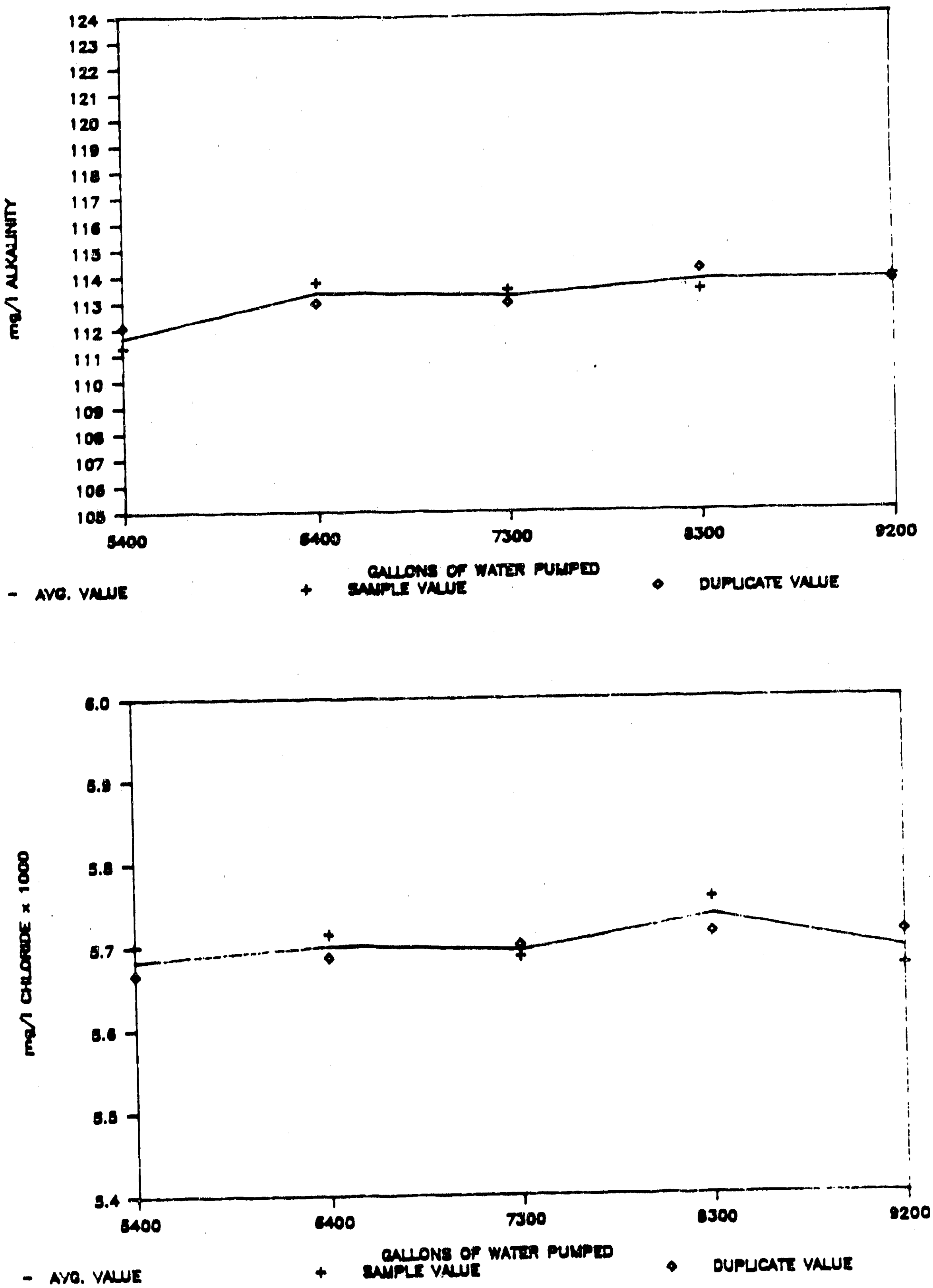
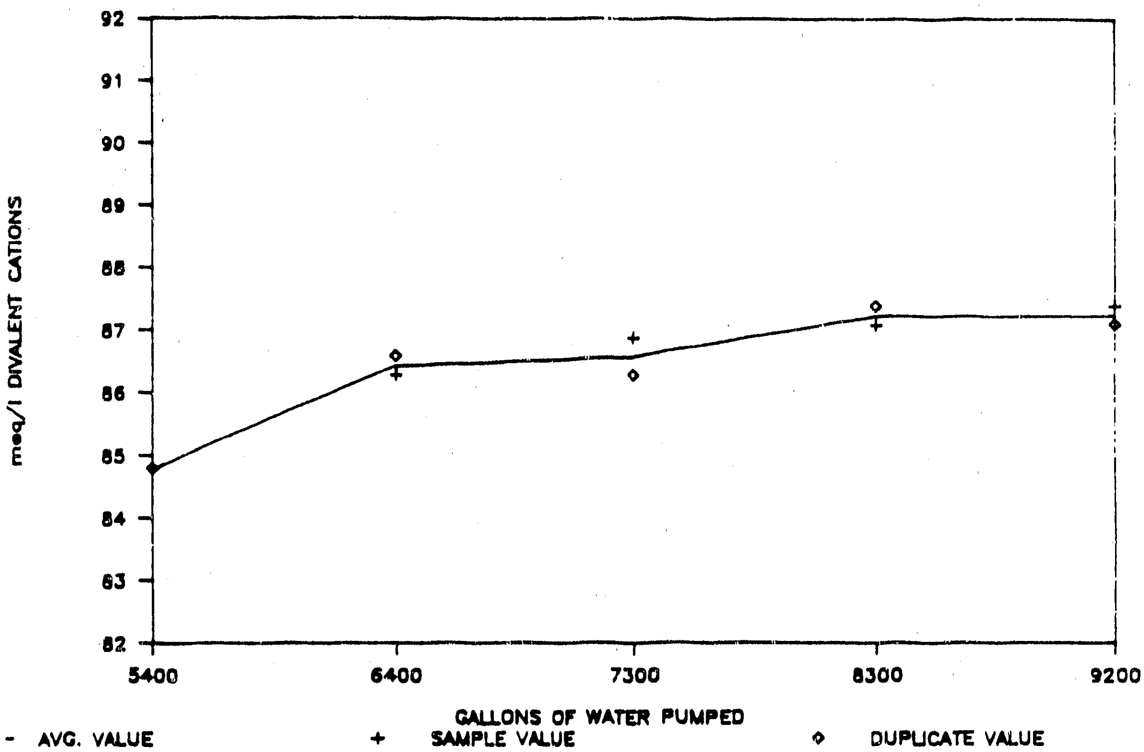


Figure 2.10.1. Graphs of alkalinity and chloride from second round serial sampling at well WIPP-26 Culebra.



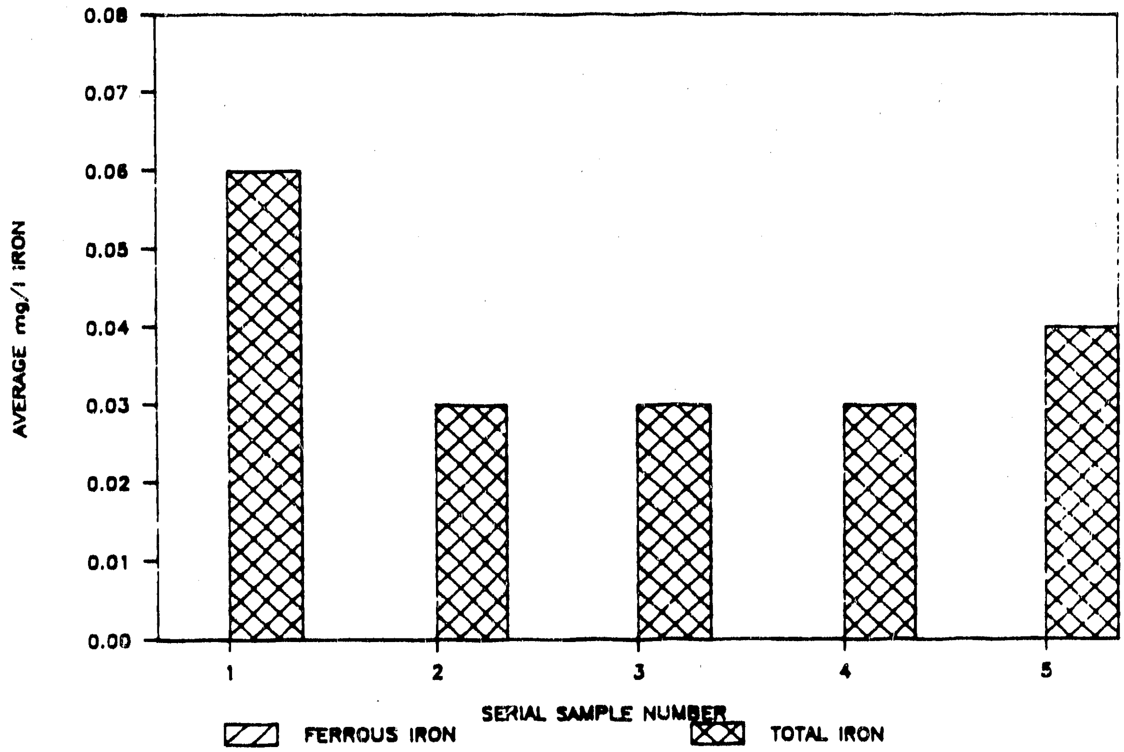


Figure 2.10.2. Graphs of divalent cations and iron from second round serial sampling at well WIPP-26 Culebra.

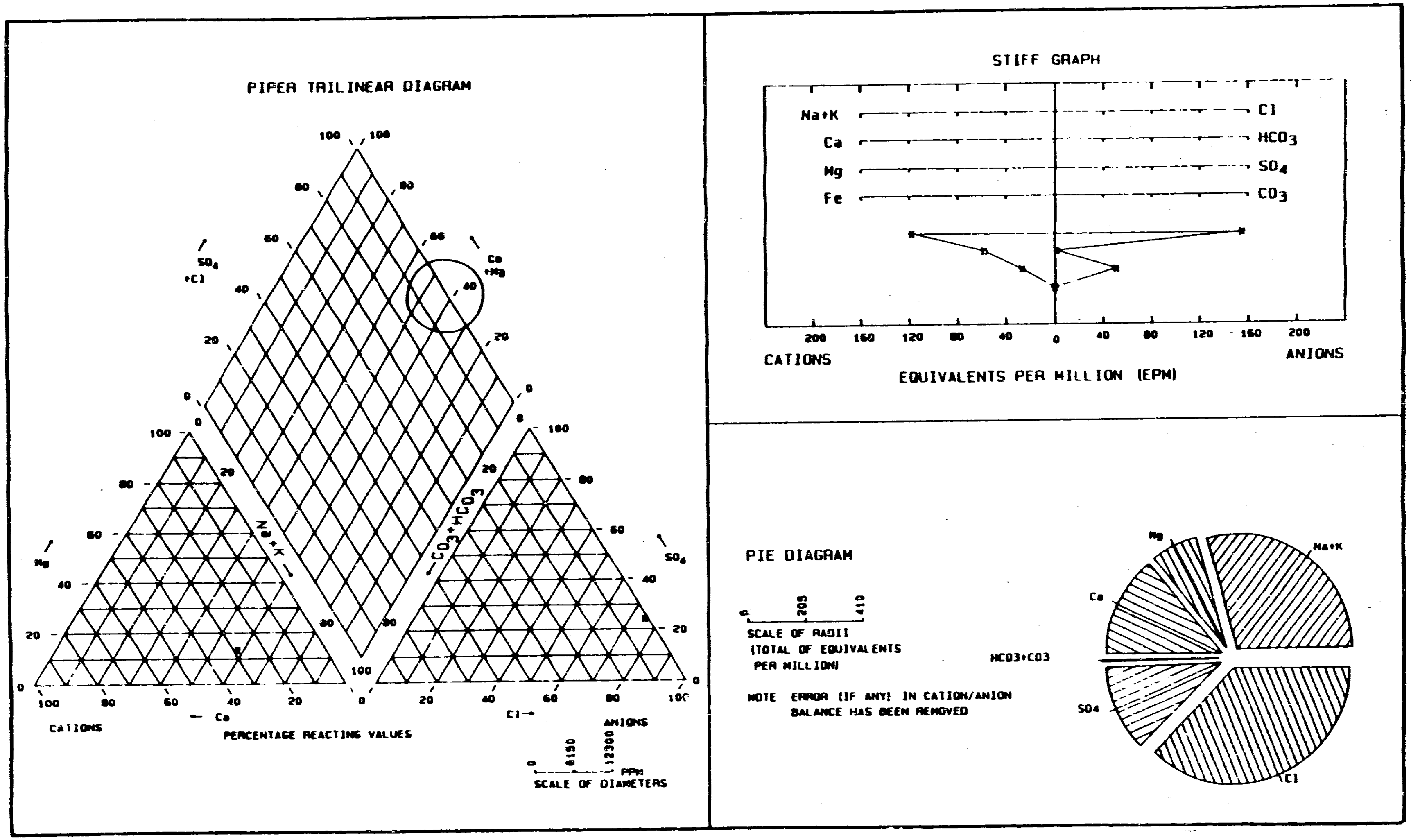


Figure 2.10.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well WIPP-26 Culebra.

2.11 SUMMARY OF CULEBRA WELL H-07b1, ROUND THREE

Well Characteristics

Well H-07b1 is located approximately 5.7 miles southwest of the center of of the WIPP site at an elevation of 3,164 feet above MSL to the top of casing (Gonzales, 1989). Total depth of the drilled hole is 286 feet BGS. Casing extends to a depth of 230 feet BGS and the well is completed open hole. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at an approximate depth interval of 232 to 280 feet BGS (Drellack and Wells, 1982a).

Sampling Process

This well was sampled using an electric submersible pump. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. Obstructions were encountered in the well during emplacement of the pump. Consequently, the pump intake was located at approximately 198 feet BTOC, which is approximately 30 feet above the Culebra Dolomite.

Pumping began on 04/13/88 and ceased on 04/25/88. The average flow rate was between six and seven gpm during the sampling period. Serial sampling began on 04/20/88, after approximately 69,300 gallons of water had been purged from the well. One serial sample was taken each day for six consecutive days. Serial sampling ended and final samples were collected on 04/25/88 after an approximate total of 112,400 gallons had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity remaining fairly constant between 122 and 126 mg/l (Figure 2.11.1).

Chloride content remained static between 290 and 300 mg/l (Figure 2.11.1).

Divalent cations remained stable between 40 and 41 meq/l (Figure 2.11.2).

Total iron varied between 0.05 and 0.09 mg/l, and ferrous iron ranged between 0.02 and 0.06 mg/l during the entire sampling period (Figure 2.11.2).

The water pH was constant at 7.2 SU during serial sampling.

Physical Parameters

Eh values were reported between 282 and 343 mV relative to the SHE throughout the entire sampling period.

The water temperature ranged between 21.8 and 22.4°C.

Specific gravity was reported as 1.002 at 21.2°C on the final day of serial sampling.

Specific conductance was nearly constant and reported at 3,680 umhos/cm at 25°C on the final day of sampling.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were collected following procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from this well was not effervescent.

Tabular data are presented in Tables 2.11.1, 2.11.2, 2.11.3, and 2.11.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.11.1 and 2.11.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.11.3 illustrates the general water quality at well H-07b1 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds are not present in the Rustler Formation, neither above nor below the Culebra Dolomite, at this location (Mercer, 1983).

No problems were encountered while sampling well H-07b1.

Serial Parameter Comparisons With The Previous Rounds

Results from the round three serial sampling compare favorably with data from the previous two rounds of sampling. Variation in any of the parameters, measured on the last day of serial sampling, amounts to only a few percent across all three rounds of sampling.

Flow rates over the three rounds of sampling are comparable, ranging between five and seven gpm. The total volumes of water purged from the well prior to final sampling were 38,900, 62,600, and 112,400 gallons for rounds one, two, and three, respectively.

TABLE 2.11.1

SERIAL SAMPLE CHEMISTRY
H-07b1 CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	123	122	mg/l	69300	04/20/88
2	ALKALINITY	125	126	mg/l	75700	04/21/88
3	ALKALINITY	125	124	mg/l	84500	04/22/88
4	ALKALINITY	122	122	mg/l	93200	04/23/88
5	ALKALINITY	124	123	mg/l	102400	04/24/88
6	ALKALINITY	123	122	mg/l	112400	04/25/88
1	CHLORIDE	297	295	mg/l	69300	04/20/88
2	CHLORIDE	292	292	mg/l	75700	04/21/88
3	CHLORIDE	293	291	mg/l	84500	04/22/88
4	CHLORIDE	291	291	mg/l	93200	04/23/88
5	CHLORIDE	293	293	mg/l	102400	04/24/88
6	CHLORIDE	294	291	mg/l	112400	04/25/88
1	DIVALENT CATIONS	40.2	40.0	meq/l	69300	04/20/88
2	DIVALENT CATIONS	40.6	40.4	meq/l	75700	04/21/88
3	DIVALENT CATIONS	40.5	40.5	meq/l	84500	04/22/88
4	DIVALENT CATIONS	40.3	40.1	meq/l	93200	04/23/88
5	DIVALENT CATIONS	40.7	40.5	meq/l	102400	04/24/88
6	DIVALENT CATIONS	40.4	40.4	meq/l	112400	04/25/88
1	TOTAL IRON	0.05	0.06	mg/l	69300	04/20/88
2	TOTAL IRON	0.09	0.09	mg/l	75700	04/21/88
3	TOTAL IRON	0.06	0.07	mg/l	84500	04/22/88
4	TOTAL IRON	0.06	0.06	mg/l	93200	04/23/88
5	TOTAL IRON	0.07	0.06	mg/l	102400	04/24/88
6	TOTAL IRON	0.07	0.07	mg/l	112400	04/25/88
1	FERROUS IRON	0.03	0.02	mg/l	69300	04/20/88
2	FERROUS IRON	0.06	0.06	mg/l	75700	04/21/88
3	FERROUS IRON	0.04	0.04	mg/l	84500	04/22/88
4	FERROUS IRON	0.04	0.03	mg/l	93200	04/23/88
5	FERROUS IRON	0.04	0.03	mg/l	102400	04/24/88
6	FERROUS IRON	0.04	0.04	mg/l	112400	04/25/88

TABLE 2.11.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	7.2			69300	04/20/88
2	pH	7.2			75700	04/21/88
3	pH	7.2			84500	04/22/88
4	pH	7.2			93200	04/23/88
6	pH	7.2			112400	04/25/88
1	Eh	307		mV	69300	04/20/88
2	Eh	282		mV	75700	04/21/88
3	Eh	316		mV	84500	04/22/88
4	Eh	326		mV	93200	04/23/88
6	Eh	343		mV	112400	04/25/88
1	TEMPERATURE	22.4		C	69300	04/20/88
2	TEMPERATURE	22.1		C	75700	04/21/88
3	TEMPERATURE	22.2		C	84500	04/22/88
4	TEMPERATURE	21.9		C	93200	04/23/88
6	TEMPERATURE	21.8		C	112400	04/25/88
1	SPECIFIC GRAVITY	1.002		@ 23.2 C	69300	04/20/88
5	SPECIFIC GRAVITY	1.001		@ 21.6 C	102400	04/24/88
6	SPECIFIC GRAVITY	1.002		@ 21.2 C	112400	04/25/88
1	SPECIFIC CONDUCTANCE	3670	@ 25 C	umhos/cm	69300	04/20/88
6	SPECIFIC CONDUCTANCE	3680	@ 25 C	umhos/cm	112400	04/25/88

TABLE 2.11.2

ITAS LABORATORY RESULTS
H-07b1 CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	120		mg/l	04/25/88
ALKALINITY (CO3)	0		mg/l	04/25/88
BROMIDE	< 2		mg/l	04/25/88
CHLORIDE	290		mg/l	04/25/88
CYANIDE, TOTAL	< 0.02		mg/l	04/25/88
FLUORIDE	1.5		mg/l	04/25/88
IODIDE	< 2.0		mg/l	04/25/88
NITRATE	0.70		mg/l NO3-N	04/25/88
pH	6.95	6.98		04/25/88
PHENOLICS	< 0.005		mg/l	04/25/88
PHOSPHATE, TOTAL	0.03		mg/l T-PO4-P	04/25/88
RESIDUE, FILTERABLE @180 C	3400	3200	mg/l	04/25/88
RESIDUE, NONFILTERABLE @105 C	< 4	< 4	mg/l	04/25/88
SPECIFIC CONDUCTANCE	3970	3980	umhos/cm@25C	04/25/88
SULFATE	2000		mg/l	04/25/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	04/25/88
TOTAL ORGANIC HALOGEN	< 0.05	< 0.05	mg/l	04/25/88

TABLE 2.11.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	(1.0	(1.0	(0.1	(0.1	mg/l	04/25/88
ANTIMONY	(0.50	(0.50	(0.05	(0.05	mg/l	04/25/88
ARSENIC	0.0050		(0.005	(0.005	mg/l	04/25/88
BARIUM	(0.050		(0.005	(0.005	mg/l	04/25/88
BERYLLIUM	(0.050		(0.005	(0.005	mg/l	04/25/88
BORON	0.70	0.70	(0.01	(0.01	mg/l	04/25/88
CADMIUM	(0.050	(0.050	(0.005	(0.005	mg/l	04/25/88
CALCIUM	570	560			mg/l	04/25/88
CESIUM	0.010	0.010	(0.01	(0.01	mg/l	04/25/88
CHROMIUM	(0.10	(0.10	(0.01	(0.01	mg/l	04/25/88
COBALT	(0.10	(0.10	(0.01	(0.01	mg/l	04/25/88
COPPER	(0.10	(0.10	(0.01	(0.01	mg/l	04/25/88
IRON	(0.10	(0.10	(0.01	(0.01	mg/l	04/25/88
LEAD	(0.50	(0.50	(0.05	(0.05	mg/l	04/25/88
LITHIUM	0.12	0.12	0.01	0.01	mg/l	04/25/88
MAGNESIUM	130	120			mg/l	04/25/88
MANGANESE	0.060	0.050	(0.005	(0.005	mg/l	04/25/88
MERCURY	(0.0002	(0.0002	(0.0002	(0.0002	mg/l	04/25/88
MOLYBDENUM	(1.0	(1.0	(0.01	(0.01	mg/l	04/25/88
NICKEL	(0.30	(0.30	(0.03	(0.03	mg/l	04/25/88
POTASSIUM	8.2	8.4			mg/l	04/25/88
SELENIUM	0.012		(0.005	(0.005	mg/l	04/25/88
SILICA	20				mg/l	04/25/88
SILVER	(0.10	(0.10	(0.01	(0.01	mg/l	04/25/88
SODIUM	200	200			mg/l	04/25/88
STRONTIUM	8.4	8.4	(0.01	(0.01	mg/l	04/25/88
THALLIUM	(0.0050		(0.005	(0.005	mg/l	04/25/88
TITANIUM	(0.30	(0.30	(0.03	(0.03	mg/l	04/25/88
VANADIUM	(0.10	(0.10	(0.01	(0.01	mg/l	04/25/88
ZINC	(0.10	(0.10	(0.01	(0.01	mg/l	04/25/88

TABLE 2.11.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10		ug/l	04/25/88
BENZENE	< 5.0		< 5.0		ug/l	04/25/88
2-BUTANONE	< 10		< 10		ug/l	04/25/88
BROMOFORM	< 5.0		< 5.0		ug/l	04/25/88
CARBON DISULFIDE	< 5.0		< 5.0		ug/l	04/25/88
CARBON TETRACHLORIDE	< 5.0		< 5.0		ug/l	04/25/88
CHLOROBENZENE	< 5.0		< 5.0		ug/l	04/25/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0		ug/l	04/25/88
CHLOROETHANE	< 10		< 10		ug/l	04/25/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10		ug/l	04/25/88
CHLOROFORM	< 5.0		< 5.0		ug/l	04/25/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	04/25/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0		ug/l	04/25/88
1,1-DICHLOROETHANE	< 5.0		< 5.0		ug/l	04/25/88
1,2-DICHLOROETHANE	< 5.0		< 5.0		ug/l	04/25/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/25/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0		ug/l	04/25/88
ETHYLBENZENE	< 5.0		< 5.0		ug/l	04/25/88
2-HEXANONE	< 10		< 10		ug/l	04/25/88
METHYL BROMIDE	< 10		< 10		ug/l	04/25/88
METHYL CHLORIDE	< 10		< 10		ug/l	04/25/88
4-METHYL-2-PENTANONE	< 10		< 10		ug/l	04/25/88
METHYLENE CHLORIDE	< 5.0		9.8		ug/l	04/25/88
STYRENE	< 5.0		< 5.0		ug/l	04/25/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0		ug/l	04/25/88
TETRACHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/25/88
TOLUENE	< 5.0		< 5.0		ug/l	04/25/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/25/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	04/25/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	04/25/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	04/25/88
TRICHLOROETHYLENE	< 5.0		< 5.0		ug/l	04/25/88
VINYL ACETATE	< 10		< 10		ug/l	04/25/88
VINYL CHLORIDE	< 10		< 10		ug/l	04/25/88
TOTAL XYLENES	< 5.0		< 5.0		ug/l	04/25/88

TABLE 2.11.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	04/25/88
ACENAPHTHYLENE	< 10		ug/l	04/25/88
ANTHRACENE	< 10		ug/l	04/25/88
BENZO(A)ANTHRACENE	< 10		ug/l	04/25/88
BENZO(A)PYRENE	< 10		ug/l	04/25/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	04/25/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	04/25/88
BENZOIC ACID	< 50		ug/l	04/25/88
BENZO(K)FLUORANTHENE	< 10		ug/l	04/25/88
BENZYL ALCOHOL	< 10		ug/l	04/25/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	04/25/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	04/25/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	04/25/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	04/25/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	04/25/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	04/25/88
4-CHLOROANILINE	< 10		ug/l	04/25/88
2-CHLORONAPHTHALENE	< 10		ug/l	04/25/88
2-CHLOROPHENOL	< 10		ug/l	04/25/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	04/25/88
CHRYSENE	< 10		ug/l	04/25/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	04/25/88
DIBENZOFURAN	< 10		ug/l	04/25/88
1,2-DICHLOROBENZENE	< 10		ug/l	04/25/88
1,3-DICHLOROBENZENE	< 10		ug/l	04/25/88
1,4-DICHLOROBENZENE	< 10		ug/l	04/25/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	04/25/88
2,4-DICHLOROPHENOL	< 10		ug/l	04/25/88
DIETHYL PHTHALATE	< 10		ug/l	04/25/88
2,4-DIMETHYLPHENOL	< 10		ug/l	04/25/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	04/25/88
2,4-DINITROPHENOL	< 50		ug/l	04/25/88
DIMETHYL PHTHALATE	< 10		ug/l	04/25/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	04/25/88
2,4-DINITROTOLUENE	< 10		ug/l	04/25/88
2,6-DINITROTOLUENE	< 10		ug/l	04/25/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	04/25/88

TABLE 2.11.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	04/25/88
FLUORENE	< 10		ug/l	04/25/88
HEXACHLOROBENZENE	< 10		ug/l	04/25/88
HEXACHLOROBUTADIENE	< 10		ug/l	04/25/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	04/25/88
HEXACHLOROETHANE	< 10		ug/l	04/25/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	04/25/88
ISOPHORONE	< 10		ug/l	04/25/88
2-METHYLNAPHTHALENE	< 10		ug/l	04/25/88
2-METHYLPHENOL	< 10		ug/l	04/25/88
4-METHYLPHENOL	< 10		ug/l	04/25/88
NAPHTHALENE	< 10		ug/l	04/25/88
2-NITROANILINE	< 50		ug/l	04/25/88
3-NITROANILINE	< 50		ug/l	04/25/88
4-NITROANILINE	< 50		ug/l	04/25/88
NITROBENZENE	< 10		ug/l	04/25/88
2-NITROPHENOL	< 10		ug/l	04/25/88
4-NITROPHENOL	< 50		ug/l	04/25/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	04/25/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	04/25/88
P-CHLORO-M-CRESOL	< 10		ug/l	04/25/88
PENTACHLOROPHENOL	< 50		ug/l	04/25/88
PHENANTHRENE	< 10		ug/l	04/25/88
PHENOL	< 10		ug/l	04/25/88
PYRENE	< 10		ug/l	04/25/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	04/25/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	04/25/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	04/25/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	04/25/88

TABLE 2.11.3

UMC LABORATORY ANALYSIS
H-07b1 CULEBRA ROUND THREE

REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
AMMONIA	< 0.10	< 0.10	mg/l	04/25/88
NITRATE	2.50	2.60	mg/l	04/25/88
TOTAL IRON	< 0.030	< 0.030	mg/l	04/25/88
FERROUS IRON	< 0.03	< 0.03	mg/l	04/25/88
TOTAL ARSENIC	0.0010	0.0010	mg/l	04/25/88
TOTAL SELENIUM	0.010	0.010	mg/l	04/25/88
SELENIUM IV	< 0.001		mg/l	04/25/88
IODIDE	70	80	ug/l	04/25/88
IODATE	< 20	< 20	ug/l	04/25/88

TABLE 2.11.4

PRESSURE AND FLOW
H-07b1 CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPM FLOW RATE	COMMENTS
04/13/88	10:56	04	10	0.00	PUMP OFF/PACKER DEFLATED
04/13/88	11:05	04	10	0.00	PUMP ON /PACKER INFLATED
04/13/88	15:30	14	28	8.00	TRANSDUCER FAILURE
04/14/88	07:30	13	06	8.00	
04/14/88	15:30	06	08	7.77	
04/15/88	07:35	11	NA	8.20	PSI BELOW MALFUNCTION
04/15/88	14:00	04	11	6.40	TRANSDUCER BELOW CORRECTED
04/16/88	05:00	04	16	6.70	
04/17/88	08:00	04	19	6.70	
04/17/88	20:00	04	17	6.50	
04/18/88	08:00	04	13	6.84	
04/18/88	16:00	03	08	6.32	
04/19/88	07:00	00	05	6.83	PSI ABOVE ELECTRONIC GLITCH
04/19/88	16:00	04	04	6.57	
04/20/88	07:00	03	06	6.89	
04/20/88	14:30	03	21	6.44	
04/21/88	07:00	04	35	6.66	
04/21/88	16:30	04	27	6.40	
04/22/88	07:00	04	28	6.61	
04/22/88	14:30	04	26	6.29	
04/23/88	07:15	04	25	6.29	PSI TAKEN AT 07:00
04/23/88	17:30	04	21	6.33	
04/24/88	07:00	04	26	6.75	
04/24/88	16:30	04	17	6.61	
04/25/88	08:00	04	25	6.45	
04/25/88	13:30	04	22	6.38	PUMP OFF 13:36

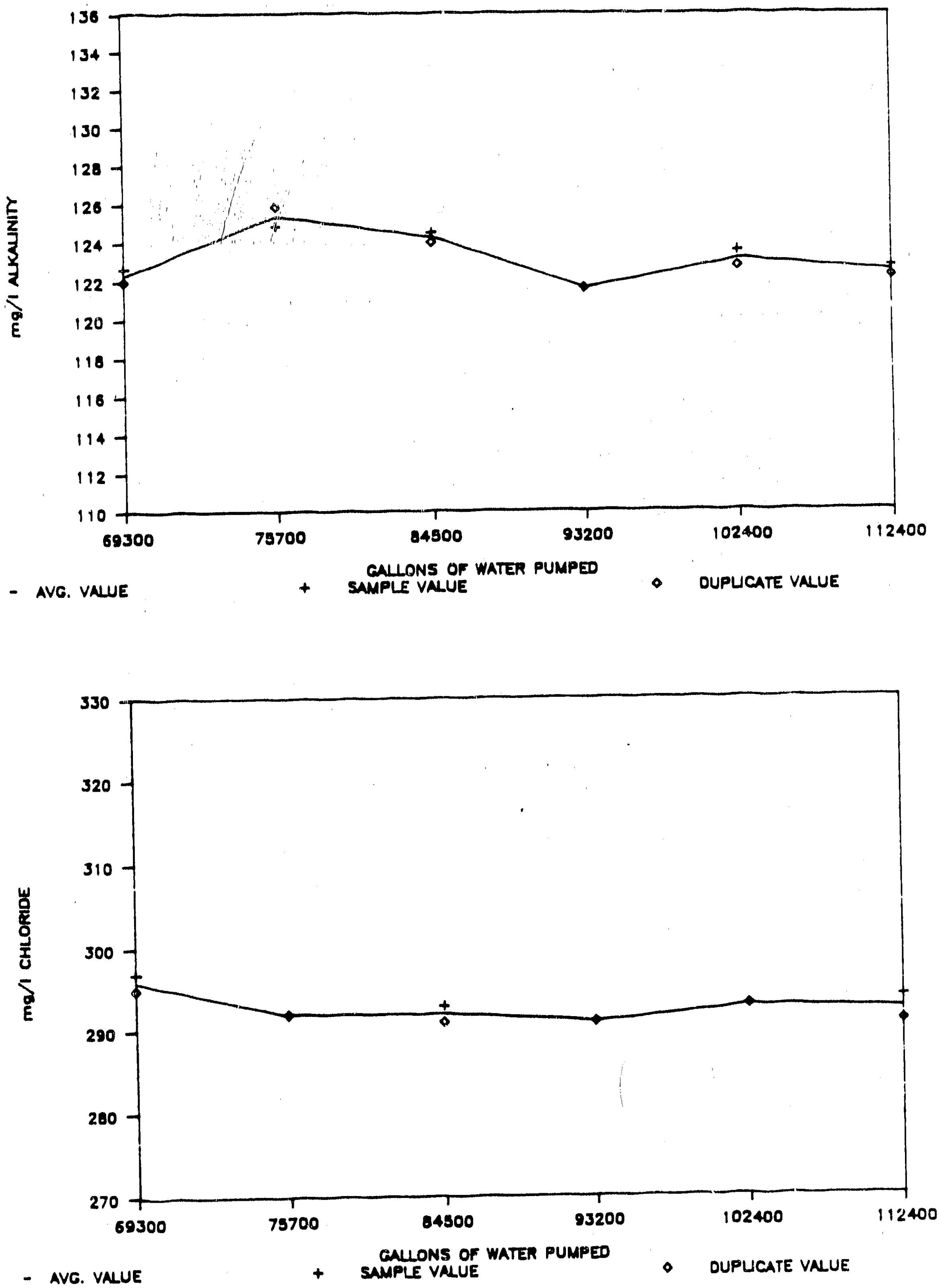
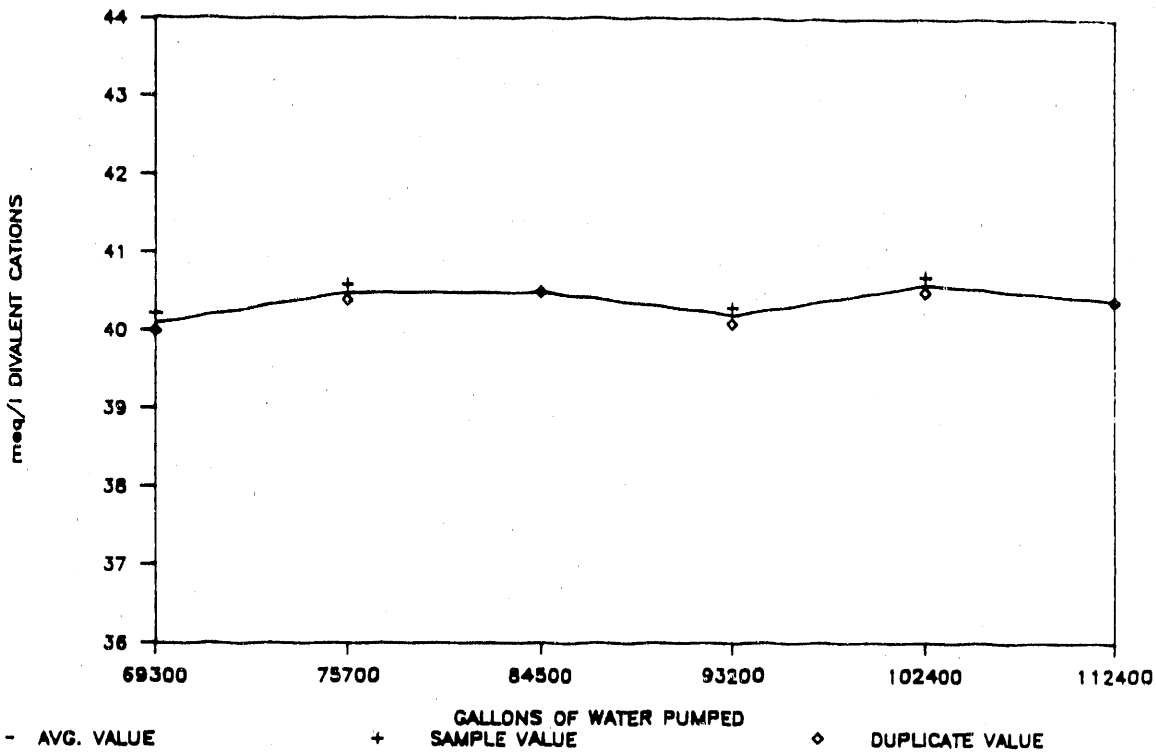


Figure 2.11.1. Graphs of alkalinity and chloride from third round serial sampling at well H-07b1 Culebra.



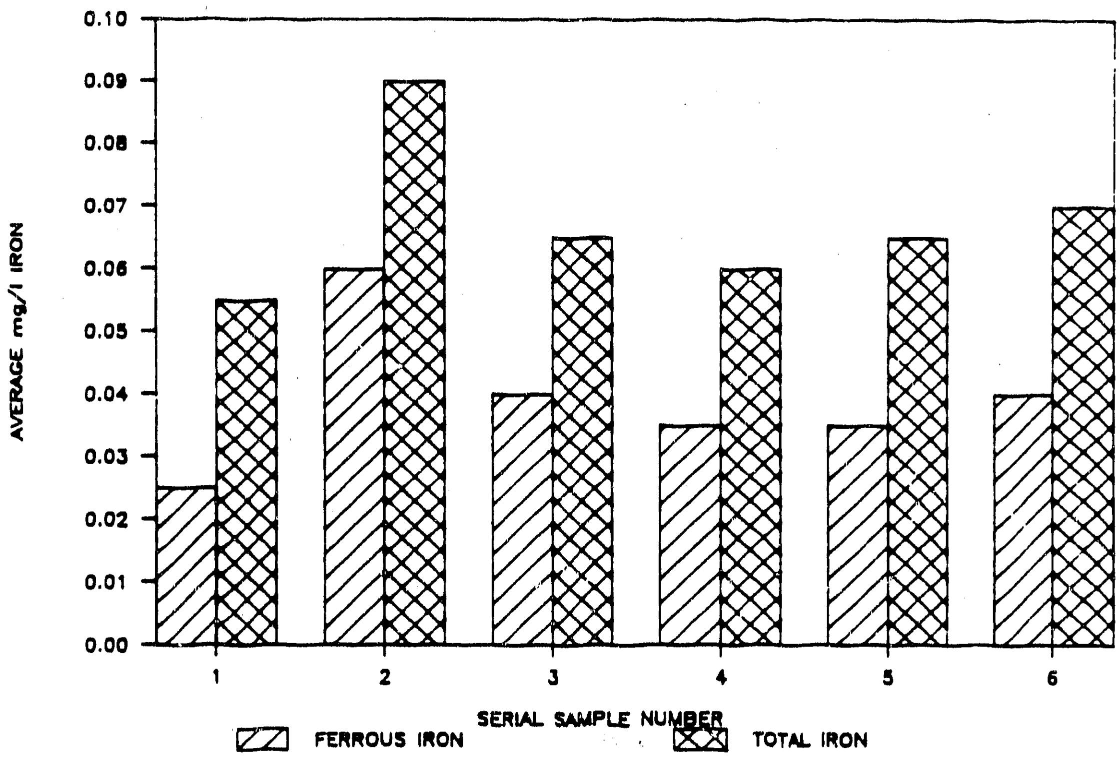


Figure 2.11.2. Graphs of divalent cations and iron from third round serial sampling at well H-07b1 Culebra.

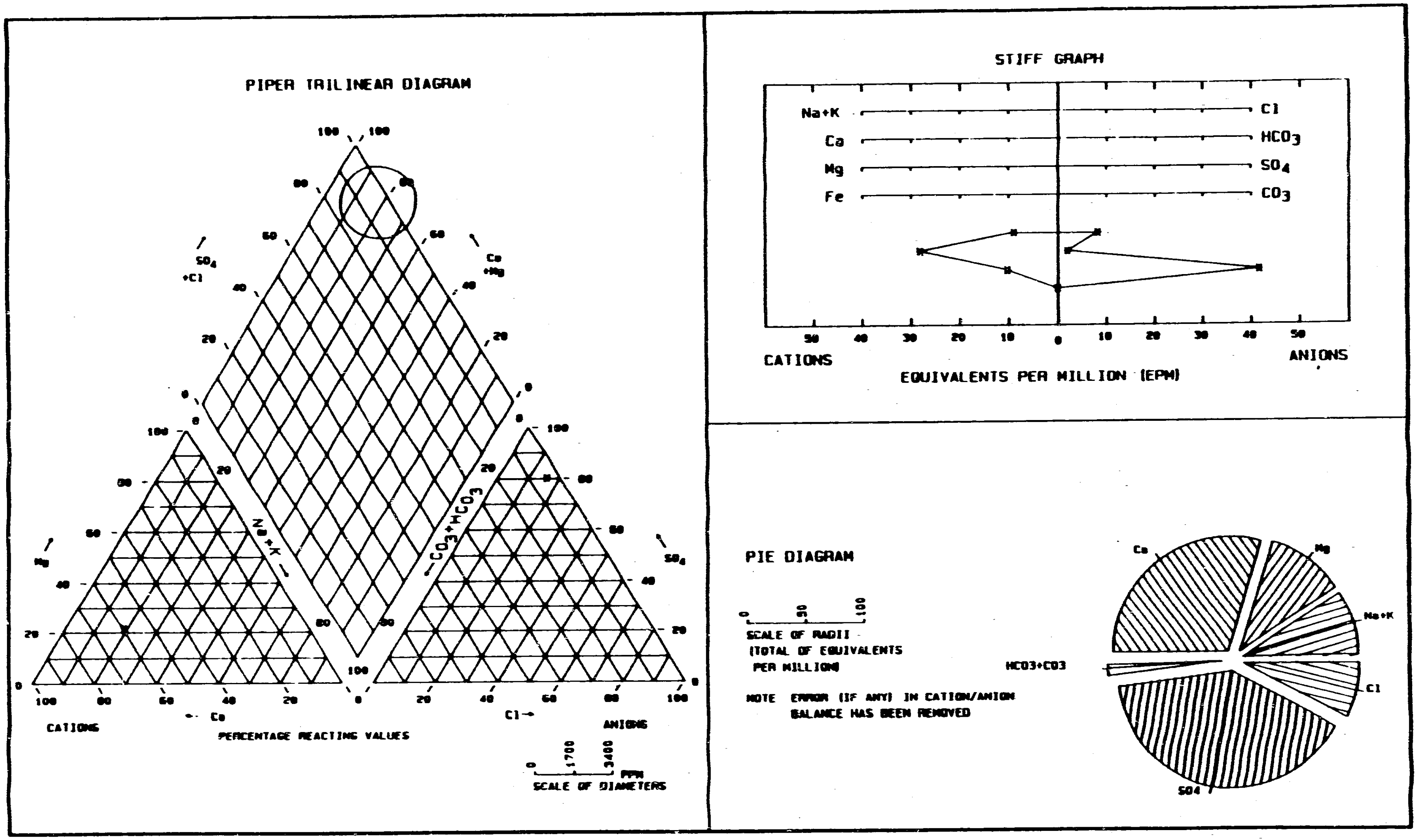


Figure 2.11.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well H-07b1 Culebra.

2.12 SUMMARY OF CULEBRA WELL DOE-2, ROUND THREE

Well Characteristics

Well DOE-2 is located approximately 2.1 miles north of the center of the WIPP site at an elevation of 3,419 feet above MSL, to the top of casing (Gonzales, 1989). Total depth of the drilled hole is 4,325 feet BGS. The hole is cased to a depth of 1,009 feet BGS with a bridge plug in place at 868 feet BGS. The casing is perforated in only one interval, from 822 to 848 feet BGS, accessing the Culebra Dolomite Member of the Rustler Formation. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation, which occurs here at a depth interval of 824 to 846 feet BGS (Mercer et al., 1987).

Sampling Process

This well was sampled using a Grundfos model electric submersible pump. A Baski inflatable packer set above the pump isolated the pump intake from stagnant water above it in the well bore. The pump intake was located at 821 feet BTOC.

Pumping began on 04/27/88. The pump flow rate was approximately five gallons per minute until 05/07/88 when the pump failed. During this period approximately 57,000 gallons of water were pumped from the well. The pump was removed from the well and replaced. Pumping resumed on 05/10/88 and finally ceased on 05/19/88. The flow rate averaged approximately seven gallons per minute during the second pumping period.

Serial sampling began on 05/01/88 after approximately 22,300 gallons of water had been pumped from the well. One serial sample was taken each day for six consecutive days, until the first pump failed. Then there was a ten-day hiatus in sampling. Sampling resumed on 05/16/88. Four more daily serial samples were collected until serial sampling ended and final samples were collected on 05/19/88. At the time of final sampling, approximately 149,000 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity steadily decreasing from 217 to approximately 130 mg/l throughout the sampling period (Figure 2.11.1).

Chloride content remained nearly constant around 32,000 mg/l (Figure 2.11.1).

Divalent cations varied between 184 and 198 meq/l (Figure 2.11.2).

Total and ferrous iron increased over the first three days of sampling. During the remainder of this sampling episode iron values decreased and then stabilized. Ending values for total iron were approximately 0.35 mg/l, and 0.26 mg/l for ferrous iron (Figure 2.11.2).

Except for the pH measurement on the first day of sampling (6.6 SU), the water pH gradually increased from 6.2 to 6.7 SU.

Physical Parameters

Values for Eh were reported between 322 and 296 mV relative to the SHE.

The water temperature ranged between 22 and 23°C.

Specific gravity was 1.044 at 23.3°C on the final day of sampling.

Specific conductance measured 75,500 umhos/cm at 25°C on the final day of sampling.

Final Sample Collection

Samples were taken following procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual 07-230. With the exceptions of alkalinity and pH, serial sampling parameters stabilized by the time final samples were collected. Alkalinity may have been slowly decreasing and pH may have been slowly increasing at the time final samples were collected.

The collected samples were sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from this well was very effervescent. This well had been acidized with hydrochloric acid prior to the round two sampling. Perhaps excess carbon dioxide, from acid dissolution of carbonate rocks, remains as a contaminant plume in the aquifer around DOE-2. This may explain the present low pH and high alkalinity values relative to the round one sampling, which occurred prior to acidification of the well.

Some fine-grained particulate matter was deposited on the 0.45-um filters employed during sampling. The amount of particulates decreased as pumping progressed.

Tabular data are presented in Tables 2.12.1, 2.12.2, 2.12.3, and 2.12.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.12.1 and 2.12.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.12.3 illustrates the general water quality at well DOE-2 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds occur below the Culebra Dolomite Member within the Rustler Formation at well DOE-2 (Mercer et al., 1987).

Serial Parameter Comparisons With The Previous Rounds

Comparisons of serial sampling data from rounds two and three agree generally, but both differ significantly from round one. The well was acidified between rounds one and two. The well may still be affected from the acid treatment. Round one reported an alkalinity of approximately 68 mg/l. Round two and three both report alkalinities initially above 200 mg/l decreasing to the 150 to 130 mg/l range. The water pH decreased from the round one value of 7.0 to 6.7 SU at the end of the round three sampling. Iron was undetectable during most of round one. Iron concentration increased with each subsequent sampling. Specific conductance was 68,000 umhos/cm at 25°C in round one. Specific conductance increased to approximately 77,500 umhos/cm at 25°C during rounds two and three. Chloride, divalent cations, and specific gravity, while varying slightly, have remained nearly the same for all three rounds. Eh values increased significantly during the round one and two pumping episodes. For the first time, during round three, the Eh values decreased slightly as serial sampling progressed.

The total volumes of water pumped prior to final sampling for rounds one, two, and three were approximately 178,000; 119,000; and 149,000 gallons, respectively.

TABLE 2.12.1

SERIAL SAMPLE CHEMISTRY
DOE-2 CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	217	217	mg/l	22300	05/01/88
2	ALKALINITY	202	202	mg/l	28500	05/02/88
3	ALKALINITY	194	193	mg/l	34100	05/03/88
4	ALKALINITY	186	187	mg/l	40000	05/04/88
5	ALKALINITY	174	174	mg/l	48400	05/05/88
6	ALKALINITY	168	169	mg/l	54200	05/06/88
7	ALKALINITY	133	134	mg/l	126000	05/16/88
8	ALKALINITY	135	134	mg/l	135000	05/17/88
9	ALKALINITY	131	130	mg/l	142000	05/18/88
10	ALKALINITY	131	131	mg/l	149000	05/19/88
1	CHLORIDE	32300	32400	mg/l	22300	05/01/88
2	CHLORIDE	32200	32400	mg/l	28500	05/02/88
3	CHLORIDE	32300	32100	mg/l	34100	05/03/88
4	CHLORIDE	31700	32000	mg/l	40000	05/04/88
5	CHLORIDE	31800	31700	mg/l	48400	05/05/88
6	CHLORIDE	31700	31500	mg/l	54200	05/06/88
7	CHLORIDE	32000	32000	mg/l	126000	05/16/88
8	CHLORIDE	32200	32000	mg/l	135000	05/17/88
9	CHLORIDE	31600	31900	mg/l	142000	05/18/88
10	CHLORIDE	31600	31500	mg/l	149000	05/19/88
1	DIVALENT CATIONS	184	185	meq/l	22300	05/01/88
2	DIVALENT CATIONS	198	198	meq/l	28500	05/02/88
3	DIVALENT CATIONS	192	193	meq/l	34100	05/03/88
4	DIVALENT CATIONS	185	185	meq/l	40000	05/04/88
5	DIVALENT CATIONS	187	186	meq/l	48400	05/05/88
6	DIVALENT CATIONS	186	185	meq/l	54200	05/06/88
7	DIVALENT CATIONS	184	184	meq/l	126000	05/16/88
8	DIVALENT CATIONS	186	185	meq/l	135000	05/17/88
9	DIVALENT CATIONS	187	187	meq/l	142000	05/18/88
10	DIVALENT CATIONS	184	184	meq/l	149000	05/19/88

TABLE 2.12.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	TOTAL IRON	0.40	0.42	mg/l	22300	05/01/88
2	TOTAL IRON	0.64	0.61	mg/l	28500	05/02/88
3	TOTAL IRON	0.60	0.59	mg/l	34100	05/03/88
4	TOTAL IRON	0.52	0.53	mg/l	40000	05/04/88
5	TOTAL IRON	0.44	0.43	mg/l	48400	05/05/88
6	TOTAL IRON	0.38	0.39	mg/l	54200	05/06/88
7	TOTAL IRON	0.31	0.31	mg/l	126000	05/16/88
8	TOTAL IRON	0.32	0.33	mg/l	135000	05/17/88
9	TOTAL IRON	0.35	0.31	mg/l	142000	05/18/88
10	TOTAL IRON	0.35	0.35	mg/l	149000	05/19/88
1	FERROUS IRON	0.34	0.38	mg/l	22300	05/01/88
2	FERROUS IRON	0.58	0.56	mg/l	28500	05/02/88
3	FERROUS IRON	0.53	0.51	mg/l	34100	05/03/88
4	FERROUS IRON	0.39	0.46	mg/l	40000	05/04/88
5	FERROUS IRON	0.40	0.39	mg/l	48400	05/05/88
6	FERROUS IRON	0.27	0.28	mg/l	54200	05/06/88
7	FERROUS IRON	0.23	0.22	mg/l	126000	05/16/88
8	FERROUS IRON	0.26	0.24	mg/l	135000	05/17/88
9	FERROUS IRON	0.27	0.29	mg/l	142000	05/18/88
10	FERROUS IRON	0.26	0.26	mg/l	149000	05/19/88
1	pH	6.6			22300	05/01/88
2	pH	6.2			28500	05/02/88
3	pH	6.2			34100	05/03/88
4	pH	6.2			40000	05/04/88
5	pH	6.3			48400	05/05/88
6	pH	6.3			54200	05/06/88
7	pH	6.5			126000	05/16/88
8	pH	6.6			135000	05/17/88
9	pH	6.6			142000	05/18/88
10	pH	6.7			149000	05/19/88
2	Eh	322		mV	28500	05/02/88
3	Eh	316		mV	34100	05/03/88
4	Eh	304		mV	40000	05/04/88
5	Eh	307		mV	48400	05/05/88
6	Eh	309		mV	54200	05/06/88
7	Eh	313		mV	126000	05/16/88
8	Eh	296		mV	135000	05/17/88
9	Eh	305		mV	142000	05/18/88
10	Eh	307		mV	149000	05/19/88

TABLE 2.12.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	TEMPERATURE	22.1		C	22300	05/01/88
2	TEMPERATURE	22.2		C	28500	05/02/88
3	TEMPERATURE	22.9		C	34100	05/03/88
4	TEMPERATURE	22.7		C	40000	05/04/88
5	TEMPERATURE	22.9		C	48400	05/05/88
6	TEMPERATURE	22.9		C	54200	05/06/88
7	TEMPERATURE	22.8		C	126000	05/16/88
8	TEMPERATURE	22.9		C	135000	05/17/88
9	TEMPERATURE	23.0		C	142000	05/18/88
10	TEMPERATURE	22.8		C	149000	05/19/88
1	SPECIFIC GRAVITY	1.042		@ 22.1 C	22300	05/01/88
7	SPECIFIC GRAVITY	1.042		@ 22.8 C	126000	05/16/88
10	SPECIFIC GRAVITY	1.044		@ 23.3 C	149000	05/19/88
1	SPECIFIC CONDUCTANCE	75700	@ 25 C	umhos/cm	22300	05/01/88
7	SPECIFIC CONDUCTANCE	74900	@ 25 C	umhos/cm	126000	05/16/88
10	SPECIFIC CONDUCTANCE	75500	@ 25 C	umhos/cm	149000	05/19/88

TABLE 2.12.2

ITAS LABORATORY RESULTS
DOE-2 CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	130	130	mg/l	05/19/88
ALKALINITY (CO3)	0	0	mg/l	05/19/88
BROMIDE	36		mg/l	05/19/88
CHLORIDE	29200		mg/l	05/19/88
CYANIDE, TOTAL	< 0.02		mg/l	05/19/88
FLUORIDE	1.4		mg/l	05/19/88
IODIDE	< 2.0	< 2.0	mg/l	05/19/88
NITRATE	< 0.02		mg/l NO3-N	05/19/88
pH	6.47	6.49		05/19/88
PHENOLICS	< 0.005		mg/l	05/19/88
PHOSPHATE, TOTAL	< 0.01		mg/l T-PO4-P	05/19/88
RESIDUE, FILTERABLE @180 C	57500	57500	mg/l	05/19/88
RESIDUE, NONFILTERABLE @105 C	120	130	mg/l	05/19/88
SPECIFIC CONDUCTANCE	76500	76200	umhos/cm@25C	05/19/88
SULFATE	4500		mg/l	05/19/88
TOTAL ORGANIC CARBON	1.0	< 1.0	mg/l	05/19/88
TOTAL ORGANIC HALOGEN	2.10	1.90	mg/l	05/19/88

TABLE 2.12.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	05/19/88
ANTIMONY	0.60	0.60	< 0.05	< 0.05	mg/l	05/19/88
ARSENIC	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	05/19/88
BARIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	05/19/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	05/19/88
BORON	15	15	< 0.01	< 0.01	mg/l	05/19/88
CADMIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	05/19/88
CALCIUM	1700	1700			mg/l	05/19/88
CESIUM	0.030	0.030	< 0.01	< 0.01	mg/l	05/19/88
CHROMIUM	0.20	0.20	< 0.01	< 0.01	mg/l	05/19/88
COBALT	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	05/19/88
COPPER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	05/19/88
IRON	0.40	0.40	< 0.01	< 0.01	mg/l	05/19/88
LEAD	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	05/19/88
LITHIUM	0.50	0.52	0.01	0.01	mg/l	05/19/88
MAGNESIUM	950	960			mg/l	05/19/88
MANGANESE	0.49	0.49	< 0.005	< 0.005	mg/l	05/19/88
MERCURY	0.0015	0.0018	0.0014	0.0009	mg/l	05/19/88
MOLYBDENUM	10	10	< 0.01	< 0.01	mg/l	05/19/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	05/19/88
POTASSIUM	460	460			mg/l	05/19/88
SELENIUM	< 0.50		< 0.005	< 0.005	mg/l	05/19/88
SILICA	6.4	6.5			mg/l	05/19/88
SILVER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	05/19/88
SODIUM	17600	17400			mg/l	05/19/88
STRONTIUM	34	34	< 0.01	< 0.01	mg/l	05/19/88
THALLIUM	< 0.050		< 0.005	< 0.005	mg/l	05/19/88
TITANIUM	0.40	0.50	< 0.03	< 0.03	mg/l	05/19/88
VANADIUM	0.10	0.10	< 0.01	< 0.01	mg/l	05/19/88
ZINC	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	05/19/88

TABLE 2.12.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	(10		(10		ug/l	05/19/88
BENZENE	(5.0		(5.0		ug/l	05/19/88
2-BUTANONE	(10		(10		ug/l	05/19/88
BROMOFORM	(5.0		(5.0		ug/l	05/19/88
CARBON DISULFIDE	(5.0		(5.0		ug/l	05/19/88
CARBON TETRACHLORIDE	(5.0		(5.0		ug/l	05/19/88
CHLOROBENZENE	(5.0		(5.0		ug/l	05/19/88
CHLORODIBROMOMETHANE	(5.0		(5.0		ug/l	05/19/88
CHLOROETHANE	(10		(10		ug/l	05/19/88
2-CHLOROETHYLVINYL ETHER	(10		(10		ug/l	05/19/88
CHLOROFORM	(5.0		(5.0		ug/l	05/19/88
CIS-1,3-DICHLOROPROPENE	(5.0		(5.0		ug/l	05/19/88
DICHLOROBROMOMETHANE	(5.0		(5.0		ug/l	05/19/88
1,1-DICHLOROETHANE	(5.0		(5.0		ug/l	05/19/88
1,2-DICHLOROETHANE	(5.0		(5.0		ug/l	05/19/88
1,1-DICHLOROETHYLENE	(5.0		(5.0		ug/l	05/19/88
1,2-DICHLOROPROPANE	(5.0		(5.0		ug/l	05/19/88
ETHYLBENZENE	(5.0		(5.0		ug/l	05/19/88
2-HEXANONE	(10		(10		ug/l	05/19/88
METHYL BROMIDE	(10		(10		ug/l	05/19/88
METHYL CHLORIDE	(10		(10		ug/l	05/19/88
4-METHYL-2-PENTANONE	(10		(10		ug/l	05/19/88
METHYLENE CHLORIDE	(5.0		(5.0		ug/l	05/19/88
STYRENE	(5.0		(5.0		ug/l	05/19/88
1,1,2,2-TETRACHLOROETHANE	(5.0		(5.0		ug/l	05/19/88
TETRACHLOROETHYLENE	(5.0		(5.0		ug/l	05/19/88
TOLUENE	(5.0		(5.0		ug/l	05/19/88
TRANS-1,2-DICHLOROETHYLENE	(5.0		(5.0		ug/l	05/19/88
TRANS-1,3-DICHLOROPROPENE	(5.0		(5.0		ug/l	05/19/88
1,1,1-TRICHLOROETHANE	(5.0		(5.0		ug/l	05/19/88
1,1,2-TRICHLOROETHANE	(5.0		(5.0		ug/l	05/19/88
TRICHLOROETHYLENE	(5.0		(5.0		ug/l	05/19/88
VINYL ACETATE	(10		(10		ug/l	05/19/88
VINYL CHLORIDE	(10		(10		ug/l	05/19/88
TOTAL XYLENES	(5.0		(5.0		ug/l	05/19/88

TABLE 2.12.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	05/19/88
ACENAPHTHYLENE	< 10		ug/l	05/19/88
ANTHRACENE	< 10		ug/l	05/19/88
BENZO(A)ANTHRACENE	< 10		ug/l	05/19/88
BENZO(A)PYRENE	< 10		ug/l	05/19/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	05/19/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	05/19/88
BENZOIC ACID	< 50		ug/l	05/19/88
BENZO(K)FLUORANTHENE	< 10		ug/l	05/19/88
BENZYL ALCOHOL	< 10		ug/l	05/19/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	05/19/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	05/19/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	05/19/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	05/19/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	05/19/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	05/19/88
4-CHLOROANILINE	< 10		ug/l	05/19/88
2-CHLORONAPHTHALENE	< 10		ug/l	05/19/88
2-CHLOROPHENOL	< 10		ug/l	05/19/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	05/19/88
CHRYSENE	< 10		ug/l	05/19/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	05/19/88
DIBENZOFURAN	< 10		ug/l	05/19/88
1,2-DICHLOROBENZENE	< 10		ug/l	05/19/88
1,3-DICHLOROBENZENE	< 10		ug/l	05/19/88
1,4-DICHLOROBENZENE	< 10		ug/l	05/19/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	05/19/88
2,4-DICHLOROPHENOL	< 10		ug/l	05/19/88
DIETHYL PHTHALATE	< 10		ug/l	05/19/88
2,4-DIMETHYLPHENOL	< 10		ug/l	05/19/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	05/19/88
2,4-DINITROPHENOL	< 50		ug/l	05/19/88
DIMETHYL PHTHALATE	< 10		ug/l	05/19/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	05/19/88
2,4-DINITROTOLUENE	< 10		ug/l	05/19/88
2,6-DINITROTOLUENE	< 10		ug/l	05/19/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	05/19/88

TABLE 2.12.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	05/19/88
FLUORENE	< 10		ug/l	05/19/88
HEXACHLOROBENZENE	< 10		ug/l	05/19/88
HEXACHLOROBUTADIENE	< 10		ug/l	05/19/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	05/19/88
HEXACHLOROETHANE	< 10		ug/l	05/19/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	05/19/88
ISOPHORONE	< 10		ug/l	05/19/88
2-METHYLNAPHTHALENE	< 10		ug/l	05/19/88
2-METHYLPHENOL	< 10		ug/l	05/19/88
4-METHYLPHENOL	< 10		ug/l	05/19/88
NAPHTHALENE	< 10		ug/l	05/19/88
2-NITROANILINE	< 50		ug/l	05/19/88
3-NITROANILINE	< 50		ug/l	05/19/88
4-NITROANILINE	< 50		ug/l	05/19/88
NITROBENZENE	< 10		ug/l	05/19/88
2-NITROPHENOL	< 10		ug/l	05/19/88
4-NITROPHENOL	< 50		ug/l	05/19/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	05/19/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	05/19/88
P-CHLORO-M-CRESOL	< 10		ug/l	05/19/88
PENTACHLOROPHENOL	< 50		ug/l	05/19/88
PHENANTHRENE	< 10		ug/l	05/19/88
PHENOL	< 10		ug/l	05/19/88
PYRENE	< 10		ug/l	05/19/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	05/19/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	05/19/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	05/19/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	05/19/88

TABLE 2.12.3

UNC LABORATORY ANALYSIS
DOE-2 CULEBRA ROUND THREE

REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
AMMONIA	0.20	0.20	mg/l	05/19/88
NITRATE	< 1.00	< 1.00	mg/l	05/19/88
TOTAL IRON	1.710	1.710	mg/l	05/19/88
FERROUS IRON	1.71	1.71	mg/l	05/19/88
TOTAL ARSENIC	0.0020	0.0020	mg/l	05/19/88
ARSENIC III	< 0.0010	< 0.0010	mg/l	05/19/88
TOTAL SELENIUM	< 0.001	< 0.001	mg/l	05/19/88
IODIDE	120	130	ug/l	05/19/88
IODATE	< 20		ug/l	05/19/88

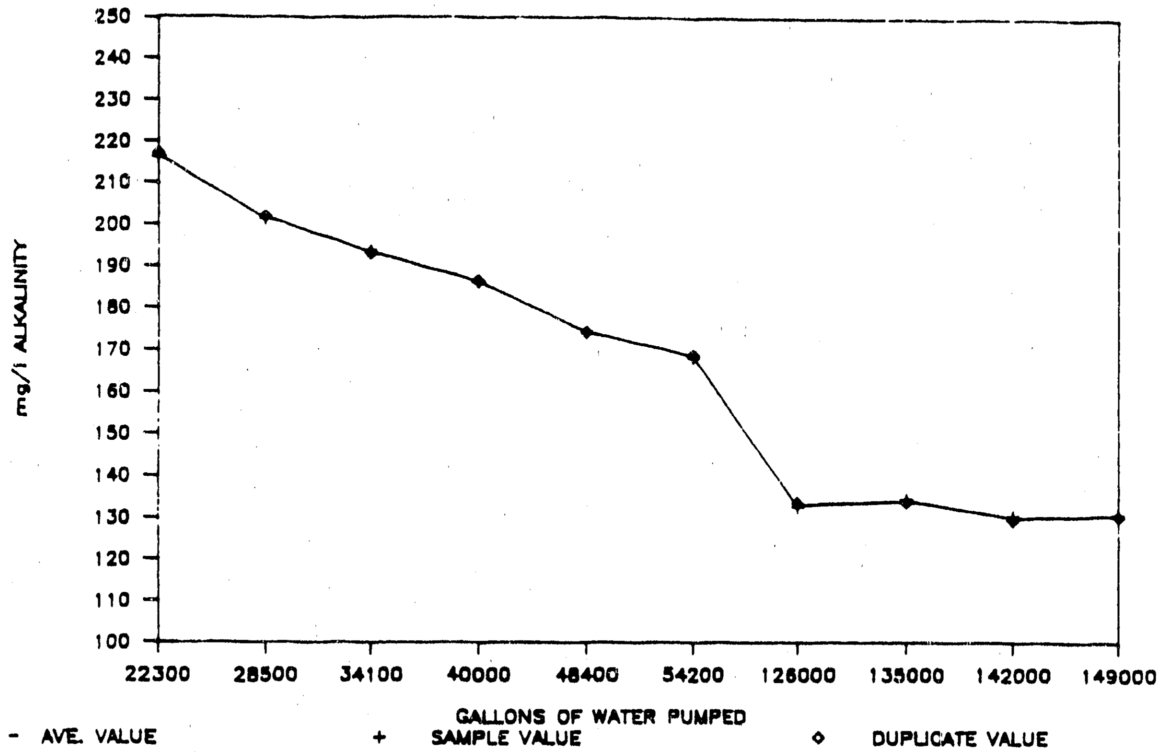
TABLE 2.12.4

PRESSURE AND FLOW
DOE-2 CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPM FLOW RATE	COMMENTS
04/27/88	13:14	108	198	0.00	PUMP OFF/PACKER DEFLATED
04/27/88	13:45	109	198	0.00	PUMP OFF/PACKER INFLATED
04/27/88	14:00	NA	NA	0.00	PUMP ON
04/27/88	14:15	NA	NA	2.76	PUMP OFF 14:18
04/27/88	14:20	108	196	6.38	PUMP ON 14:19
04/27/88	14:30	109	196	6.38	
04/27/88	15:15	108	195	6.22	
04/27/88	16:00	108	196	4.36	REDUCE FLOW RATE
04/28/88	07:30	109	NA	4.54	PSI BELOW MALFUNCTION
04/28/88	12:00	108	197	4.38	PSI BELOW GK401
04/28/88	15:30	108	197	4.51	
04/29/88	07:00	109	195	4.51	
04/29/88	14:00	109	195	4.36	
04/30/88	07:00	109	195	4.35	
04/30/88	08:30	92	190	4.27	PUMP OFF 07:20 TO 08:23
05/01/88	07:50	108	195	3.81	PSI TAKEN AT 08:00
05/01/88	20:15	103	193	3.91	PSI TAKEN AT 20:00
05/02/88	08:00	91	190	3.90	
05/02/88	12:30	100	195	4.00	
05/02/88	12:58	NA	NA	6.81	PUMP OFF 12:45 TO 12:58
05/02/88	15:00	109	195	3.94	FLOW REDUCED 13:55
05/03/88	07:30	109	195	3.78	
05/03/88	10:35	NA	NA	4.14	PUMP OFF 09:43 TO 10:22
05/03/88	15:00	100	194	4.22	
05/04/88	07:30	107	195	4.18	
05/04/88	15:00	103	195	4.06	INCREASE FLOW 15:05
05/05/88	05:30	95	192	6.67	DECREASE FLOW 05:45
05/05/88	19:00	108	194	4.34	INCREASE FLOW 19:07
05/06/88	08:00	101	193	6.50	DECREASE FLOW 08:06
05/06/88	11:00	NA	NA	6.35	INCREASE FLOW RATE
05/06/88	15:00	101	193	6.19	
05/07/88	07:00	102	195	0.00	PUMP DOWN BROKEN SHAFT
05/10/88	10:45	108	197	0.00	PUMP OFF
05/10/88	11:00	108	194	7.48	PUMP ON 10:50
05/10/88	12:00	108	194	7.21	
05/10/88	12:20	NA	NA	5.44	DECREASE FLOW RATE
05/10/88	14:30	108	193	7.66	INCREASE FLOW RATE 14:25
05/11/88	06:30	108	192	7.74	
05/11/88	14:35	108	192	7.36	

TABLE 2.12.4
(Continued)

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPM FLOW RATE	COMMENTS
05/12/88	06:30	108	192	7.53	
05/12/88	12:00	108	191	7.76	
05/13/88	07:00	107	191	7.39	
05/13/88	15:00	107	189	7.55	
05/14/88	08:30	108	181	7.74	
05/14/88	16:00	108	187	7.24	
05/15/88	08:00	107	NA	7.58	PSI BELOW MALFUNCTION
05/16/88	07:00	107	193	7.72	DECREASE FLOW RATE 07:15
05/16/88	15:30	108	191	4.60	INCREASE FLOW RATE 15:47
05/17/88	06:30	108	171	7.50	DECREASE FLOW 06:50
05/17/88	16:00	108	130	4.92	
05/18/88	07:00	106	149	5.07	
05/18/88	16:00	107	152	5.02	
05/19/88	07:00	106	117	5.25	
05/19/88	13:30	108	196	5.11	PUMP OFF 13:37
05/19/88	14:00	108	195	0.00	LOGGING OFF 14:03



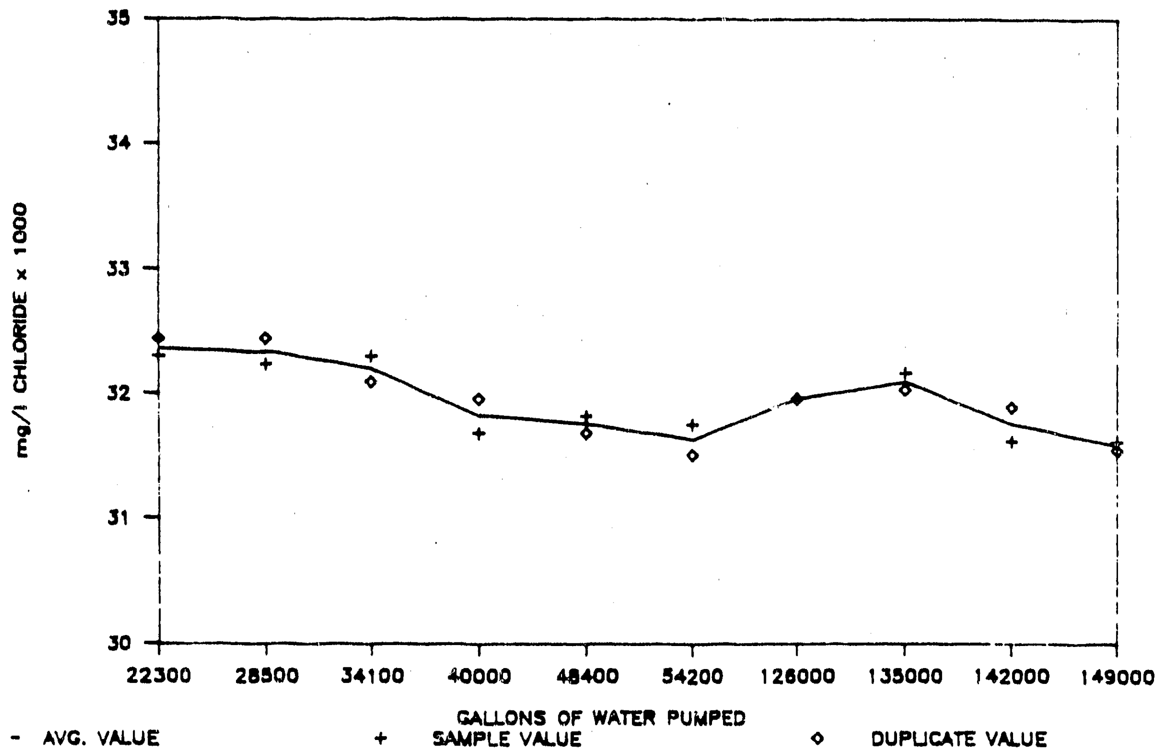
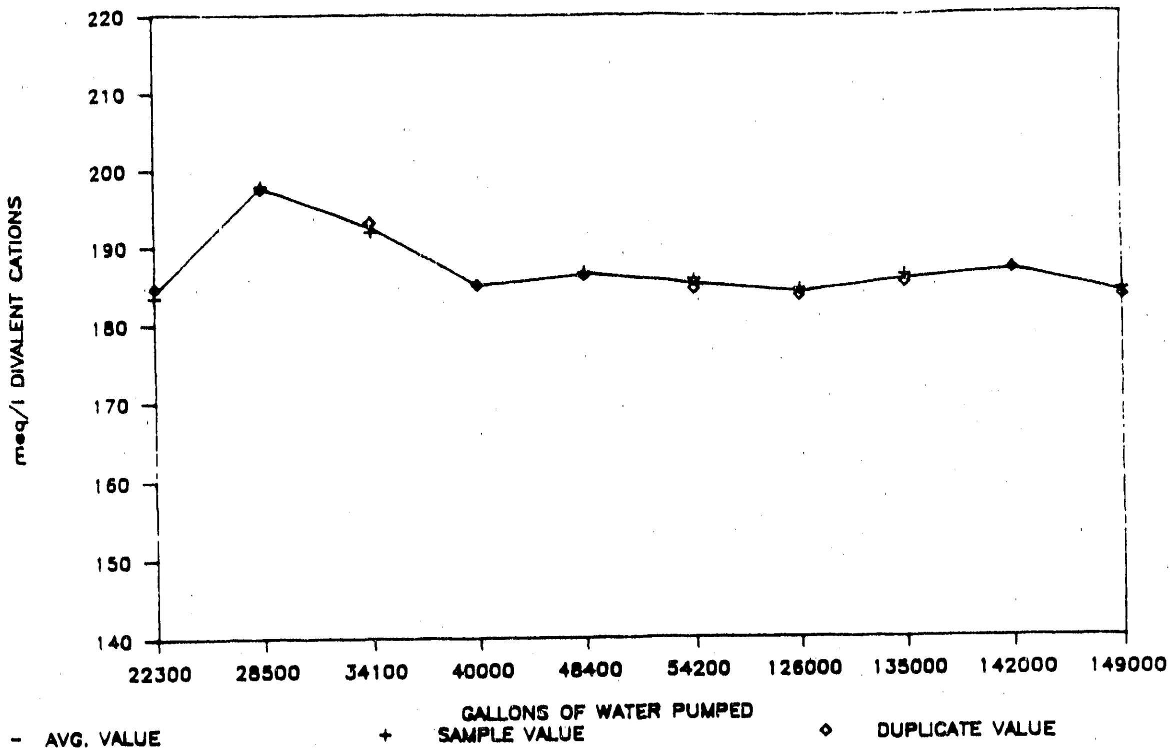


Figure 2.12.1. Graphs of alkalinity and chloride from third round serial sampling at well DOE-2 Culebra.



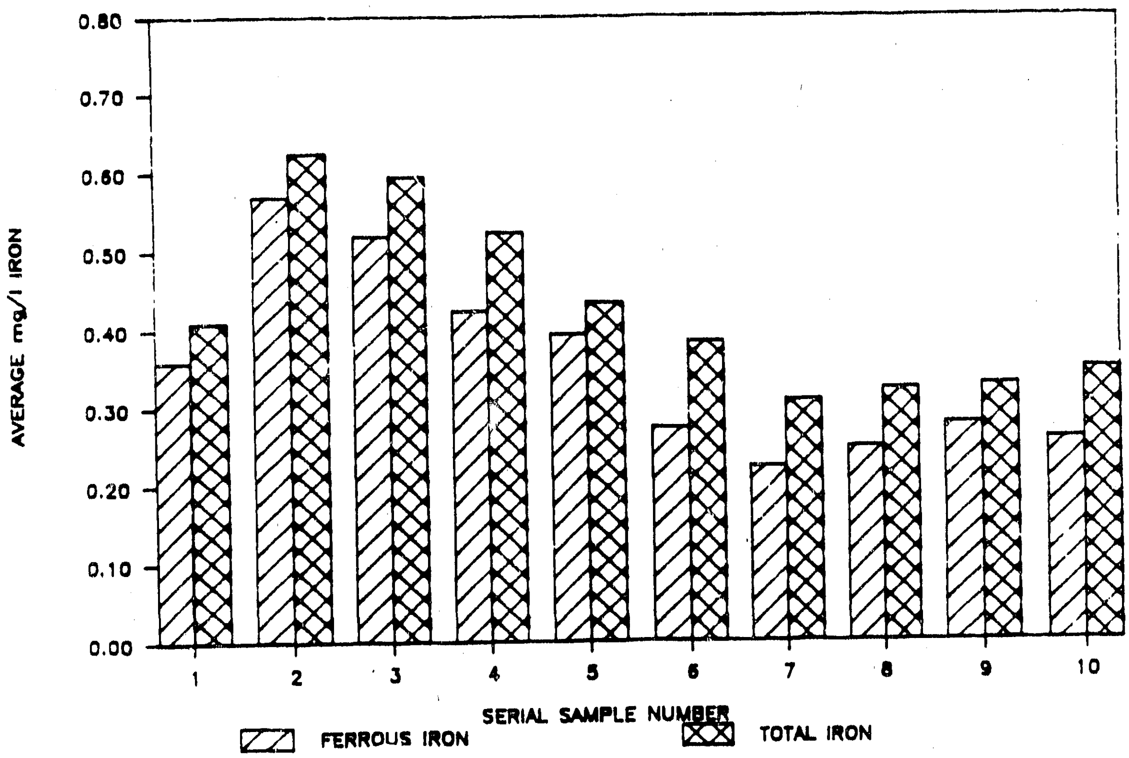


Figure 2.12.2. Graphs of divalent cations and iron from third round serial sampling at well DOE-2 Culebra.

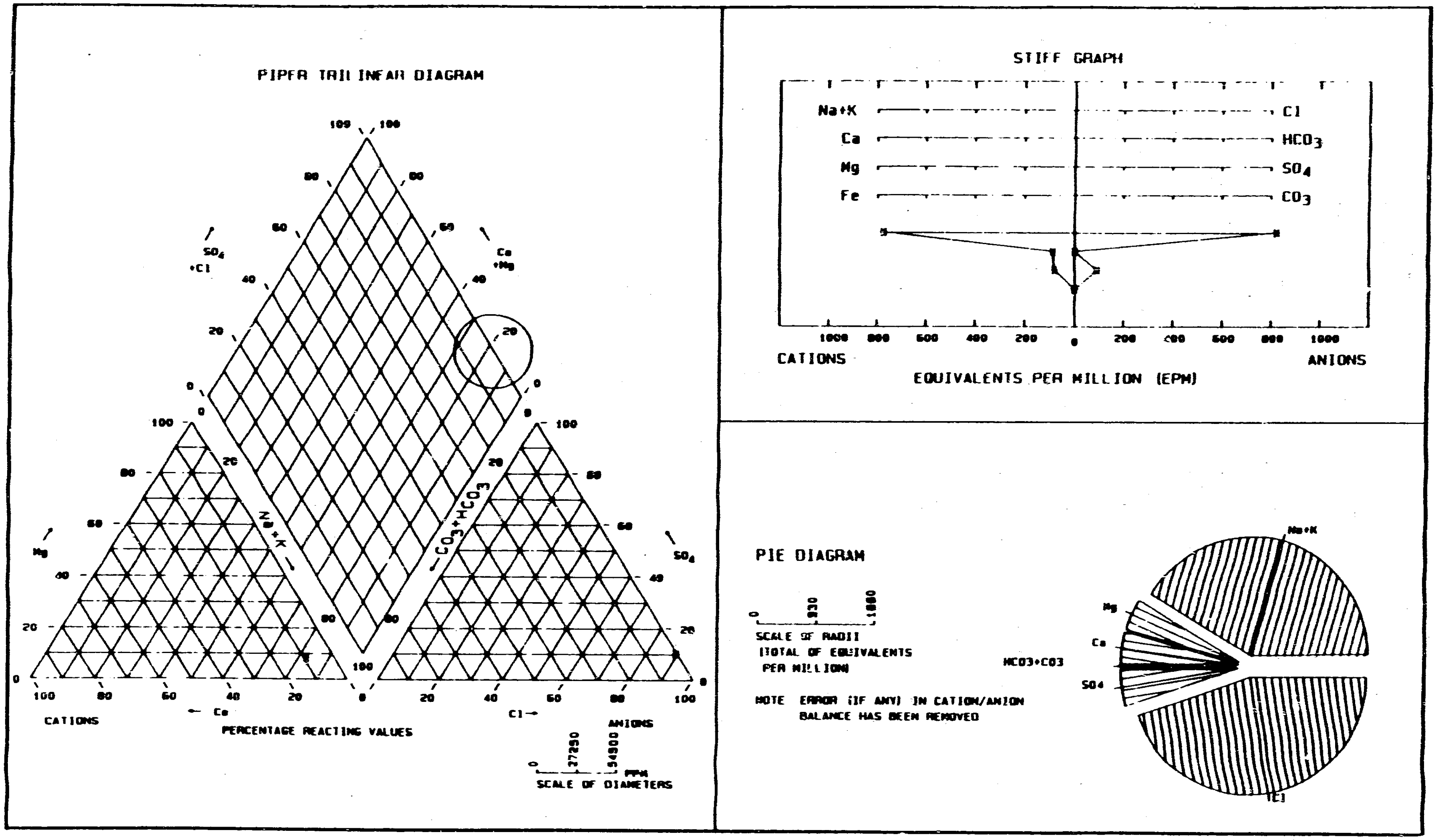


Figure 2.12.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well DOE-2 Culebra.

2.13 SUMMARY OF CULEBRA WELL H-08b, ROUND THREE

Well Characteristics

Well H-08b is located approximately 11.8 miles southwest of the center of the WIPP site at an elevation of 3,434 feet above MSL to the top of the casing (Gonzales, 1989). Total depth of the drilled hole is 624 feet BGS. Casing extends to a depth of 574 feet BGS and the well is completed open hole. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at an approximate depth interval of 588 to 614 feet BGS (Wells and Drellack, 1982).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from stagnant water in the well bore. The pump intake was located at a depth of 584 feet BTOC.

Pumping began on 06/01/88 and ceased on 06/08/88. The average flow rate was 30 gph during the sampling period. Serial sampling began on 06/03/88, after approximately 1,100 gallons of water had been purged from the well. One serial sample was taken each day for six consecutive days. Serial sampling ended and final samples were collected on 06/08/88 after an approximate total of 4,600 gallons had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity remaining fairly constant between 95 and 98 mg/l (Figure 2.13.1).

Chloride content remained between 36 and 45 mg/l (Figure 2.13.1).

Divalent cations remained stable between 40 and 41 meq/l (Figure 2.13.2).

Total iron decreased from approximately 0.17 mg/l on the first day to approximately 0.04 mg/l. Ferrous iron was detected in the second and fifth serial samples. Ferrous iron was below the detection limit on all other sampling days (Figure 2.13.2).

The water pH value was 7.3 SU.

Physical Parameters

Eh values were reported between 295 and 329 mV relative to the SHE throughout the entire sampling period.

The water temperature ranged between 22 and 23°C.

Specific gravity was constant and reported as 1.001 at 22.1°C on the final day of serial sampling.

Specific conductance decreased slightly from 3,020 to 3,000 umhos/cm at 25°C during sampling period.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were taken following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from this well was not effervescent.

Tabular data are presented in Tables 2.13.1, 2.13.2, 2.13.3, and 2.13.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.13.1 and 2.13.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.13.3 illustrates the general water quality at well H-08b utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds are not present in the Rustler Formation, neither above nor below the Culebra Dolomite, at this location (Mercer, 1983).

No problems were encountered while sampling well H-08b.

Serial Parameter Comparisons With the Previous Rounds

Data gathered during this round three serial sampling compares favorably with data from the previous rounds of sampling. Chloride concentrations have varied slightly during the three rounds. Chloride concentration in Culebra ground water in the vicinity of well H-08b is relatively low. Iron values have decreased from detectable level to near the detection limit during the three rounds of sampling. Values for Eh have steadily increased during the three sampling episodes. All other parameters remained virtually unchanged.

During the round one test, the average flow rate was 40 gph, the round two average rate was 31 gph, and this year's round three sampling averaged 30 gph. Prior to final sampling, the total volume purged from the well this year was approximately 4,600 gallons, which is less than either round two or one, when the purge volumes were 5,500 gallons and 11,000 gallons, respectively.

TABLE 2.13.1

SERIAL SAMPLE CHEMISTRY
H-08b CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	97.8	97.8	mg/l	1100	06/03/88
2	ALKALINITY	96.6	95.5	mg/l	1800	06/04/88
3	ALKALINITY	96.9	96.4	mg/l	2500	06/05/88
4	ALKALINITY	95.6	95.2	mg/l	3200	06/06/88
5	ALKALINITY	95.8	96.4	mg/l	3900	06/07/88
6	ALKALINITY	97.4	96.6	mg/l	4600	06/08/88
1	CHLORIDE	45	43	mg/l	1100	06/03/88
2	CHLORIDE	41	41	mg/l	1800	06/04/88
3	CHLORIDE	40	41	mg/l	2500	06/05/88
4	CHLORIDE	40	39	mg/l	3200	06/06/88
5	CHLORIDE	36	36	mg/l	3900	06/07/88
6	CHLORIDE	39	39	mg/l	4600	06/08/88
1	DIVALENT CATIONS	40.4	40.7	meq/l	1100	06/03/88
2	DIVALENT CATIONS	40.7	41.0	meq/l	1800	06/04/88
3	DIVALENT CATIONS	40.4	40.4	meq/l	2500	06/05/88
4	DIVALENT CATIONS	40.2	40.4	meq/l	3200	06/06/88
5	DIVALENT CATIONS	41.3	41.2	meq/l	3900	06/07/88
6	DIVALENT CATIONS	40.7	40.4	meq/l	4600	06/08/88
1	TOTAL IRON	0.17	0.16	mg/l	1100	06/03/88
2	TOTAL IRON	0.03	0.03	mg/l	1800	06/04/88
3	TOTAL IRON	0.04	0.03	mg/l	2500	06/05/88
4	TOTAL IRON	< 0.02	< 0.02	mg/l	3200	06/06/88
5	TOTAL IRON	0.04	0.03	mg/l	3900	06/07/88
6	TOTAL IRON	0.05	0.04	mg/l	4600	06/08/88
1	FERROUS IRON	< 0.02	< 0.02	mg/l	1100	06/03/88
2	FERROUS IRON	0.02	0.02	mg/l	1800	06/04/88
3	FERROUS IRON	< 0.02	< 0.02	mg/l	2500	06/05/88
4	FERROUS IRON	< 0.02	< 0.02	mg/l	3200	06/06/88
5	FERROUS IRON	0.03	0.04	mg/l	3900	06/07/88
6	FERROUS IRON	< 0.02	< 0.02	mg/l	4600	06/08/88

TABLE 2.13.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	7.3			1100	06/03/88
2	pH	7.3			1800	06/04/88
4	pH	7.3			3200	06/06/88
5	pH	7.3			3900	06/07/88
6	pH	7.3			4600	06/08/88
1	Eh	295		mV	1100	06/03/88
2	Eh	329		mV	1800	06/04/88
4	Eh	307		mV	3200	06/06/88
5	Eh	316		mV	3900	06/07/88
6	Eh	297		mV	4600	06/08/88
1	TEMPERATURE	22.5		C	1100	06/03/88
2	TEMPERATURE	22.3		C	1800	06/04/88
4	TEMPERATURE	22.5		C	3200	06/06/88
5	TEMPERATURE	22.3		C	3900	06/07/88
6	TEMPERATURE	22.7		C	4600	06/08/88
1	SPECIFIC GRAVITY	1.001		@ 22.6 C	1100	06/03/88
6	SPECIFIC GRAVITY	1.001		@ 22.1 C	4600	06/08/88
1	SPECIFIC CONDUCTANCE	3020	@ 25 C	umhos/cm	1100	06/03/88
6	SPECIFIC CONDUCTANCE	3000	@ 25 C	umhos/cm	4600	06/08/88

TABLE 2.13.2

ITAS LABORATORY RESULTS
H-08b CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER		VALUE		DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)		95		94	mg/l	06/08/88
ALKALINITY (CO3)		0			mg/l	06/08/88
BROMIDE	<	2	<	2	mg/l	06/08/88
CHLORIDE		33			mg/l	06/08/88
CYANIDE, TOTAL	<	0.01			mg/l	06/08/88
FLUORIDE		0.2			mg/l	06/08/88
IODIDE	<	2.0	<	2.0	mg/l	06/08/88
NITRATE		0.90			mg/l NO3-N	06/08/88
pH		7.15		7.14		06/08/88
PHENOLICS		0.165			mg/l	06/08/88
PHOSPHATE, TOTAL		0.02			mg/l T-PO4-P	06/08/88
RESIDUE, FILTERABLE @180 C		2900		2900	mg/l	06/08/88
RESIDUE, NONFILTERABLE @105 C	<	4	<	4	mg/l	06/08/88
SPECIFIC CONDUCTANCE		3150		3140	umhos/cm@25C	06/08/88
SULFATE		1900			mg/l	06/08/88
TOTAL ORGANIC CARBON	<	1.0	<	1.0	mg/l	06/08/88
TOTAL ORGANIC HALOGEN	<	0.05	<	0.05	mg/l	06/08/88

TABLE 2.13.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 0.10	< 0.10			mg/l	06/08/88
ANTIMONY *	< 0.20				mg/l	06/08/88
ARSENIC *	< 0.020				mg/l	06/08/88
BARIUM	0.011	0.011			mg/l	06/08/88
BERYLLIUM	< 0.0050	< 0.0050			mg/l	06/08/88
BORON	0.58	0.57			mg/l	06/08/88
CADMIUM *	< 0.0030				mg/l	06/08/88
CALCIUM	610	600			mg/l	06/08/88
CESIUM *	< 0.24				mg/l	06/08/88
CHROMIUM *	0.0050				mg/l	06/08/88
COBALT *	< 0.0070				mg/l	06/08/88
COPPER *	0.11				mg/l	06/08/88
IRON	0.050	0.050			mg/l	06/08/88
LEAD *	< 0.030				mg/l	06/08/88
LITHIUM *	0.12				mg/l	06/08/88
MAGNESIUM	170	160			mg/l	06/08/88
MANGANESE	< 0.0050	< 0.0050			mg/l	06/08/88
MERCURY	0.0002	0.0002			mg/l	06/08/88
MOLYBDENUM *	0.0080				mg/l	06/08/88
NICKEL *	0.030				mg/l	06/08/88
POTASSIUM	4.4	4.5			mg/l	06/08/88
SELENIUM *	< 0.040				mg/l	06/08/88
SILICA	11				mg/l	06/08/88
SILVER *	< 0.020				mg/l	06/08/88
SODIUM	55	55			mg/l	06/08/88
STRONTIUM	4.1	4.2			mg/l	06/08/88
THALLIUM	< 0.050				mg/l	06/08/88
TITANIUM *	< 0.0070				mg/l	06/08/88
VANADIUM	0.040	0.040			mg/l	06/08/88
ZINC *	0.24				mg/l	06/08/88

* Sample analysis by ion exchange separation method. See section 4.0.

TABLE 2.13.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10		ug/l	06/08/88
BENZENE	< 5.0		< 5.0		ug/l	06/08/88
2-BUTANONE	< 10		< 10		ug/l	06/08/88
BROMOFORM	< 5.0		< 5.0		ug/l	06/08/88
CARBON DISULFIDE	< 5.0		< 5.0		ug/l	06/08/88
CARBON TETRACHLORIDE	< 5.0		< 5.0		ug/l	06/08/88
CHLOROBENZENE	< 5.0		< 5.0		ug/l	06/08/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0		ug/l	06/08/88
CHLOROETHANE	< 10		< 10		ug/l	06/08/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10		ug/l	06/08/88
CHLOROFORM	< 5.0		< 5.0		ug/l	06/08/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	06/08/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0		ug/l	06/08/88
1,1-DICHLOROETHANE	< 5.0		< 5.0		ug/l	06/08/88
1,2-DICHLOROETHANE	< 5.0		< 5.0		ug/l	06/08/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	06/08/88
1.2-DICHLOROPROPANE	< 5.0		< 5.0		ug/l	06/08/88
ETHYLBENZENE	< 5.0		< 5.0		ug/l	06/08/88
2-HEXANONE	< 10		< 10		ug/l	06/08/88
METHYL BROMIDE	< 10		< 10		ug/l	06/08/88
METHYL CHLORIDE	< 10		< 10		ug/l	06/08/88
4-METHYL-2-PENTANONE	< 10		< 10		ug/l	06/08/88
METHYLENE CHLORIDE	< 5.0		< 5.0		ug/l	06/08/88
STYRENE	< 5.0		< 5.0		ug/l	06/08/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0		ug/l	06/08/88
TETRACHLOROETHYLENE	< 5.0		< 5.0		ug/l	06/08/88
TOLUENE	< 5.0		< 5.0		ug/l	06/08/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	06/08/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	06/08/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	06/08/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	06/08/88
TRICHLOROETHYLENE	< 5.0		< 5.0		ug/l	06/08/88
VINYL ACETATE	< 10		< 10		ug/l	06/08/88
VINYL CHLORIDE	< 10		< 10		ug/l	06/08/88
TOTAL XYLENES	< 5.0		< 5.0		ug/l	06/08/88

TABLE 2.13.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	06/08/88
ACENAPHTHYLENE	< 10		ug/l	06/08/88
ANTHRACENE	< 10		ug/l	06/08/88
BENZO(A)ANTHRACENE	< 10		ug/l	06/08/88
BENZO(A)PYRENE	< 10		ug/l	06/08/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	06/08/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	06/08/88
BENZOIC ACID	< 50		ug/l	06/08/88
BENZO(K)FLUORANTHENE	< 10		ug/l	06/08/88
BENZYL ALCOHOL	< 10		ug/l	06/08/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	06/08/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	06/08/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	06/08/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	06/08/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	06/08/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	06/08/88
4-CHLOROANILINE	< 10		ug/l	06/08/88
2-CHLORONAPHTHALENE	< 10		ug/l	06/08/88
2-CHLOROPHENOL	< 10		ug/l	06/08/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	06/08/88
CHRYSENE	< 10		ug/l	06/08/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	06/08/88
DIBENZOFURAN	< 10		ug/l	06/08/88
1,2-DICHLOROBENZENE	< 10		ug/l	06/08/88
1,3-DICHLOROBENZENE	< 10		ug/l	06/08/88
1,4-DICHLOROBENZENE	< 10		ug/l	06/08/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	06/08/88
2,4-DICHLOROPHENOL	< 10		ug/l	06/08/88
DIETHYL PHTHALATE	< 10		ug/l	06/08/88
2,4-DIMETHYLPHENOL	< 10		ug/l	06/08/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	06/08/88
2,4-DINITROPHENOL	< 50		ug/l	06/08/88
DIMETHYL PHTHALATE	< 10		ug/l	06/08/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	06/08/88
2,4-DINITROTOLUENE	< 10		ug/l	06/08/88
2,6-DINITROTOLUENE	< 10		ug/l	06/08/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	06/08/88

TABLE 2.13.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	06/08/88
FLUORENE	< 10		ug/l	06/08/88
HEXACHLOROBENZENE	< 10		ug/l	06/08/88
HEXACHLOROBUTADIENE	< 10		ug/l	06/08/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	06/08/88
HEXACHLOROETHANE	< 10		ug/l	06/08/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	06/08/88
ISOPHORONE	< 10		ug/l	06/08/88
2-METHYLNAPHTHALENE	< 10		ug/l	06/08/88
2-METHYLPHENOL	< 10		ug/l	06/08/88
4-METHYLPHENOL	< 10		ug/l	06/08/88
NAPHTHALENE	< 10		ug/l	06/08/88
2-NITROANILINE	< 50		ug/l	06/08/88
3-NITROANILINE	< 50		ug/l	06/08/88
4-NITROANILINE	< 50		ug/l	06/08/88
NITROBENZENE	< 10		ug/l	06/08/88
2-NITROPHENOL	< 10		ug/l	06/08/88
4-NITROPHENOL	< 50		ug/l	06/08/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	06/08/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	06/08/88
P-CHLORO-M-CRESOL	< 10		ug/l	06/08/88
PENTACHLOROPHENOL	< 50		ug/l	06/08/88
PHENANTHRENE	< 10		ug/l	06/08/88
PHENOL	< 10		ug/l	06/08/88
PYRENE	< 10		ug/l	06/08/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	06/08/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	06/08/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	06/08/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	06/08/88

TABLE 2.13.3

UNC LABORATORY ANALYSIS
H-08b CULEBRA ROUND THREE

DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	0.29	0.33	cc/l (STP)	06/08/88
OXYGEN	< 0.05	< 0.05	cc/l (STP)	06/08/88
NITROGEN	11.54	10.76	cc/l (STP)	06/08/88
CARBON MONOXIDE	< 0.001	< 0.001	cc/l (STP)	06/08/88
CARBON DIOXIDE	2.750	3.260	cc/l (STP)	06/08/88
METHANE	0.002	0.002	cc/l (STP)	06/08/88
ETHANE	< 0.001	< 0.001	cc/l (STP)	06/08/88
C-3	< 0.001	< 0.001	cc/l (STP)	06/08/88
C-4	< 0.001	< 0.001	cc/l (STP)	06/08/88
C-5	< 0.001	< 0.001	cc/l (STP)	06/08/88
C-6	< 0.001	< 0.001	cc/l (STP)	06/08/88
SUM OF CO2	36.28		cc/l (STP)	06/08/88
TOTAL GAS	14.582	14.352	cc/l (STP)	06/08/88
AMMONIA	< 0.10	< 0.10	mg/l	06/08/88
NITRATE	5.00	5.00	mg/l	06/08/88
TOTAL IRON	0.310	0.310	mg/l	06/08/88
FERROUS IRON	0.26	0.26	mg/l	06/08/88
TOTAL ARSENIC	< 0.0010	< 0.0010	mg/l	06/08/88
TOTAL SELENIUM	< 0.001	< 0.001	mg/l	06/08/88
IODIDE	120	120	ug/l	06/08/88
IODATE	< 20	< 20	ug/l	06/08/88

TABLE 2.13.4

PRESSURE AND FLOW
H-08b CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
06/01/88	14:10	48	60	00	PUMP OFF
06/01/88	14:20	48	60	00	PACKER INFLATED
06/01/88	14:30	48	59	35	PUMP ON 14:25
06/01/88	15:00	48	59	34	
06/01/88	15:30	48	59	37	
06/02/88	07:30	48	59	33	
06/02/88	15:00	48	58	38	
06/02/88	15:30	48	59	20	FLOW REDUCED 15:10
06/03/88	07:00	48	59	37	FLOW RESTORED 07:07
06/03/88	07:30	48	59	30	FLOW DECREASED 07:15
06/03/88	14:00	48	59	29	
06/04/88	09:00	48	58	29	
06/04/88	15:00	47	58	30	
06/05/88	08:00	47	58	29	
06/05/88	16:00	47	58	29	
06/06/88	07:00	47	58	29	
06/06/88	15:30	47	58	31	
06/07/88	07:30	47	58	29	
06/07/88	15:30	47	58	30	
06/08/88	07:00	47	58	30	
06/08/88	12:30	47	57	31	PUMP OFF 12:33

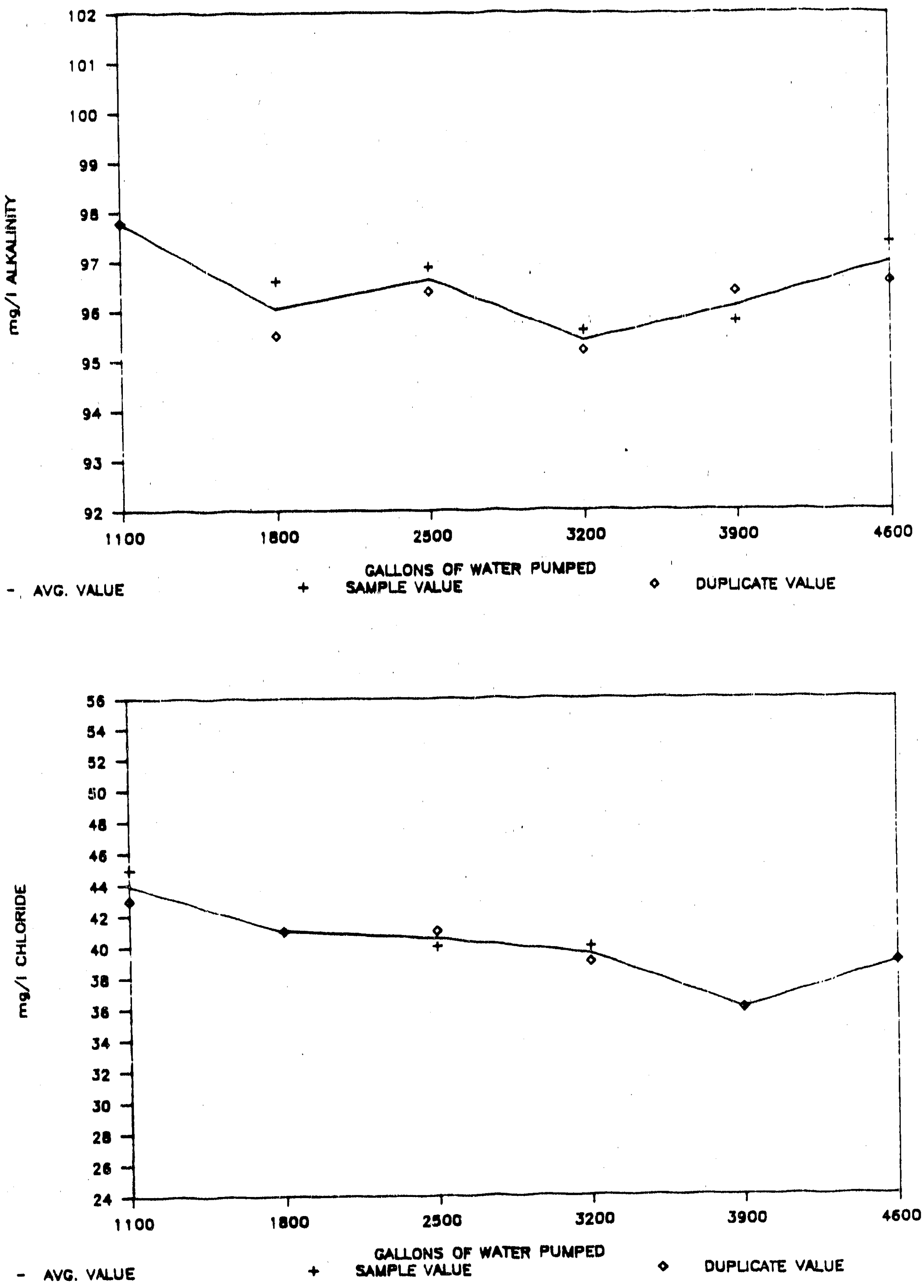
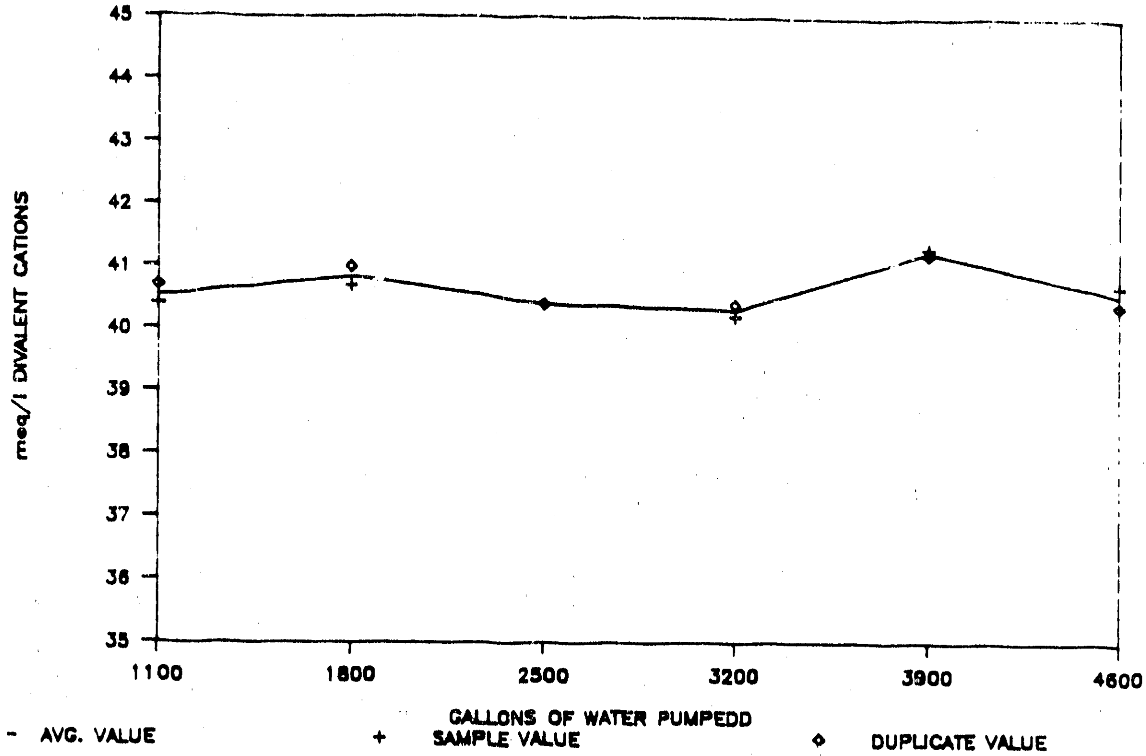


Figure 2.13.1. Graphs of alkalinity and chloride from third round serial sampling at well H-08b Culebra.



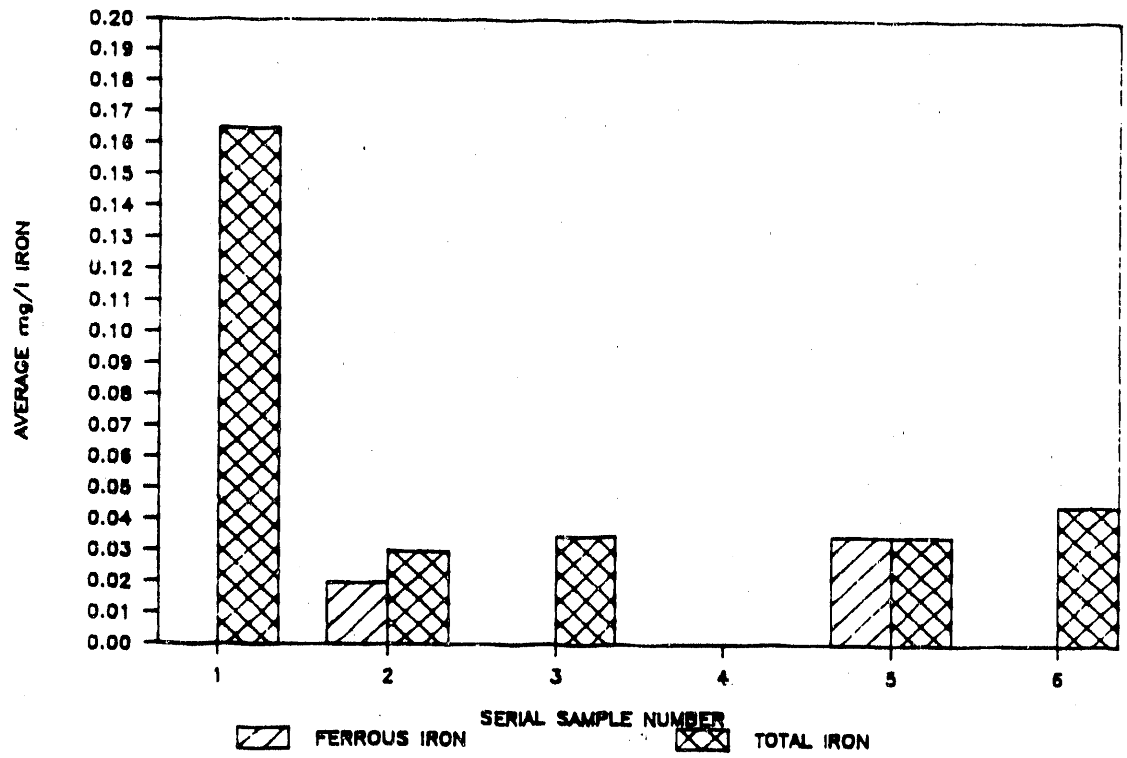


Figure 2.13.2. Graphs of divalent cations and iron from third round serial sampling at well H-08b Culebra. Lower limit of dectection for iron was 0.02 mg/l.

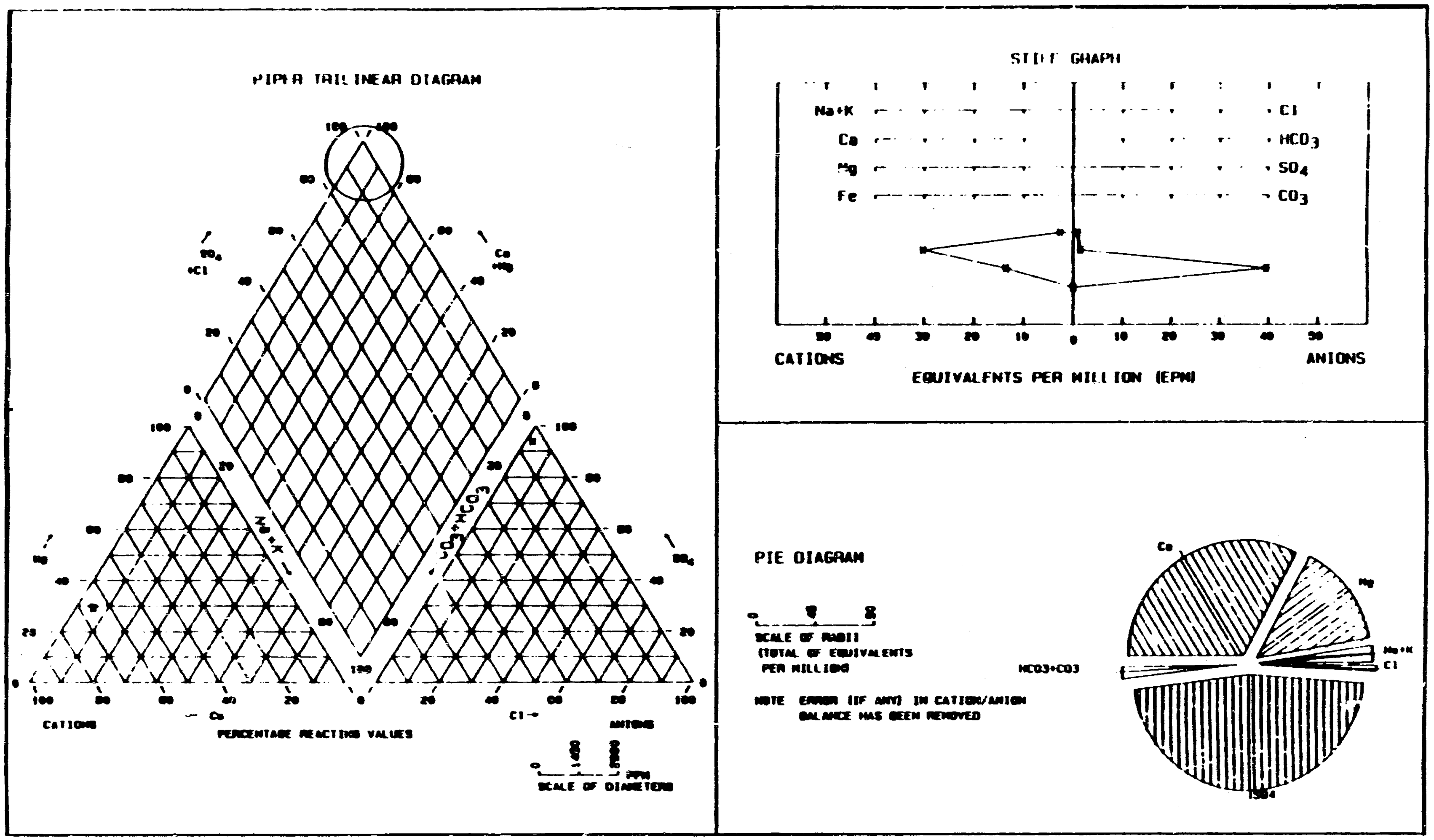


Figure 2.13.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well H-08b Culebra.

2.14 SUMMARY OF CULEBRA WELL H-09b, ROUND THREE

Well Characteristics

Well H-09b is located approximately 8.5 miles south of the center of the WIPP site at an elevation of 3,407 feet above MSL, to the top of the casing (Gonzales, 1989). Total depth of the drilled hole was 708 feet BGS. The well is cased to a depth of 638 feet BGS and completed open hole. The hole has caved in and is plugged at 670 feet BGS (Crawley, 1987). The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 647 to 677 feet BGS (Drellack and Wells, 1982b).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. The pump intake was set at a depth of 634 feet BTOC.

Pumping began on 06/14/88 and ceased on 06/21/88. The average flow rate was approximately 32 gph for the sampling period. Approximately 1,350 gallons of water had been pumped from the well when serial sampling began on 06/14/88. One serial sample was taken daily for six days. Serial sampling ended and final samples were collected on 06/21/88, after a total of 5,150 gallons had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analyses showed alkalinity remaining fairly constant around 117 mg/l (Figure 2.14.1).

Chloride values were nearly constant between 169 and 172 mg/l (Figure 2.14.1).

Divalent cations were nearly constant between 41 and 42 meq/l during the sampling period (Figure 2.14.2).

Total iron fluctuated slightly between 0.10 and 0.15 mg/l. Ferrous iron ranged between 0.08 and 0.10 mg/l (Figure 2.14.2).

The water pH ranged between 7.2 and 7.3 SU.

Physical Parameters

The water Eh value varied between 202 and 214 mV relative to the SHE during the serial sampling period.

The water temperature ranged between 22.2 and 22.5°C.

Specific gravity decreased from 1.003 at 21.2°C to 1.002 at 22.8°C during the sampling period.

Specific conductance remained approximately 3,400 umhos/cm at 25°C during the sampling episode.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were collected following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from this well was not effervescent.

Tabular data are presented in Tables 2.14.1, 2.14.2, 2.14.3, and 2.14.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.14.1 and 2.14.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.14.3 illustrates the general water quality at well H-09b utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds are not present in the Rustler Formation, neither above nor below the Culebra Dolomite, in the vicinity of H-09b (Mercer, 1983).

No problems were encountered during sampling H-09b.

Serial Parameter Comparisons With The Previous Rounds

Data gathered during this round three sampling compare favorably with the data from previous rounds. Analytical results obtained in the field have been reproducible for all parameters over the three rounds of sampling.

During the round one test, the average flow rate was 38 gph. Round two averaged 21 gph and this year the round three flow rate averaged 31 gph. Prior to final sampling, the total volume purged from the well this year was approximately 5,150 gallons compared to 4,300 and approximately 8,440 gallons for rounds two and one, respectively.

TABLE 2.14.1

SERIAL SAMPLE CHEMISTRY
H-09b CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	117	117	mg/l	1350	06/16/88
2	ALKALINITY	117	118	mg/l	2200	06/17/88
3	ALKALINITY	116	117	mg/l	2800	06/18/88
4	ALKALINITY	116	116	mg/l	3600	06/19/88
5	ALKALINITY	118	118	mg/l	4450	06/20/88
6	ALKALINITY	118	117	mg/l	5150	06/21/88
1	CHLORIDE	170	169	mg/l	1350	06/16/88
2	CHLORIDE	172	171	mg/l	2200	06/17/88
3	CHLORIDE	171	171	mg/l	2800	06/18/88
4	CHLORIDE	171	171	mg/l	3600	06/19/88
5	CHLORIDE	172	172	mg/l	4450	06/20/88
6	CHLORIDE	172	172	mg/l	5150	06/21/88
1	DIVALENT CATIONS	41.0	41.1	meq/l	1350	06/16/88
2	DIVALENT CATIONS	40.8	41.2	meq/l	2200	06/17/88
3	DIVALENT CATIONS	41.2	41.2	meq/l	2800	06/18/88
4	DIVALENT CATIONS	41.9	41.6	meq/l	3600	06/19/88
5	DIVALENT CATIONS	41.3	41.2	meq/l	4450	06/20/88
6	DIVALENT CATIONS	41.4	41.2	meq/l	5150	06/21/88
1	TOTAL IRON	0.13	0.13	mg/l	1350	06/16/88
2	TOTAL IRON	0.15	0.11	mg/l	2200	06/17/88
3	TOTAL IRON	0.11	0.12	mg/l	2800	06/18/88
4	TOTAL IRON	0.10	0.11	mg/l	3600	06/19/88
5	TOTAL IRON	0.12	0.11	mg/l	4450	06/20/88
6	TOTAL IRON	0.12	0.12	mg/l	5150	06/21/88
1	FERROUS IRON	0.10	0.10	mg/l	1350	06/16/88
2	FERROUS IRON	0.08	0.08	mg/l	2200	06/17/88
3	FERROUS IRON	0.07	0.08	mg/l	2800	06/18/88
4	FERROUS IRON	0.09	0.08	mg/l	3600	06/19/88
5	FERROUS IRON	0.09	0.08	mg/l	4450	06/20/88
6	FERROUS IRON	0.08	0.08	mg/l	5150	06/21/88

TABLE 2.14.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	7.3			1350	06/16/88
2	pH	7.3			2200	06/17/88
4	pH	7.2			3600	06/19/88
5	pH	7.3			4450	06/20/88
6	pH	7.3			5150	06/21/88
1	Eh	202		mV	1350	06/16/88
2	Eh	203		mV	2200	06/17/88
4	Eh	213		mV	3600	06/19/88
5	Eh	214		mV	4450	06/20/88
6	Eh	213		mV	5150	06/21/88
1	TEMPERATURE	22.4		C	1350	06/16/88
2	TEMPERATURE	22.5		C	2200	06/17/88
4	TEMPERATURE	22.2		C	3600	06/19/88
5	TEMPERATURE	22.3		C	4450	06/20/88
6	TEMPERATURE	22.2		C	5150	06/21/88
1	SPECIFIC GRAVITY	1.003		@ 21.2 C	1350	06/16/88
3	SPECIFIC GRAVITY	1.002		@ 21.4 C	2800	06/18/88
6	SPECIFIC GRAVITY	1.002		@ 22.8 C	5150	06/21/88
1	SPECIFIC CONDUCTANCE	3390	@ 25 C	umhos/cm	1350	06/16/88
6	SPECIFIC CONDUCTANCE	3400	@ 25 C	umhos/cm	5150	06/21/88

TABLE 2.14.2

ITAS LABORATORY RESULTS
H-09b CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	120	120	mg/l	06/21/88
ALKALINITY (CO3)	0		mg/l	06/21/88
BROMIDE	< 2		mg/l	06/21/88
CHLORIDE	180		mg/l	06/21/88
CYANIDE, TOTAL	< 0.01		mg/l	06/21/88
FLUORIDE	3.1		mg/l	06/21/88
IODIDE	< 2.0		mg/l	06/21/88
NITRATE	0.11	0.12	mg/l NO3-N	06/21/88
pH	7.03	7.08		06/21/88
PHENOLICS	< 0.010		mg/l	06/21/88
PHOSPHATE, TOTAL	0.02	0.03	mg/l T-PO4-P	06/21/88
RESIDUE, FILTERABLE @180 C	3100	3100	mg/l	06/21/88
RESIDUE, NONFILTERABLE @105 C	< 4	< 4	mg/l	06/21/88
SPECIFIC CONDUCTANCE	3420	3460	umhos/cm@25C	06/21/88
SULFATE	1600		mg/l	06/21/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	06/21/88
TOTAL ORGANIC HALOGEN	< 0.05	< 0.05	mg/l	06/21/88

TABLE 2.14.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	(0.10	(0.10	(0.1	(0.1	mg/l	06/21/88
ANTIMONY	0.080	0.13	(0.05	(0.05	mg/l	06/21/88
ARSENIC	(0.0050	(0.0050	(0.005	(0.005	mg/l	06/21/88
BARIUM	(0.050	(0.050	(0.005	(0.005	mg/l	06/21/88
BERYLLIUM	(0.050	(0.050	(0.005	(0.005	mg/l	06/21/88
BORON	0.70	0.70	(0.01	(0.01	mg/l	06/21/88
CADMIUM	(0.0050	(0.0050	(0.005	(0.005	mg/l	06/21/88
CALCIUM	690	600			mg/l	06/21/88
CESIUM	0.030	0.030	(0.01	(0.01	mg/l	06/21/88
CHROMIUM	0.040	0.040	(0.01	(0.01	mg/l	06/21/88
COBALT	(0.010	0.020	(0.01	(0.01	mg/l	06/21/88
COPPER	(0.010	(0.010	(0.01	(0.01	mg/l	06/21/88
IRON	0.12	0.10	(0.01	(0.01	mg/l	06/21/88
LEAD	(0.050	0.060	(0.05	(0.05	mg/l	06/21/88
LITHIUM	0.20	0.19	(0.01	(0.01	mg/l	06/21/88
MAGNESIUM	140	120			mg/l	06/21/88
MANGANESE	0.018	0.019	(0.005	(0.005	mg/l	06/21/88
MERCURY	0.0002	(0.0002	0.0002	(0.0002	mg/l	06/21/88
MOLYBDENUM	0.050	0.050	(0.01	(0.01	mg/l	06/21/88
NICKEL	(0.030	0.030	(0.03	(0.03	mg/l	06/21/88
POTASSIUM	8.2	7.9			mg/l	06/21/88
SELENIUM	(0.50	(0.50	(0.005	(0.005	mg/l	06/21/88
SILICA	12	13			mg/l	06/21/88
SILVER	(0.010	0.010	(0.01	(0.01	mg/l	06/21/88
SODIUM	140	140			mg/l	06/21/88
STRONTIUM	8.0	8.1	(0.01	(0.01	mg/l	06/21/88
THALLIUM	(0.050	(0.050	(0.005	(0.005	mg/l	06/21/88
TITANIUM	0.13	0.11	0.01	0.01	mg/l	06/21/88
VANADIUM	0.030	0.050	(0.01	(0.01	mg/l	06/21/88
ZINC	(0.010	(0.010	(0.01	(0.01	mg/l	06/21/88

TABLE 2.14.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10		ug/l	06/21/88
BENZENE	< 5.0		< 5.0		ug/l	06/21/88
2-BUTANONE	< 10		< 10		ug/l	06/21/88
BROMOFORM	< 5.0		< 5.0		ug/l	06/21/88
CARBON DISULFIDE	< 5.0		< 5.0		ug/l	06/21/88
CARBON TETRACHLORIDE	< 5.0		< 5.0		ug/l	06/21/88
CHLOROBENZENE	< 5.0		< 5.0		ug/l	06/21/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0		ug/l	06/21/88
CHLOROETHANE	< 10		< 10		ug/l	06/21/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10		ug/l	06/21/88
CHLOROFORM	< 5.0		< 5.0		ug/l	06/21/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	06/21/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0		ug/l	06/21/88
1,1-DICHLOROETHANE	< 5.0		< 5.0		ug/l	06/21/88
1,2-DICHLOROETHANE	< 5.0		< 5.0		ug/l	06/21/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	06/21/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0		ug/l	06/21/88
ETHYLBENZENE	< 5.0		< 5.0		ug/l	06/21/88
2-HEXANONE	< 10		< 10		ug/l	06/21/88
METHYL BROMIDE	< 10		< 10		ug/l	06/21/88
METHYL CHLORIDE	< 10		< 10		ug/l	06/21/88
4-METHYL-2-PENTANONE	< 10		< 10		ug/l	06/21/88
METHYLENE CHLORIDE	< 5.0		5.8		ug/l	06/21/88
STYRENE	< 5.0		< 5.0		ug/l	06/21/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0		ug/l	06/21/88
TETRACHLOROETHYLENE	< 5.0		< 5.0		ug/l	06/21/88
TOLUENE	< 5.0		< 5.0		ug/l	06/21/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0		ug/l	06/21/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0		ug/l	06/21/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	06/21/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0		ug/l	06/21/88
TRICHLOROETHYLENE	< 5.0		< 5.0		ug/l	06/21/88
VINYL ACETATE	< 10		< 10		ug/l	06/21/88
VINYL CHLORIDE	< 10		< 10		ug/l	06/21/88
TOTAL XYLENES	< 5.0		< 5.0		ug/l	06/21/88

TABLE 2.14.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	06/21/88
ACENAPHTHYLENE	< 10		ug/l	06/21/88
ANTHRACENE	< 10		ug/l	06/21/88
BENZO(A)ANTHRACENE	< 10		ug/l	06/21/88
BENZO(A)PYRENE	< 10		ug/l	06/21/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	06/21/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	06/21/88
BENZOIC ACID	< 50		ug/l	06/21/88
BENZO(K)FLUORANTHENE	< 10		ug/l	06/21/88
BENZYL ALCOHOL	< 10		ug/l	06/21/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	06/21/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	06/21/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	06/21/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	06/21/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	06/21/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	06/21/88
4-CHLOROANILINE	< 10		ug/l	06/21/88
2-CHLORONAPHTHALENE	< 10		ug/l	06/21/88
2-CHLOROPHENOL	< 10		ug/l	06/21/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	06/21/88
CHRYSENE	< 10		ug/l	06/21/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	06/21/88
DIBENZOFURAN	< 10		ug/l	06/21/88
1,2-DICHLOROBENZENE	< 10		ug/l	06/21/88
1,3-DICHLOROBENZENE	< 10		ug/l	06/21/88
1,4-DICHLOROBENZENE	< 10		ug/l	06/21/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	06/21/88
2,4-DICHLOROPHENOL	< 10		ug/l	06/21/88
DIETHYL PHTHALATE	< 10		ug/l	06/21/88
2,4-DIMETHYLPHENOL	< 10		ug/l	06/21/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	06/21/88
2,4-DINITROPHENOL	< 50		ug/l	06/21/88
DIMETHYL PHTHALATE	< 10		ug/l	06/21/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	06/21/88
2,4-DINITROTOLUENE	< 10		ug/l	06/21/88
2,6-DINITROTOLUENE	< 10		ug/l	06/21/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	06/21/88

TABLE 2.14.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	06/21/88
FLUORENE	< 10		ug/l	06/21/88
HEXACHLOROBENZENE	< 10		ug/l	06/21/88
HEXACHLOROBUTADIENE	< 10		ug/l	06/21/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	06/21/88
HEXACHLOROETHANE	< 10		ug/l	06/21/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	06/21/88
ISOPHORONE	< 10		ug/l	06/21/88
2-METHYLNAPHTHALENE	< 10		ug/l	06/21/88
2-METHYLPHENOL	< 10		ug/l	06/21/88
4-METHYLPHENOL	< 10		ug/l	06/21/88
NAPHTHALENE	< 10		ug/l	06/21/88
2-NITROANILINE	< 50		ug/l	06/21/88
3-NITROANILINE	< 50		ug/l	06/21/88
4-NITROANILINE	< 50		ug/l	06/21/88
NITROBENZENE	< 10		ug/l	06/21/88
2-NITROPHENOL	< 10		ug/l	06/21/88
4-NITROPHENOL	< 50		ug/l	06/21/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	06/21/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	06/21/88
P-CHLORO-M-CRESOL	< 10		ug/l	06/21/88
PENTACHLOROPHENOL	< 50		ug/l	06/21/88
PHENANTHRENE	< 10		ug/l	06/21/88
PHENOL	< 10		ug/l	06/21/88
PYRENE	< 10		ug/l	06/21/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	06/21/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	06/21/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	06/21/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	06/21/88

TABLE 2.14.3

UNC LABORATORY ANALYSIS
H-09b CULEBRA ROUND THREE

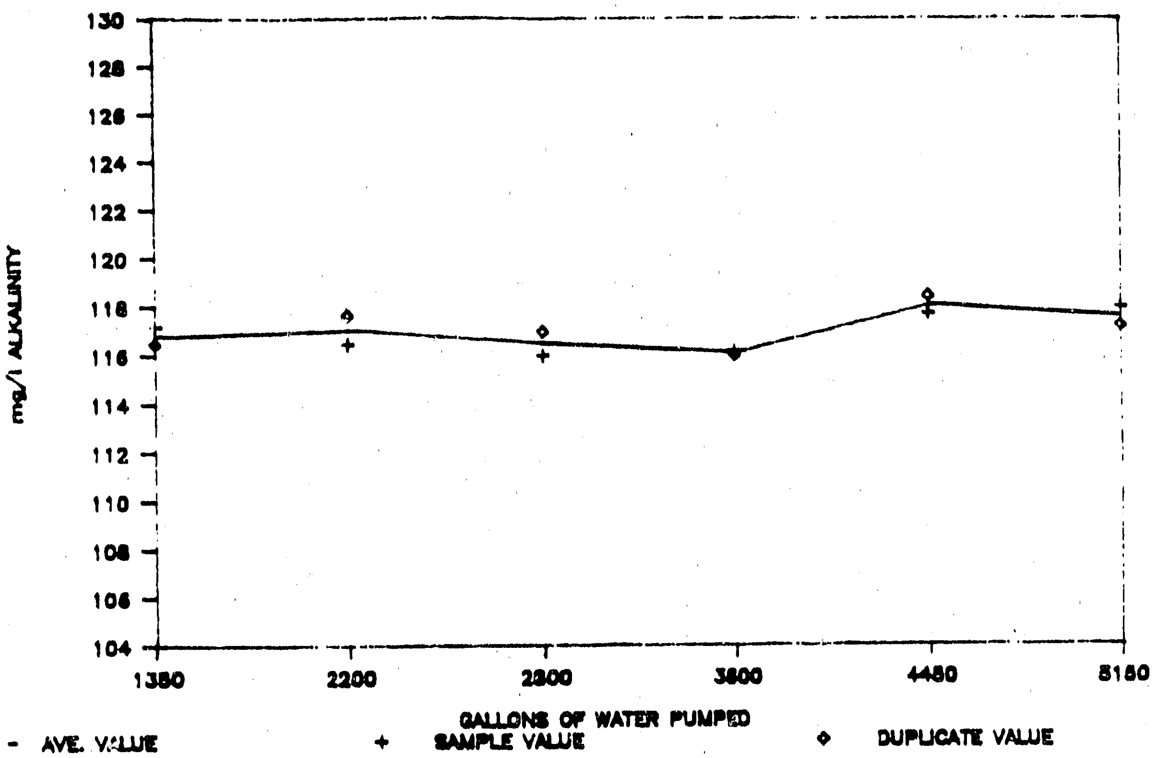
DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	0.59	0.61	cc/l (STP)	06/21/88
OXYGEN	< 0.05	< 0.05	cc/l (STP)	06/21/88
NITROGEN	26.14	24.80	cc/l (STP)	06/21/88
CARBON MONOXIDE	< 0.001	< 0.001	cc/l (STP)	06/21/88
CARBON DIOXIDE	6.480	6.050	cc/l (STP)	06/21/88
METHANE	0.039	0.059	cc/l (STP)	06/21/88
ETHANE	< 0.001	< 0.001	cc/l (STP)	06/21/88
C-3	< 0.001	< 0.001	cc/l (STP)	06/21/88
C-4	< 0.001	< 0.001	cc/l (STP)	06/21/88
C-5	< 0.001	< 0.001	cc/l (STP)	06/21/88
C-6	< 0.001	< 0.001	cc/l (STP)	06/21/88
SUM OF CO2	71.11		cc/l (STP)	06/21/88
TOTAL GAS	33.249	31.519	cc/l (STP)	06/21/88
AMMONIA	< 0.10	< 0.10	mg/l	06/21/88
NITRATE	< 1.00	< 1.00	mg/l	06/21/88
TOTAL IRON	0.540	0.510	mg/l	06/21/88
FERROUS IRON	0.44	0.45	mg/l	06/21/88
TOTAL ARSENIC	< 0.0010	< 0.0010	mg/l	06/21/88
TOTAL SELENIUM	< 0.001	< 0.001	mg/l	06/21/88
IODIDE	100	100	ug/l	06/21/88
IODATE	< 20	< 20	ug/l	06/21/88

TABLE 2.14.4

PRESSURE AND FLOW
H-09b CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
06/14/88	10:30	75	88	00	PUMP OFF
06/14/88	12:25	74	87	00	PACKER INFLATED
06/14/88	12:30	74	87	00	PUMP TURNED ON
06/14/88	12:35	75	87	27	DISCHARGE 12:32
06/14/88	12:45	75	87	29	
06/14/88	13:10	74	87	32	
06/14/88	13:30	74	87	32	
06/14/88	16:00	74	87	33	
06/15/88	07:30	75	87	32	
06/15/88	16:00	74	87	33	
06/16/88	07:00	74	87	32	
06/16/88	14:30	74	87	33	
06/17/88	07:00	74	87	32	
06/17/88	15:00	74	91	32	
06/18/88	08:00	74	87	32	
06/18/88	15:00	74	91	33	
06/19/88	07:30	74	87	33	
06/19/88	18:00	74	87	32	
06/20/88	07:00	74	87	31	
06/20/88	15:30	74	87	30	
06/21/88	06:30	74	87	31	
06/21/88	12:00	74	87	31	PUMP OFF 12:05



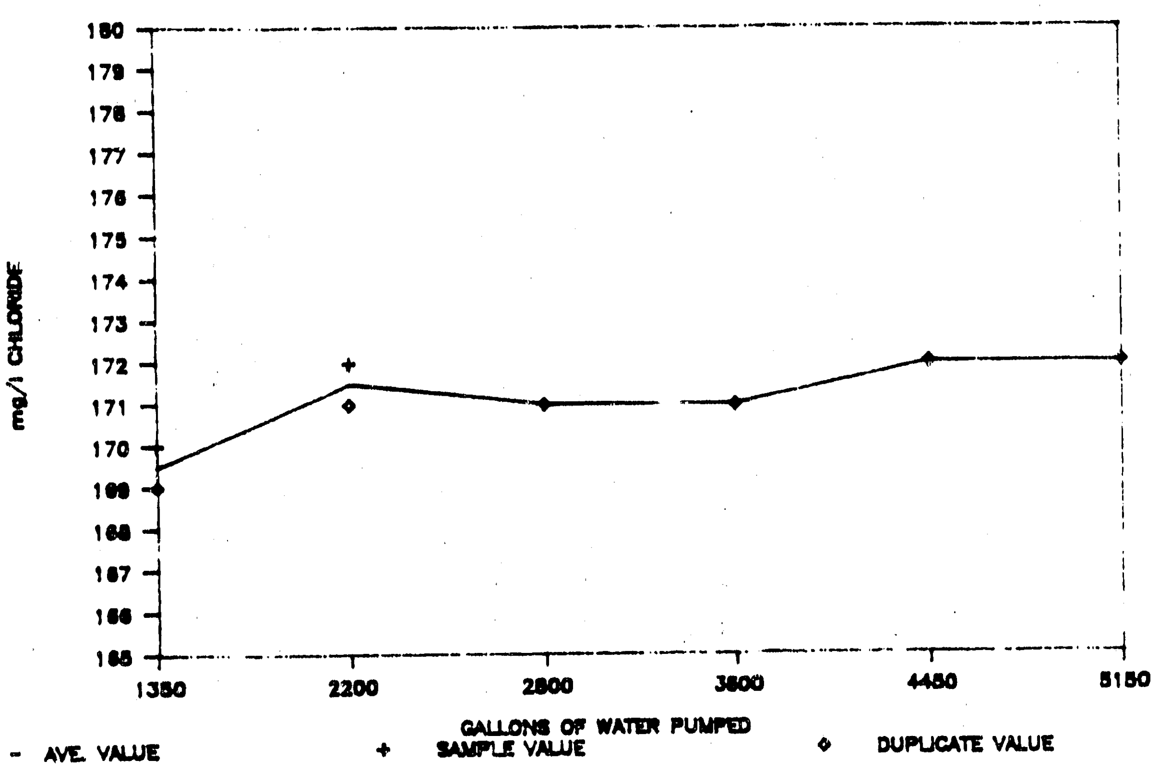
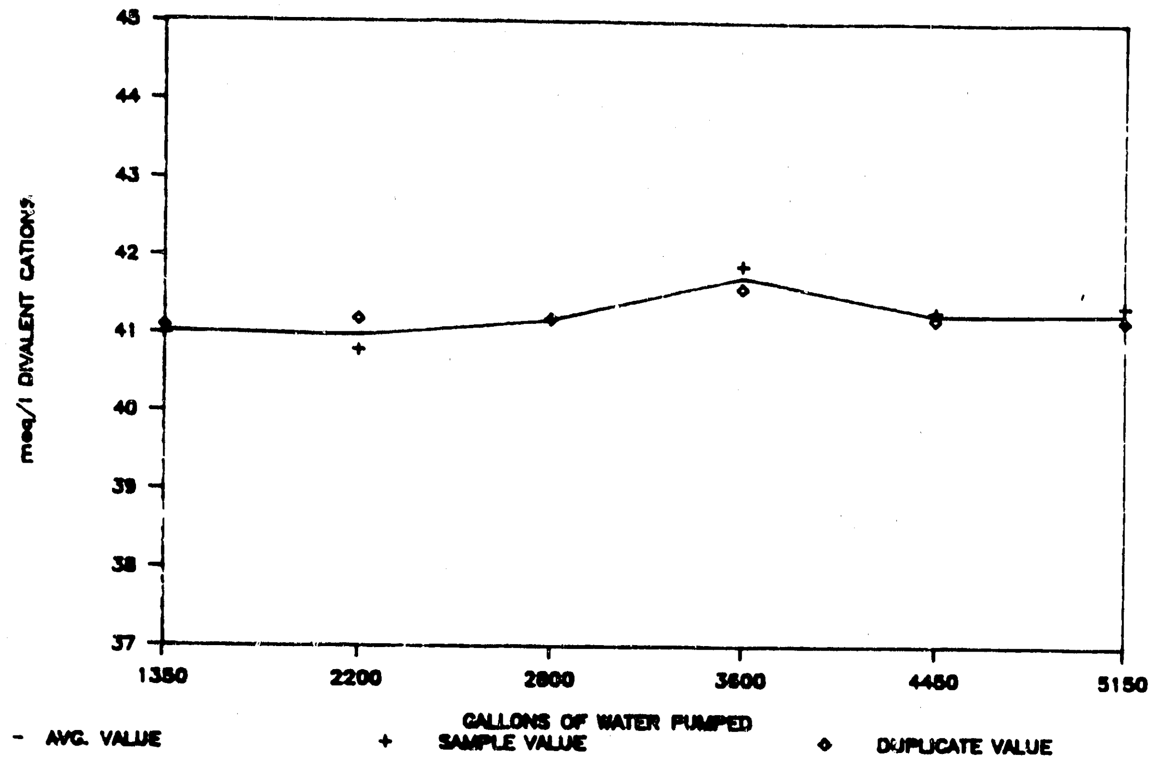


Figure 2.14.1. Graphs of alkalinity and chloride from third round serial sampling at well H-09b Culebra.



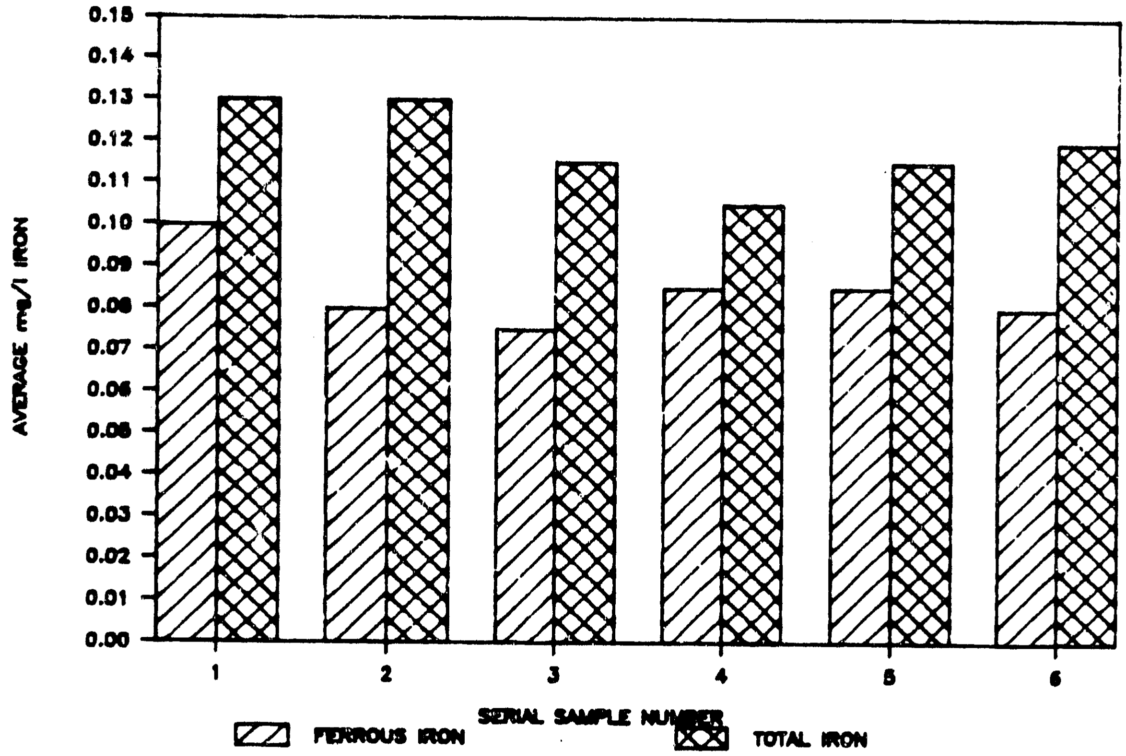


Figure 2.14.2. Graphs of divalent cations and iron from third round serial sampling at well H-09b Culebra.

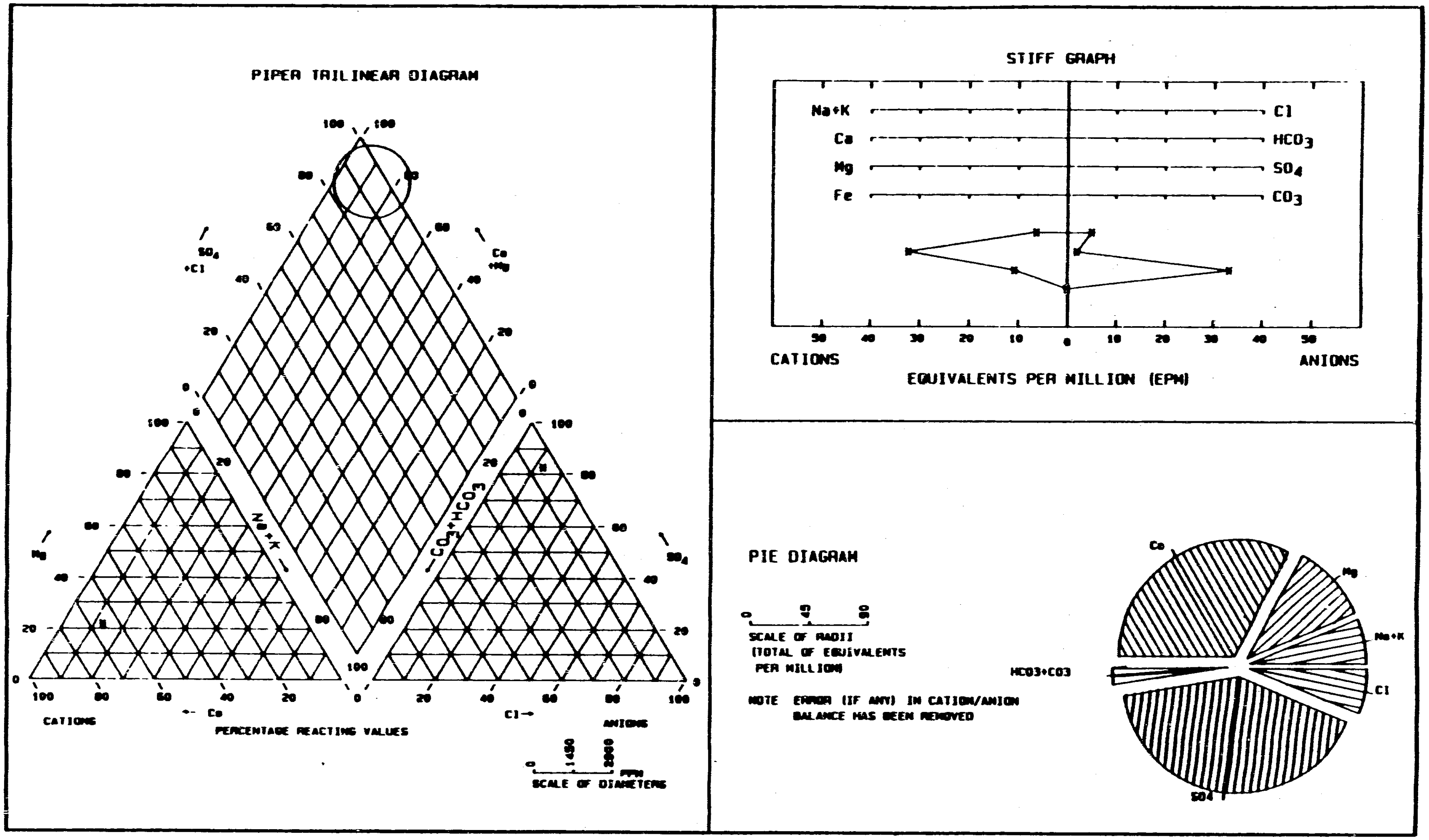


Figure 2.14.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well H-09b Culebra.

2.15 SUMMARY OF MAGENTA WELL H-04c, ROUND THREE

Well Characteristics

Well H-04c is located approximately 2.3 miles south southwest of the center of the WIPP site at an elevation of 3,334 feet above MSL, to the top of the casing (Gonzales, 1989). Total depth of the drilled hole is 661 feet BGS. The hole is cased to a depth of 610 feet BGS. Below the casing the well is completed open hole but, the casing is also perforated at two intervals, 373 to 399 feet BTOC accessing the Magenta Dolomite and 494 to 520 feet BTOC accessing the Culebra Dolomite. Bridge plugs have been set below the Magenta Dolomite at 435 feet BTOC and below the Culebra Dolomite at 530 feet BTOC. Currently only the Magenta Dolomite is accessible. The source of water sampled from this well is the Magenta Dolomite Member of the Rustler Formation, located at depths of 377 to 403 feet BGS (Stensrud, 1986).

Sampling Process

This well was sampled using a Bennett model piston pump. Initially the well was purged to remove standing water in the well bore. Then a Baski packer was inflated above the pump intake isolating the production zone. The pump intake was set at a depth of 358 feet BTOC.

Pumping began on 07/12/88 and ceased on 07/19/88. The flow rate varied between approximately 2.5 and 5.0 gph once the packer had been set. Serial sampling began on 07/14/88 after 350 gallons of water had been pumped from the well. One serial sample was taken daily for six consecutive days. Serial sampling ended and final samples were collected on 07/19/88, after approximately 700 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity ranging between approximately 82 and 85 mg/l (Figure 2.15.1).

Chloride content remained fairly constant ranging between 8,300 and 8,500 mg/l (Figure 2.15.1).

Divalent cations remained at approximately 68 meq/l (Figure 2.15.2).

Total iron concentrations were variable between approximately 0.4 and 0.2 mg/l, while ferrous iron ranged from approximately 0.2 to 0.1 mg/l, during the course of serial sampling (Figure 2.15.2).

The pH of the water ranged between 8.1 and 8.0 SU over the course of serial sampling.

Physical Parameters

Eh values ranged from -42 to -68 mV relative to the SHE.

The water temperature varied between 21 and 25°C.

Specific gravity was 1.020 at 21.9°C on the final day of sampling.

Specific conductance remained at approximately 30,600 umhos/cm at 25°C over the course of the sampling period.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were taken following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

Well H-04c produces little water and difficulties were encountered in maintaining a constant flow rate.

The water from well H-04c was slightly effervescent.

Particulates were observed on the 0.45-um filters after sampling each day.

There was a strong sulfurous odor to the water.

Tabular data are presented in Tables 2.15.1, 2.15.2, 2.15.3, and 2.15.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.15.1 and 2.15.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.15.3 illustrates the general water quality at well H-04c utilizing Stiff, pie, and Piper trilinear diagrams.

<u>Serial Parameter Comparisons With The Previous Rounds</u>

Serial sampling data from round three tended to exhibit greater stability than data from rounds two and one. Generally, most parameters are in good agreement between each round of sampling. Values for iron, pH, specific gravity, and specific conductance were slightly lower at the conclusion of each round of sampling. Values for chloride and divalent cations were nearly identical between each round. The values for Eh increased from -120 to -63 mV relative to the SHE on the last days of serial sampling during rounds two and three respectively.

The pump flow rate and purge volume were less during round three than in the previous rounds of sampling. The round three sampling did not experience dewatering of the well as occurred during rounds two and one.

TABLE 2.15.1

SERIAL SAMPLE CHEMISTRY
H-04c MAGENTA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	85.4	85.1	mg/l	350	07/14/88
2	ALKALINITY	84.1	84.1	mg/l	450	07/15/88
3	ALKALINITY	82.6	81.5	mg/l	550	07/16/88
4	ALKALINITY	84.1	83.4	mg/l	600	07/17/88
5	ALKALINITY	82.9	82.2	mg/l	650	07/18/88
6	ALKALINITY	81.7	82.4	mg/l	700	07/19/88
1	CHLORIDE	8370	8330	mg/l	350	07/14/88
2	CHLORIDE	8420	8380	mg/l	450	07/15/88
3	CHLORIDE	8370	8370	mg/l	550	07/16/88
4	CHLORIDE	8380	8440	mg/l	600	07/17/88
5	CHLORIDE	8330	8350	mg/l	650	07/18/88
6	CHLORIDE	8330	8280	mg/l	700	07/19/88
1	DIVALENT CATIONS	68.3	68.3	meq/l	350	07/14/88
2	DIVALENT CATIONS	68.7	68.8	meq/l	450	07/15/88
3	DIVALENT CATIONS	68.0	67.9	meq/l	550	07/16/88
4	DIVALENT CATIONS	68.0	67.8	meq/l	600	07/17/88
5	DIVALENT CATIONS	68.8	68.7	meq/l	650	07/18/88
6	DIVALENT CATIONS	68.5	68.5	meq/l	700	07/19/88
1	TOTAL IRON	0.31	0.36	mg/l	350	07/14/88
2	TOTAL IRON	0.36	0.37	mg/l	450	07/15/88
3	TOTAL IRON	0.17	0.18	mg/l	550	07/16/88
4	TOTAL IRON	0.19	0.18	mg/l	600	07/17/88
5	TOTAL IRON	0.21	0.21	mg/l	650	07/18/88
6	TOTAL IRON	0.18	0.18	mg/l	700	07/19/88
1	FERROUS IRON	0.18	0.19	mg/l	350	07/14/88
2	FERROUS IRON	0.22	0.24	mg/l	450	07/15/88
3	FERROUS IRON	0.17	0.17	mg/l	550	07/16/88
4	FERROUS IRON	0.15	0.15	mg/l	600	07/17/88
5	FERROUS IRON	0.17	0.15	mg/l	650	07/18/88
6	FERROUS IRON	0.10	0.11	mg/l	700	07/19/88

TABLE 2.15.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	8.1			350	07/14/88
2	pH	8.0			450	07/15/88
3	pH	8.1			550	07/16/88
5	pH	8.1			650	07/18/88
6	pH	8.1			700	07/19/88
1	Eh	-68		mV	350	07/14/88
2	Eh	-42		mV	450	07/15/88
3	Eh	-64		mV	550	07/16/88
5	Eh	-62		mV	650	07/18/88
6	Eh	-63		mV	700	07/19/88
1	TEMPERATURE	23.0		C	350	07/14/88
2	TEMPERATURE	23.5		C	450	07/15/88
3	TEMPERATURE	22.6		C	550	07/16/88
5	TEMPERATURE	24.8		C	650	07/18/88
6	TEMPERATURE	21.0		C	700	07/19/88
1	SPECIFIC GRAVITY	1.020		@ 21.9 C	350	07/14/88
4	SPECIFIC GRAVITY	1.020		@ 20.9 C	600	07/17/88
6	SPECIFIC GRAVITY	1.020		@ 21.9 C	700	07/19/88
1	SPECIFIC CONDUCTANCE	30500	@ 25 C	umhos/cm	350	07/14/88
6	SPECIFIC CONDUCTANCE	30600	@ 25 C	umhos/cm	700	07/19/88

TABLE 2.15.2

ITAS LABORATORY RESULTS
H-04c MAGENTA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	74		mg/l	07/19/88
ALKALINITY (CO3)	0		mg/l	07/19/88
BROMIDE	7	7	mg/l	07/19/88
CHLORIDE	7600		mg/l	07/19/88
CYANIDE, TOTAL	< 0.02		mg/l	07/19/88
FLUORIDE	2.6	2.6	mg/l	07/19/88
IODIDE	< 2.0	< 2.0	mg/l	07/19/88
NITRATE	< 0.02		mg/l NO3-N	07/19/88
pH	7.71	7.69		07/19/88
PHENOLICS	< 0.005		mg/l	07/19/88
PHOSPHATE, TOTAL	0.02		mg/l T-PO4-P	07/19/88
RESIDUE, FILTERABLE @180 C	23500		mg/l	07/19/88
RESIDUE, NONFILTERABLE @105 C	26		mg/l	07/19/88
SPECIFIC CONDUCTANCE	30400	30500	umhos/cm@25C	07/19/88
SULFATE	8300	8300	mg/l	07/19/88
TOTAL ORGANIC CARBON	1.0	1.0	mg/l	07/19/88
TOTAL ORGANIC HALOGEN	0.18	0.30	mg/l	07/19/88

TABLE 2.15.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	07/19/88
ANTIMONY	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	07/19/88
ARSENIC	< 0.050		< 0.005	< 0.005	mg/l	07/19/88
BARIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	07/19/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	07/19/88
BORON	12	12	< 0.01	< 0.01	mg/l	07/19/88
CADMIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	07/19/88
CALCIUM	640	660			mg/l	07/19/88
CESIUM	< 0.060	< 0.060	< 0.06	< 0.06	mg/l	07/19/88
CHROMIUM	< 0.10	0.10	0.01	0.01	mg/l	07/19/88
COBALT	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/19/88
COPPER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/19/88
IRON	0.20	0.20	< 0.01	< 0.01	mg/l	07/19/88
LEAD	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	07/19/88
LITHIUM	0.39	0.39	< 0.01	< 0.01	mg/l	07/19/88
MAGNESIUM	430	440			mg/l	07/19/88
MANGANESE	0.11	0.11	< 0.005	< 0.005	mg/l	07/19/88
MERCURY	0.0008		0.0002	< 0.0002	mg/l	07/19/88
MOLYBDENUM	0.090	0.10	< 0.05	< 0.05	mg/l	07/19/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	07/19/88
POTASSIUM	99	100			mg/l	07/19/88
SELENIUM	< 0.50		< 0.005	< 0.005	mg/l	07/19/88
SILICA	4.0	4.1			mg/l	07/19/88
SILVER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/19/88
SODIUM	7100	7200			mg/l	07/19/88
STRONTIUM	13	13	< 0.01	< 0.01	mg/l	07/19/88
THALLIUM	< 5.0		< 0.005	< 0.005	mg/l	07/19/88
TITANIUM	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	07/19/88
VANADIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/19/88
ZINC	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/19/88

TABLE 2.15.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	(10		(10	(10	ug/l	07/19/88
BENZENE	(5.0		(5.0	(5.0	ug/l	07/19/88
2-BUTANONE	(10		(10	(10	ug/l	07/19/88
BROMOFORM	(5.0		(5.0	(5.0	ug/l	07/19/88
CARBON DISULFIDE	(5.0		(5.0	(5.0	ug/l	07/19/88
CARBON TETRACHLORIDE	(5.0		(5.0	(5.0	ug/l	07/19/88
CHLOROBENZENE	(5.0		(5.0	(5.0	ug/l	07/19/88
CHLORODIBROMOMETHANE	(5.0		(5.0	(5.0	ug/l	07/19/88
CHLOROETHANE	(10		(10	(10	ug/l	07/19/88
2-CHLOROETHYLVINYL ETHER	(10		(10	(10	ug/l	07/19/88
CHLOROFORM	(5.0		(5.0	(5.0	ug/l	07/19/88
CIS-1,3-DICHLOROPROPENE	(5.0		(5.0	(5.0	ug/l	07/19/88
DICHLOROBROMOMETHANE	(5.0		(5.0	(5.0	ug/l	07/19/88
1,1-DICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/19/88
1,2-DICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/19/88
1,1-DICHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	07/19/88
1,2-DICHLOROPROPANE	(5.0		(5.0	(5.0	ug/l	07/19/88
ETHYLBENZENE	(5.0		(5.0	(5.0	ug/l	07/19/88
2-HEXANONE	(10		(10	(10	ug/l	07/19/88
METHYL BROMIDE	(10		(10	(10	ug/l	07/19/88
METHYL CHLORIDE	(10		(10	(10	ug/l	07/19/88
4-METHYL-2-PENTANONE	(10		(10	(10	ug/l	07/19/88
METHYLENE CHLORIDE	(5.0		13	26	ug/l	07/19/88
STYRENE	(5.0		(5.0	(5.0	ug/l	07/19/88
1,1,2,2-TETRACHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/19/88
TETRACHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	07/19/88
TOLUENE	(5.0		(5.0	(5.0	ug/l	07/19/88
TRANS-1,2-DICHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	07/19/88
TRANS-1,3-DICHLOROPROPENE	(5.0		(5.0	(5.0	ug/l	07/19/88
1,1,1-TRICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/19/88
1,1,2-TRICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/19/88
TRICHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	07/19/88
VINYL ACETATE	(10		(10	(10	ug/l	07/19/88
VINYL CHLORIDE	(10		(10	(10	ug/l	07/19/88
TOTAL XYLENES	(5.0		(5.0	(5.0	ug/l	07/19/88

TABLE 2.15.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	07/19/88
ACENAPHTHYLENE	< 10		ug/l	07/19/88
ANTHRACENE	< 10		ug/l	07/19/88
BENZO(A)ANTHRACENE	< 10		ug/l	07/19/88
BENZO(A)PYRENE	< 10		ug/l	07/19/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	07/19/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	07/19/88
BENZOIC ACID	< 50		ug/l	07/19/88
BENZO(K)FLUORANTHENE	< 10		ug/l	07/19/88
BENZYL ALCOHOL	< 10		ug/l	07/19/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	07/19/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	07/19/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	07/19/88
BIS(2-ETHYLHEXYL)PHTHALATE	110		ug/l	07/19/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	07/19/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	07/19/88
4-CHLOROANILINE	< 10		ug/l	07/19/88
2-CHLORONAPHTHALENE	< 10		ug/l	07/19/88
2-CHLOROPHENOL	< 10		ug/l	07/19/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	07/19/88
CHRYSENE	< 10		ug/l	07/19/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	07/19/88
DIBENZOFURAN	< 10		ug/l	07/19/88
1,2-DICHLOROBENZENE	< 10		ug/l	07/19/88
1,3-DICHLOROBENZENE	15		ug/l	07/19/88
1,4-DICHLOROBENZENE	< 10		ug/l	07/19/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	07/19/88
2,4-DICHLOROPHENOL	< 10		ug/l	07/19/88
DIETHYL PHTHALATE	< 10		ug/l	07/19/88
2,4-DIMETHYLPHENOL	< 10		ug/l	07/19/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	07/19/88
2,4-DINITROPHENOL	< 50		ug/l	07/19/88
DIMETHYL PHTHALATE	< 10		ug/l	07/19/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	07/19/88
2,4-DINITROTOLUENE	< 10		ug/l	07/19/88
2,6-DINITROTOLUENE	< 10		ug/l	07/19/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	07/19/88

TABLE 2.15.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	07/19/88
FLUORENE	< 10		ug/l	07/19/88
HEXACHLOROBENZENE	< 10		ug/l	07/19/88
HEXACHLOROBUTADIENE	< 10		ug/l	07/19/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	07/19/88
HEXACHLOROETHANE	< 10		ug/l	07/19/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	07/19/88
ISOPHORONE	< 10		ug/l	07/19/88
2-METHYLNAPHTHALENE	< 10		ug/l	07/19/88
2-METHYLPHENOL	< 10		ug/l	07/19/88
4-METHYLPHENOL	< 10		ug/l	07/19/88
NAPHTHALENE	< 10		ug/l	07/19/88
2-NITROANILINE	< 50		ug/l	07/19/88
3-NITROANILINE	< 50		ug/l	07/19/88
4-NITROANILINE	< 50		ug/l	07/19/88
NITROBENZENE	< 10		ug/l	07/19/88
2-NITROPHENOL	< 10		ug/l	07/19/88
4-NITROPHENOL	< 50		ug/l	07/19/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	07/19/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	07/19/88
P-CHLORO-M-CRESOL	< 10		ug/l	07/19/88
PENTACHLOROPHENOL	< 50		ug/l	07/19/88
PHENANTHRENE	< 10		ug/l	07/19/88
PHENOL	< 10		ug/l	07/19/88
PYRENE	< 10		ug/l	07/19/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	07/19/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	07/19/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	07/19/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	07/19/88

TABLE 2.15.3

UNC LABORATORY ANALYSIS
H-04c MAGENTA ROUND THREE

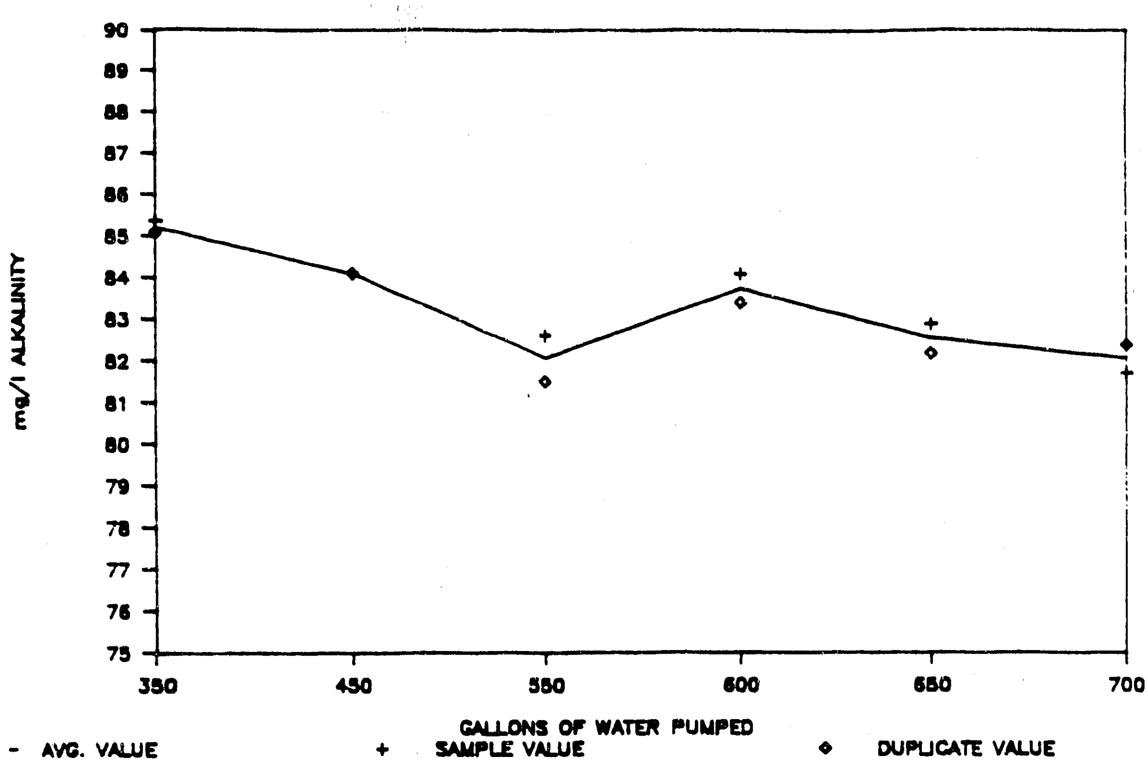
DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	0.36	0.35	cc/l (STP)	07/19/88
OXYGEN	0.23	0.22	cc/l (STP)	07/19/88
NITROGEN	15.63	16.14	cc/l (STP)	07/19/88
CARBON DIOXIDE	8.750	7.520	cc/l (STP)	07/19/88
METHANE	0.312	0.374	cc/l (STP)	07/19/88
ETHANE	0.010	0.010	cc/l (STP)	07/19/88
C-3	< 0.001	< 0.001	cc/l (STP)	07/19/88
C-4	< 0.001	< 0.001	cc/l (STP)	07/19/88
C-5	< 0.001	< 0.001	cc/l (STP)	07/19/88
C-6	< 0.001	< 0.001	cc/l (STP)	07/19/88
SUM OF CO2	33.05		cc/l (STP)	07/19/88
TOTAL GAS	25.292	24.614	cc/l (STP)	07/19/88
AMMONIA	3.06	3.09	mg/l	07/19/88
NITRATE	< 1.00	< 1.00	mg/l	07/19/88
TOTAL IRON	0.080	0.060	mg/l	07/19/88
FERROUS IRON	< 0.02	< 0.02	mg/l	07/19/88
TOTAL ARSENIC	0.0030	0.0030	mg/l	07/19/88
ARSENIC III	< 0.0010	< 0.0010	mg/l	07/19/88
TOTAL SELENIUM	< 0.001	< 0.001	mg/l	07/19/88
IODIDE	330	350	ug/l	07/19/88
IODATE	< 20	< 20	ug/l	07/19/88

TABLE 2.15.4

PRESSURE AND FLOW
H-04c MAGENTA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
07/12/88	09:39	67	73	00	PUMP OFF
07/12/88	09:50	67	73	00	PACKER INFLATED
07/12/88	09:56	67	02	25	PUMP ON 09:55
07/12/88	10:05	67	00	12	DECREASING FLOW RATE
07/12/88	10:10	67	00	11	
07/12/88	10:18	67	00	09	PUMP OFF 10:23
07/12/88	10:33	67	70	00	DEFLATE PACKER
07/12/88	10:40	66	72	00	PUMP ON
07/12/88	10:45	65	71	22	
07/12/88	10:52	64	70	30	
07/12/88	10:57	62	69	45	
07/12/88	11:15	56	62	43	
07/12/88	11:30	51	57	40	
07/12/88	11:45	46	52	40	
07/12/88	12:00	41	47	45	
07/12/88	12:30	32	38	43	
07/12/88	13:00	23	29	45	
07/12/88	13:15	18	24	46	DECREASING FLOW RATE
07/12/88	13:25	15	21	42	
07/12/88	13:30	14	20	40	
07/12/88	13:35	13	19	27	
07/12/88	14:00	11	17	17	
07/12/88	14:30	09	15	13	
07/13/88	07:30	02	08	05	
07/13/88	14:30	00	06	05	
07/14/88	07:30	00	01	05	INFLATE PACKER 07:45
07/14/88	16:00	00	01	05	
07/15/88	07:30	00	14	03	
07/15/88	14:30	00	16	03	
07/15/88	15:00	00	17	03	
07/15/88	15:30	00	17	03	
07/15/88	16:00	00	17	03	
07/16/88	07:00	00	18	03	
07/16/88	15:00	00	19	03	
07/17/88	08:30	00	22	03	
07/17/88	18:15	00	22	03	
07/18/88	07:30	00	22	03	
07/18/88	15:30	00	21	03	
07/19/88	07:00	00	24	03	
07/19/88	14:30	00	14	04	PUMP OFF 14:40



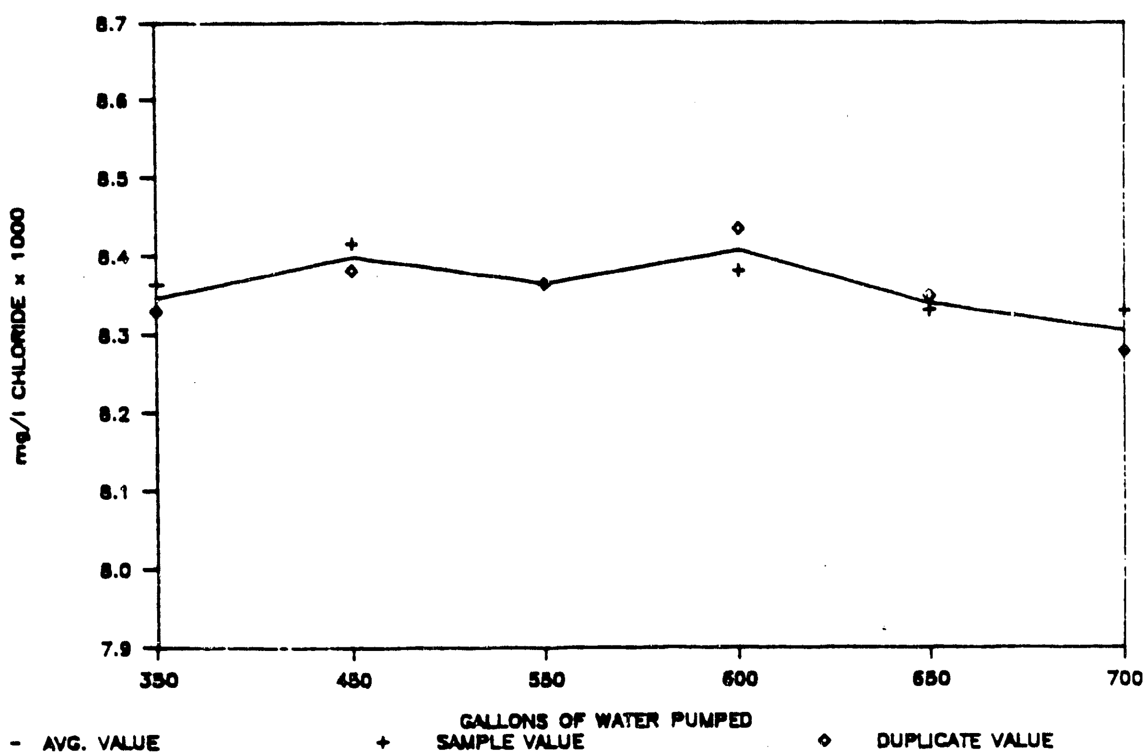
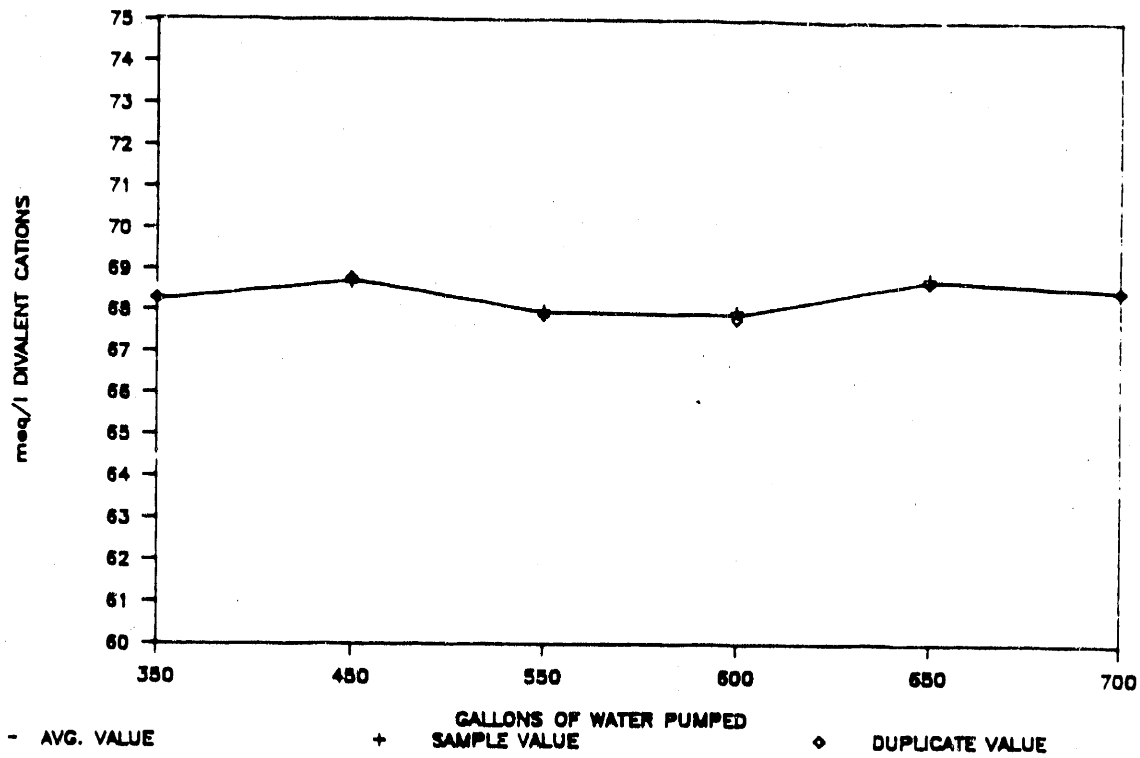


Figure 2.15.1. Graphs of alkalinity and chloride from third round serial sampling at well H-04c Magenta.



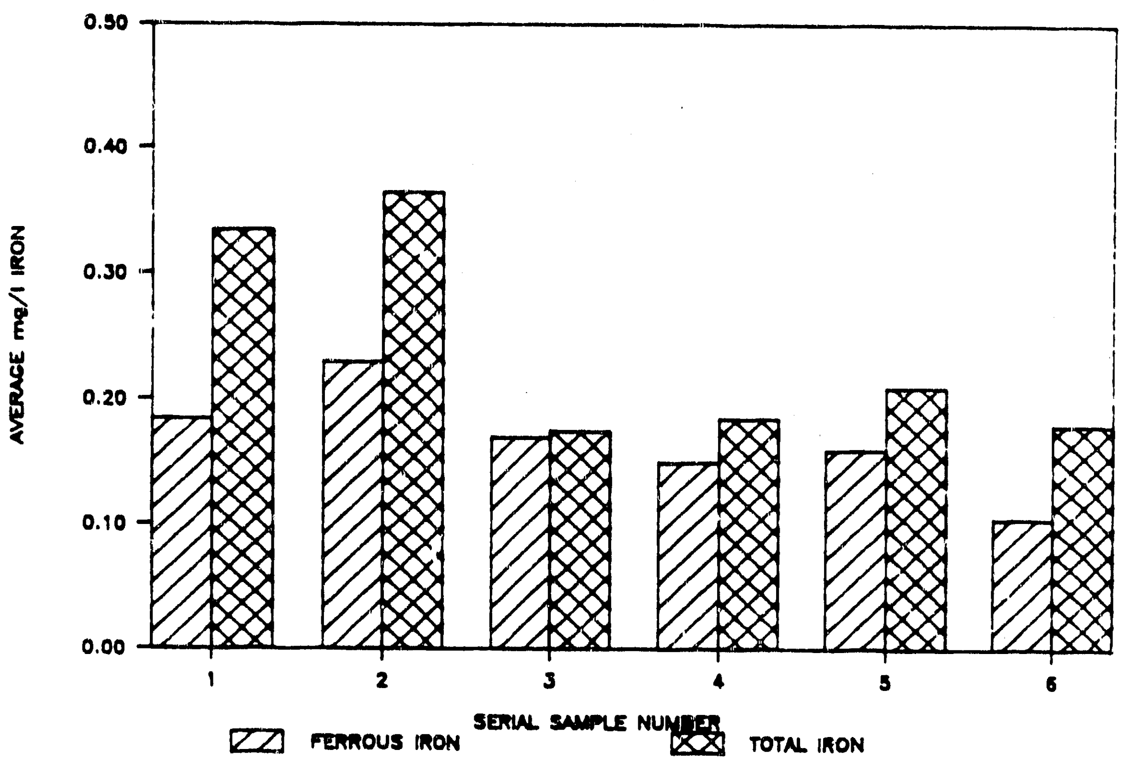


Figure 2.15.2. Graphs of divalent cations and iron from third round serial sampling at well H-04c Magenta.

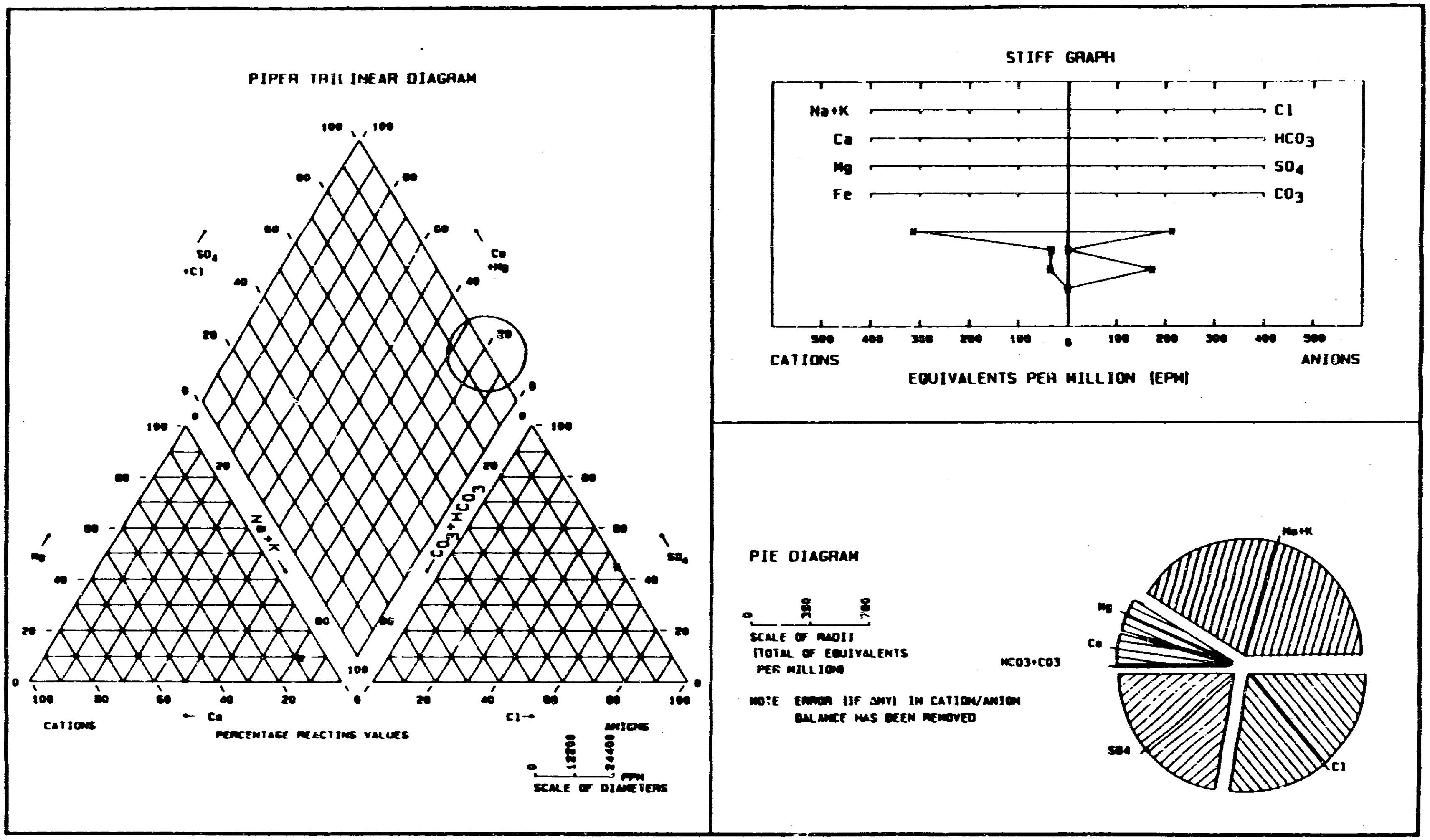


Figure 2.15.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well H-04c Magenta.

2.16 SUMMARY OF MAGENTA WELL H-06c, ROUND THREE

Well Characteristics

Well H-06c is located approximately 2.7 miles northwest of the center of the WIPP site at an elevation of 3,349 feet above MSL, to the top of casing (Gonzales, 1989). The total depth of the hole is 741 feet BTOC. The hole is cased to a depth of 699 feet BGS, completed open hole below the casing, and perforated in two intervals accessing the Magenta and Culebra Dolomites. Bridge plugs have been set below the Magenta and Culebra Dolomites at 534 and 641 feet BTOC, respectively. Currently only the Magenta Dolomite is accessible. The source of water sampled from this well is the Magenta Dolomite Member of the Rustler Formation located at a depth interval of 490 to 514 feet BGS (Stensrud, 1986).

Sampling Process

This well was sampled using a Bennett model piston pump. An Aardvark model sliding end inflatable packer isolated the pump intake from stagnant water above it in the well bore. The pump intake was set at a depth of 483 feet BTOC.

Pumping began on 07/19/88 and ceased on 07/26/88. The average flow rate was approximately 13 gph during the sampling period. Serial sampling began on 07/22/88 after 1,000 gallons of water had been pumped from the well. Five consecutive daily samples were collected and analyzed. Serial sampling ended and final samples were collected on 07/26/88 after approximately 2,200 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity at approximately 52 mg/l during the serial sampling period (Figure 2.16.1).

Chloride concentration was nearly constant at approximately 410 mg/l (Figure 2.16.1).

Divalent cations remained nearly constant at approximately 41 meq/l (Figure 2.16.2).

Total iron concentrations dropped from approximately 0.6 on the first sampling day to approximately 0.3 mg/l on the second and succeeding sampling days. Ferrous iron remained at approximately 0.3 mg/l throughout the sampling period, until the final day of sampling when ferrous iron was reported at 0.15 mg/l (Figure 2.16.2).

The water pH value remained at 7.8 SU throughout the serial sampling period.

Physical Parameters

Values for Eh ranged between 111 and 132 mV relative to the SHE during the sampling period.

The water temperature varied between 21 and 22°C.

Specific gravity was 1.003 at 21.3°C on the final day of sampling.

Specific conductance was measured at 5,320 and 5,300 umhos/cm at 25°C on the first and final days of sampling, respectively.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were taken following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from well H-06c was not effervescent.

There were very few particulates observed on the 0.45-um filters after sampling each day.

Tabular data are presented in Tables 2.16.1, 2.16.2, 2.16.3, and 2.16.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.16.1 and 2.16.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.16.3 illustrates the general water quality of well H-06c utilizing Stiff, pie, and Piper trilinear diagrams.

There were no problems encountered in sampling well H-06c.

Serial Parameter Comparisons With The Previous Rounds

Data from serial sampling field analyses compare favorably over the past three rounds. Most chemical and physical parameters were nearly identical at the time of final sampling for each round. The only exceptions were total and ferrous iron values which were much lower during the second and third rounds. The variable iron values may be related to the fact that during the round one sampling a packer was not set in the well while rounds two and three utilized a packer.

Pump flow rates for the round two and three sampling episodes were quite similar, though different from the round one sampling. The round one flow rate was 24 gph and the total volume pumped was 7,000 gallons. Round two and three average flow rates were 12 and 13 gph respectively with 4,700 and 2,200 gallons pumped.

TABLE 2.16.1

SERIAL SAMPLE CHEMISTRY
H-06c MAGENTA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	50.9	51.1	mg/l	1000	07/22/88
2	ALKALINITY	51.9	51.1	mg/l	1300	07/23/88
3	ALKALINITY	51.6	52.1	mg/l	1600	07/24/88
4	ALKALINITY	52.1	51.4	mg/l	1900	07/25/88
5	ALKALINITY	52.6	52.1	mg/l	2200	07/26/88
1	CHLORIDE	409	408	mg/l	1000	07/22/88
2	CHLORIDE	412	410	mg/l	1300	07/23/88
3	CHLORIDE	410	409	mg/l	1600	07/24/88
4	CHLORIDE	408	411	mg/l	1900	07/25/88
5	CHLORIDE	408	407	mg/l	2200	07/26/88
1	DIVALENT CATIONS	40.7	40.9	meq/l	1000	07/22/88
2	DIVALENT CATIONS	40.5	40.5	meq/l	1300	07/23/88
3	DIVALENT CATIONS	40.8	40.9	meq/l	1600	07/24/88
4	DIVALENT CATIONS	40.9	40.9	meq/l	1900	07/25/88
5	DIVALENT CATIONS	41.4	41.2	meq/l	2200	07/26/88
1	TOTAL IRON	0.56	0.57	mg/l	1000	07/22/88
2	TOTAL IRON	0.30	0.30	mg/l	1300	07/23/88
3	TOTAL IRON	0.31	0.31	mg/l	1600	07/24/88
4	TOTAL IRON	0.33	0.35	mg/l	1900	07/25/88
5	TOTAL IRON	0.36	0.32	mg/l	2200	07/26/88
1	FERROUS IRON	0.33	0.33	mg/l	1000	07/22/88
2	FERROUS IRON	0.29	0.29	mg/l	1300	07/23/88
3	FERROUS IRON	0.28	0.29	mg/l	1600	07/24/88
4	FERROUS IRON	0.28	0.29	mg/l	1900	07/25/88
5	FERROUS IRON	0.15	0.16	mg/l	2200	07/26/88
1	pH	7.8			1000	07/22/88
2	pH	7.8			1300	07/23/88
4	pH	7.8			1900	07/25/88
5	pH	7.8			2200	07/26/88

TABLE 2.16.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	Eh	115		mV	1000	07/22/88
2	Eh	132		mV	1300	07/23/88
4	Eh	125		mV	1900	07/25/88
5	Eh	111		mV	2200	07/26/88
1	TEMPERATURE	21.5		C	1000	07/22/88
2	TEMPERATURE	21.4		C	1300	07/23/88
4	TEMPERATURE	21.8		C	1900	07/25/88
5	TEMPERATURE	21.4		C	2200	07/26/88
1	SPECIFIC GRAVITY	1.002		@ 21.2 C	1000	07/22/88
3	SPECIFIC GRAVITY	1.003		@ 21.4 C	1600	07/24/88
5	SPECIFIC GRAVITY	1.003		@ 21.3 C	2200	07/26/88
1	SPECIFIC CONDUCTANCE	5320	@ 25 C	umhos/cm	1000	07/22/88
5	SPECIFIC CONDUCTANCE	5300	@ 25 C	umhos/cm	2200	07/26/88

TABLE 2.16.2

ITAS LABORATORY RESULTS
H-06c MAGENTA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	52		mg/l	07/26/88
ALKALINITY (CO3)	0		mg/l	07/26/88
BROMIDE	< 2		mg/l	07/26/88
CHLORIDE	390		mg/l	07/26/88
CYANIDE, TOTAL	< 0.02		mg/l	07/26/88
FLUORIDE	2.0		mg/l	07/26/88
IODIDE	< 2.0		mg/l	07/26/88
NITRATE	< 0.02		mg/l NO3-N	07/26/88
pH	7.19	7.21	--	07/26/88
PHENOLICS	< 0.005		mg/l	07/26/88
PHOSPHATE, TOTAL	0.02		mg/l T-PO4-P	07/26/88
RESIDUE, FILTERABLE @180 C	4800		mg/l	07/26/88
RESIDUE, NONFILTERABLE @105 C	29		mg/l	07/26/88
SPECIFIC CONDUCTANCE	3860	3880	umhos/cm@25C	07/26/88
SULFATE	2600		mg/l	07/26/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	07/26/88

TABLE 2.16.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 1.0	< 1.0	< 0.1	< 0.1	mg/l	07/26/88
ANTIMONY	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	07/26/88
ARSENIC	< 0.0050		< 0.005	< 0.005	mg/l	07/26/88
BARIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	07/26/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	07/26/88
BORON	2.4	2.4	< 0.01	< 0.01	mg/l	07/26/88
CADMIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	07/26/88
CALCIUM	590	590			mg/l	07/26/88
CESIUM	< 0.060	< 0.060	< 0.06	< 0.06	mg/l	07/26/88
CHROMIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/26/88
COBALT	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/26/88
COPPER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/26/88
IRON	0.40	0.40	< 0.01	< 0.01	mg/l	07/26/88
LEAD	< 0.50	< 0.50	< 0.05	< 0.05	mg/l	07/26/88
LITHIUM	0.22	0.22	0.01	0.01	mg/l	07/26/88
MAGNESIUM	170	170			mg/l	07/26/88
MANGANESE	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	07/26/88
MERCURY	< 0.0002				mg/l	07/26/88
MOLYBDENUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/26/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	07/26/88
POTASSIUM	18	18			mg/l	07/26/88
SELENIUM	< 0.050		< 0.005	< 0.005	mg/l	07/26/88
SILICA	5.4				mg/l	07/26/88
SILVER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/26/88
SODIUM	640	630			mg/l	07/26/88
STRONTIUM	9.4	9.3	< 0.01	< 0.01	mg/l	07/26/88
THALLIUM	< 0.050		< 0.005	< 0.005	mg/l	07/26/88
TITANIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/26/88
VANADIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/26/88
ZINC	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	07/26/88

TABLE 2.16.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	(10		(10	(10	ug/l	07/26/88
BENZENE	(5.0		(5.0	(5.0	ug/l	07/26/88
2-BUTANONE	(10		(10	(10	ug/l	07/26/88
BROMOFORM	(5.0		(5.0	(5.0	ug/l	07/26/88
CARBON DISULFIDE	(5.0		(5.0	(5.0	ug/l	07/26/88
CARBON TETRACHLORIDE	(5.0		(5.0	(5.0	ug/l	07/26/88
CHLOROBENZENE	(5.0		(5.0	(5.0	ug/l	07/26/88
CHLORODIBROMOMETHANE	(5.0		(5.0	(5.0	ug/l	07/26/88
CHLOROETHANE	(10		(10	(10	ug/l	07/26/88
2-CHLOROETHYLVINYL ETHER	(10		(10	(10	ug/l	07/26/88
CHLOROFORM	(5.0		(5.0	(5.0	ug/l	07/26/88
CIS-1,3-DICHLOROPROPENE	(5.0		(5.0	(5.0	ug/l	07/26/88
DICHLOROBROMOMETHANE	(5.0		(5.0	(5.0	ug/l	07/26/88
1,1-DICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/26/88
1,2-DICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/26/88
1,1-DICHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	07/26/88
1,2-DICHLOROPROPANE	(5.0		(5.0	(5.0	ug/l	07/26/88
ETHYLBENZENE	(5.0		(5.0	(5.0	ug/l	07/26/88
2-HEXANONE	(10		(10	(10	ug/l	07/26/88
METHYL BROMIDE	(10		(10	(10	ug/l	07/26/88
METHYL CHLORIDE	(10		(10	(10	ug/l	07/26/88
4-METHYL-2-PENTANONE	(10		(10	(10	ug/l	07/26/88
METHYLENE CHLORIDE	(5.0		13	7.4	ug/l	07/26/88
STYRENE	(5.0		(5.0	(5.0	ug/l	07/26/88
1,1,2,2-TETRACHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/26/88
TETRACHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	07/26/88
TOLUENE	(5.0		(5.0	(5.0	ug/l	07/26/88
TRANS-1,2-DICHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	07/26/88
TRANS-1,3-DICHLOROPROPENE	(5.0		(5.0	(5.0	ug/l	07/26/88
1,1,1-TRICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/26/88
1,1,2-TRICHLOROETHANE	(5.0		(5.0	(5.0	ug/l	07/26/88
TRICHLOROETHYLENE	(5.0		(5.0	(5.0	ug/l	07/26/88
VINYL ACETATE	(10		(10	(10	ug/l	07/26/88
VINYL CHLORIDE	(10		(10	(10	ug/l	07/26/88
TOTAL XYLENES	(5.0		(5.0	(5.0	ug/l	07/26/88

TABLE 2.16.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	07/26/88
ACENAPHTHYLENE	< 10		ug/l	07/26/88
ANTHRACENE	< 10		ug/l	07/26/88
BENZO(A)ANTHRACENE	< 10		ug/l	07/26/88
BENZO(A)PYRENE	< 10		ug/l	07/26/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	07/26/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	07/26/88
BENZOIC ACID	< 50		ug/l	07/26/88
BENZO(K)FLUORANTHENE	< 10		ug/l	07/26/88
BENZYL ALCOHOL	< 10		ug/l	07/26/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	07/26/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	07/26/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	07/26/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	07/26/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	07/26/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	07/26/88
4-CHLOROANILINE	< 10		ug/l	07/26/88
2-CHLORONAPHTHALENE	< 10		ug/l	07/26/88
2-CHLOROPHENOL	< 10		ug/l	07/26/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	07/26/88
CHRYSENE	< 10		ug/l	07/26/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	07/26/88
DIBENZOFURAN	< 10		ug/l	07/26/88
1,2-DICHLOROBENZENE	< 10		ug/l	07/26/88
1,3-DICHLOROBENZENE	< 10		ug/l	07/26/88
1,4-DICHLOROBENZENE	< 10		ug/l	07/26/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	07/26/88
2,4-DICHLOROPHENOL	< 10		ug/l	07/26/88
DIETHYL PHTHALATE	< 10		ug/l	07/26/88
2,4-DIMETHYLPHENOL	< 10		ug/l	07/26/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	07/26/88
2,4-DINITROPHENOL	< 50		ug/l	07/26/88
DIMETHYL PHTHALATE	< 10		ug/l	07/26/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	07/26/88
2,4-DINITROTOLUENE	< 10		ug/l	07/26/88
2,6-DINITROTOLUENE	< 10		ug/l	07/26/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	07/26/88

TABLE 2.16.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	07/26/88
FLUORENE	< 10		ug/l	07/26/88
HEXACHLOROBENZENE	< 10		ug/l	07/26/88
HEXACHLOROBUTADIENE	< 10		ug/l	07/26/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	07/26/88
HEXACHLOROETHANE	< 10		ug/l	07/26/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	07/26/88
ISOPHORONE	< 10		ug/l	07/26/88
2-METHYLNAPHTHALENE	< 10		ug/l	07/26/88
2-METHYLPHENOL	< 10		ug/l	07/26/88
4-METHYLPHENOL	< 10		ug/l	07/26/88
NAPHTHALENE	< 10		ug/l	07/26/88
2-NITROANILINE	< 50		ug/l	07/26/88
3-NITROANILINE	< 50		ug/l	07/26/88
4-NITROANILINE	< 50		ug/l	07/26/88
NITROBENZENE	< 10		ug/l	07/26/88
2-NITROPHENOL	< 10		ug/l	07/26/88
4-NITROPHENOL	< 50		ug/l	07/26/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	07/26/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	07/26/88
P-CHLORO-M-CRESOL	< 10		ug/l	07/26/88
PENTACHLOROPHENOL	< 50		ug/l	07/26/88
PHENANTHRENE	< 10		ug/l	07/26/88
PHENOL	< 10		ug/l	07/26/88
PYRENE	< 10		ug/l	07/26/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	07/26/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	07/26/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	07/26/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	07/26/88

TABLE 2.16.3

UNC LABORATORY ANALYSIS
H-06c MAGENTA ROUND THREE

DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	0.79	0.53	cc/l (STP)	07/26/88
OXYGEN	0.71	0.78	cc/l (STP)	07/26/88
NITROGEN	22.35	23.52	cc/l (STP)	07/26/88
CARBON DIOXIDE	2.940	4.310	cc/l (STP)	07/26/88
METHANE	0.033	0.038	cc/l (STP)	07/26/88
ETHANE	< 0.001	< 0.001	cc/l (STP)	07/26/88
C-3	< 0.001	< 0.001	cc/l (STP)	07/26/88
C-4	< 0.001	< 0.001	cc/l (STP)	07/26/88
C-5	< 0.001	< 0.001	cc/l (STP)	07/26/88
C-6	< 0.001	< 0.001	cc/l (STP)	07/26/88
SUM OF CO2	25.67		cc/l (STP)	07/26/88
TOTAL GAS	26.823	29.178	cc/l (STP)	07/26/88
AMMONIA	0.06	0.04	mg/l	07/26/88
NITRATE	< 0.10	< 0.10	mg/l	07/26/88
TOTAL IRON	0.530	0.530	mg/l	07/26/88
FERROUS IRON	0.41	0.40	mg/l	07/26/88
TOTAL ARSENIC	< 0.0010	< 0.0010	mg/l	07/26/88
TOTAL SELENIUM	< 0.001	< 0.001	mg/l	07/26/88
IODIDE	70	70	ug/l	07/26/88
IODATE	< 20	< 20	ug/l	07/26/88

TABLE 2.16.4

PRESSURE AND FLOW
H-06c MAGENTA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
07/19/88	11:16	72	84	00	PUMP OFF
07/19/88	11:45	72	81	00	PACKER INFLATED
07/19/88	11:52	72	51	16	PUMP ON 11:50
07/19/88	12:30	73	48	17	
07/19/88	12:45	72	46	17	DECREASE FLOW
07/19/88	13:00	72	49	15	
07/19/88	13:15	72	49	15	
07/19/88	13:30	73	48	15	
07/19/88	15:00	72	49	15	
07/20/88	08:30	73	40	17	
07/20/88	15:00	72	44	15	FLOW REDUCED 12:00
07/21/88	07:30	72	44	13	
07/21/88	15:00	72	44	15	
07/22/88	07:30	72	43	14	
07/22/88	15:00	72	43	13	
07/23/88	08:00	72	43	14	
07/23/88	18:00	72	42	14	
07/24/88	06:30	72	42	13	
07/24/88	16:00	72	43	12	
07/25/88	07:30	72	42	13	
07/25/88	15:30	72	42	12	
07/26/88	07:00	72	42	12	
07/26/88	13:00	72	41	13	PUMP OFF 13:10

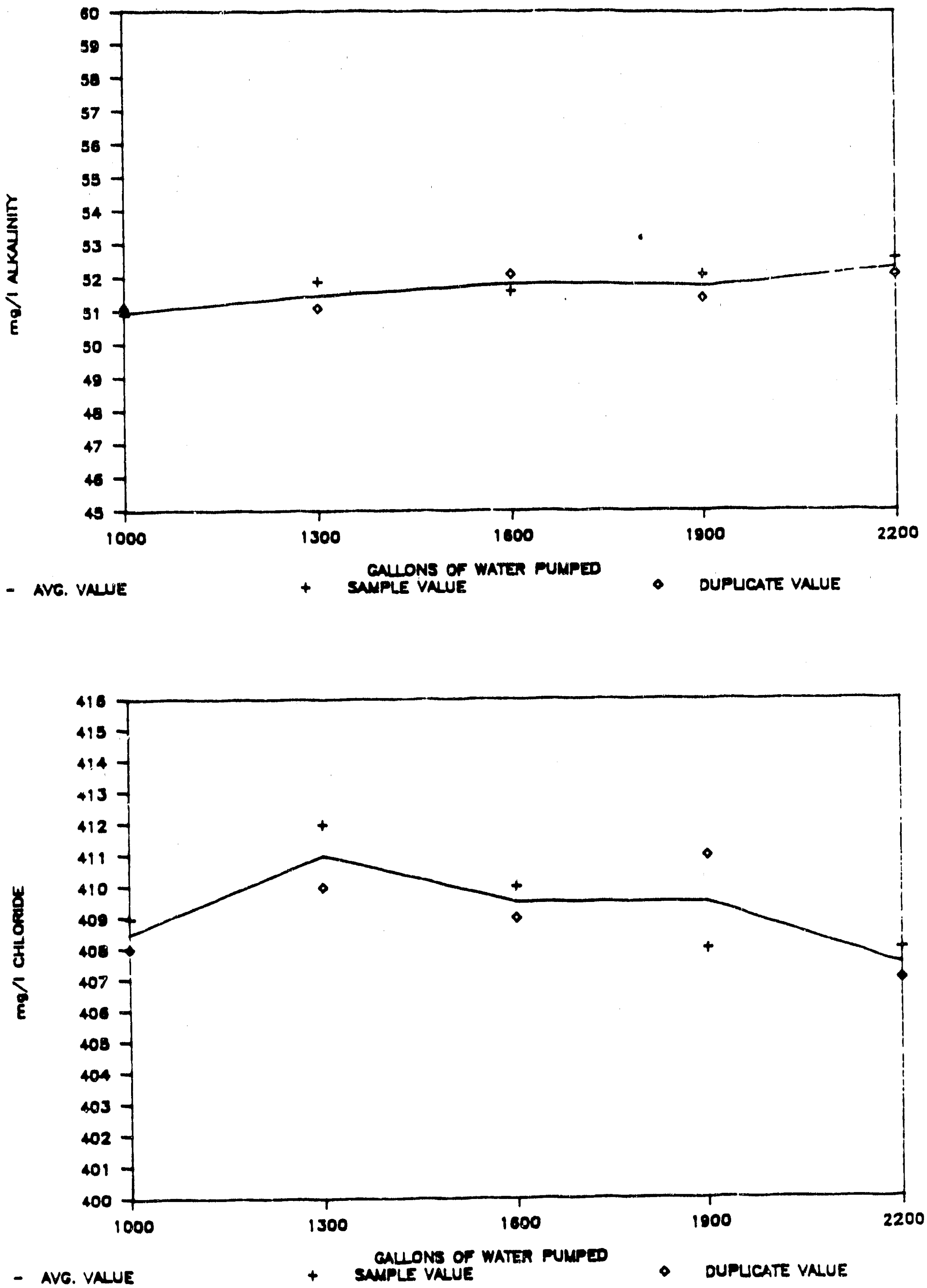
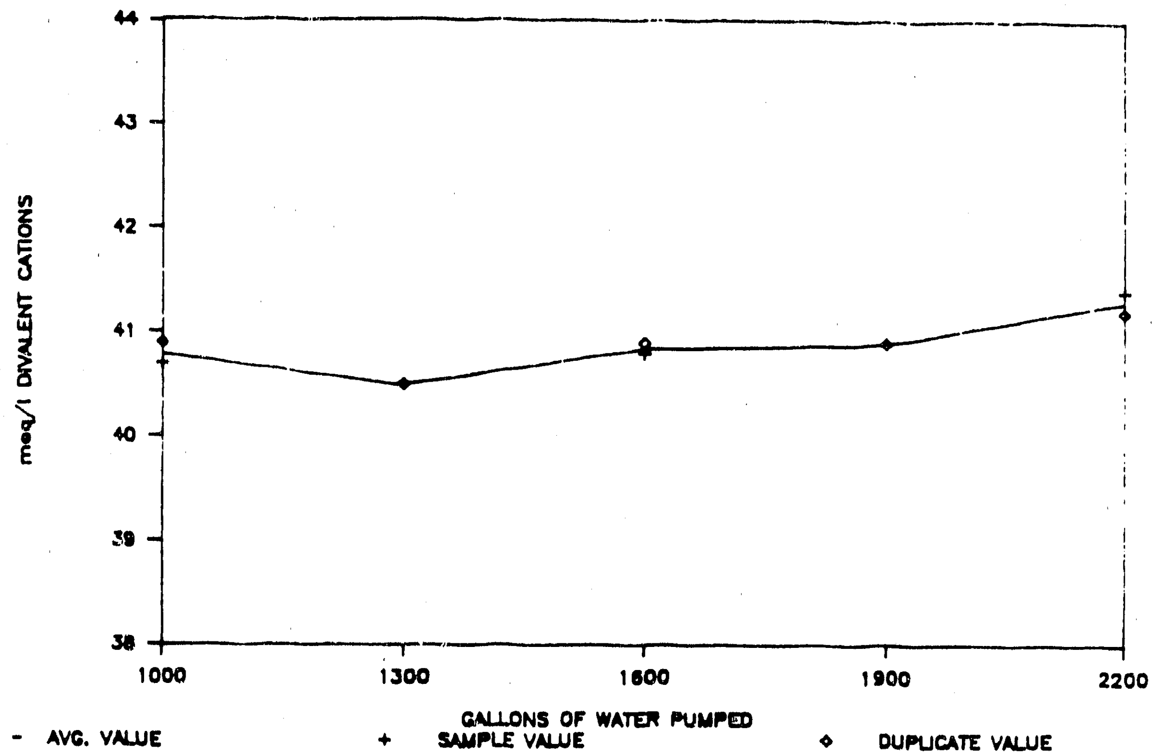


Figure 2.16.1. Graphs of alkalinity and chloride from third round serial sampling at well H-06c Magenta.



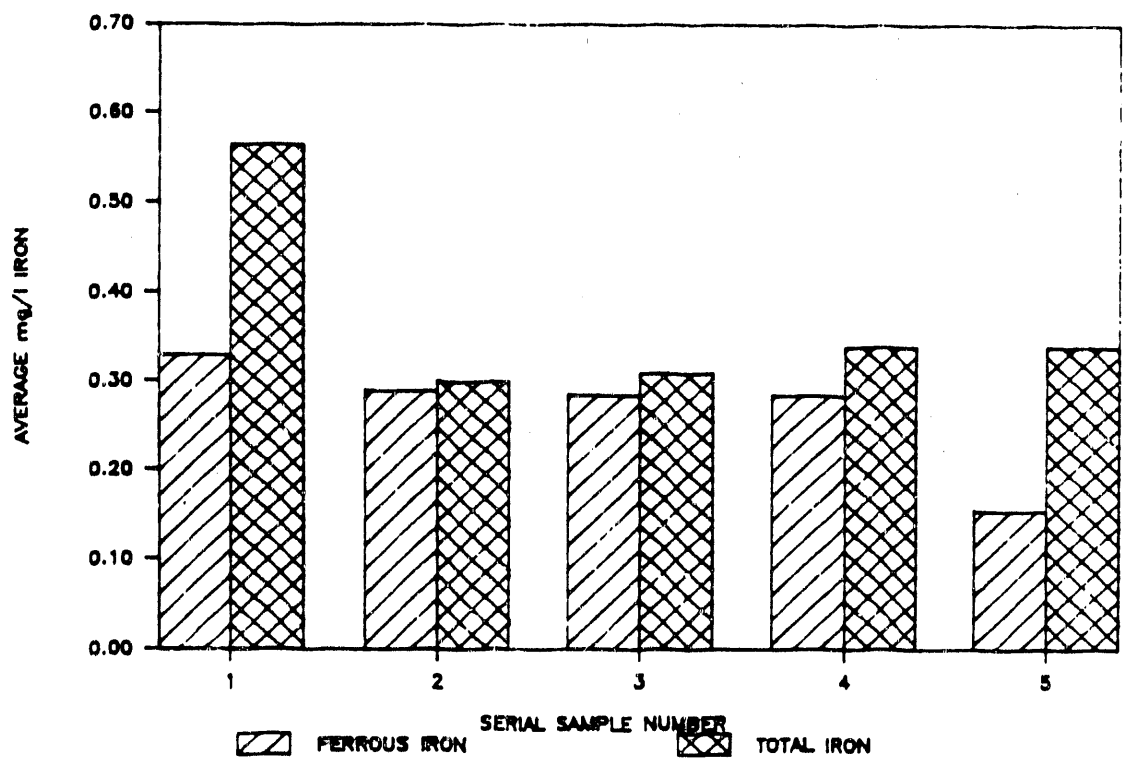


Figure 2.16.2. Graphs of divalent cations and iron from third round serial sampling at well H-06c Magenta.

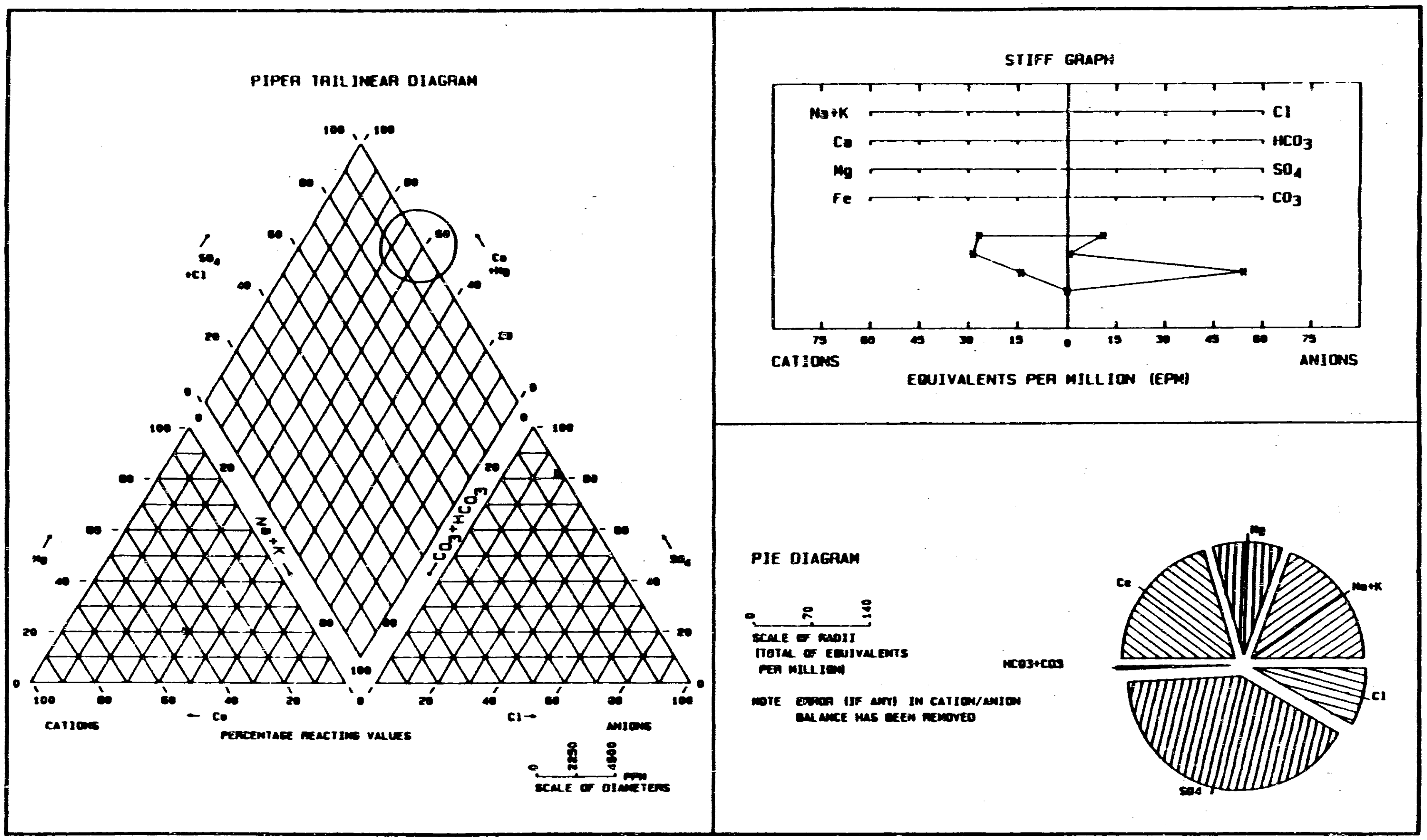


Figure 2.16.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well H-06c Magenta.

2.17 SUMMARY OF MAGENTA WELL H-05c, ROUND THREE

Well Characteristics

Well H-05c is located approximately 2.7 miles northeast of the center of the WIPP site at an elevation of 3,506 feet above MSL, to the top of the casing (Gonzales, 1989). Total depth of the drilled hole is 1,076 feet BGS. The hole is cased to a depth of 1,024 feet BGS. Below the casing the well is completed open hole, but the casing is also perforated at two intervals accessing the Magenta Dolomite and the Culebra Dolomite. Bridge plugs have been set below the Magenta Dolomite at 837 feet BTOC, and below the Culebra Dolomite at 935 feet BTOC. Currently only the Magenta Dolomite is accessible. The source of water sampled from this well is the Magenta Dolomite Member of the Rustler Formation, located at depths of 788 to 812 feet BGS (Stensrud, 1986).

Sampling Process

This well was sampled using a Bennett model piston pump. Initially the pump assembly was set at 575 feet BTOC, on 08/09/88. Water was pumped at approximately 41 gph for 24 hours lowering the column of water in the well. The pump assembly was then lowered so that the intake was located at 759 feet BTOC. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. Removing a portion of the water column from the well reduced the pressure above the packer lessening the probability of equipment failure.

Regulated pumping began on 08/10/88 and ceased on 08/18/88. The average flow rate was approximately 10 gph, although flow rates varied daily. Usually pump flow rates decreased to near zero overnight and were readjusted each morning to 13 or 14 gph. Serial sampling began on 08/15/88 after 1,900 gallons of water had been pumped from the well. One serial sample was taken daily for four consecutive days. Serial sampling ended and final samples were collected on 08/18/88, after approximately 2,500 gallons of water had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity values steady between approximately 57 and 58 mg/l (Figure 2.17.1).

Chloride content remained fairly constant ranging between 1,030 and 1,040 mg/l (Figure 2.17.1).

Divalent cations remained constant at approximately 42 meq/l (Figure 2.17.2).

Total iron concentrations decreased from the day one high of approximately 0.8 mg/l to approximately 0.7 mg/l on the second day. Ferrous iron values followed the same general trend as total iron (Figure 2.17.2).

The water pH ranged between 7.8 and 8.1 SU over the course of serial sampling.

Physical Parameters

Eh values ranged from 37 to 45 mV relative to the SHE.

The water temperature varied between 22 and 23°C.

Specific gravity was 1.008 at 22.1°C on the final day of sampling.

Specific conductance remained at approximately 8,400 umhos/cm at 25°C over the course of the sampling period.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were taken following the procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from well H-05c was slightly effervescent.

Particulates were observed on the 0.45-um filters after sampling each day. The amount of particulates decreased as sampling progressed.

Tabular data are presented in Tables 2.17.1, 2.17.2, 2.17.3, and 2.17.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.17.1 and 2.17.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.17.3 illustrates the general water quality at well H-05c utilizing Stiff, pie, and Piper trilinear diagrams.

Serial Parameter Comparisons With The Previous Rounds

Serial sampling data from rounds two and three tended to exhibit greater stability than data from round one. Generally, most parameters are in good agreement between the three rounds of sampling. Values for iron were slightly greater in round three than round two.

Average purge volumes and flow rates were 2,500 gallons and approximately 10 gph for round three, 1,900 gallons and 10 gph for round two, and 5,800 gallons and 13 gph for round one.

TABLE 2.17.1

SERIAL SAMPLE CHEMISTRY
H-05c MAGENTA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	57.0	57.5	mg/l	1900	08/15/88
2	ALKALINITY	57.2	57.5	mg/l	2000	08/16/88
3	ALKALINITY	58.0	57.2	mg/l	2300	08/17/88
4	ALKALINITY	57.5	57.5	mg/l	2500	08/18/88
1	CHLORIDE	1040	1040	mg/l	1900	08/15/88
2	CHLORIDE	1030	1040	mg/l	2000	08/16/88
3	CHLORIDE	1030	1030	mg/l	2300	08/17/88
4	CHLORIDE	1030	1030	mg/l	2500	08/18/88
1	DIVALENT CATIONS	41.6	41.6	meq/l	1900	08/15/88
2	DIVALENT CATIONS	42.0	42.3	meq/l	2000	08/16/88
3	DIVALENT CATIONS	42.0	42.2	meq/l	2300	08/17/88
4	DIVALENT CATIONS	42.0	42.1	meq/l	2500	08/18/88
1	TOTAL IRON	0.79	0.80	mg/l	1900	08/15/88
2	TOTAL IRON	0.70	0.72	mg/l	2000	08/16/88
3	TOTAL IRON	0.84	0.80	mg/l	2300	08/17/88
4	TOTAL IRON	0.67	0.71	mg/l	2500	08/18/88
1	FERROUS IRON	0.53	0.52	mg/l	1900	08/15/88
2	FERROUS IRON	0.59	0.60	mg/l	2000	08/16/88
3	FERROUS IRON	0.73	0.70	mg/l	2300	08/17/88
4	FERROUS IRON	0.57	0.57	mg/l	2500	08/18/88
1	pH	8.1			1900	08/15/88
2	pH	8.0			2000	08/16/88
3	pH	7.8			2300	08/17/88
4	pH	8.1			2500	08/18/88
2	Eh	37		mV	2000	08/16/88
3	Eh	43		mV	2300	08/17/88
4	Eh	45		mV	2500	08/18/88

TABLE 2.17.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	TEMPERATURE	22.3		C	1900	08/15/88
2	TEMPERATURE	22.5		C	2000	08/16/88
3	TEMPERATURE	22.5		C	2300	08/17/88
4	TEMPERATURE	22.0		C	2500	08/18/88
1	SPECIFIC GRAVITY	1.008		@ 22.1 C	1900	08/15/88
4	SPECIFIC GRAVITY	1.008		@ 22.1 C	2500	08/18/88
1	SPECIFIC CONDUCTANCE	8410	@ 25 C	umhos/cm	1900	08/15/88
4	SPECIFIC CONDUCTANCE	8450	@ 25 C	umhos/cm	2500	08/18/88

TABLE 2.17.2

ITAS LABORATORY RESULTS
H-05c MAGENTA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	54		mg/l	08/18/88
ALKALINITY (CO3)	0		mg/l	08/18/88
BROMIDE	3.0		mg/l	08/18/88
CHLORIDE	1000	1000	mg/l	08/18/88
CYANIDE, TOTAL	< 0.02		mg/l	08/18/88
FLUORIDE	3.1		mg/l	08/18/88
IODIDE	< 2.0		mg/l	08/18/88
NITRATE	< 0.02		mg/l NO3-N	08/18/88
pH	7.49	7.50		08/18/88
PHENOLICS	< 0.005		mg/l	08/18/88
PHOSPHATE, TOTAL	0.01	0.01	mg/l T-PO4-P	08/18/88
RESIDUE, FILTERABLE @180 C	7000		mg/l	08/18/88
RESIDUE, NONFILTERABLE @105 C	50		mg/l	08/18/88
SPECIFIC CONDUCTANCE	9240	9250	umhos/cm@25C	08/18/88
SULFATE	3000		mg/l	08/18/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	08/18/88
TOTAL ORGANIC HALOGEN	< 0.05	< 0.05	mg/l	08/18/88

TABLE 2.17.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	1.0	< 1.0	< 0.1	< 0.1	mg/l	08/18/88
ANTIMONY	0.60	0.50	< 0.05	< 0.05	mg/l	08/18/88
ARSENIC	< 0.050		< 0.005	< 0.005	mg/l	08/18/88
BARIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	08/18/88
BERYLLIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	08/18/88
BORON	11	11	< 0.01	< 0.01	mg/l	08/18/88
CADMIUM	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	08/18/88
CALCIUM	570	570			mg/l	08/18/88
CESIUM	< 0.060	< 0.060	< 0.06	< 0.06	mg/l	08/18/88
CHROMIUM	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	08/18/88
COBALT	0.10	0.10	< 0.01	< 0.01	mg/l	08/18/88
COPPER	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	08/18/88
IRON	1.0	1.0	< 0.01	< 0.01	mg/l	08/18/88
LEAD	0.60	0.60	< 0.05	< 0.05	mg/l	08/18/88
LITHIUM	0.22	0.22	0.01	0.01	mg/l	08/18/88
MAGNESIUM	180	180			mg/l	08/18/88
MANGANESE	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	08/18/88
MERCURY	0.0005	0.0005	0.0007	0.0005	mg/l	08/18/88
MOLYBDENUM	0.080	0.060	0.10	0.11	mg/l	08/18/88
NICKEL	< 0.30	< 0.030	< 0.03	< 0.03	mg/l	08/18/88
POTASSIUM	36	38			mg/l	08/18/88
SELENIUM	< 0.050		< 0.005	< 0.005	mg/l	08/18/88
SILICA	4.6	4.7			mg/l	08/18/88
SILVER	0.20	0.20	< 0.01	< 0.01	mg/l	08/18/88
SODIUM	1400	1400			mg/l	08/18/88
STRONTIUM	9.5	9.4	0.02	0.1	mg/l	08/18/88
THALLIUM	< 0.50		< 0.005	< 0.005	mg/l	08/18/88
TITANIUM	0.20	0.10	< 0.01	< 0.01	mg/l	08/18/88
VANADIUM	0.20	0.10	< 0.01	< 0.01	mg/l	08/18/88
ZINC	0.10	< 0.10	< 0.01	< 0.01	mg/l	08/18/88

TABLE 2.17.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10	< 10	ug/l	08/18/88
BENZENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
2-BUTANONE	< 10		< 10	< 10	ug/l	08/18/88
BROMOFORM	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
CARBON DISULFIDE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
CARBON TETRACHLORIDE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
CHLOROBENZENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
CHLOROETHANE	< 10		< 10	< 10	ug/l	08/18/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10	< 10	ug/l	08/18/88
CHLOROFORM	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
1,1-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
1,2-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
ETHYLBENZENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
2-HEXANONE	< 10		< 10	< 10	ug/l	08/18/88
METHYL BROMIDE	< 10		< 10	< 10	ug/l	08/18/88
METHYL CHLORIDE	< 10		< 10	< 10	ug/l	08/18/88
4-METHYL-2-PENTANONE	< 10		< 10	< 10	ug/l	08/18/88
METHYLENE CHLORIDE	< 5.0		8.7	7.0	ug/l	08/18/88
STYRENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
TETRACHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
TOLUENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
TRICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	08/18/88
VINYL ACETATE	< 10		< 10	< 10	ug/l	08/18/88
VINYL CHLORIDE	< 10		< 10	< 10	ug/l	08/18/88
TOTAL XYLENES	< 5.0		< 5.0	< 5.0	ug/l	08/18/88

TABLE 2.17.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	08/18/88
ACENAPHTHYLENE	< 10		ug/l	08/18/88
ANTHRACENE	< 10		ug/l	08/18/88
BENZO(A)ANTHRACENE	< 10		ug/l	08/18/88
BENZO(A)PYRENE	< 10		ug/l	08/18/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	08/18/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	08/18/88
BENZOIC ACID	< 50		ug/l	08/18/88
BENZO(K)FLUORANTHENE	< 10		ug/l	08/18/88
BENZYL ALCOHOL	< 10		ug/l	08/18/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	08/18/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	08/18/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	08/18/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	08/18/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	08/18/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	08/18/88
4-CHLOROANILINE	< 10		ug/l	08/18/88
2-CHLORONAPHTHALENE	< 10		ug/l	08/18/88
2-CHLOROPHENOL	< 10		ug/l	08/18/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	08/18/88
CHRYSENE	< 10		ug/l	08/18/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	08/18/88
DIBENZOFURAN	< 10		ug/l	08/18/88
1,2-DICHLOROBENZENE	< 10		ug/l	08/18/88
1,3-DICHLOROBENZENE	< 10		ug/l	08/18/88
1,4-DICHLOROBENZENE	< 10		ug/l	08/18/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	08/18/88
2,4-DICHLOROPHENOL	< 10		ug/l	08/18/88
DIETHYL PHTHALATE	< 10		ug/l	08/18/88
2,4-DIMETHYLPHENOL	< 10		ug/l	08/18/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	08/18/88
2,4-DINITROPHENOL	< 50		ug/l	08/18/88
DIMETHYL PHTHALATE	< 10		ug/l	08/18/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	08/18/88
2,4-DINITROTOLUENE	< 10		ug/l	08/18/88
2,6-DINITROTOLUENE	< 10		ug/l	08/18/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	08/18/88

TABLE 2.17.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	08/18/88
FLUORENE	< 10		ug/l	08/18/88
HEXACHLOROBENZENE	< 10		ug/l	08/18/88
HEXACHLOROBUTADIENE	< 10		ug/l	08/18/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	08/18/88
HEXACHLOROETHANE	< 10		ug/l	08/18/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	08/18/88
ISOPHORONE	< 10		ug/l	08/18/88
2-METHYLNAPHTHALENE	< 10		ug/l	08/18/88
2-METHYLPHENOL	< 10		ug/l	08/18/88
4-METHYLPHENOL	< 10		ug/l	08/18/88
NAPHTHALENE	< 10		ug/l	08/18/88
2-NITROANILINE	< 50		ug/l	08/18/88
3-NITROANILINE	< 50		ug/l	08/18/88
4-NITROANILINE	< 50		ug/l	08/18/88
NITROBENZENE	< 10		ug/l	08/18/88
2-NITROPHENOL	< 10		ug/l	08/18/88
4-NITROPHENOL	< 50		ug/l	08/18/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	08/18/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	08/18/88
P-CHLORO-M-CRESOL	< 10		ug/l	08/18/88
PENTACHLOROPHENOL	< 50		ug/l	08/18/88
PHENANTHRENE	< 10		ug/l	08/18/88
PHENOL	< 10		ug/l	08/18/88
PYRENE	< 10		ug/l	08/18/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	08/18/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	08/18/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	08/18/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	08/18/88

TABLE 2.17.3

UNC LABORATORY ANALYSIS
H-05c MAGENTA ROUND THREE

DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	0.70	0.76	cc/l (STP)	08/18/88
OXYGEN	1.56	0.90	cc/l (STP)	08/18/88
NITROGEN	34.79	42.12	cc/l (STP)	08/18/88
CARBON DIOXIDE		4.810	cc/l (STP)	08/18/88
METHANE	0.319	0.416	cc/l (STP)	08/18/88
ETHANE	(0.001	(0.001	cc/l (STP)	08/18/88
C-3	(0.001	(0.001	cc/l (STP)	08/18/88
C-4	(0.001	(0.001	cc/l (STP)	08/18/88
C-5	(0.001	(0.001	cc/l (STP)	08/18/88
C-6	(0.001	(0.001	cc/l (STP)	08/18/88
SUM OF CO2	19.56		cc/l (STP)	08/18/88
TOTAL GAS		49.006	cc/l (STP)	08/18/88
AMMONIA	0.85	0.82	mg/l	08/18/88
NITRATE	(0.10	(0.10	mg/l	08/18/88
TOTAL IRON	0.710	0.710	mg/l	08/18/88
FERROUS IRON	0.55	0.55	mg/l	08/18/88
TOTAL ARSENIC	(0.0010	(0.0010	mg/l	08/18/88
TOTAL SELENIUM	(0.001	(0.001	mg/l	08/18/88
IODIDE	220	220	ug/l	08/18/88
IODATE	(20	(20	ug/l	08/18/88

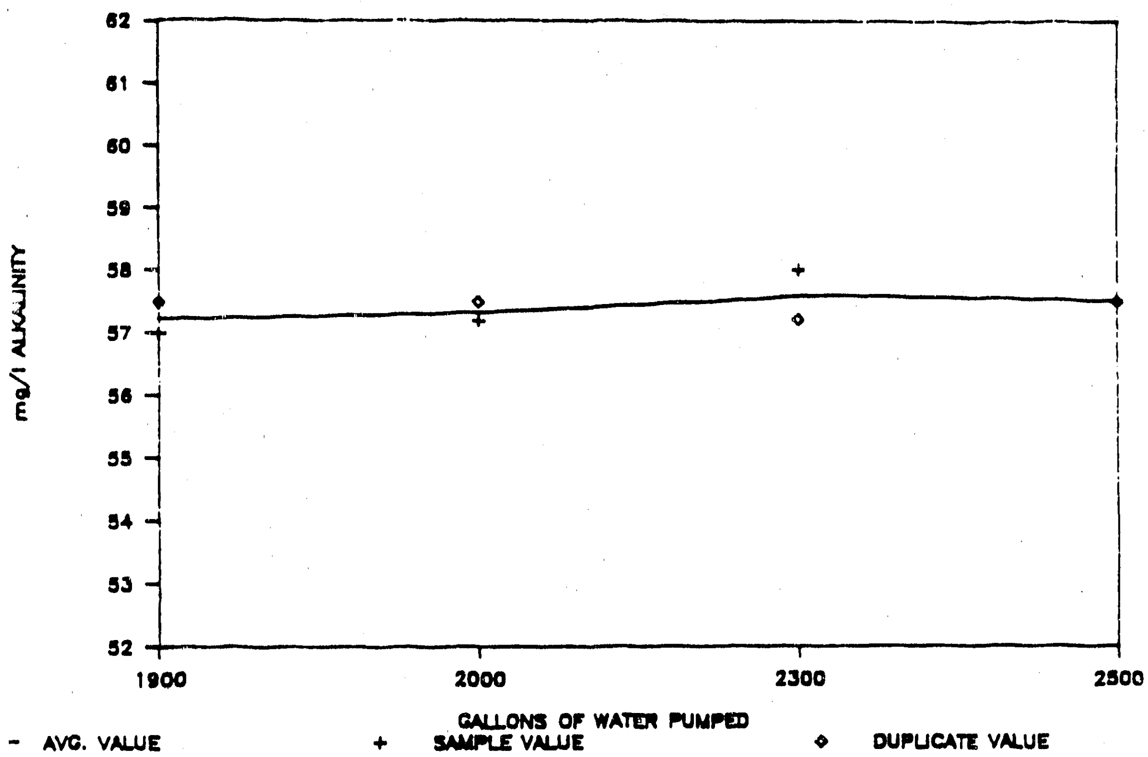
TABLE 2.17.4

PRESSURE AND FLOW
H-05c MAGENTA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
08/09/88	11:59	91	101	00	PUMP OFF
08/09/88	12:17	90	96	40	PACKER DEFLATED
08/09/88	12:30	82	99	42	
08/09/88	13:00	79	88	43	
08/09/88	13:30	73	84	43	
08/09/88	14:00	66	76	44	
08/09/88	15:00	47	58	42	
08/10/88	07:30	00	00	(10	FLOW INTERMITTANT
08/10/88	08:45	00	00	00	PUMP OFF
08/10/88	09:10	68	80	00	PUMP LOWERED 200 FEET
08/10/88	09:15	68	118	00	PACKER INFLATED
08/10/88	09:17	68	48	20	PUMP ON 09:15
08/10/88	09:22	68	51	12	
08/10/88	09:30	68	85	08	
08/10/88	09:36	68	81	13	
08/10/88	09:50	67	83	12	
08/10/88	15:00	69	104	06	FLOW 15:15
08/10/88	15:30	69	80	13	
08/11/88	07:30	73	87	13	FLOW RESORTED
08/11/88	11:00	74	90	11	
08/11/88	11:10	74	86	12	
08/11/88	11:30	74	83	13	
08/11/88	12:10	74	83	12	
08/11/88	12:20	74	82	11	
08/11/88	12:30	74	83	11	
08/11/88	12:40	74	79	11	
08/11/88	12:50	74	84	11	
08/11/88	13:00	74	66	14	
08/11/88	13:10	73	74	13	
08/11/88	13:30	73	77	12	
08/11/88	13:45	73	75	13	
08/11/88	14:00	73	66	14	
08/11/88	14:15	73	62	15	
08/11/88	14:30	73	66	13	
08/11/88	15:00	73	65	14	
08/12/88	07:30	71	77	10	
08/12/88	07:45	71	70	12	
08/12/88	15:00	70	76	10	
08/13/88	06:00	69	77	10	
08/13/88	15:30	69	76	09	
08/13/88	15:45	69	67	14	

TABLE 2.17.4
(Continued)

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
08/14/88	08:00	69	79	14	
08/14/88	18:00	69	77	12	
08/15/88	09:00	68	63	11	
08/15/88	15:30	67	79	10	
08/16/88	07:30	67	57	13	
08/16/88	14:30	68	79	09	
08/17/88	06:30	70	64	14	
08/17/88	15:00	69	59	13	FLOW INCREASED FROM 07
08/18/88	07:00	69	82	06	
08/18/88	07:30	69	52	14	
08/18/88	14:30	67	69	10	PUMP OFF 14:32



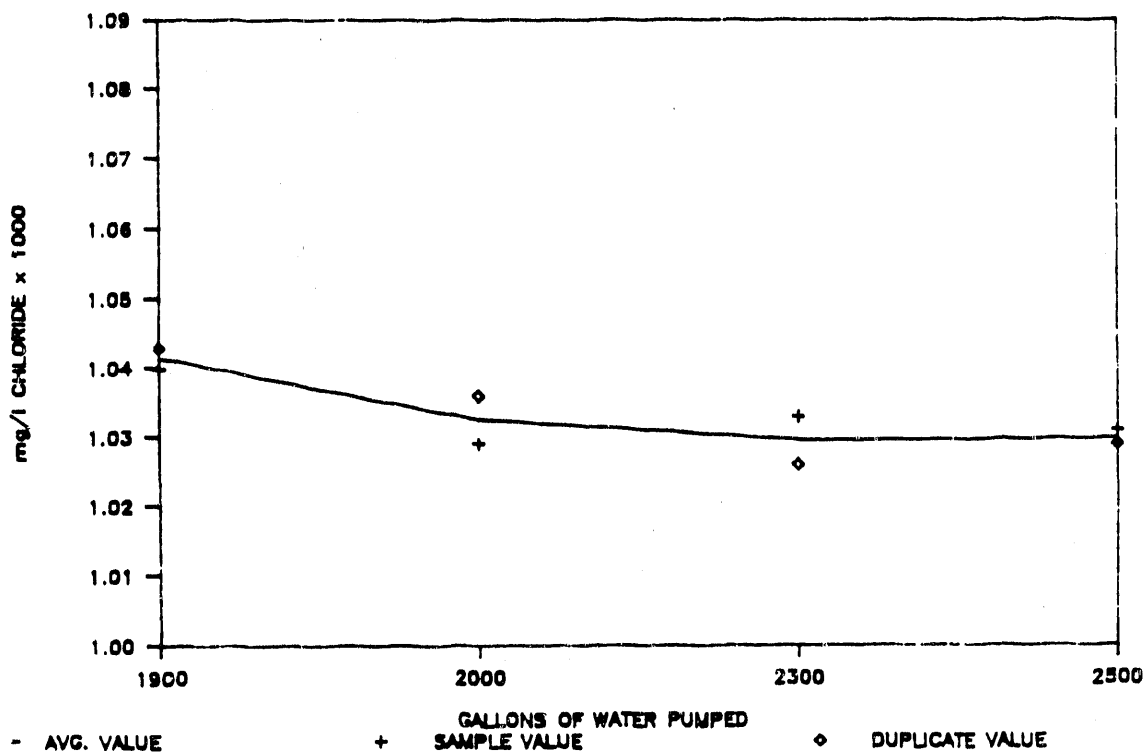


Figure 2.17.1. Graphs of alkalinity and chloride from third round serial sampling at well H-05c Magenta.

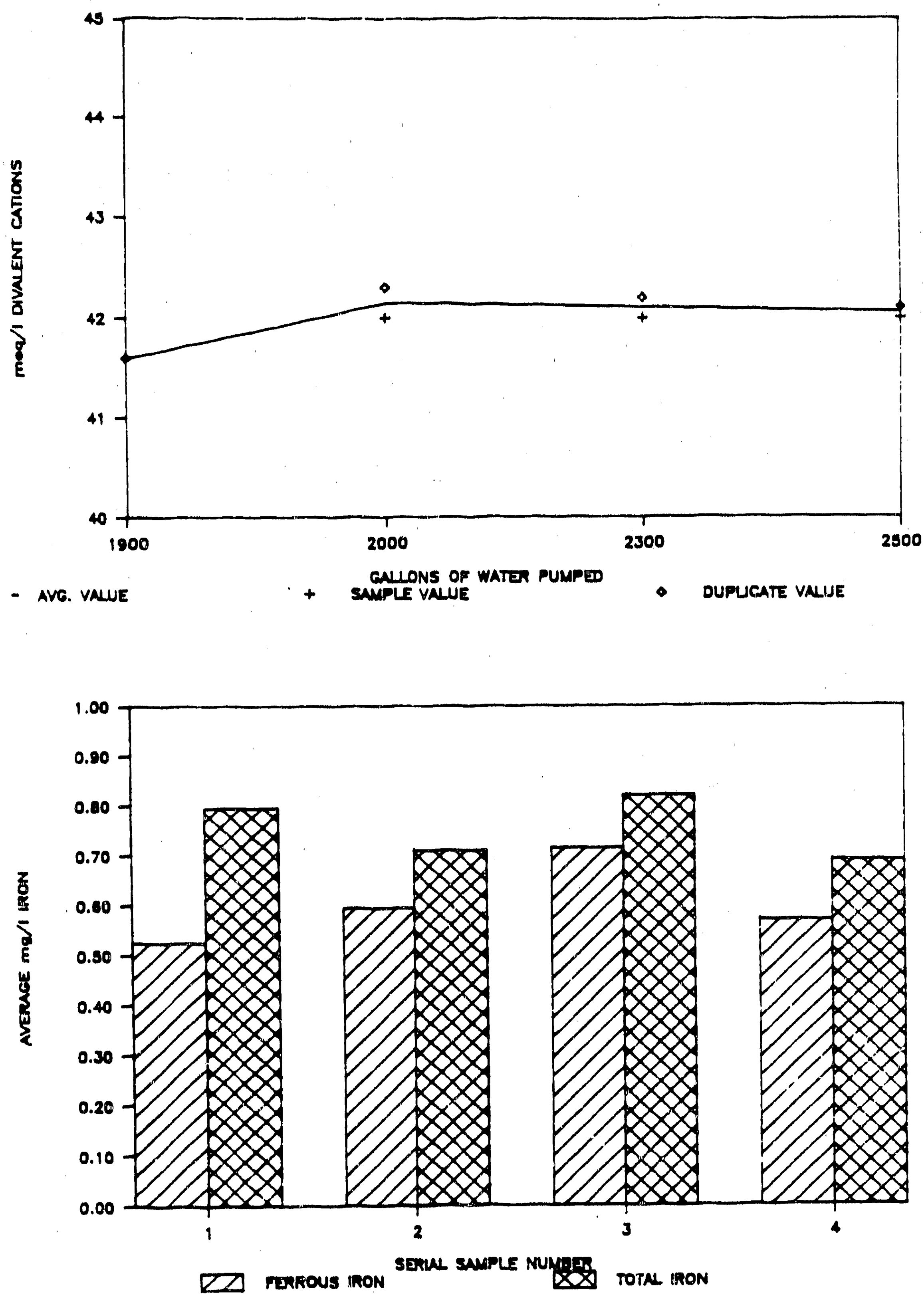


Figure 2.17.2. Graphs of divalent cations and iron from third round serial sampling at well H-05c Magenta.

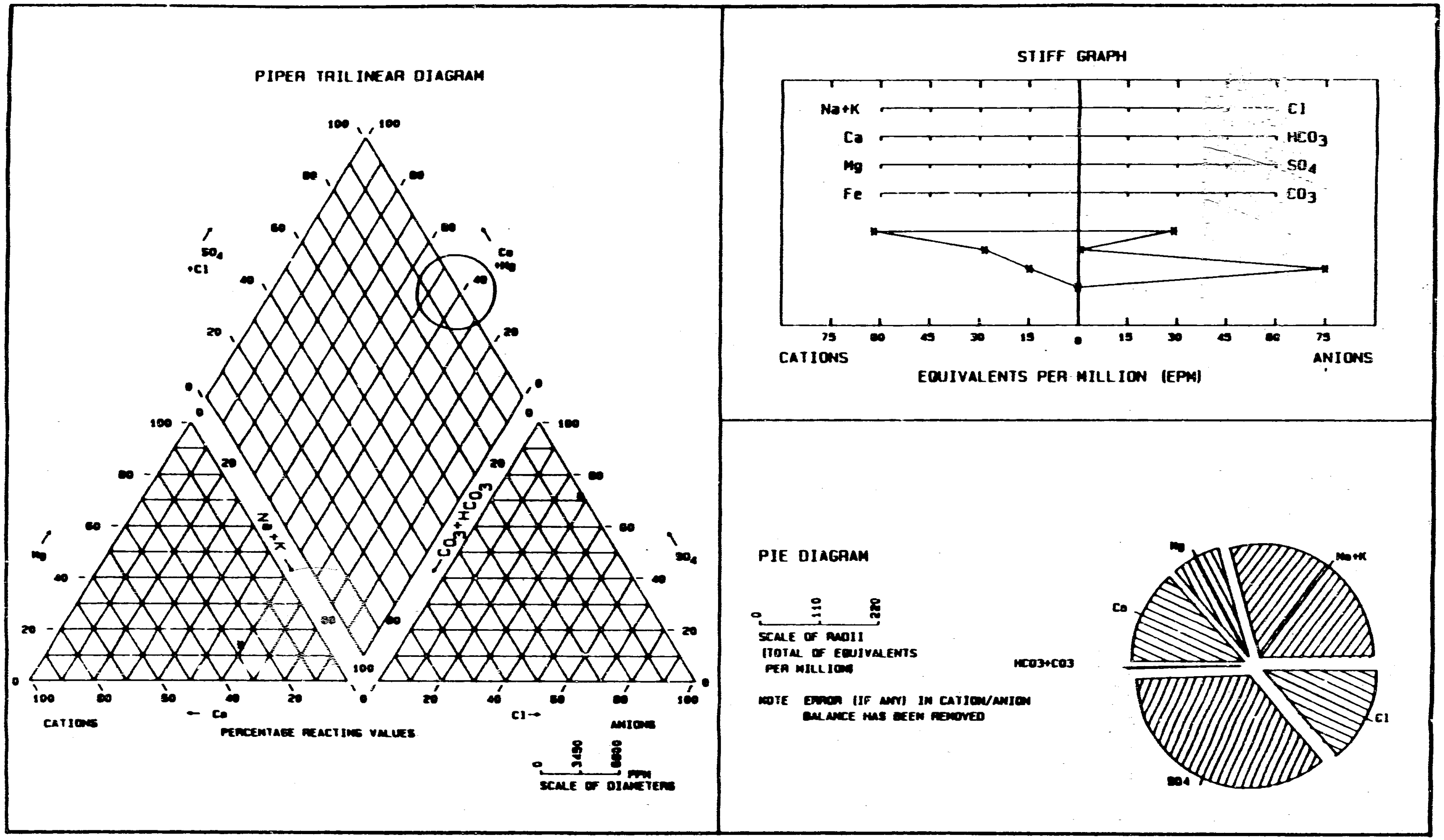


Figure 2.17.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well H-05c Magenta.

2.18 SUMMARY OF CULEBRA WELL WIPP-19, ROUND THREE

Well Characteristics

Well WIPP-19 is located approximately 0.6 miles north of the center of the WIPP site at an elevation of 3,435 feet above MSL, to the top of the casing (Gonzales, 1989). The total depth of the drilled hole is 1,040 feet BGS. Casing is in place to a depth of 1,037 feet BGS. The casing is perforated in only one interval. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation, which occurs here at a depth interval from 756 to 779 feet BGS (Sandia Laboratories and U.S. Geological Survey, 1980a).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer isolated the pump intake from stagnant water above it in the well bore. The pump intake was located at 754 feet BTOC.

Pumping began on 08/17/88 and ceased on 08/29/88. During the first 24 hours of pumping the flow rate was slightly greater than 20 gph. This flow rate lowered the pressure below the packer to a level where the differential pressure rating for the packer was exceeded. The packer appeared to fail equalizing pressures above and below the packer. Thereafter the flow rate was maintained at approximately 19 gph, and the packer appeared to maintain a good seal.

Serial sampling began on 08/24/88 after approximately 3,100 gallons of water had been pumped from the well. One serial sample was taken each day for six consecutive days. Serial sampling ended and final samples were collected on 08/29/88 after approximately 5,300 gallons had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analysis showed alkalinity increasing from approximately 54 to 61 mg/l during the sampling period (Figure 2.18.1).

Chloride concentrations decreased from approximately 47,000 to 44,000 mg/l during the serial sampling period (Figure 2.18.1).

Divalent cations were steady at approximately 219 meq/l, until the final day of sampling when divalent cations were reported at approximately 208 meq/l (Figure 2.18.2).

Total iron decreased from an average of 1.08 down to 0.80 mg/l during the sampling period. Ferrous iron followed the same general pattern as total iron (Figure 2.18.2).

The water pH was steady at 7.2 SU.

Physical Parameters

Values for Eh ranged from 85 to 147 mV relative to the SHE.

The water temperature ranged between 21 and 23°C.

The specific gravity of the water decreased slightly from 1.062, at 22.2°C, to 1.061, at 21.1°C over the sampling period.

Specific conductance decreased slightly from 100,000 umhos/cm on the first day to 98,000 umhos/cm on the final day, both at 25°C.

Final Sample Collection

Final samples were collected after the analyzed field parameters stabilized. Samples were taken following procedures outlined in the WIPP Geotechnical and Geosciences Procedure Manual 07-230.

The collected samples were sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples collected for full suite radionuclide analysis were sent to WAESD. Archival samples were also collected for the WIPP project.

General Observations

The water from this well was very effervescent.

Fine-grained particulate matter deposited on the 0.45-um filters employed during sampling, requiring frequent changing of the filters.

Tabular data are presented in Tables 2.18.1, 2.18.2, 2.18.3, and 2.18.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data respectively.

Figures 2.18.1 and 2.18.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.18.3 illustrates the general water quality at well WIPP-19 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds occur below the Culebra Dolomite Member within the Rustler Formation at WIPP-19 (Sandia Laboratories and U.S. Geological Survey, 1980a).

Serial Parameter Comparisons With The Previous Rounds

Concentration values for the serial sampling parameters alkalinity, chloride, divalent cations, total iron, and ferrous iron all decreased significantly between rounds one, two, and three. The amount of decrease between rounds two and three was less than that between rounds one and two. Over the three rounds of sampling values on the final day of serial sampling have ranged form 84 to 61 mg/l alkalinity, 62,000 to 44,100 mg/l chloride, 286 to 208 meq/l divalent cations, 1.75 to 0.8 mg/l total iron, and 1.6 to 0.8 mg/l ferrous iron. Specific conductance, specific gravity, and Eh values also decreased each round. Values for pH increased slightly from 7.0 to 7.2 over the three rounds of sampling.

Volumes of water pumped prior to final sampling for each round were 2,400, 3,000, and 5,300 gallons for rounds one, two, and three. Flow rates during each sampling episode were approximately seven, 17, and 19 gph for rounds one, two, and three.

TABLE 2.18.1

SERIAL SAMPLE CHEMISTRY
WIPP-19 CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	54.2	55.2	mg/l	3100	08/24/88
2	ALKALINITY	54.5	55.4	mg/l	3500	08/25/88
3	ALKALINITY	64.3	62.3	mg/l	4000	08/26/88
4	ALKALINITY	61.3	61.3	mg/l	4400	08/27/88
5	ALKALINITY	62.8	62.6	mg/l	4900	08/28/88
6	ALKALINITY	61.1	60.6	mg/l	5300	08/29/88
1	CHLORIDE	47000	47300	mg/l	3100	08/24/88
2	CHLORIDE	45700	45200	mg/l	3500	08/25/88
3	CHLORIDE	45100	45500	mg/l	4000	08/26/88
4	CHLORIDE	44900	45200	mg/l	4400	08/27/88
5	CHLORIDE	45200	45200	mg/l	4900	08/28/88
6	CHLORIDE	44200	44100	mg/l	5300	08/29/88
1	DIVALENT CATIONS	218	219	meq/l	3100	08/24/88
2	DIVALENT CATIONS	216	217	meq/l	3500	08/25/88
3	DIVALENT CATIONS	218	222	meq/l	4000	08/26/88
4	DIVALENT CATIONS	219	219	meq/l	4400	08/27/88
5	DIVALENT CATIONS	220	219	meq/l	4900	08/28/88
6	DIVALENT CATIONS	208	207	meq/l	5300	08/29/88
1	TOTAL IRON	1.07	1.09	mg/l	3100	08/24/88
2	TOTAL IRON	0.97	0.99	mg/l	3500	08/25/88
3	TOTAL IRON	0.94	1.00	mg/l	4000	08/26/88
4	TOTAL IRON	0.91	1.01	mg/l	4400	08/27/88
5	TOTAL IRON	0.90	0.95	mg/l	4900	08/28/88
6	TOTAL IRON	0.79	0.81	mg/l	5300	08/29/88
1	FERROUS IRON	1.05	1.02	mg/l	3100	08/24/88
2	FERROUS IRON	0.91	0.93	mg/l	3500	08/25/88
3	FERROUS IRON	0.89	0.87	mg/l	4000	08/26/88
4	FERROUS IRON	0.89	0.91	mg/l	4400	08/27/88
5	FERROUS IRON	0.87	0.89	mg/l	4900	08/28/88
6	FERROUS IRON	0.80	0.80	mg/l	5300	08/29/88

TABLE 2.18.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	7.2			3100	08/24/88
2	pH	7.2			3500	08/25/88
3	pH	7.2			4000	08/26/88
4	pH	7.2			4400	08/27/88
6	pH	7.2			5300	08/29/88
1	Eh	147		mV	3100	08/24/88
2	Eh	95		mV	3500	08/25/88
3	Eh	85		mV	4000	08/26/88
4	Eh	93		mV	4400	08/27/88
6	Eh	95		mV	5300	08/29/88
1	TEMPERATURE	22.7		C	3100	08/24/88
2	TEMPERATURE	22.4		C	3500	08/25/88
3	TEMPERATURE	22.5		C	4000	08/26/88
4	TEMPERATURE	21.9		C	4400	08/27/88
6	TEMPERATURE	21.5		C	5300	08/29/88
1	SPECIFIC GRAVITY	1.062		@ 22.2 C	3100	08/24/88
5	SPECIFIC GRAVITY	1.062		@ 21.6 C	4900	08/28/88
6	SPECIFIC GRAVITY	1.061		@ 22.1 C	5300	08/29/88
1	SPECIFIC CONDUCTANCE	100000	@ 25 C	umhos/cm	3100	08/24/88
6	SPECIFIC CONDUCTANCE	98000	@ 25 C	umhos/cm	5300	08/29/88

TABLE 2.18.2

ITAS LABORATORY RESULTS
WIPP-19 CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	61	60	mg/l	08/29/88
ALKALINITY (CO3)	0	0	mg/l	08/29/88
BROMIDE	78	78	mg/l	08/29/88
CHLORIDE	38900		mg/l	08/29/88
CYANIDE, TOTAL	< 0.02		mg/l	08/29/88
FLUORIDE	1.0		mg/l	08/29/88
IODIDE	< 2.0	< 2.0	mg/l	08/29/88
NITRATE	< 0.02		mg/l NO3-N	08/29/88
pH	6.91			08/29/88
PHENOLICS	0.097		mg/l	08/29/88
PHOSPHATE, TOTAL	0.03		mg/l T-PO4-P	08/29/88
RESIDUE, FILTERABLE @180 C	79000	77000	mg/l	08/29/88
RESIDUE, NONFILTERABLE @105 C	17	16	mg/l	08/29/88
SPECIFIC CONDUCTANCE	90600	90900	umhos/cm@25C	08/29/88
SULFATE	5500	5400	mg/l	08/29/88
TOTAL ORGANIC CARBON	5.0	5.0	mg/l	08/29/88
TOTAL ORGANIC HALOGEN	1.60	4.80	mg/l	08/29/88

TABLE 2.18.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 10	< 10			mg/l	08/29/88
ANTIMONY *	1.08	1.10			mg/l	08/29/88
ARSENIC *	< 0.020	< 0.020			mg/l	08/29/88
BARIUM	< 0.50	< 0.50			mg/l	08/29/88
BERYLLIUM	< 0.50	< 0.50			mg/l	08/29/88
BORON	34	33			mg/l	08/29/88
CADMIUM *	< 0.0030	< 0.0040			mg/l	08/29/88
CALCIUM	1800	1800			mg/l	08/29/88
CESIUM *	< 0.24	< 0.24			mg/l	08/29/88
CHROMIUM *	0.0060	0.0060			mg/l	08/29/88
COBALT *	< 0.0070	< 0.0080			mg/l	08/29/88
COPPER *	0.013	0.11			mg/l	08/29/88
IRON	2.0	2.0			mg/l	08/29/88
LEAD *	< 0.030	< 0.040			mg/l	08/29/88
LITHIUM *	0.73	0.68			mg/l	08/29/88
MAGNESIUM	1500	1500			mg/l	08/29/88
MANGANESE	2.0	2.0			mg/l	08/29/88
MERCURY	< 0.0020				mg/l	08/29/88
MOLYBDENUM *	0.024	0.029			mg/l	08/29/88
NICKEL *	< 0.020	< 0.030			mg/l	08/29/88
POTASSIUM	760	740			mg/l	08/29/88
SELENIUM *	< 0.040	< 0.040			mg/l	08/29/88
SILICA	4.3				mg/l	08/29/88
SILVER *	< 0.020	< 0.020			mg/l	08/29/88
SODIUM	30900	31200			mg/l	08/29/88
STRONTIUM	28	28			mg/l	08/29/88
THALLIUM	< 5.0				mg/l	08/29/88
TITANIUM *	< 0.0070	< 0.0080			mg/l	08/29/88
VANADIUM	1.0	1.0			mg/l	08/29/88
ZINC *	0.051	0.147			mg/l	08/29/88

* Sample analysis by ion exchange separation method. See section 4.0.

TABLE 2.18.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	45.0	33.0	< 10		ug/l	08/29/88
BENZENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
2-BUTANONE	< 10	< 10	< 10		ug/l	08/29/88
BROMOFORM	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
CARBON DISULFIDE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
CARBON TETRACHLORIDE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
CHLOROBENZENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
CHLORODIBROMOMETHANE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
CHLOROETHANE	< 10	< 10	< 10		ug/l	08/29/88
2-CHLOROETHYLVINYL ETHER	< 10	< 10	< 10		ug/l	08/29/88
CHLOROFORM	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
CIS-1,3-DICHLOROPROPENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
DICHLOROBROMOMETHANE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
1,1-DICHLOROETHANE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
1,2-DICHLOROETHANE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
1,1-DICHLOROETHYLENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
1,2-DICHLOROPROPANE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
ETHYLBENZENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
2-HEXANONE	< 10	< 10	< 10		ug/l	08/29/88
METHYL BROMIDE	< 10	< 10	< 10		ug/l	08/29/88
METHYL CHLORIDE	< 10	< 10	< 10		ug/l	08/29/88
4-METHYL-2-PENTANONE	< 10	< 10	< 10		ug/l	08/29/88
METHYLENE CHLORIDE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
STYRENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
1,1,2,2-TETRACHLOROETHANE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
TETRACHLOROETHYLENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
TOLUENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
TRANS-1,3-DICHLOROPROPENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
1,1,1-TRICHLOROETHANE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
1,1,2-TRICHLOROETHANE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
TRICHLOROETHYLENE	< 5.0	< 5.0	< 5.0		ug/l	08/29/88
VINYL ACETATE	< 10	< 10	< 10		ug/l	08/29/88
VINYL CHLORIDE	< 10	< 10	< 10		ug/l	08/29/88
TOTAL XYLENES	< 5.0	< 5.0	< 5.0		ug/l	08/29/88

TABLE 2.18.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	08/29/88
ACENAPHTHYLENE	< 10		ug/l	08/29/88
ANTHRACENE	< 10		ug/l	08/29/88
BENZO(A)ANTHRACENE	< 10		ug/l	08/29/88
BENZO(A)PYRENE	< 10		ug/l	08/29/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	08/29/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	08/29/88
BENZOIC ACID	< 50		ug/l	08/29/88
BENZO(K)FLUORANTHENE	< 10		ug/l	08/29/88
BENZYL ALCOHOL	< 10		ug/l	08/29/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	08/29/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	08/29/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	08/29/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	08/29/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	08/29/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	08/29/88
4-CHLOROANILINE	< 10		ug/l	08/29/88
2-CHLORONAPHTHALENE	< 10		ug/l	08/29/88
2-CHLOROPHENOL	< 10		ug/l	08/29/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	08/29/88
CHRYSENE	< 10		ug/l	08/29/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	08/29/88
DIBENZOFURAN	< 10		ug/l	08/29/88
1,2-DICHLOROBENZENE	< 10		ug/l	08/29/88
1,3-DICHLOROBENZENE	< 10		ug/l	08/29/88
1,4-DICHLOROBENZENE	< 10		ug/l	08/29/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	08/29/88
2,4-DICHLOROPHENOL	< 10		ug/l	08/29/88
DIETHYL PHTHALATE	< 10		ug/l	08/29/88
2,4-DIMETHYLPHENOL	< 10		ug/l	08/29/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	08/29/88
2,4-DINITROPHENOL	< 50		ug/l	08/29/88
DIMETHYL PHTHALATE	< 10		ug/l	08/29/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	08/29/88
2,4-DINITROTOLUENE	< 10		ug/l	08/29/88
2,6-DINITROTOLUENE	< 10		ug/l	08/29/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	08/29/88

TABLE 2.18.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	08/29/88
FLUORENE	< 10		ug/l	08/29/88
HEXACHLOROBENZENE	< 10		ug/l	08/29/88
HEXACHLOROBUTADIENE	< 10		ug/l	08/29/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	08/29/88
HEXACHLOROETHANE	< 10		ug/l	08/29/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	08/29/88
ISOPHORONE	< 10		ug/l	08/29/88
2-METHYLNAPHTHALENE	< 10		ug/l	08/29/88
2-METHYLPHENOL	< 10		ug/l	08/29/88
4-METHYLPHENOL	< 10		ug/l	08/29/88
NAPHTHALENE	< 10		ug/l	08/29/88
2-NITROANILINE	< 50		ug/l	08/29/88
3-NITROANILINE	< 50		ug/l	08/29/88
4-NITROANILINE	< 50		ug/l	08/29/88
NITROBENZENE	< 10		ug/l	08/29/88
2-NITROPHENOL	< 10		ug/l	08/29/88
4-NITROPHENOL	< 50		ug/l	08/29/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	08/29/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	08/29/88
P-CHLORO-M-CRESOL	< 10		ug/l	08/29/88
PENTACHLOROPHENOL	< 50		ug/l	08/29/88
PHENANTHRENE	< 10		ug/l	08/29/88
PHENOL	< 10		ug/l	08/29/88
PYRENE	< 10		ug/l	08/29/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	08/29/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	08/29/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	08/29/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	08/29/88

TABLE 2.18.3

UNC LABORATORY ANALYSIS
WIPP-19 CULEBRA ROUND THREE

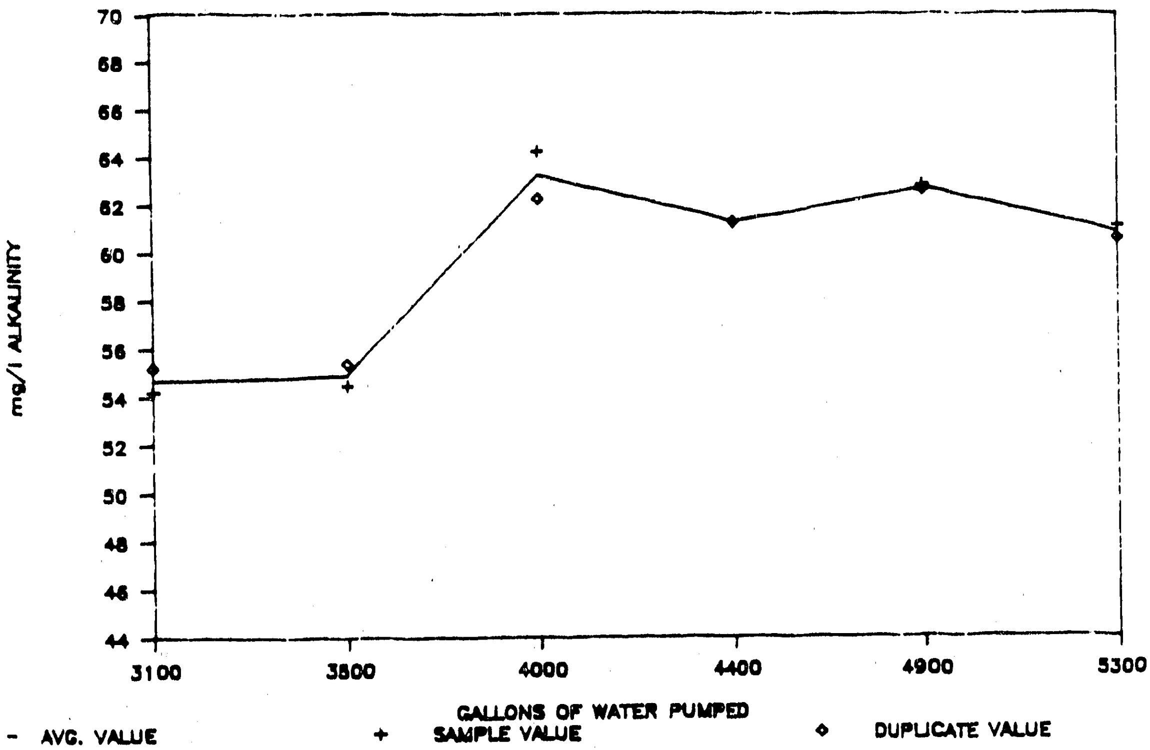
DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	1.27		cc/l (STP)	08/29/88
OXYGEN	0.49		cc/l (STP)	08/29/88
NITROGEN	78.55		cc/l (STP)	08/29/88
CARBON DIOXIDE	2.370		cc/l (STP)	08/29/88
METHANE	0.191		cc/l (STP)	08/29/88
ETHANE	(0.001		cc/l (STP)	08/29/88
C-3	(0.001		cc/l (STP)	08/29/88
C-4	(0.001		cc/l (STP)	08/29/88
C-5	(0.001		cc/l (STP)	08/29/88
C-6	(0.001		cc/l (STP)	08/29/88
SUM OF CO2	21.57		cc/l (STP)	08/29/88
TOTAL GAS	82.870		cc/l (STP)	08/29/88
AMMONIA	1.36	1.35	mg/l	08/29/88
NITRATE	(1.00	(1.00	mg/l	08/29/88
TOTAL IRON	3.230	3.720	mg/l	08/29/88
FERROUS IRON	3.19	3.18	mg/l	08/29/88
TOTAL ARSENIC	0.0075	0.0072	mg/l	08/29/88
ARSENIC III	0.0025	0.0024	mg/l	08/29/88
TOTAL SELENIUM	(0.001	(0.001	mg/l	08/29/88
IODIDE	(200	(200	ug/l	08/29/88
IODATE	(20	(20	ug/l	08/29/88

TABLE 2.18.4

PRESSURE AND FLOW
WIPP-19 CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
08/17/88	11:57	141	147	00	PUMP OFF
08/17/88	12:13	133	142	00	PACKER INFLATED 12:05
08/17/88	12:18	133	88	36	PUMP ON 12:15
08/17/88	12:25	133	86	19	
08/17/88	12:30	133	86	17	
08/17/88	12:45	133	80	19	
08/17/88	13:00	133	76	19	
08/17/88	13:15	132	74	19	
08/17/88	13:30	132	74	19	
08/17/88	14:30	132	70	19	
08/18/88	08:00	78	71	21	DIFFERENTIAL PRESSURE
08/18/88	11:30	72	68	20	EXCEEDED
08/18/88	11:45	72	66	24	
08/18/88	11:55	72	56	18	
08/18/88	15:30	71	63	18	
08/19/88	07:30	71	58	18	
08/19/88	14:30	70	59	19	
08/20/88	08:00	69	54	19	
08/20/88	18:30	68	53	18	
08/21/88	08:00	67	51	18	
08/21/88	16:30	67	51	19	
08/22/88	07:30	66	48	18	
08/22/88	16:00	65	49	18	
08/23/88	07:00	65	46	18	
08/23/88	15:00	64	47	19	
08/24/88	07:30	64	44	19	FLOW 07:35
08/24/88	15:30	63	45	20	
08/25/88	06:30	63	44	19	
08/25/88	15:00	62	43	19	
08/26/88	07:30	62	41	19	FLOW 07:45
08/26/88	15:00	62	42	19	
08/27/88	07:30	61	41	18	
08/27/88	15:00	61	41	18	
08/28/88	08:30	61	40	20	
08/28/88	21:00	61	43	19	
08/29/88	07:30	61	44	17	
08/29/88	14:30	61	44	17	PUMP OFF 14:32
08/29/88	15:00	61	113	00	RECOVERY



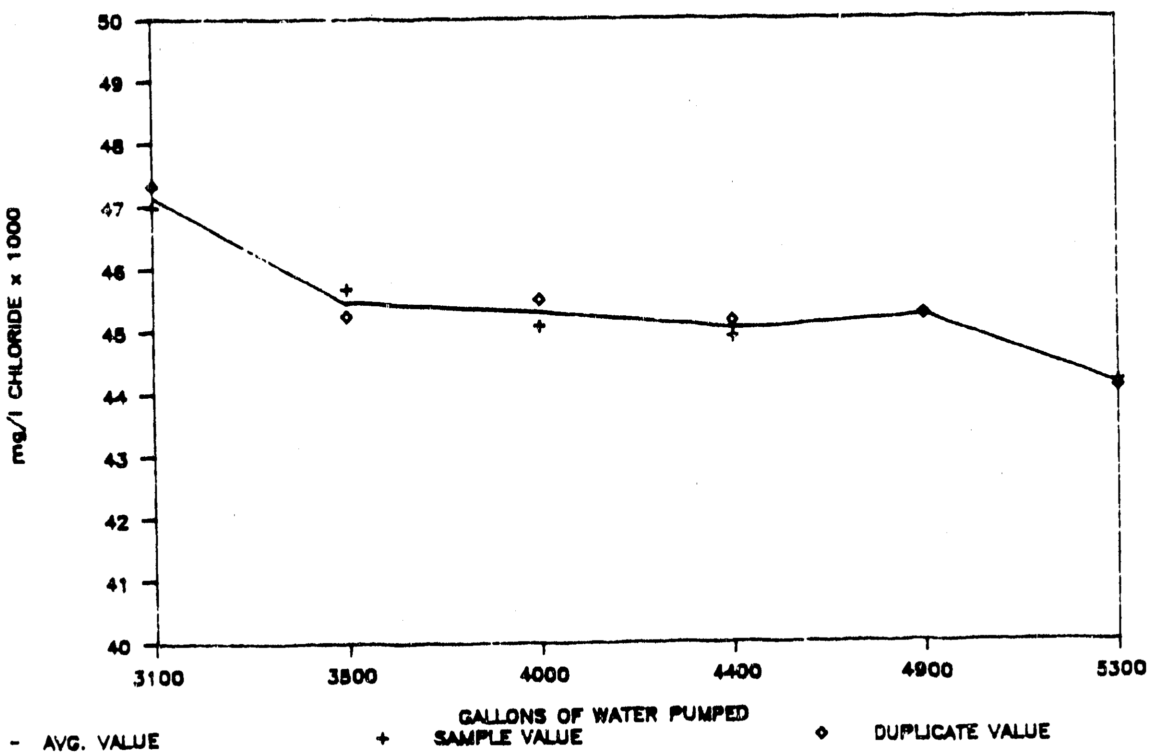
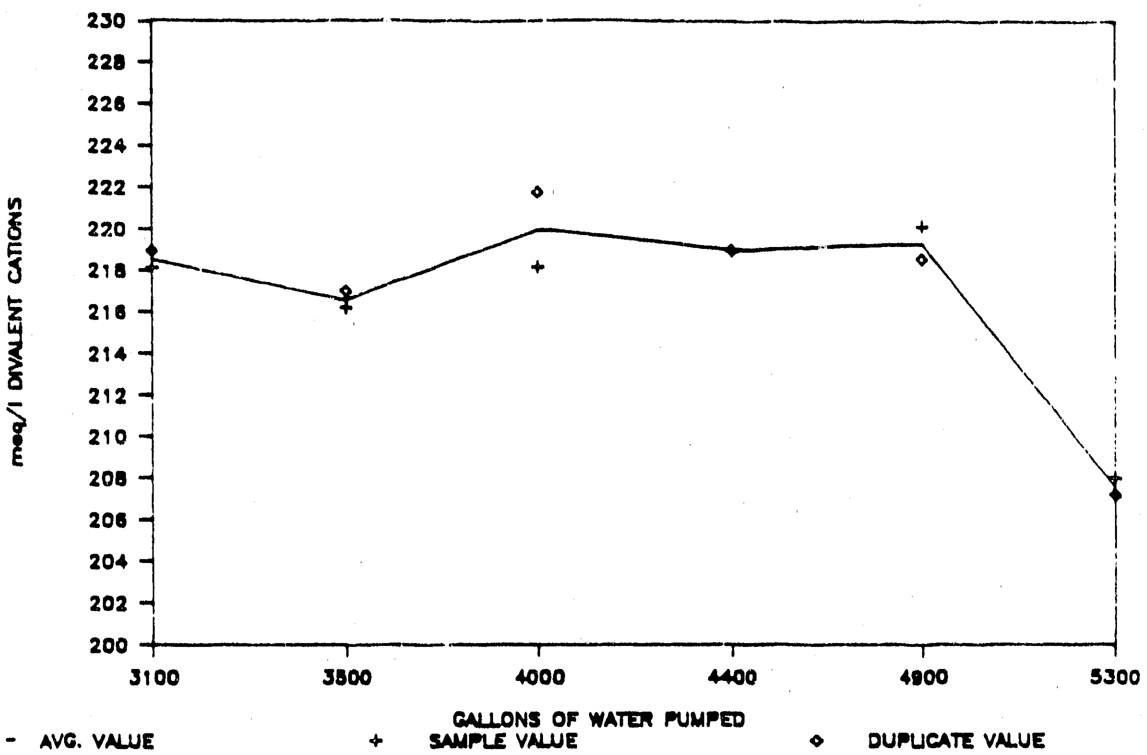


Figure 2.18.1. Graphs of alkalinity and chloride from third round serial sampling at well WIPP-19 Culebra.



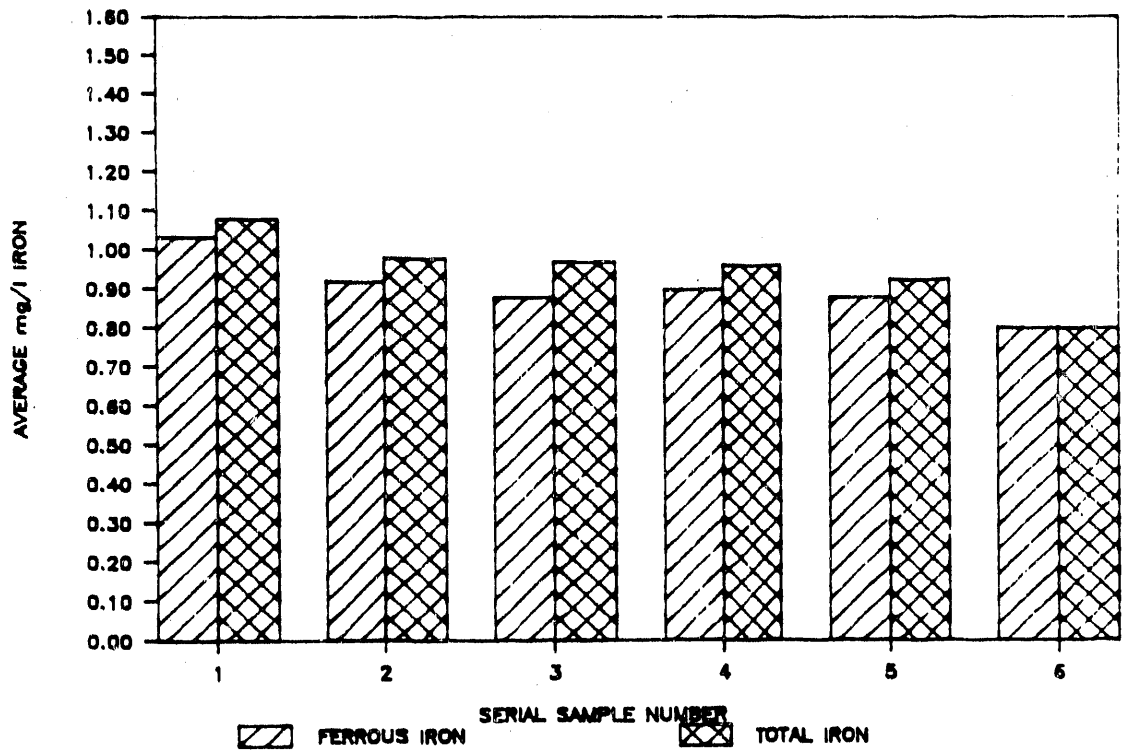


Figure 2.18.2. Graphs of divalent cations and iron from third round serial sampling at well WIPP-19 Culebra.

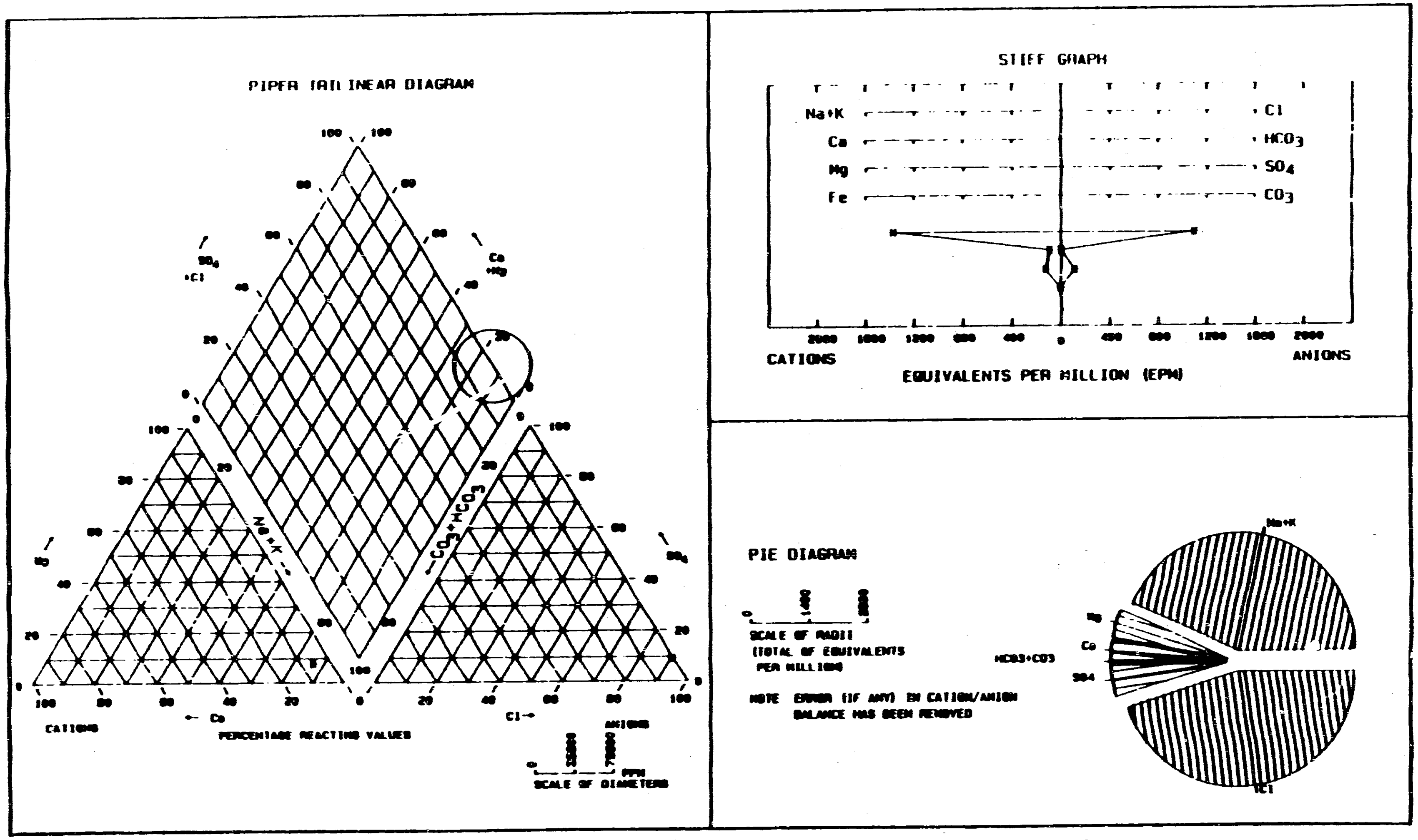


Figure 2.18.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well WIPP-19 Culebra.

2.19 SUMMARY OF CULEBRA WELL H-01, ROUND ONE

Well Characteristics

Well H-01 is located 0.2 miles southwest of the center of the WIPP site at an elevation of 3,400 feet above MSL, to the top of the casing (Gonzales, 1989). Total depth of the well is 856 feet with casing installed to a depth of 848 feet BGS. The well is completed in three zones accessing the Magenta and Culebra Dolomite Members of the Rustler Formation, and the base of the Rustler formation where it contacts the Salado Formation. A bridge plug is installed between the Culebra and the base of the Rustler at 790 feet BGS. A production-injection packer (PIP) is in place at 651 BGS isolating the Culebra Dolomite from the Magenta Dolomite. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 676 to 699 feet BGS (Mercer and Orr, 1979).

Sampling Process

After removal of the PIP, a Bennett model piston pump and Baski inflatable packer were set in the well at approximately 650 feet BGS. Purging of the well began on 09/19/88. A series of equipment failures, i.e., pumps, packers, and pressure transducers, led to the installation of three separate pumping systems during the purging period. Serial sampling began on 10/04/88. At the start of serial sampling approximately 4,300 gallons of water had been removed from the well.

Pump flow rates during serial sampling declined from approximately 18 down to 15 gph. One serial sample was taken daily for four consecutive days. After the fourth serial sample, on 10/07/88, the pump failed again. Final samples were not collected and the sampling episode was terminated. Approximately 5,300 gallons of water had been pumped from the well when the pump failed for the final time.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Proce .re Manual WP 07-2.

Field chemical analyses showed alkalinity generally decreasing and ranging from approximately 120 to 96 mg/l (Figure 2.19.1).

Chloride content was reported between 12,400 and 11,800 mg/l (Figure 2.19.1).

Divalent cations concentrations were between 82 and 86 meq/l (Figure 2.19.2).

Total iron concentration varied between approximately 3.0 and 3.7 mg/l over the sampling period. Ferrous iron ranged between 2.5 and 3.2 mg/l (Figure 2.19.2).

The water pH was between 7.7 and 7.8 SU.

Physical Parameters

The water Eh value increased from 27 to 42 mV relative to the SHE.

The water temperature was between 21.3 and 21.5°C.

Specific gravity was 1.024 at 22.4°C on the first day of serial sampling.

Specific conductance was measured at 38,900 at 25°C on the first day of sampling.

General Observations

The water from this well was very effervescent, and a hydrocarbon odor was present.

A dense cake of fine-grained particulate matter was observed on the 0.45-um filters employed during sampling each day. The amount of particulates decreased as pumping progressed.

Tabular data are presented in Tables 2.19.1 and 2.19.2. These tables list results from serial sampling and pressure versus flow data.

Figures 2.19.1 and 2.19.2 graphically depict serial sampling results and the degree of stabilization achieved.

TABLE 2.19.1

SERIAL SAMPLE CHEMISTRY
H-01 CULEBRA ROUND ONE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	120	118	mg/l	4300	10/04/88
2	ALKALINITY	98.5	95.5	mg/l	4700	10/05/88
3	ALKALINITY	105	102	mg/l	4950	10/06/88
4	ALKALINITY	99.1	98.9	mg/l	5300	10/07/88
1	CHLORIDE	12400	12300	mg/l	4300	10/04/88
2	CHLORIDE	12000	12000	mg/l	4700	10/05/88
3	CHLORIDE	11900	11800	mg/l	4950	10/06/88
4	CHLORIDE	12200	12100	mg/l	5300	10/07/88
1	DIVALENT CATIONS	82.4	82.8	meq/l	4300	10/04/88
2	DIVALENT CATIONS	83.9	83.8	meq/l	4700	10/05/88
3	DIVALENT CATIONS	85.1	84.4	meq/l	4950	10/06/88
4	DIVALENT CATIONS	83.9	83.9	meq/l	5300	10/07/88
1	TOTAL IRON	3.16	2.98	mg/l	4300	10/04/88
2	TOTAL IRON	3.29	3.68	mg/l	4700	10/05/88
3	TOTAL IRON	3.44	3.54	mg/l	4950	10/06/88
4	TOTAL IRON	3.23	3.21	mg/l	5300	10/07/88
1	FERROUS IRON	2.64	2.58	mg/l	4300	10/04/88
2	FERROUS IRON	2.74	2.93	mg/l	4700	10/05/88
3	FERROUS IRON	3.19	3.02	mg/l	4950	10/06/88
4	FERROUS IRON	2.70	2.84	mg/l	5300	10/07/88
1	pH	7.8			4300	10/04/88
2	pH	7.8			4700	10/05/88
3	pH	7.7			4950	10/06/88
4	pH	7.8			5300	10/07/88
1	Eh	27		mV	4300	10/04/88
2	Eh	36		mV	4700	10/05/88
3	Eh	42		mV	4950	10/06/88
4	Eh	42		mV	5300	10/07/88

TABLE 2.19.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	TEMPERATURE	21.4		C	4300	10/04/88
2	TEMPERATURE	21.3		C	4700	10/05/88
3	TEMPERATURE	21.5		C	4950	10/06/88
4	TEMPERATURE	21.5		C	5300	10/07/88
1	SPECIFIC GRAVITY	1.024		@ 22.4 C	4300	10/04/88
1	SPECIFIC CONDUCTANCE	38900	@ 25 C	umhos/cm	4300	10/04/88

TABLE 2.19.2

PRESSURE AND FLOW
H-01 CULEBRA ROUND ONE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
09/19/88	13:04	148	161	00	BEFORE PUMP TURN ON
09/19/88	14:00	148	161	00	PUMP ON
09/19/88	14:05	148	161	18	FLOW TO SURFACE
09/19/88	14:10	148	161	21	
09/19/88	14:20	147	160	22	
09/19/88	14:30	147	160	21	
09/19/88	15:00	146	159	21	
09/20/88	07:30	115	128	19	PUMP DOWN 09:55
09/20/88	12:30	119	111	00	LOGGING OFF
09/22/88	12:17	131	144	00	PUMP OFF
09/22/88	12:22	131	144	00	PACKER INFLATING
09/22/88	12:50	132	126	00	PUMP FAILURE
09/23/88	12:00	123	148	00	PUMP OFF
09/23/88	12:30	124	119	26	PUMP ON 12:20
09/23/88	12:40	124	113	24	
09/23/88	12:50	124	112	24	
09/23/88	13:00	123	122	24	
09/23/88	13:15	123	116	23	
09/23/88	13:30	122	116	23	
09/23/88	14:00	121	112	23	
09/24/88	09:00	80	N/A	24	PSI BELOW MALFUNCTION
09/24/88	19:00	65	N/A	23	PACKER SEAL BREACH
09/25/88	08:00	54	N/A	24	FLOW RATE 07:40
09/25/88	18:15	49	N/A	24	PSI 18:00
09/26/88	07:00	44	N/A	26	FLOW 07:10
09/26/88	16:00	41	N/A	25	
09/27/88	11:00	115	N/A	26	SHUT PUMP DOWN
09/28/88	15:18	77	101	00	PUMP ON 15:16
09/28/88	15:20	77	101	24	
09/28/88	15:30	76	101	24	
09/28/88	15:45	76	100	25	
09/28/88	16:00	75	99	27	
09/28/88	16:15	74	99	27	
09/28/88	16:30	74	98	26	
09/29/88	07:00	66	48	18	PSI BELOW FAILS 14:30
09/29/88	17:00	76	N/A	00	PUMP FAILURE
10/03/88	09:10	116	140	00	PUMP OFF
10/03/88	13:28	116	32	17	PUMP ON 13:15
10/03/88	13:45	116	25	18	
10/03/88	14:00	116	19	18	
10/03/88	14:15	117	24	17	
10/03/88	14:30	117	20	17	
10/03/88	15:00	117	18	18	

TABLE 2.19.2
(Continued)

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
10/03/88	15:30	117	18	17	
10/03/88	15:45	117	18	17	
10/04/88	07:05	120	11	17	
10/04/88	07:30	120	14	17	
10/04/88	08:00	120	15	17	
10/04/88	16:30	121	19	16	
10/05/88	07:00	124	14	16	
10/05/88	15:00	125	16	16	
10/06/88	07:00	126	16	16	
10/06/88	16:00	127	16	16	
10/07/88	07:00	128	13	16	
10/07/88	15:00	129	22	14	
10/07/88	15:30	N/A	N/A	N/A	PUMP FAILURE
10/10/88	10:22	133	91	00	TESTING ABANDONED
10/10/88	10:31	133	158	00	LOGGING OFF

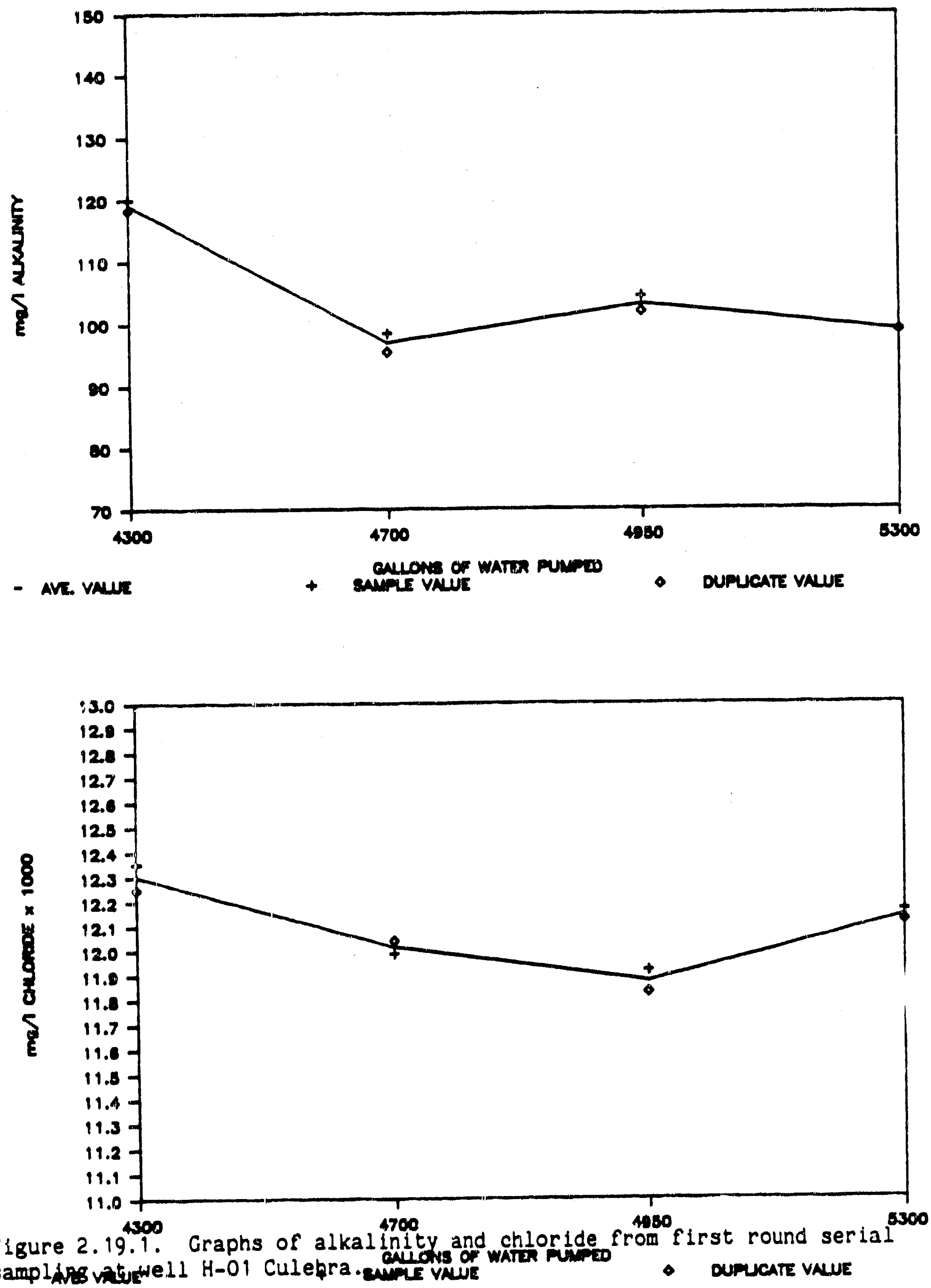
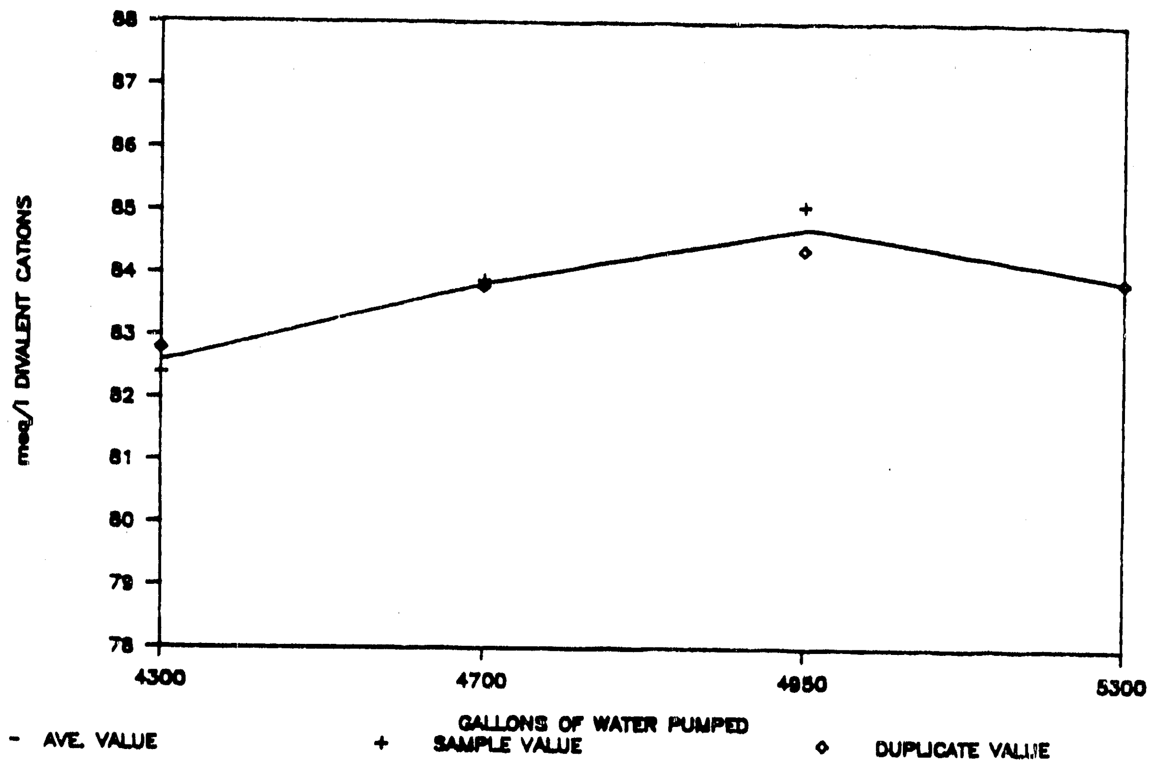


Figure 2.19.1. Graphs of alkalinity and chloride from first round serial sampling at well H-01 Culebra.



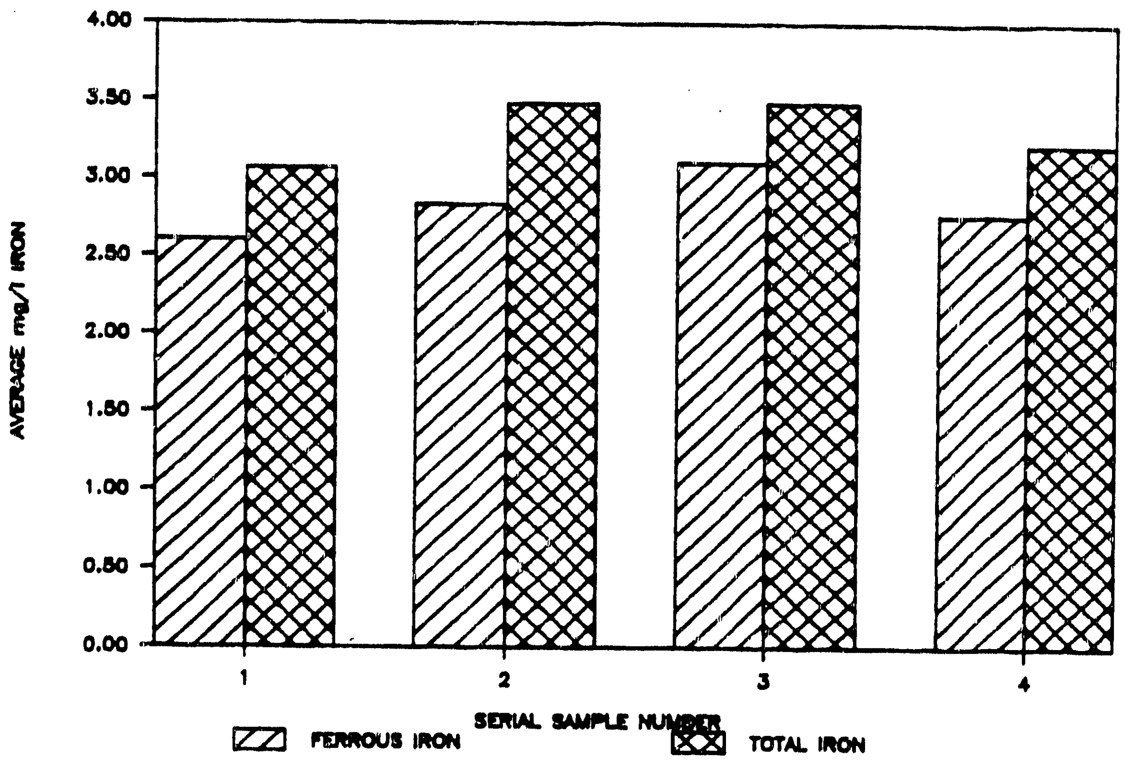


Figure 2.19.2. Graphs of divalent cations and iron from first round serial sampling at well H-01 Culebra.

2.20 SUMMARY OF CULEBRA WATER SAMPLING IN THE AIR INTAKE SHAFT (AIS)

Shaft Characteristics

Construction of the Air Intake Shaft was initiated during the summer of 1988. Upon completion of boring, the shaft measured approximately 20 feet in diameter with a total depth of approximately 2,150 feet. Water samples were collected in the shaft from the Culebra Dolomite Member of the Rustler Formation at an approximate depth of 717 feet BGS.

Sample Collection

On 10/28/88 seven pieces of a fabricated "water ring" were lowered into the shaft and assembled slightly above the base or lower contact of the Culebra Dolomite with the lower unnamed member of the Rustler Formation. The water ring collected and diverted water from the Culebra Dolomite away from the shaft wall toward a single drain allowing personnel to make flow measurements and collect water samples. Prior to sample collection the water flow rate was measured six times during one to two minute measurement intervals, over a total elapsed time of approximately 90 minutes. Water yield from the Culebra Dolomite ranged from the equivalent of 50 to 55 gph during the six measurements (Deshler, 1989).

After completing the flow measurements, a total of six gallons were collected for water samples. Samples were immediately brought to the surface, preserved or treated as required, and packaged for shipment. Samples were collected for ITAS, WAESD, and Sandia National Laboratories. Samples forwarded to ITAS were analyzed for general chemistry and inorganic parameters only. A sample for full suite radionuclide analysis was collected for WAESD. Untreated water samples were provided to Sandia National Laboratories at their request. One sample was provided to the WQSP field laboratory for analysis of field parameters at the WIPP site.

Tabular data from field analysis and ITAS final results are presented in Tables 2.20.1 and 2.20.2. Figure 2.20.1 illustrates the general water quality for the Culebra water from the Air Intake Shaft utilizing Stiff, pie, and Piper trilinear diagrams.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

Water from the Air Intake Shaft had a pH of 7.8 SU, a specific conductance of 55,100 umhos/cm at 25°C, and a specific gravity of 1.037 at 24.6°C.

Alkalinity measurements averaged 108 mg/l.

Chloride concentration was between 19,300 and 19,400 mg/l.

Divalent cations were analyzed at approximately 92 meq/l.

Total iron concentration was reported at 0.21 and 0.19 mg/l.

TABLE 2.20.1

AIS CULEBRA
FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	109	108	mg/l	10/28/88
CHLORIDE	19300	19400	mg/l	10/28/88
DIVALENT CATIONS	92.4	91.7	meq/l	10/28/88
pH	7.8			10/28/88
SPECIFIC CONDUCTANCE	55100	@ 25 C	umhos/cm	10/28/88
SPECIFIC GRAVITY	1.037		@ 24.6 C	10/28/88

TABLE 2.20.2

ITAS LABORATORY RESULTS
AIS CULEBRA

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	98	100	mg/l	10/28/88
ALKALINITY (CO3)	0	0	mg/l	10/28/88
BROMIDE	22	23	mg/l	10/28/88
CHLORIDE	20500		mg/l	10/28/88
CYANIDE, TOTAL	(0.01		mg/l	10/28/88
FLUORIDE	1.4	1.4	mg/l	10/28/88
IODIDE	(2.0	(2.0	mg/l	10/28/88
NITRATE	(0.02		mg/l NO3-N	10/28/88
pH	7.94	7.95		10/28/88
PHENOLICS	0.024		mg/l	10/28/88
PHOSPHATE, TOTAL	0.01	0.01	mg/l T-PO4-P	10/28/88
RESIDUE, FILTERABLE @180 C	43100	42200	mg/l	10/28/88
RESIDUE, NONFILTERABLE @105 C	110	120	mg/l	10/28/88
SPECIFIC CONDUCTANCF	61400	60500	umhos/cm@25C	10/28/88
SULFATE	5900	5400	mg/l	10/28/88
TOTAL ORGANIC CARBON	3.0	3.0	mg/l	10/28/88
TOTAL ORGANIC HALOGEN	(0.05	0.07	mg/l	10/28/88

TABLE 2.20.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 10	< 10			mg/l	10/28/88
ANTIMONY	< 5.0	< 5.0			mg/l	10/28/88
ARSENIC	< 0.050	< 0.050			mg/l	10/28/88
BARIUM	< 0.50	< 0.50			mg/l	10/28/88
BERYLLIUM	< 0.50	< 0.050			mg/l	10/28/88
BORON	30	30			mg/l	10/28/88
CADMIUM	< 0.50	< 0.50			mg/l	10/28/88
CALCIUM	1000	1000			mg/l	10/28/88
CESIUM	0.060	0.080			mg/l	10/28/88
CHROMIUM	2.0	2.0			mg/l	10/28/88
COBALT	< 1.0	< 1.0			mg/l	10/28/88
COPPER	1.0	1.0			mg/l	10/28/88
IRON	< 1.0	< 1.0			mg/l	10/28/88
LEAD	< 5.0	< 5.0			mg/l	10/28/88
LITHIUM	0.50	0.50			mg/l	10/28/88
MAGNESIUM	510	520			mg/l	10/28/88
MANGANESE	< 0.50	< 0.50			mg/l	10/28/88
MERCURY	< 0.0002	< 0.0002			mg/l	10/28/88
MOLYBDENUM	0.15	0.15			mg/l	10/28/88
NICKEL	< 3.0	< 3.0			mg/l	10/28/88
POTASSIUM	400	420			mg/l	10/28/88
SELENIUM	< 0.50	< 0.50			mg/l	10/28/88
SILICA	3.7	3.7			mg/l	10/28/88
SILVER	< 1.0	< 1.0			mg/l	10/28/88
SODIUM	12600	12400			mg/l	10/28/88
STRONTIUM	12	12			mg/l	10/28/88
THALLIUM	< 0.50				mg/l	10/28/88
TITANIUM	< 1.0	< 1.0			mg/l	10/28/88
VANADIUM	< 1.0	< 1.0			mg/l	10/28/88
ZINC	< 1.0	< 1.0			mg/l	10/28/88

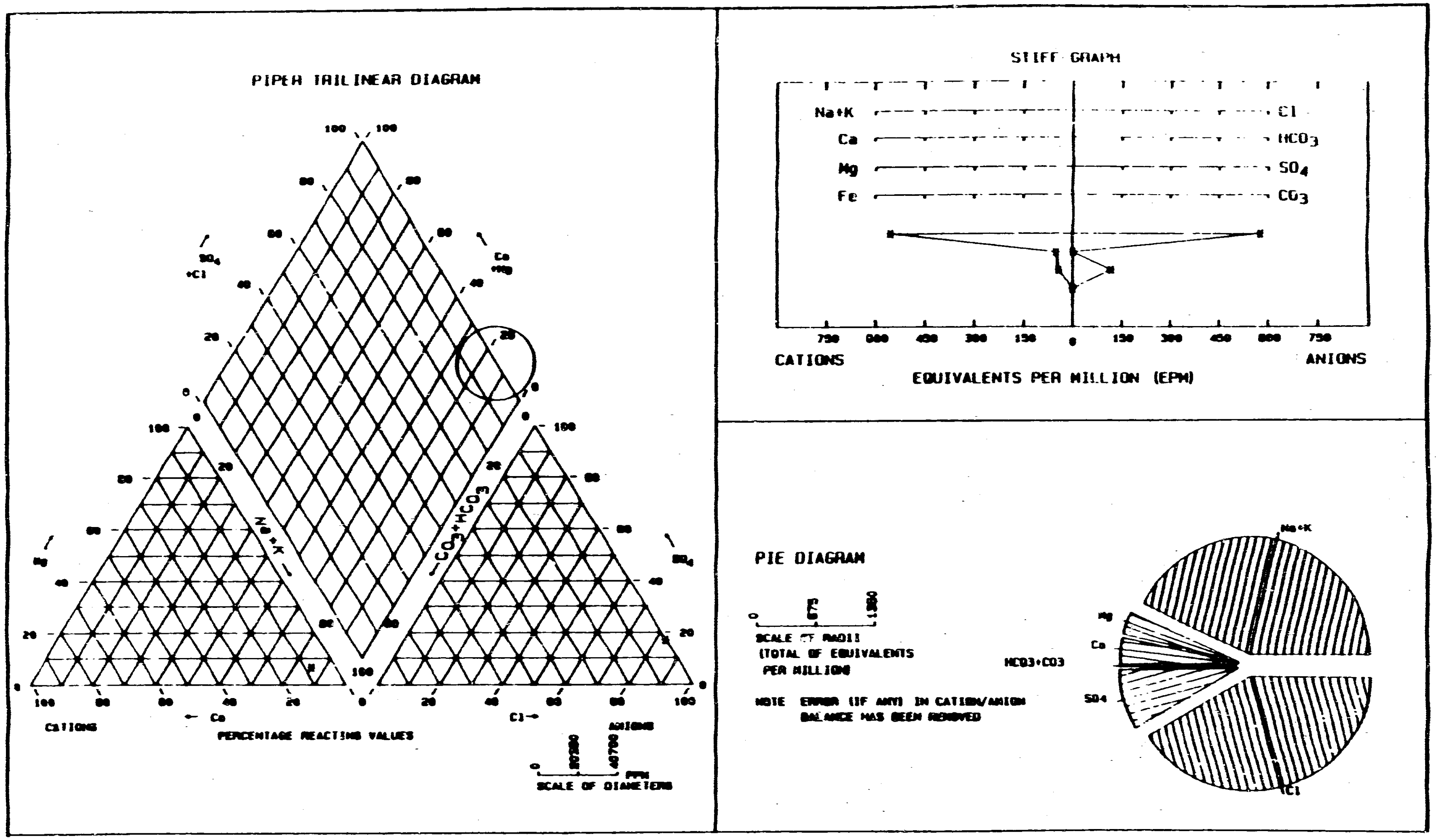


Figure 2.20.1 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from Culebra water sampling sampling in the Air Intake Shaft.

2.21 SUMMARY OF CULEBRA WELL H-15, ROUND THREE

Well Characteristics

Well H-15 is located approximately one mile east of the center of the WIPP site at an elevation of 3,482 feet above MSL, to the top of the casing (Gonzales, 1989). The well is completed to a depth of 900 feet BGS, with casing installed to a depth of 853 feet BGS. The bottom 47 feet of the well are completed open hole. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 861 to 883 feet BGS (Beauheim, 1987).

Sampling Process

This well was sampled using a Bennett model piston pump. Water in the well bore was purged prior to serial sampling, and the well was sampled open hole without a packer.

Pumping began on 10/25/88. Over a three-day period the well bore was evacuated of water by lowering the pump in stages from 645 to 850 feet BTOC. On 10/26/88 a second Bennett pump with an Aardvark inflatable packer was set at depth of 850 feet BTOC. The packer failed to operate, consequently pumping proceeded open hole. Serial sampling began on 11/01/88 after approximately 1,400 gallons had been pumped from the well. The pump flow rate varied between five and seven gph during the sampling period. Seven daily serial samples were collected and analyzed. Serial sampling ended and final samples were collected on 11/07/88 after approximately 2,200 gallons had been pumped from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analyses showed alkalinity decreasing from approximately 47 down to 41 mg/l (Figure 2.21.1).

Chloride content varied between 133,000 and 135,000 mg/l (Figure 2.21.1).

Divalent cations varied between 280 and 295 meq/l (Figure 2.21.2).

Total iron concentrations decreased from approximately 4.2 down to 2.8 mg/l over the entire sampling period. Ferrous iron concentrations followed a trend similar to total iron (Figure 2.21.2).

The water pH ranged between 6.7 and 7.0 SU during serial sampling.

Physical Parameters

Values for Eh ranged between 117 and 141 mV, relative to the SHE, exhibiting no distinct trend.

The water temperature varied between 20.2 and 23.3°C probably caused by temperature fluctuations at the ground surface.

The water had a specific gravity of 1.160 at 23.4°C on the final day of serial sampling.

Specific conductance was reported at 199,000 umhos/cm at 25°C on the final day of serial sampling.

Final Sample Collection

Final samples were collected following procedures outlined in the WIPP Geotechnical and Geosciences Procedures Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples for full suite radionuclide analysis were collected for WAESD. Archival samples were collected for the WIPP project.

General Observations

The water from this well was effervescent.

Tabular data are presented in Tables 2.21.1, 2.21.2, 2.21.3, and 2.21.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively.

Figures 2.21.1 and 2.21.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.21.3 illustrates the general water quality at well H-15 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds exist below the Culebra Dolomite Member within the Rustler Formation in the vicinity of H-15 (Lappin, 1988).

Serial Parameter Comparisons With The Previous Rounds

The data gathered during this round compare favorably with the data from the previous rounds of serial sampling. Most chemical parameters are reported within a few percent during each round. Generally, most chemical parameters exhibited a slight increasing trend in round two, but the round three values appear to duplicate results from round one more closely. Specific conductance and iron values appear to have decreased over the three rounds of sampling.

The volumes of water pumped prior to final sampling during each round were 5,300, 1,100, and 2,200 gallons for rounds one, two, and three, respectively. Problems with the pumping equipment were experienced during all three rounds. Most of the problems were alleviated during the round three sampling episode by purging the well bore prior to setting the pump for sampling.

TABLE 2.21.1

SERIAL SAMPLE CHEMISTRY
H-15 CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	47.7	46.4	mg/l	1400	11/01/88
2	ALKALINITY	46.7	45.9	mg/l	1550	11/02/88
3	ALKALINITY	44.2	43.5	mg/l	1650	11/03/88
4	ALKALINITY	43.0	43.0	mg/l	1800	11/04/88
5	ALKALINITY	42.5	43.5	mg/l	1950	11/05/88
6	ALKALINITY	41.5	41.1	mg/l	2100	11/06/88
7	ALKALINITY	40.6	41.1	mg/l	2200	11/07/88
1	CHLORIDE	133000	134000	mg/l	1400	11/01/88
2	CHLORIDE	134000	135000	mg/l	1550	11/02/88
3	CHLORIDE	135000	135000	mg/l	1650	11/03/88
4	CHLORIDE	134000	134000	mg/l	1800	11/04/88
5	CHLORIDE	134000	135000	mg/l	1950	11/05/88
6	CHLORIDE	134000	134000	mg/l	2100	11/06/88
7	CHLORIDE	134000	135000	mg/l	2200	11/07/88
1	DIVALENT CATIONS	294	292	meq/l	1400	11/01/88
2	DIVALENT CATIONS	288	286	meq/l	1550	11/02/88
3	DIVALENT CATIONS	285	292	meq/l	1650	11/03/88
4	DIVALENT CATIONS	285	284	meq/l	1800	11/04/88
5	DIVALENT CATIONS	283	283	meq/l	1950	11/05/88
6	DIVALENT CATIONS	286	288	meq/l	2100	11/06/88
7	DIVALENT CATIONS	284	280	meq/l	2200	11/07/88
1	TOTAL IRON	3.37	3.41	mg/l	1400	11/01/88
2	TOTAL IRON	3.74	4.20	mg/l	1550	11/02/88
3	TOTAL IRON	3.53	3.55	mg/l	1650	11/03/88
4	TOTAL IRON	3.23	3.20	mg/l	1800	11/04/88
5	TOTAL IRON	3.31	3.26	mg/l	1950	11/05/88
6	TOTAL IRON	3.58	3.58	mg/l	2100	11/06/88
7	TOTAL IRON	2.84	2.91	mg/l	2200	11/07/88
1	FERROUS IRON	3.19	3.18	mg/l	1400	11/01/88
2	FERROUS IRON	3.31	3.19	mg/l	1550	11/02/88
3	FERROUS IRON	2.93	2.90	mg/l	1650	11/03/88
4	FERROUS IRON	2.68	2.61	mg/l	1800	11/04/88
5	FERROUS IRON	2.72	2.70	mg/l	1950	11/05/88
6	FERROUS IRON	3.16	2.85	mg/l	2100	11/06/88
7	FERROUS IRON	2.49	2.45	mg/l	2200	11/07/88

TABLE 2.21.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	pH	6.7			1400	11/01/88
2	pH	6.9			1550	11/02/88
3	pH	7.0			1650	11/03/88
4	pH	7.0			1800	11/04/88
5	pH	7.0			1950	11/05/88
6	pH	6.9			2100	11/06/88
7	pH	6.9			2200	11/07/88
1	Eh	141		mV	1400	11/01/88
2	Eh	128		mV	1550	11/02/88
3	Eh	126		mV	1650	11/03/88
4	Eh	117		mV	1800	11/04/88
5	Eh	122		mV	1950	11/05/88
6	Eh	136		mV	2100	11/06/88
7	Eh	131		mV	2200	11/07/88
1	TEMPERATURE	22.2		C	1400	11/01/88
2	TEMPERATURE	22.0		C	1550	11/02/88
3	TEMPERATURE	22.5		C	1650	11/03/88
4	TEMPERATURE	22.4		C	1800	11/04/88
5	TEMPERATURE	20.2		C	1950	11/05/88
6	TEMPERATURE	21.8		C	2100	11/06/88
7	TEMPERATURE	23.3		C	2200	11/07/88
1	SPECIFIC GRAVITY	1.159		@ 22.4 C	1400	11/01/88
5	SPECIFIC GRAVITY	1.160		@ 20.2 C	1950	11/05/88
7	SPECIFIC GRAVITY	1.160		@ 23.4 C	2200	11/07/88
1	SPECIFIC CONDUCTANCE	199000	@ 25 C	umhos/cm	1400	11/01/88
7	SPECIFIC CONDUCTANCE	199000	@ 25 C	umhos/cm	2200	11/07/88

TABLE 2.21.2

ITAS LABORATORY RESULTS
H-15 CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	38		mg/l	11/07/88
ALKALINITY (CO3)	0		mg/l	11/07/88
BROMIDE	94	99	mg/l	11/07/88
CHLORIDE	135000		mg/l	11/07/88
CYANIDE, TOTAL	< 0.01	< 0.02	mg/l	11/07/88
FLUORIDE	0.6		mg/l	11/07/88
IODIDE	< 2.0	< 2.0	mg/l	11/07/88
NITRATE	< 0.02		mg/l NO3-N	11/07/88
pH	6.55	6.58		11/07/88
PHENOLICS	0.026		mg/l	11/07/88
PHOSPHATE, TOTAL	0.01	0.01	mg/l T-PO4-P	11/07/88
RESIDUE, FILTERABLE @180 C	246000	244000	mg/l	11/07/88
RESIDUE, NONFILTERABLE @105 C	930	820	mg/l	11/07/88
SPECIFIC CONDUCTANCE	210000	210000	umhos/cm@25C	11/07/88
SULFATE	5500	5700	mg/l	11/07/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	11/07/88
TOTAL ORGANIC HALOGEN	1.30	1.10	mg/l	11/07/88

TABLE 2.21.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	(10	(10	(0.1	(0.1	mg/l	11/07/88
ANTIMONY	7.0	7.0	(0.05	(0.05	mg/l	11/07/88
ARSENIC	(0.050	(0.050	(0.005	(0.005	mg/l	11/07/88
BARIUM	(0.50	(0.50	(0.005	(0.005	mg/l	11/07/88
BERYLLIUM	0.50	(0.50	(0.005	(0.005	mg/l	11/07/88
BORON	50	50	(0.01	(0.01	mg/l	11/07/88
CADMIUM	0.70	0.70	(0.005	(0.005	mg/l	11/07/88
CALCIUM	1600	1600			mg/l	11/07/88
CESIUM	0.40	0.40	(0.06	(0.06	mg/l	11/07/88
CHROMIUM	3.0	3.0	(0.01	(0.01	mg/l	11/07/88
COBALT	1.0	1.0	(0.01	(0.01	mg/l	11/07/88
COPPER	2.0	2.0	(0.01	(0.01	mg/l	11/07/88
IRON	3.0	3.0	(0.01	(0.01	mg/l	11/07/88
LEAD	7.0	7.0	(0.05	(0.05	mg/l	11/07/88
LITHIUM	0.90	0.90	(0.01	(0.01	mg/l	11/07/88
MAGNESIUM	2700	2700			mg/l	11/07/88
MANGANESE	(0.50		(0.005	(0.005	mg/l	11/07/88
MERCURY	(0.40	(0.40	(0.0002	(0.0002	mg/l	11/07/88
MOLYBDENUM	0.29	0.27	(0.05	(0.05	mg/l	11/07/88
NICKEL	(3.0	(3.0	(0.03	(0.03	mg/l	11/07/88
POTASSIUM	1800	1900			mg/l	11/07/88
SELENIUM	(5.0	(5.0	(0.005	(0.005	mg/l	11/07/88
SILICA	1.6				mg/l	11/07/88
SILVER	1.0	1.0	(0.01	(0.01	mg/l	11/07/88
SODIUM	71000	71000			mg/l	11/07/88
STRONTIUM	31	31	(0.01	(0.01	mg/l	11/07/88
THALLIUM	(0.50		(0.005	(0.005	mg/l	11/07/88
TITANIUM	(1.0	(1.0	(0.01	(0.01	mg/l	11/07/88
VANADIUM	1.0	1.0	(0.01	(0.01	mg/l	11/07/88
ZINC	1.0	1.0	(0.01	(0.01	mg/l	11/07/88

TABLE 2.21.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	< 10		< 10	< 10	ug/l	11/07/88
BENZENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
2-BUTANONE	< 10		< 10	< 10	ug/l	11/07/88
BROMOFORM	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
CARBON DISULFIDE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
CARBON TETRACHLORIDE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
CHLOROBENZENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
CHLORODIBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
CHLOROETHANE	< 10		< 10	< 10	ug/l	11/07/88
2-CHLOROETHYLVINYL ETHER	< 10		< 10	< 10	ug/l	11/07/88
CHLOROFORM	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
CIS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
DICHLOROBROMOMETHANE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
1,1-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
1,2-DICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
1,1-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
1,2-DICHLOROPROPANE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
ETHYLBENZENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
2-HEXANONE	< 10		< 10	< 10	ug/l	11/07/88
METHYL BROMIDE	< 10		< 10	< 10	ug/l	11/07/88
METHYL CHLORIDE	< 10		< 10	< 10	ug/l	11/07/88
4-METHYL-2-PENTANONE	< 10		< 10	< 10	ug/l	11/07/88
METHYLENE CHLORIDE	< 5.0		9.6	14	ug/l	11/07/88
STYRENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
1,1,2,2-TETRACHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
TETRACHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
TOLUENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
TRANS-1,2-DICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
TRANS-1,3-DICHLOROPROPENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
1,1,1-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
1,1,2-TRICHLOROETHANE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
TRICHLOROETHYLENE	< 5.0		< 5.0	< 5.0	ug/l	11/07/88
VINYL ACETATE	< 10		< 10	< 10	ug/l	11/07/88
VINYL CHLORIDE	< 10		< 10	< 10	ug/l	11/07/88
TOTAL XYLENES	< 5.0		< 5.0	< 5.0	ug/l	11/07/88

TABLE 2.21.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	11/07/88
ACENAPHTHYLENE	< 10		ug/l	11/07/88
ANTHRACENE	< 10		ug/l	11/07/88
BENZO(A)ANTHRACENE	< 10		ug/l	11/07/88
BENZO(A)PYRENE	< 10		ug/l	11/07/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	11/07/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	11/07/88
BENZOIC ACID	< 50		ug/l	11/07/88
BENZO(K)FLUORANTHENE	< 10		ug/l	11/07/88
BENZYL ALCOHOL	< 10		ug/l	11/07/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	11/07/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	11/07/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	11/07/88
BIS(2-ETHYLHEXYL)PHTHALATE	44		ug/l	11/07/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	11/07/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	11/07/88
4-CHLOROANILINE	< 10		ug/l	11/07/88
2-CHLORONAPHTHALENE	< 10		ug/l	11/07/88
2-CHLOROPHENOL	< 10		ug/l	11/07/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	11/07/88
CHRYSENE	< 10		ug/l	11/07/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	11/07/88
DIBENZOFURAN	< 10		ug/l	11/07/88
1,2-DICHLOROBENZENE	< 10		ug/l	11/07/88
1,3-DICHLOROBENZENE	< 10		ug/l	11/07/88
1,4-DICHLOROBENZENE	< 10		ug/l	11/07/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	11/07/88
2,4-DICHLOROPHENOL	< 10		ug/l	11/07/88
DIETHYL PHTHALATE	< 10		ug/l	11/07/88
2,4-DIMETHYLPHENOL	< 10		ug/l	11/07/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	11/07/88
2,4-DINITROPHENOL	< 50		ug/l	11/07/88
DIMETHYL PHTHALATE	< 10		ug/l	11/07/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	11/07/88
2,4-DINITROTOLUENE	< 10		ug/l	11/07/88
2,6-DINITROTOLUENE	< 10		ug/l	11/07/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	11/07/88

TABLE 2.21.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	11/07/88
FLUORENE	< 10		ug/l	11/07/88
HEXACHLOROBENZENE	< 10		ug/l	11/07/88
HEXACHLOROBUTADIENE	< 10		ug/l	11/07/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	11/07/88
HEXACHLOROETHANE	< 10		ug/l	11/07/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	11/07/88
ISOPHORONE	< 10		ug/l	11/07/88
2-METHYLNAPHTHALENE	< 10		ug/l	11/07/88
2-METHYLPHENOL	< 10		ug/l	11/07/88
4-METHYLPHENOL	< 10		ug/l	11/07/88
NAPHTHALENE	< 10		ug/l	11/07/88
2-NITROANILINE	< 50		ug/l	11/07/88
3-NITROANILINE	< 50		ug/l	11/07/88
4-NITROANILINE	< 50		ug/l	11/07/88
NITROBENZENE	< 10		ug/l	11/07/88
2-NITROPHENOL	< 10		ug/l	11/07/88
4-NITROPHENOL	< 50		ug/l	11/07/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	11/07/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	11/07/88
P-CHLORO-M-CRESOL	< 10		ug/l	11/07/88
PENTACHLOROPHENOL	< 50		ug/l	11/07/88
PHENANTHRENE	< 10		ug/l	11/07/88
PHENOL	< 10		ug/l	11/07/88
PYRENE	< 10		ug/l	11/07/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	11/07/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	11/07/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	11/07/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	11/07/88

TABLE 2.21.3

UNC LABORATORY ANALYSIS
H-15 CULEBRA ROUND THREE

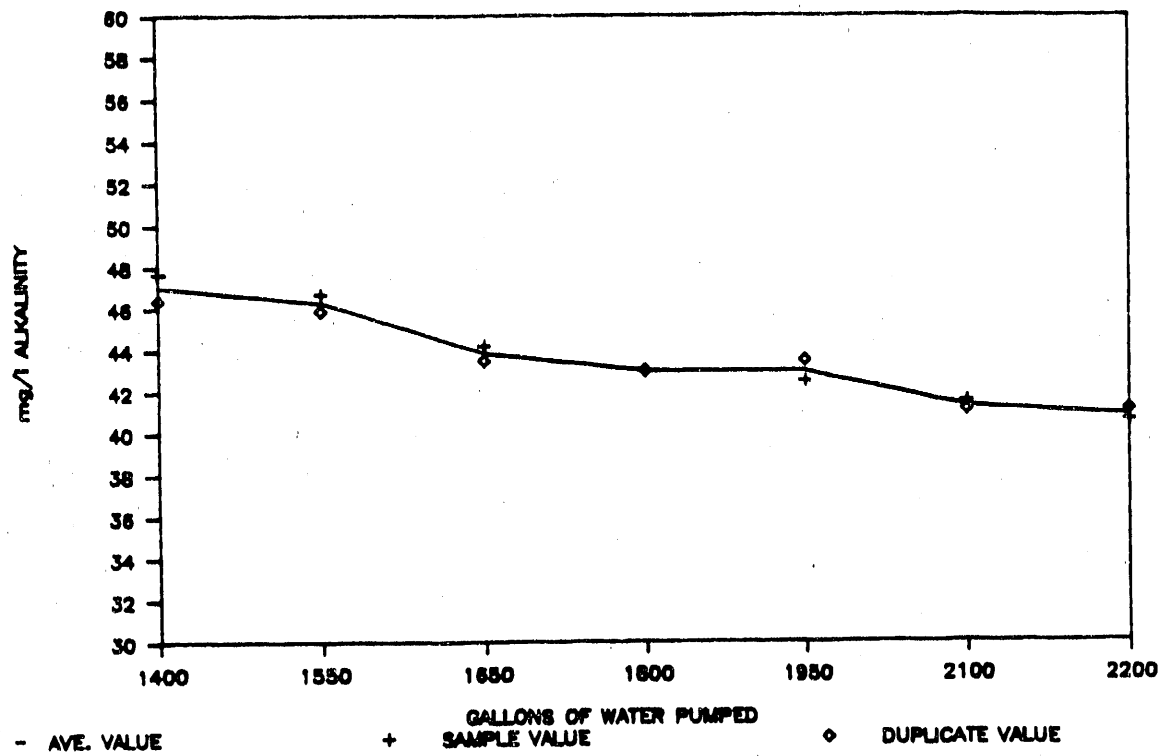
DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	< 0.05	< 0.05	cc/l (STP)	11/07/88
OXYGEN	0.30	< 0.05	cc/l (STP)	11/07/88
NITROGEN	175.28	13.38	cc/l (STP)	11/07/88
CARBON MONOXIDE	< 0.001	< 0.001	cc/l (STP)	11/07/88
CARBON DIOXIDE	1.490	1.320	cc/l (STP)	11/07/88
METHANE	0.263	0.863	cc/l (STP)	11/07/88
ETHANE	< 0.001	< 0.001	cc/l (STP)	11/07/88
C-3	< 0.001	< 0.001	cc/l (STP)	11/07/88
C-4	< 0.001	< 0.001	cc/l (STP)	11/07/88
C-5	< 0.001	< 0.001	cc/l (STP)	11/07/88
C-6	< 0.001	< 0.001	cc/l (STP)	11/07/88
SUM OF CO2	13.78		cc/l (STP)	11/07/88
TOTAL GAS	96.598		cc/l (STP)	11/07/88
AMMONIA	0.85	0.85	mg/l	11/07/88
NITRATE	< 1.00	< 1.00	mg/l	11/07/88
TOTAL IRON	3.520	3.500	mg/l	11/07/88
FERROUS IRON	3.49	3.46	mg/l	11/07/88
TOTAL ARSENIC	0.0020	0.0020	mg/l	11/07/88
ARSENIC III	< 0.0010	< 0.0010	mg/l	11/07/88
TOTAL SELENIUM	< 0.001	< 0.001	mg/l	11/07/88
IODIDE	300	300	ug/l	11/07/88
IODATE	< 15	< 15	ug/l	11/07/88

TABLE 2.21.4

PRESSURE AND FLOW
H-15 CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
10/25/88	10:45	N/A	56	36	PUMP ON 10:38
10/25/88	11:00	N/A	52	38	OPEN HOLE 645 FT
10/25/88	11:15	N/A	50	38	
10/25/88	11:30	N/A	44	36	
10/25/88	12:30	N/A	30	42	
10/25/88	13:00	N/A	23	38	
10/25/88	14:00	N/A	08	40	PUMP OFF 14:03
10/25/88	14:10	N/A	N/A	00	DEPTH 750 FT
10/25/88	14:39	N/A	70	24	PSI 14:35 PUMP ON 14:35
10/25/88	15:18	N/A	58	24	PSI 15:15
10/25/88	15:30	N/A	58	17	
10/26/88	07:00	N/A	03	04	PUMP OFF
10/26/88	07:40	N/A	N/A	00	DEPTH 850 FT
10/26/88	08:00	N/A	50	19	PUMP ON 07:48
10/26/88	16:40	N/A	10	15	REPLACE PUMP 10/27
10/28/88	08:00	52	60	14	PUMP ON 07:54
10/28/88	08:25	50	61	08	OPEN HOLE
10/28/88	08:37	50	60	09	
10/28/88	11:00	44	55	09	
10/28/88	14:00	37	47	09	
10/29/88	06:30	14	23	08	
10/29/88	10:00	12	21	07	
10/30/88	08:00	15	26	05	
10/30/88	11:00	15	22	06	
10/31/88	07:00	09	16	07	
10/31/88	15:30	10	22	05	
11/01/88	07:00	10	22	06	
11/01/88	09:30	12	24	07	FLOW STOPS 08:40-09:20
11/01/88	12:00	12	24	04	
11/01/88	12:30	12	24	06	
11/01/88	16:00	12	24	05	
11/02/88	07:00	16	27	05	
11/02/88	07:30	15	27	05	
11/02/88	15:30	17	29	04	
11/03/88	07:00	17	29	05	
11/03/88	07:31	16	29	06	
11/03/88	15:30	14	26	06	
11/04/88	07:00	12	25	06	
11/04/88	14:00	14	26	06	
11/05/88	09:00	16	26	05	
11/06/88	07:00	18	31	06	
11/07/88	07:00	28	36	05	
11/08/88	06:00	29	41	06	
/08/88	08:30	29	39	05	PUMP OFF 08:40



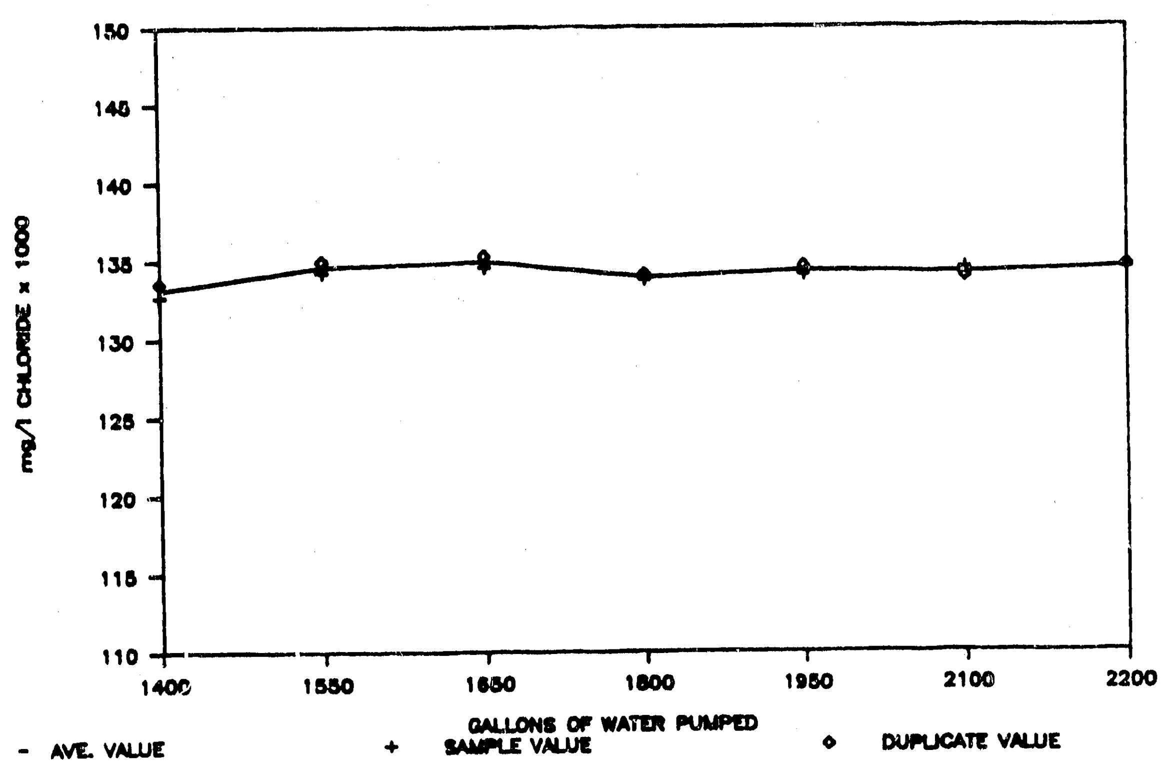


Figure 2.21.1. Graphs of alkalinity and chloride from third round serial sampling at well H-15 Culebra.

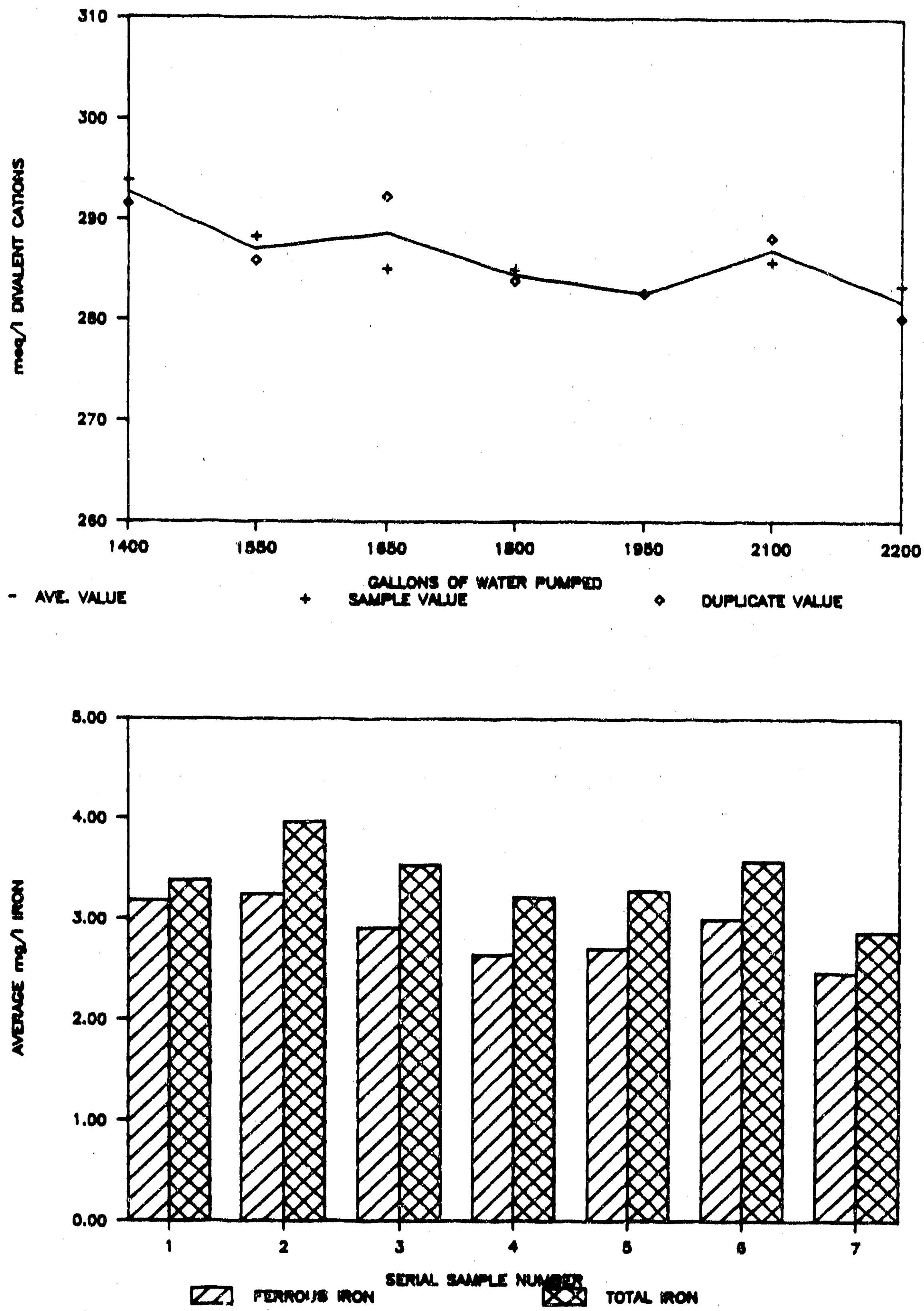


Figure 2.21.2. Graphs of divalent cations and iron from third round serial sampling at well H-15 Culebra.

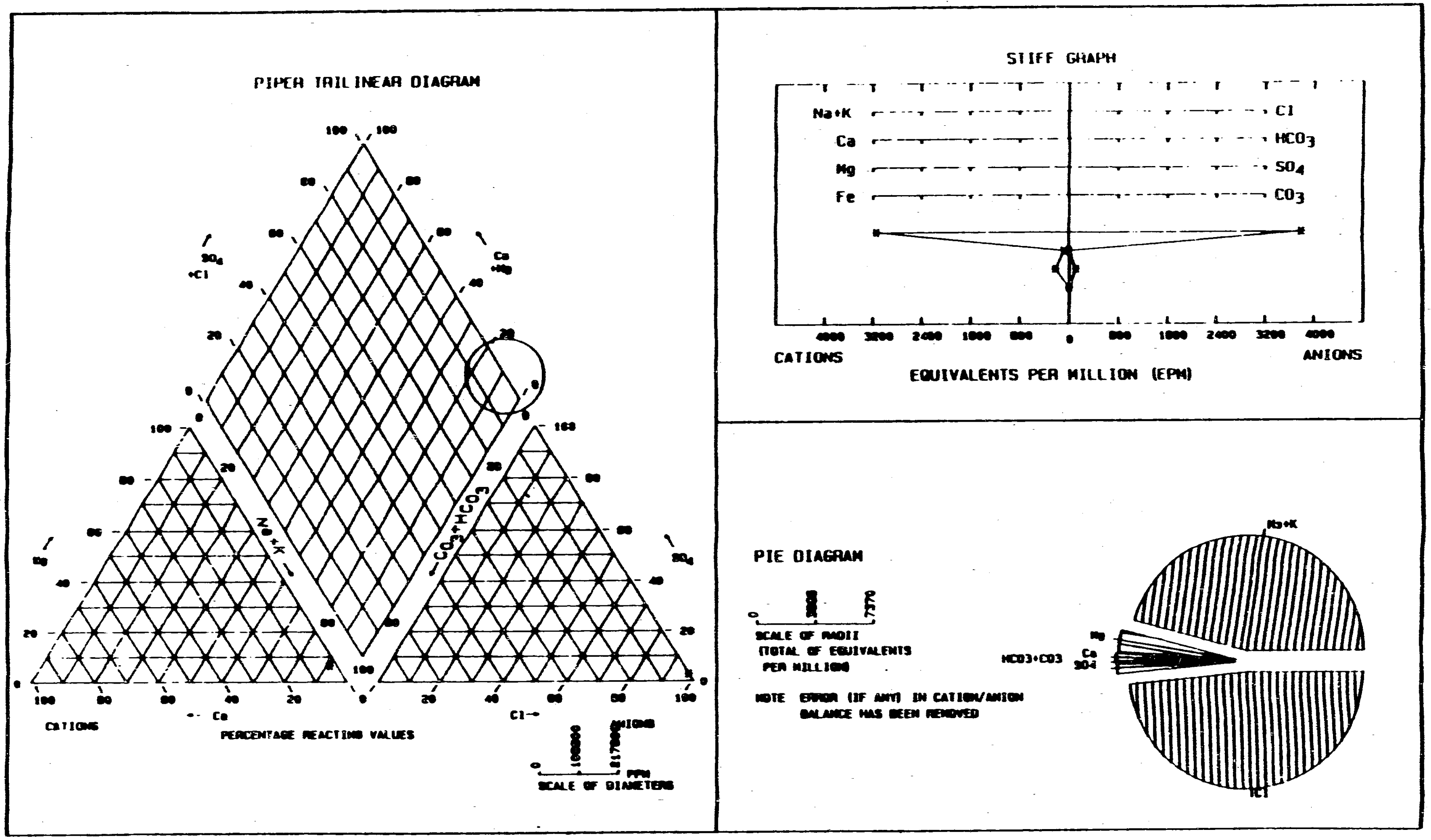


Figure 2.21.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well H-15 Culebra.

2.22 SUMMARY OF CULEBRA WELL H-12, ROUND THREE

Well Characteristics

Well H-12 is located approximately 4.5 miles southeast of the center of the WIPP site at an elevation of 3,427 feet above MSL, to the top of the casing (Gonzales, 1989). Total depth of the drilled hole was 1,001 feet, but the hole was plugged back to a depth of 890 BGS. Casing is installed to a depth of 820 feet BGS and the well is completed open hole. The source of water sampled from this well is the Culebra Dolomite Member of the Rustler Formation located at a depth interval of 823 to 850 feet BGS (Winstanley and Carrasco, 1986).

Sampling Process

This well was sampled using a Bennett model piston pump. A Baski inflatable packer was set above the pump intake isolating it from stagnant water in the well bore. The pump intake was located at approximately 808 feet BTOC.

Pumping began on 11/08/88. After pumping only 38 gallons of the water the packer failed. After removal of the pump assembly from the well a second pump and packer assembly was installed on 11/10/88. The second pump failed to operate. During removal, the second pump assembly became lodged in the well. This pump and packer were finally knocked loose and recovered on 11/15/88. A third pump assembly was installed on 11/28/88, but a pressure transducer failure forced removal of this pump also. Finally, on 12/01/88 an operable pump and packer assembly was installed in the well. Pumping continued until 12/03/88 when the pump stopped and had to be restarted. Steady pumping then continued until the end of sampling.

Serial sampling began on 12/02/88. Approximately 250 gallons of water had been removed from the well at the time of the first serial sampling. Then there was a five-day hiatus while the well was allowed to pump before the second serial sample was collected. Daily serial sampling began on 12/07/88 after approximately 850 gallons of water had been pumped from the well. The average flow rate was approximately 12 gph during the sampling period. Serial sampling ended and final samples were collected on 12/14/88 after approximately 2,900 gallons had been removed from the well.

Field Chemistry Summary

Procedures used in the field chemical analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 07-2.

Field chemical analyses showed alkalinity decreasing from the first day value of approximately 69 down to 51 mg/l (Figure 2.22.1).

Chloride content ranged between 85,300 and 79,500 mg/l (Figure 2.22.1).

Divalent cations varied between 265 and 242 meq/l. Divalent cation concentration was approximately 250 meq/l on the final day of sampling (Figure 2.22.2).

Total iron concentrations decreased from over 12 mg/l on the first serial sample, down to approximately 2.1 mg/l at the end of serial sampling. Ferrous iron concentrations followed a trend similar to total iron (Figure 2.22.2).

The water pH ranged between 7.7 and 7.2 SU, and was 7.3 SU on the final day of serial sampling.

Physical Parameters

Values for Eh ranged between -26 mV and 124 mV relative to the SHE over the course of serial sampling. Eh was 109 mV relative to the SHE on the final day of sampling.

The water temperature varied between 16.7 and 22.2°C.

The water had a specific gravity of 1.088 at 21.2°C on the final day of serial sampling.

Specific conductance was reported at approximately 147,000 umhos/cm at 25°C on the final day of serial sampling.

Final Sample Collection

Final samples were collected following procedures outlined in the WIPP Geotechnical and Geosciences Procedures Manual WP 07-230.

Samples were collected and sent to ITAS, UNC analytical laboratory, Sandia National Laboratories, and the EEG. Samples for full suite radionuclide analysis were collected for WAESD. Archival samples were collected for the WIPP project.

General Observations

The water from this well was very effervescent.

Tabular data are presented in Tables 2.22.1, 2.22.2, 2.22.3, and 2.22.4. These tables list results from serial sampling, ITAS laboratory analyses, UNC laboratory analyses, and pressure versus flow data, respectively. Figures 2.22.1 and 2.22.2 graphically depict serial sampling results and the degree of stabilization achieved. Figure 2.22.3 illustrates the general water quality at well H-12 utilizing Stiff, pie, and Piper trilinear diagrams.

Halite beds exist both above and below the Culebra Dolomite Member within the Rustler Formation in the vicinity of H-12 (Mercer, 1983).

Serial Parameter Comparisons With The Previous Rounds

The total volume of water pumped prior to the start of final sampling was 2,400, 1,100, and 2,900 gallons for rounds one, two, and three. Average flow rates during serial sampling were approximately 17, six, and 12 gph for the three rounds of sampling.

Data gathered from serial sampling at well H-12 are generally in good agreement between the three rounds of sampling. Data gathered during rounds one and three are more similar than data from the round two sampling episode. The round two ending serial sample values for alkalinity, divalent cations, specific gravity, and specific conductance were all greater than those ending values for either rounds one or three. The Eh value for round two was lower than either round one or three. The round two sampling may have been terminated prior to the water reaching a steady state as is indicated by data differences with the other two rounds of sampling.

TABLE 2.22.1

SERIAL SAMPLE CHEMISTRY
H-12 CULEBRA ROUND THREE

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	ALKALINITY	69.5	67.8	mg/l	250	12/02/88
2	ALKALINITY	54.1	51.6	mg/l	850	12/07/88
3	ALKALINITY	48.5	46.7	mg/l	1150	12/08/88
4	ALKALINITY	52.2	51.6	mg/l	1400	12/09/88
5	ALKALINITY	51.6	50.4	mg/l	1700	12/10/88
6	ALKALINITY	51.6	51.6	mg/l	2000	12/11/88
7	ALKALINITY	51.8	51.1	mg/l	2300	12/12/88
8	ALKALINITY	52.2	51.5	mg/l	2600	12/13/88
9	ALKALINITY	51.0	51.2	mg/l	2900	12/14/88
1	CHLORIDE	85100	85300	mg/l	250	12/02/88
2	CHLORIDE	81200	82400	mg/l	850	12/07/88
3	CHLORIDE	80700	80700	mg/l	1150	12/08/88
4	CHLORIDE	79500	80000	mg/l	1400	12/09/88
5	CHLORIDE	80000	80500	mg/l	1700	12/10/88
6	CHLORIDE	80300	80000	mg/l	2000	12/11/88
7	CHLORIDE	79800	80200	mg/l	2300	12/12/88
8	CHLORIDE	80300	79800	mg/l	2600	12/13/88
9	CHLORIDE	80100	80100	mg/l	2900	12/14/88
1	DIVALENT CATIONS	265	262	meq/l	250	12/02/88
2	DIVALENT CATIONS	244	242	meq/l	850	12/07/88
3	DIVALENT CATIONS	246	249	meq/l	1150	12/08/88
4	DIVALENT CATIONS	248	246	meq/l	1400	12/09/88
5	DIVALENT CATIONS	248	251	meq/l	1700	12/10/88
6	DIVALENT CATIONS	254	254	meq/l	2000	12/11/88
7	DIVALENT CATIONS	247	250	meq/l	2300	12/12/88
8	DIVALENT CATIONS	250	249	meq/l	2600	12/13/88
9	DIVALENT CATIONS	249	250	meq/l	2900	12/14/88
1	TOTAL IRON	12.48	12.10	mg/l	250	12/02/88
2	TOTAL IRON	3.10	3.21	mg/l	850	12/07/88
3	TOTAL IRON	2.72	2.72	mg/l	1150	12/08/88
4	TOTAL IRON	2.75	2.75	mg/l	1400	12/09/88
5	TOTAL IRON	2.47	2.49	mg/l	1700	12/10/88
6	TOTAL IRON	2.35	2.46	mg/l	2000	12/11/88
7	TOTAL IRON	2.67	2.60	mg/l	2300	12/12/88
8	TOTAL IRON	2.13	2.08	mg/l	2600	12/13/88
9	TOTAL IRON	2.06	2.16	mg/l	2900	12/14/88

TABLE 2.22.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	FERROUS IRON	10.04	10.12	mg/l	250	12/02/88
2	FERROUS IRON	2.99	3.01	mg/l	850	12/07/88
3	FERROUS IRON	2.69	2.69	mg/l	1150	12/08/88
4	FERROUS IRON	2.71	2.71	mg/l	1400	12/09/88
5	FERROUS IRON	2.46	2.46	mg/l	1700	12/10/88
6	FERROUS IRON	2.31	2.31	mg/l	2000	12/11/88
7	FERROUS IRON	2.47	2.44	mg/l	2300	12/12/88
8	FERROUS IRON	1.94	1.97	mg/l	2600	12/13/88
9	FERROUS IRON	1.96	1.93	mg/l	2900	12/14/88
1	pH	7.7			250	12/02/88
2	pH	7.3			850	12/07/88
3	pH	7.2			1150	12/08/88
4	pH	7.4			1400	12/09/88
5	pH	7.4			1700	12/10/88
6	pH	7.3			2000	12/11/88
7	pH	7.3			2300	12/12/88
8	pH	7.3			2600	12/13/88
9	pH	7.3			2900	12/14/88
1	Eh	-26		mV	250	12/02/88
2	Eh	99		mV	850	12/07/88
3	Eh	124		mV	1150	12/08/88
4	Eh	101		mV	1400	12/09/88
5	Eh	116		mV	1700	12/10/88
6	Eh	106		mV	2000	12/11/88
7	Eh	116		mV	2300	12/12/88
8	Eh	101		mV	2600	12/13/88
9	Eh	109		mV	2900	12/14/88
1	TEMPERATURE	21.9		C	250	12/02/88
2	TEMPERATURE	19.5		C	850	12/07/88
3	TEMPERATURE	16.7		C	1150	12/08/88
4	TEMPERATURE	20.6		C	1400	12/09/88
5	TEMPERATURE	20.3		C	1700	12/10/88
6	TEMPERATURE	21.5		C	2000	12/11/88
7	TEMPERATURE	22.2		C	2300	12/12/88
8	TEMPERATURE	21.4		C	2600	12/13/88
9	TEMPERATURE	21.5		C	2900	12/14/88

TABLE 2.22.1
(continued)

SAMPLE NUMBER	PARAMETER	VALUE	DUPLICATE VALUE	UNITS	GALLONS PUMPED	DATE COLLECTED
1	SPECIFIC GRAVITY	1.105		@ 21.3 C	250	12/02/88
7	SPECIFIC GRAVITY	1.088		@ 20.8 C	2300	12/12/88
9	SPECIFIC GRAVITY	1.088		@ 21.2 C	2900	12/14/88
1	SPECIFIC CONDUCTANCE	153000	@ 25 C	umhos/cm	250	12/02/88
9	SPECIFIC CONDUCTANCE	147000	@ 25 C	umhos/cm	2900	12/14/88

TABLE 2.22.2

ITAS LABORATORY RESULTS
H-12 CULEBRA ROUND THREE

GENERAL CHEMISTRY AND ANIONS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	46	48	mg/l	12/14/88
ALKALINITY (CO3)	0		mg/l	12/14/88
BROMIDE	86	88	mg/l	12/14/88
CHLORIDE	78200	78600	mg/l	12/14/88
CYANIDE, TOTAL	< 0.02	< 0.05	mg/l	12/14/88
FLUORIDE	1.1	1.2	mg/l	12/14/88
IODIDE	< 2.0	< 2.0	mg/l	12/14/88
NITRATE	< 0.02	< 0.02	mg/l NO3-N	12/14/88
pH	6.97	6.98		12/14/88
PHENOLICS	< 0.029	1.100	mg/l	12/14/88
PHOSPHATE, TOTAL	0.01	< 0.01	mg/l T-PO4-P	12/14/88
RESIDUE, FILTERABLE @180 C	130000	124000	mg/l	12/14/88
RESIDUE, NONFILTERABLE @105 C	86	84	mg/l	12/14/88
SPECIFIC CONDUCTANCE	129000	129000	umhos/cm@25C	12/14/88
SULFATE	7500		mg/l	12/14/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	12/14/88
TOTAL ORGANIC HALOGEN	1.00	0.72	mg/l	12/14/88

TABLE 2.22.2
(continued)

CATIONS AND TRACE METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	(1.0	(1.0	(0.1	(0.1	mg/l	12/14/88
ANTIMONY	1.9	2.0	(0.05	(0.05	mg/l	12/14/88
ARSENIC	(0.050		(0.005	(0.005	mg/l	12/14/88
BARIUM	(0.050	(0.050	(0.005	(0.005	mg/l	12/14/88
BERYLLIUM	(0.050	(0.050	(0.005	(0.005	mg/l	12/14/88
BORON	41	41	(0.01	(0.01	mg/l	12/14/88
CADMIUM	0.15	0.15	(0.005	(0.005	mg/l	12/14/88
CALCIUM	1700	1700			mg/l	12/14/88
CESIUM	(0.060	(0.060	(0.06	(0.06	mg/l	12/14/88
CHROMIUM	0.70	0.80	(0.01	(0.01	mg/l	12/14/88
COBALT	0.20	0.20	(0.01	(0.01	mg/l	12/14/88
COPPER	0.10	0.10	(0.01	(0.01	mg/l	12/14/88
IRON	1.8	1.8	(0.01	(0.01	mg/l	12/14/88
LEAD	1.2	1.2	(0.05	(0.05	mg/l	12/14/88
LITHIUM	10	11	(0.01	(0.01	mg/l	12/14/88
MAGNESIUM	1700	1700			mg/l	12/14/88
MANGANESE	(0.050	(0.050	(0.005	(0.005	mg/l	12/14/88
MERCURY	(0.0004		(0.0002	(0.0002	mg/l	12/14/88
MOLYBDENUM	0.32	0.32	(0.05	0.05	mg/l	12/14/88
NICKEL	0.40	0.40	(0.03	(0.03	mg/l	12/14/88
POTASSIUM	1300	1380			mg/l	12/14/88
SELENIUM	(0.50		(0.005	(0.005	mg/l	12/14/88
SILICA	2.8	2.6			mg/l	12/14/88
SILVER	0.20	0.20	(0.01	(0.01	mg/l	12/14/88
SODIUM	44500	44000			mg/l	12/14/88
STRONTIUM	34	35	(0.01	(0.01	mg/l	12/14/88
THALLIUM	(0.050		(0.005	(0.005	mg/l	12/14/88
TITANIUM	(0.10	0.10	(0.01	(0.01	mg/l	12/14/88
VANADIUM	0.30	0.30	(0.01	(0.01	mg/l	12/14/88
ZINC	0.30	0.30	(0.01	(0.01	mg/l	12/14/88

TABLE 2.22.2
(continued)

VOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
ACETONE	(10	(10	(10		ug/l	12/14/88
BENZENE	(5.0	(5.0	(5.0		ug/l	12/14/88
2-BUTANONE	(10	(10	(10		ug/l	12/14/88
BROMOFORM	(5.0	(5.0	(5.0		ug/l	12/14/88
CARBON DISULFIDE	(5.0	(5.0	(5.0		ug/l	12/14/88
CARBON TETRACHLORIDE	(5.0	(5.0	(5.0		ug/l	12/14/88
CHLOROBENZENE	(5.0	(5.0	(5.0		ug/l	12/14/88
CHLORODIBROMOMETHANE	(5.0	(5.0	(5.0		ug/l	12/14/88
CHLOROETHANE	(10	(10	(10		ug/l	12/14/88
2-CHLOROETHYLVINYL ETHER	(10	(10	(10		ug/l	12/14/88
CHLOROFORM	(5.0	(5.0	(5.0		ug/l	12/14/88
CIS-1,3-DICHLOROPROPENE	(5.0	(5.0	(5.0		ug/l	12/14/88
DICHLOROBROMOMETHANE	(5.0	(5.0	(5.0		ug/l	12/14/88
1,1-DICHLOROETHANE	(5.0	(5.0	(5.0		ug/l	12/14/88
1,2-DICHLOROETHANE	(5.0	(5.0	(5.0		ug/l	12/14/88
1,1-DICHLOROETHYLENE	(5.0	(5.0	(5.0		ug/l	12/14/88
1,2-DICHLOROPROPANE	(5.0	(5.0	(5.0		ug/l	12/14/88
ETHYLBENZENE	(5.0	(5.0	(5.0		ug/l	12/14/88
2-HEXANONE	(10	(10	(10		ug/l	12/14/88
METHYL BROMIDE	(10	(10	(10		ug/l	12/14/88
METHYL CHLORIDE	(10	(10	(10		ug/l	12/14/88
4-METHYL-2-PENTANONE	(10	(10	(10		ug/l	12/14/88
METHYLENE CHLORIDE	5.6	5.3	(5.0		ug/l	12/14/88
STYRENE	(5.0	(5.0	(5.0		ug/l	12/14/88
1,1,2,2-TETRACHLOROETHANE	(5.0	(5.0	(5.0		ug/l	12/14/88
TETRACHLOROETHYLENE	(5.0	(5.0	(5.0		ug/l	12/14/88
TOLUENE	(5.0	(5.0	(5.0		ug/l	12/14/88
TRANS-1,2-DICHLOROETHYLENE	(5.0	(5.0	(5.0		ug/l	12/14/88
TRANS-1,3-DICHLOROPROPENE	(5.0	(5.0	(5.0		ug/l	12/14/88
1,1,1-TRICHLOROETHANE	(5.0	(5.0	(5.0		ug/l	12/14/88
1,1,2-TRICHLOROETHANE	(5.0	(5.0	(5.0		ug/l	12/14/88
TRICHLOROETHYLENE	(5.0	(5.0	(5.0		ug/l	12/14/88
VINYL ACETATE	(10	(10	(10		ug/l	12/14/88
VINYL CHLORIDE	(10	(10	(10		ug/l	12/14/88
TOTAL XYLENES	(5.0	(5.0	(5.0		ug/l	12/14/88

TABLE 2.22.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	(10		ug/l	12/14/88
ACENAPHTHYLENE	(10		ug/l	12/14/88
ANTHRACENE	(10		ug/l	12/14/88
BENZO(A)ANTHRACENE	(10		ug/l	12/14/88
BENZO(A)PYRENE	(10		ug/l	12/14/88
3,4-BENZOFLUORANTHENE	(10		ug/l	12/14/88
BENZO(G,H,I)PERYLENE	(10		ug/l	12/14/88
BENZOIC ACID	(50		ug/l	12/14/88
BENZO(K)FLUORANTHENE	(10		ug/l	12/14/88
BENZYL ALCOHOL	(10		ug/l	12/14/88
BIS(2-CHLOROETHOXY)METHANE	(10		ug/l	12/14/88
BIS(2-CHLOROETHYL)ETHER	(10		ug/l	12/14/88
BIS(2-CHLOROISOPROPYL)ETHER	(10		ug/l	12/14/88
BIS(2-ETHYLHEXYL)PHTHALATE	16		ug/l	12/14/88
4-BROMOPHENYL PHENYL ETHER	(10		ug/l	12/14/88
BUTYL BENZYL PHTHALATE	(10		ug/l	12/14/88
4-CHLOROANILINE	(10		ug/l	12/14/88
2-CHLORONAPHTHALENE	(10		ug/l	12/14/88
2-CHLOROPHENOL	(10		ug/l	12/14/88
4-CHLOROPHENYL PHENYL ETHER	(10		ug/l	12/14/88
CHRYSENE	(10		ug/l	12/14/88
DIBENZO(A,H)ANTHRACENE	(10		ug/l	12/14/88
DIBENZOFURAN	(10		ug/l	12/14/88
1,2-DICHLOROBENZENE	(10		ug/l	12/14/88
1,3-DICHLOROBENZENE	(10		ug/l	12/14/88
1,4-DICHLOROBENZENE	(10		ug/l	12/14/88
3,3'-DICHLOROBENZIDINE	(20		ug/l	12/14/88
2,4-DICHLOROPHENOL	(10		ug/l	12/14/88
DIETHYL PHTHALATE	(10		ug/l	12/14/88
2,4-DIMETHYLPHENOL	(10		ug/l	12/14/88
4,6-DINITRO-O-CRESOL	(50		ug/l	12/14/88
2,4-DINITROPHENOL	(50		ug/l	12/14/88
DIMETHYL PHTHALATE	(10		ug/l	12/14/88
DI-N-BUTYL PHTHALATE	(10		ug/l	12/14/88
2,4-DINITROTOLUENE	(10		ug/l	12/14/88
2,6-DINITROTOLUENE	(10		ug/l	12/14/88
DI-N-OCTYL PHTHALATE	(10		ug/l	12/14/88

TABLE 2.22.2
(continued)

SEMIVOLATILE HAZARDOUS SUBSTANCES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	12/14/88
FLUORENE	< 10		ug/l	12/14/88
HEXACHLOROBENZENE	< 10		ug/l	12/14/88
HEXACHLOROBUTADIENE	< 10		ug/l	12/14/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	12/14/88
HEXACHLOROETHANE	< 10		ug/l	12/14/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	12/14/88
ISOPHORONE	< 10		ug/l	12/14/88
2-METHYLNAPHTHALENE	< 10		ug/l	12/14/88
2-METHYLPHENOL	< 10		ug/l	12/14/88
4-METHYLPHENOL	< 10		ug/l	12/14/88
NAPHTHALENE	< 10		ug/l	12/14/88
2-NITROANILINE	< 50		ug/l	12/14/88
3-NITROANILINE	< 50		ug/l	12/14/88
4-NITROANILINE	< 50		ug/l	12/14/88
NITROBENZENE	< 10		ug/l	12/14/88
2-NITROPHENOL	< 10		ug/l	12/14/88
4-NITROPHENOL	< 50		ug/l	12/14/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	12/14/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	12/14/88
P-CHLORO-M-CRESOL	< 10		ug/l	12/14/88
PENTACHLOROPHENOL	< 50		ug/l	12/14/88
PHENANTHRENE	< 10		ug/l	12/14/88
PHENOL	< 10		ug/l	12/14/88
PYRENE	< 10		ug/l	12/14/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	12/14/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	12/14/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	12/14/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	12/14/88

TABLE 2.22.3

UNC LABORATORY ANALYSIS
H-12 CULEBRA ROUND THREE

DISSOLVED GASES AND REDOX COUPLES

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ARGON	9.25	9.14	cc/l (STP)	12/14/88
OXYGEN	1.74	0.62	cc/l (STP)	12/14/88
NITROGEN	36.83	121.02	cc/l (STP)	12/14/88
CARBON MONOXIDE	(0.001	(0.001	cc/l (STP)	12/14/88
CARBON DIOXIDE	1.790	3.000	cc/l (STP)	12/14/88
METHANE	0.198	0.068	cc/l (STP)	12/14/88
ETHANE	(0.001	(0.001	cc/l (STP)	12/14/88
C-3	(0.001	(0.001	cc/l (STP)	12/14/88
C-4	(0.001	(0.001	cc/l (STP)	12/14/88
C-5	(0.001	(0.001	cc/l (STP)	12/14/88
C-6	(0.001	(0.001	cc/l (STP)	12/14/88
SUM OF CO2	46.55		cc/l (STP)	12/14/88
TOTAL GAS	91.831		cc/l (STP)	12/14/88
AMMONIA	2.32	2.32	mg/l	12/14/88
NITRATE	(0.50	(0.50	mg/l	12/14/88
TOTAL IRON	2.110	2.090	mg/l	12/14/88
FERROUS IRON	2.09	2.06	mg/l	12/14/88
TOTAL ARSENIC	0.0072	0.0072	mg/l	12/14/88
ARSENIC III	0.0013	0.0014	mg/l	12/14/88
TOTAL SELENIUM	0.001	0.001	mg/l	12/14/88
SELENIUM IV	0.001		mg/l	12/14/88
IODIDE	250	280	ug/l	12/14/88
IODATE	(15	(15	ug/l	12/14/88

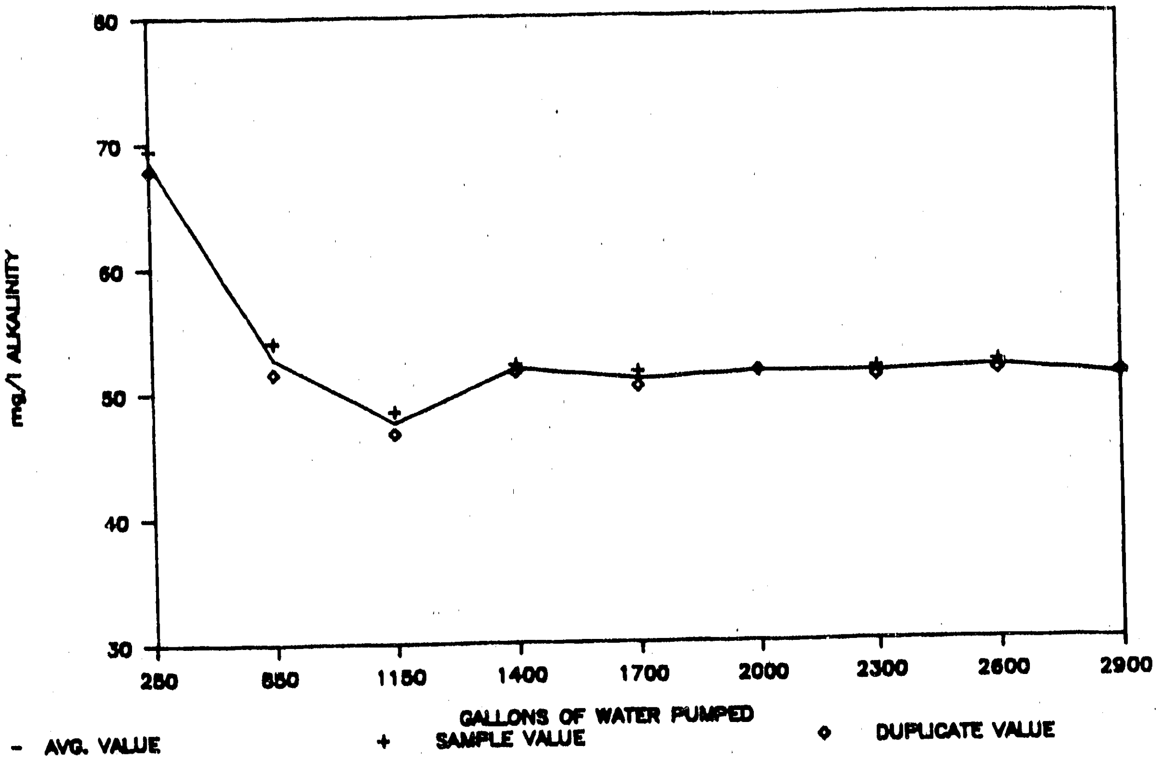
TABLE 2.22.4

PRESSURE AND FLOW
H-12 CULEBRA ROUND THREE

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
11/08/88	06:52	111	159	00	PUMP OFF
11/08/88	07:32	112	145	16	PUMP ON 07:32
11/08/88	07:45	111	125	13	
11/08/88	08:00	109	139	14	PUMP OFF 08:20
11/10/88	12:47	109	156	00	PUMP ON 13:00 FAILURE
12/01/88	13:20	114	162	00	PUMP NOT ON
12/01/88	13:23	114	162	00	PACKER INFLATING
12/01/88	13:25	115	167	00	PACKER SEALS
12/01/88	14:00	114	98	14	PUMP ON 13:43
12/01/88	14:10	114	91	15	FLOW REDUCED
12/01/88	14:20	113	98	13	
12/01/88	14:30	113	98	13	
12/01/88	14:45	112	97	13	
12/01/88	15:00	111	96	13	
12/01/88	15:15	110	91	13	
12/01/88	15:30	110	90	13	
12/01/88	22:30	76	116	12	DIFFERENTIAL PRESSURE
12/02/88	08:00	52	92	11	EXCEEDED
12/02/88	15:00	44	82	10	
12/03/88	07:30	60	114	00	PUMP OFF
12/05/88	07:40	95	141	22	PUMP ON 07:25
12/05/88	10:45	69	116	20	
12/05/88	11:00	67	114	17	
12/05/88	11:30	64	110	19	
12/05/88	12:00	61	108	17	
12/05/88	13:00	57	102	14	
12/05/88	16:15	44	75	12	
12/06/88	07:30	61	118	00	PUMP FAILURE
12/06/88	14:43	75	122	00	PUMP OFF
12/06/88	15:15	75	56	12	PUMP ON 15:04
12/06/88	15:30	76	61	13	
12/06/88	15:45	76	50	12	
12/06/88	18:00	75	43	12	
12/07/88	07:00	75	36	12	
12/07/88	14:30	75	30	12	
12/08/88	07:30	76	35	11	
12/08/88	15:30	76	24	13	
12/09/88	07:00	76	21	12	
12/09/88	15:00	75	21	12	
12/10/88	07:00	75	27	12	
12/10/88	09:30	75	26	12	
12/11/88	08:30	75	20	12	
12/11/88	12:00	75	25	11	
12/12/88	07:30	75	20	12	

TABLE 2.22.4
(continued)

DATE	TIME	PSI ABOVE PACKER	PSI BELOW PACKER	GPH FLOW RATE	COMMENTS
12/12/88	14:00	75	23	11	
12/13/88	08:00	75	24	12	
12/13/88	18:00	75	18	13	
12/14/88	06:00	75	21	13	PUMP FAILURE @
12/14/88	15:40	74	121	00	14:00-14:30



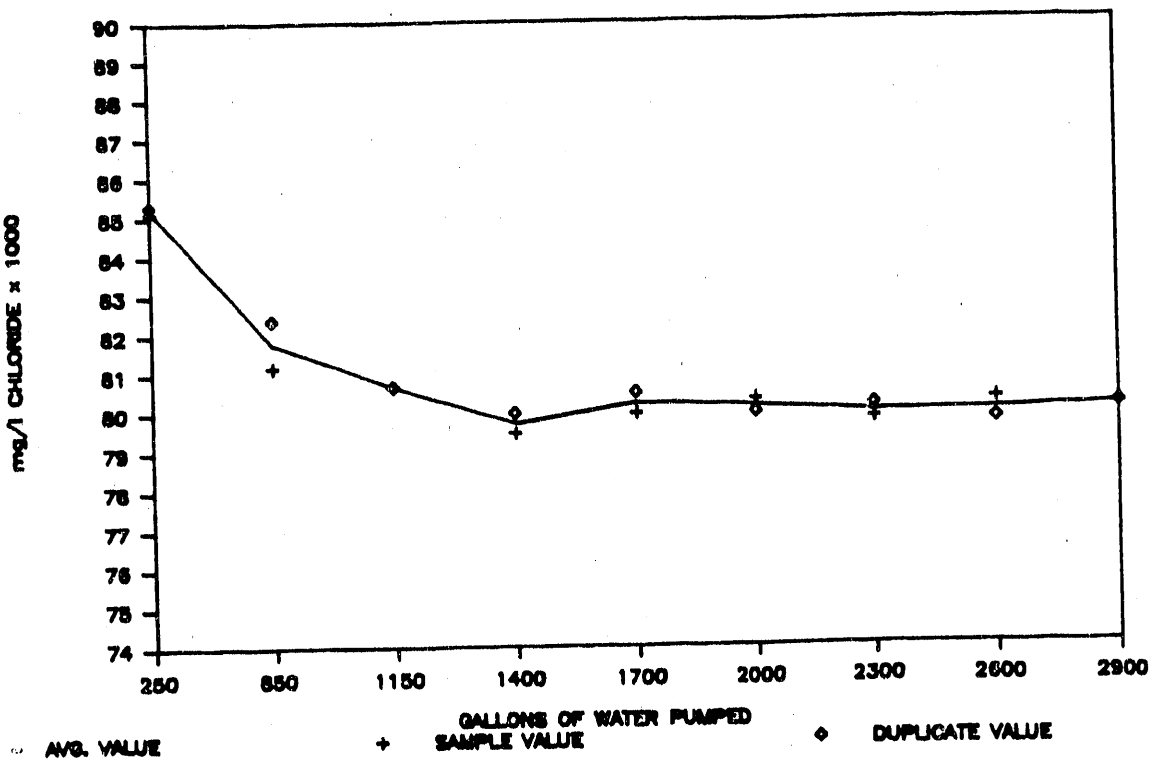


Figure 2.22.1. Graphs of alkalinity and chloride from third round serial sampling at well H-12 Culebra.

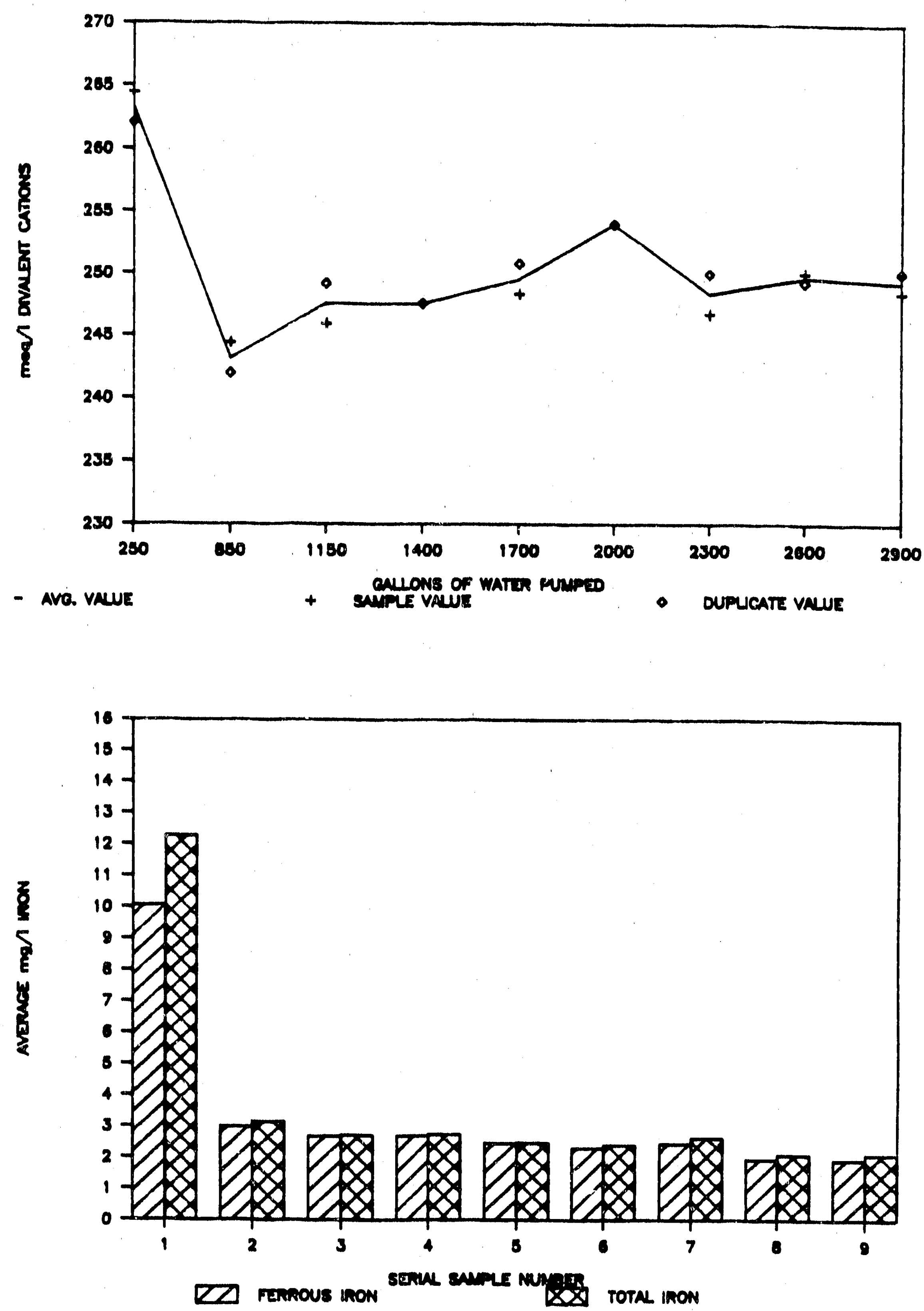


Figure 2.22.2. Graphs of divalent cations and iron from second round serial sampling at well H-12 Culebra.

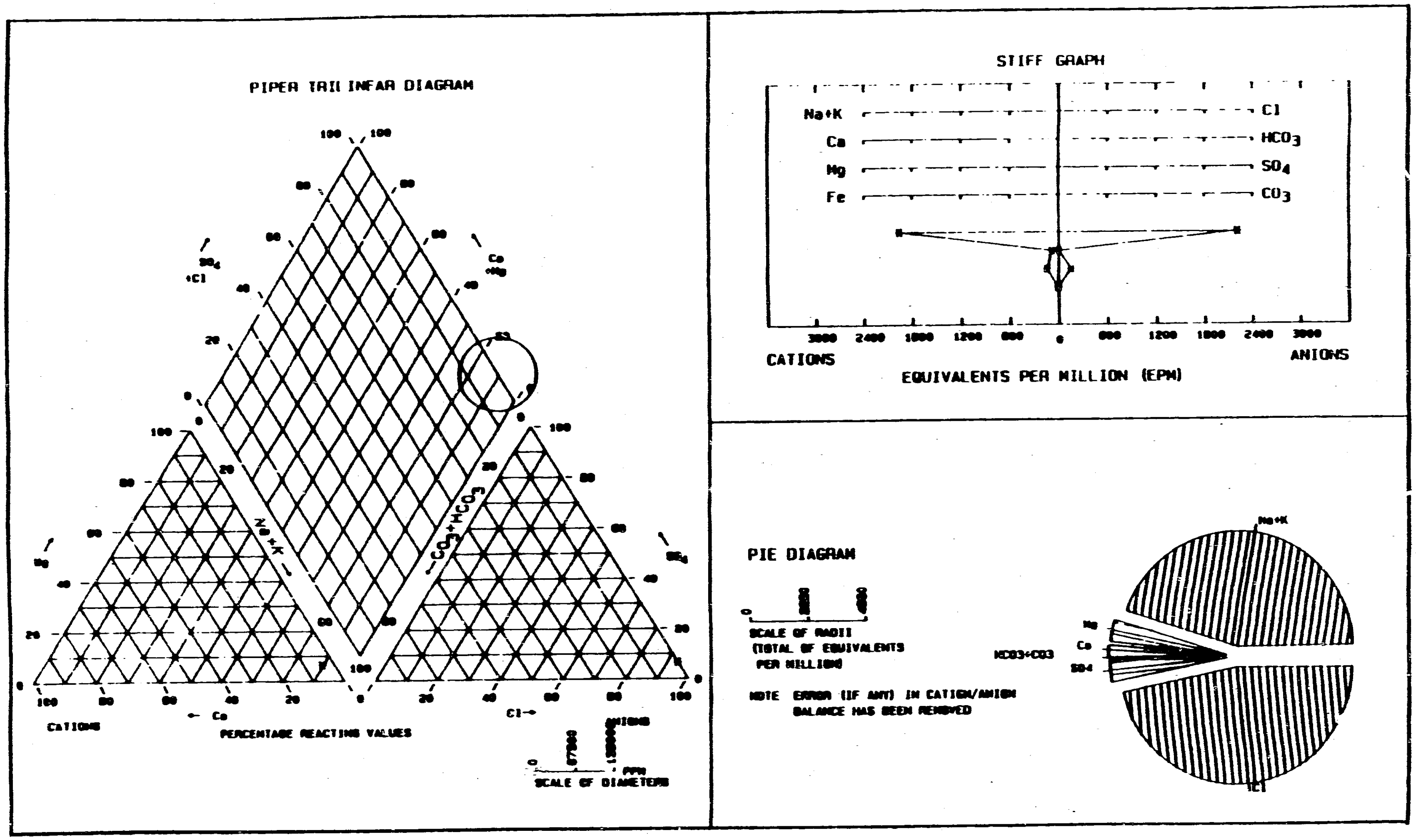


Figure 2.22.3 Stiff graph, pie diagram, and Piper trilinear diagram illustrating the water chemistry from third round serial sampling at well H-12 Culebra.

3.0 PRIVATE WELL DATA

Ten private wells in the WIPP vicinity (11 sampling episodes) were sampled by the WQSP in 1988. A total of 11 privately-owned wells in the WIPP vicinity have been selected by the WQSP for sampling at least twice during the pre-operational baseline establishment period at the WIPP. These private wells were sampled for primary and secondary drinking water parameters (EPA 40 CFR 141). When the private well was thought to be completed and producing from the Culebra Dolomite Member of the Rustler Formation, the parameter list was expanded to partially mimic the final sample parameters analyzed by the contract laboratories for the WQSP wells.

Generally, the sample collection process for private wells conforms to procedures for the WQSP final sample collections (WIPP Geotechnical and Geosciences Procedure Manual, WP 07-230). However, several factors prohibit serial sampling of the private wells. First, the wells and pumping systems are generally under the control of private individuals who utilize these wells to water livestock. There are problems with removal of private property and the installation of WQSP pumping equipment for sampling; consequently, this has not been a common practice. Second, several of the wells are extremely poor producers which can only be pumped for limited periods of time before they are dewatered. Third, many of the wells are pumped by windmills and water is only produced intermittently. Consequently, these wells are sampled in a grab-sample fashion with the owners' pumping systems in place. Three of the privately-owned wells have been sampled by the WQSP before, under WQSP procedures. These wells include Twin Wells-Pasture Well, Ranch Well, and Engle Well. Comparative data for these and the other private wells can be found in Uhland and Randall (1986), Uhland et al. (1987), Randall et al. (1988), and this report.

Each privately-owned well sampling episode is reported here utilizing a short summary of the sampling episode and a table of field and laboratory analytical results.

3.1 SUMMARY OF WELL USGS-1, CULEBRA, ROUND ONE

Well Characteristics

Well USGS-1 is located approximately 8.9 miles southwest of the center of the WIPP site at an elevation of approximately 3,426 feet above MSL (Gonzales, 1989). The well was originally constructed as an observation and test hole as part of the Gnome Project, an underground nuclear test in 1961. Total depth of the drilled hole was 722 feet BGS, but after being cased the hole was plugged back to 566 feet BGS. The casing is perforated in one zone accessing the Culebra Dolomite Member of the Rustler Formation. The Culebra Dolomite occurs here at a depth interval of 517 to 549 feet BGS, and is the source of water sampled from this well (Cooper and Glanzman, 1971). Following activities at the Gnome site, and after several years of monitoring which indicated that no contamination was present, the well was released to local ranchers for their use. Water from this well is currently pumped by a windmill.

Sampling Process

Water samples were collected on 04/12/88, from a port on the discharge pipe before it empties into a storage tank. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 7.8 SU, a specific conductance of 4,850 umhos/cm at 25°C, and a specific gravity of 1.003 at 20.8°C.

Alkalinity was analyzed at approximately 107 mg/l.

Chloride concentration averaged 672 mg/l over two measurements.

Divalent cations were 41 meq/l.

General Observations

This well supplies drinking water for livestock.

Tabular data from field analysis and ITAS final results are presented in Table 3.1.1.

No problems were encountered during the sampling process.

TABLE 3.1.1

FIELD AND ITAS ANALYSIS
USGS-1 CULEBRA ROUND ONE

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	107	107	mg/l	04/12/88
CHLORIDE	675	668	mg/l	04/12/88
DIVALENT CATIONS	41.4	41.2	meq/l	04/12/88
pH	7.8			04/12/88
SPECIFIC CONDUCTANCE	4850	@ 25 C	umhos/cm	04/12/88
SPECIFIC GRAVITY	1.003		@ 20.8 C	04/12/88

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	110		mg/l	04/12/88
ALKALINITY (CO3)	0		mg/l	04/12/88
BROMIDE	6		mg/l	04/12/88
CHLORIDE	600		mg/l	04/12/88
FLUORIDE	1.9		mg/l	04/12/88
IODIDE	(2.0		mg/l	04/12/88
NITRATE	4.0		mg/l NO3-N	04/12/88
pH	7.35	7.36		04/12/88
PHOSPHATE, TOTAL	0.02	0.03	mg/l T-PO4-P	04/12/88
RESIDUE, FILTERABLE @180 C	2100		mg/l	04/12/88
RESIDUE, NONFILTERABLE @105 C	7		mg/l	04/12/88
SPECIFIC CONDUCTANCE	5200	5220	umhos/cm@25C	04/12/88
SULFATE	2100		mg/l	04/12/88
TOTAL ORGANIC CARBON	(1.0	(1.0	mg/l	04/12/88
TOTAL ORGANIC HALOGEN	(0.05	0.06	mg/l	04/12/88

TABLE 3.1.1
(continued)

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	1.0	1.0	< 0.1	< 0.1	mg/l	04/12/88
ANTIMONY	0.50	< 0.50	< 0.05	< 0.05	mg/l	04/12/88
ARSENIC	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/12/88
BARIUM	0.090	0.090	< 0.005	< 0.005	mg/l	04/12/88
BERYLLIUM	0.010	0.010	< 0.005	< 0.005	mg/l	04/12/88
BORON	0.78	0.78	0.023	< 0.005	mg/l	04/12/88
CADMIUM	< 0.0010	< 0.0010	< 0.001	< 0.001	mg/l	04/12/88
CALCIUM	540	540			mg/l	04/12/88
CESIUM	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	04/12/88
CHROMIUM	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/12/88
COBALT	0.20	0.10	< 0.01	< 0.01	mg/l	04/12/88
COPPER	0.40	0.40	< 0.01	< 0.01	mg/l	04/12/88
IRON	0.20	0.20	< 0.01	< 0.01	mg/l	04/12/88
LEAD	< 0.0050		< 0.005	< 0.005	mg/l	04/12/88
LITHIUM	0.10	0.10	< 0.005	< 0.005	mg/l	04/12/88
MAGNESIUM	110	110			mg/l	04/12/88
MANGANESE	< 0.050	< 0.050	< 0.005	< 0.005	mg/l	04/12/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	04/12/88
MOLYBDENUM	< 5.0	< 5.0	< 0.01	< 0.01	mg/l	04/12/88
NICKEL	< 0.30	< 0.30	< 0.03	< 0.03	mg/l	04/12/88
POTASSIUM	14	14			mg/l	04/12/88
SELENIUM	< 0.050		< 0.005	< 0.005	mg/l	04/12/88
SILICA	< 0.40				mg/l	04/12/88
SILVER	< 0.0050		< 0.005	< 0.005	mg/l	04/12/88
SODIUM	420	430			mg/l	04/12/88
STRONTIUM	7.5	7.4	< 0.01	< 0.01	mg/l	04/12/88
THALLIUM	< 0.0050		< 0.005	< 0.005	mg/l	04/12/88
TITANIUM	0.80	0.70	< 0.01	< 0.01	mg/l	04/12/88
VANADIUM	0.30	0.30	< 0.01	< 0.01	mg/l	04/12/88
ZINC	< 0.10	< 0.10	< 0.01	< 0.01	mg/l	04/12/88

TABLE 3.1.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	(1.0		(1.0		ug/l	04/12/88
BROMOFORM	(1.0		(1.0		ug/l	04/12/88
CARBON TETRACHLORIDE	(1.0		(1.0		ug/l	04/12/88
CHLORODIBROMOMETHANE	(1.0		(1.0		ug/l	04/12/88
CHLOROFORM	(1.0		(1.0		ug/l	04/12/88
DICHLOROBROMOMETHANE	(1.0		(1.0		ug/l	04/12/88
P-DICHLOROBENZENE	(1.0		(1.0		ug/l	04/12/88
1,2-DICHLOROETHANE	(1.0		(1.0		ug/l	04/12/88
1,1-DICHLOROETHYLENE	(1.0		(1.0		ug/l	04/12/88
TETRACHLOROETHYLENE	(1.0		(1.0		ug/l	04/12/88
1,1,1-TRICHLOROETHANE	(1.0		(1.0		ug/l	04/12/88
TRICHLOROETHYLENE	(1.0		(1.0		ug/l	04/12/88
VINYL CHLORIDE	(2.0		(2.0		ug/l	04/12/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	(0.02	ug/l	04/12/88
LINDANE	(0.04	ug/l	04/12/88
METHOXYCHLOR	(0.001	mg/l	04/12/88
TOXAPHENE	(0.0005	mg/l	04/12/88
2,4-D	(0.005	mg/l	04/12/88
2,4,5-TP (SILVEX)	(0.0005	mg/l	04/12/88

3.2 SUMMARY OF MOBLEY WELL, CULEBRA, ROUND TWO

Well Characteristics

Mobley Well is located approximately 6.8 miles (on Figure 1.2) southwest of the center of the WIPP site. Very little is known about the completion of this well. The water quality is very similar to that at H-07b (less than two miles east of Mobley Well). It is thought that this well is completed in the Culebra Dolomite Member of the Rustler Formation. The water is pumped by an electric submersible pump to a pressurized holding tank located inside a small building.

Sampling Process

Water samples were collected on 04/14/88, from a spigot located on the north side of the small building housing the pressurized holding tank. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 7.3 SU, a specific conductance of 4,340 umhos/cm at 25°C, and a specific gravity of 1.000 at 25.2°C.

Alkalinity analyses averaged 134 mg/l.

Chloride concentration was approximately 480 mg/l.

Divalent cations were 43 meq/l.

General Observations

This well supplies water for domestic livestock.

Tabular data from field analysis and ITAS final results are presented in Table 3.2.1.

No problems were encountered during the sampling process.

Field Parameter Comparison With The Previous Round

Sampling parameters analyzed in the field laboratory are generally in good agreement for rounds one and two. Values reported for the field parameters are nearly identical for each round.

TABLE 3.2.1

FIELD AND ITAS ANALYSIS
MOBLEY WELL CULEBRA ROUND TWO

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	134	133	mg/l	04/14/88
CHLORIDE	478	481	mg/l	04/14/88
DIVALENT CATIONS	43.4	43.2	meq/l	04/14/88
pH	7.3			04/14/88
SPECIFIC CONDUCTANCE	4340	@ 25 C	umhos/cm	04/14/88
SPECIFIC GRAVITY	1.000		@ 25.2 C	04/14/88

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	140		mg/l	04/14/88
ALKALINITY (CO3)	0		mg/l	04/14/88
BROMIDE	5		mg/l	04/14/88
CHLORIDE	430		mg/l	04/14/88
FLUORIDE	2.2		mg/l	04/14/88
IODIDE	< 2.0		mg/l	04/14/88
NITRATE	1.2		mg/l NO3-N	04/14/88
pH	7.10			04/14/88
PHOSPHATE, TOTAL	< 0.01	< 0.01	mg/l T-PO4-P	04/14/88
RESIDUE, FILTERABLE @180 C	3800		mg/l	04/14/88
RESIDUE, NONFILTERABLE @105 C	< 4		mg/l	04/14/88
SPECIFIC CONDUCTANCE	4530		umhos/cm@25C	04/14/88
SULFATE	2100		mg/l	04/14/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	04/14/88
TOTAL ORGANIC HALOGEN	< 0.05	< 0.05	mg/l	04/14/88

TABLE 3.2.1
(continued)

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	0.20	0.20	< 0.1	< 0.1	mg/l	04/14/88
ANTIMONY	0.12	0.15	< 0.05	< 0.05	mg/l	04/14/88
ARSENIC	0.0050	0.0050	< 0.005	< 0.005	mg/l	04/14/88
BARIUM	0.016	0.017	< 0.005	< 0.005	mg/l	04/14/88
BERYLLIUM	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/14/88
BORON	1.6	1.7	0.03	< 0.01	mg/l	04/14/88
CADMIUM	< 0.010		< 0.001	< 0.001	mg/l	04/14/88
CALCIUM	620	610			mg/l	04/14/88
CESIUM	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	04/14/88
CHROMIUM	< 0.0050		< 0.005	< 0.005	mg/l	04/14/88
COBALT	0.020	0.030	< 0.01	< 0.01	mg/l	04/14/88
COPPER	0.040	0.050	0.01	0.01	mg/l	04/14/88
IRON	0.060	0.060	0.04	< 0.01	mg/l	04/14/88
LEAD	< 0.0050		< 0.005	< 0.005	mg/l	04/14/88
LITHIUM	0.20	0.20	< 0.01	< 0.01	mg/l	04/14/88
MAGNESIUM	140	140			mg/l	04/14/88
MANGANESE	0.0080	0.0090	< 0.005	< 0.005	mg/l	04/14/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	04/14/88
MOLYBDENUM	< 10	< 10	< 0.01	< 0.01	mg/l	04/14/88
NICKEL	0.040	0.040	< 0.03	< 0.03	mg/l	04/14/88
POTASSIUM	10	10			mg/l	04/14/88
SELENIUM	0.011		< 0.005	< 0.005	mg/l	04/14/88
SILICA	19				mg/l	04/14/88
SILVER	< 0.0050		< 0.005	< 0.005	mg/l	04/14/88
SODIUM	280	280			mg/l	04/14/88
STRONTIUM	9.1	9.2	< 0.01	< 0.01	mg/l	04/14/88
THALLIUM	< 0.0050		< 0.005	< 0.005	mg/l	04/14/88
TITANIUM	0.30	0.33	< 0.03	< 0.03	mg/l	04/14/88
VANADIUM	0.080	0.090	< 0.01	< 0.01	mg/l	04/14/88
ZINC	< 0.010	0.010	< 0.01	< 0.01	mg/l	04/14/88

TABLE 3.2.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	04/14/88
BROMOFORM	< 1.0		< 1.0		ug/l	04/14/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	04/14/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	04/14/88
CHLOROFORM	< 1.0		< 1.0		ug/l	04/14/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	04/14/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	04/14/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	04/14/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	04/14/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	04/14/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	04/14/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	04/14/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	04/14/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	04/14/88
LINDANE	< 0.04	ug/l	04/14/88
METHOXYCHLOR	< 0.001	mg/l	04/14/88
TOXAPHENE	< 0.0005	mg/l	04/14/88
2,4-D	< 0.005	mg/l	04/14/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	04/14/88

3.3 SUMMARY OF BARN WELL, DEWEY LAKE, ROUND TWO

Well Characteristics

Barn Well (possibly referred to as "Conoco Well" in Cooper and Glanzman, 1971) is located approximately 3.4 miles south southwest of the center of the WIPP site at an elevation of 3,315 feet above MSL. This well is completed in the Dewey Lake Red Beds. The total depth of this well is 138 feet BGS (Cooper and Glanzman, 1971). The water is pumped by an electric submersible pump.

Sampling Process

Water samples were collected on 04/20/88, from a spigot located in the owner's yard. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 8.0 SU, a specific conductance of 1,060 umhos/cm at 25°C, and a specific gravity of at 1.001 at 25.1°C.

Alkalinity was analyzed as approximately 284 mg/l.

Chloride concentration was 43 mg/l.

Divalent cations were 7.5 meq/l.

General Observations

This well supplies drinking water for a residence located approximately one mile northwest of the well site.

Tabular data from field and ITAS final results are presented in Table 3.3.1.

No problems were encountered during the sampling process.

Field Parameter Comparison With The Previous Round

Sampling parameters analyzed in the field laboratory are generally in good agreement between rounds one and two. Slight variations exist with alkalinity, chloride, and divalent cations. Alkalinity was reported at 283 mg/l in round two compared with 276 mg/l for round one. Chloride concentrations were reported at 52 mg/l in round one and at 43 mg/l for round two. Divalent cation values appeared to increase from 6.4 to 7.5 meq/l between rounds one and two. All other field parameters were nearly identical between rounds one and two.

TABLE 3.3.1

FIELD AND ITAS ANALYSIS
BARN WELL DEWEY LAKE ROUND TWO

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	285	282	mg/l	04/20/88
CHLORIDE	43	43	mg/l	04/20/88
DIVALENT CATIONS	7.4	7.5	meq/l	04/20/88
pH	8.0			04/20/88
SPECIFIC CONDUCTANCE	1060	@ 25 C	umhos/cm	04/20/88
SPECIFIC GRAVITY	1.001		@ 25.1 C	04/20/88

TABLE 3.3.1
(continued)

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
CHLORIDE	39		mg/l	04/20/88
COLOR	< 1		CU	04/20/88
LSI CORROSIVITY	0.02			04/20/88
FLUORIDE	2.6	2.6	mg/l	04/20/88
NITRATE	7.2	6.9	mg/l NO3-N	04/20/88
MBAS	0.030		mg/l	04/20/88
ODOR	1		T.O.N.	04/20/88
pH	7.69	7.72		04/20/88
RESIDUE, FILTERABLE @180 C	720		mg/l	04/20/88
SULFATE	230		mg/l	04/20/88
TURBIDITY	1.0		NTU	04/20/88

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ARSENIC	0.0060		< 0.005	< 0.005	mg/l	04/20/88
BARIUM	0.032	0.032	< 0.005	< 0.005	mg/l	04/20/88
CADMIUM	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/20/88
CHROMIUM	0.020	0.020	0.02	0.01	mg/l	04/20/88
COPPER	0.010	0.010	0.02	0.01	mg/l	04/20/88
IRON	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	04/20/88
LEAD	< 0.050	< 0.050	< 0.05	< 0.05	mg/l	04/20/88
MANGANESE	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/20/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	04/20/88
SELENIUM	0.032		< 0.005	< 0.005	mg/l	04/20/88
SILVER	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	04/20/88
ZINC	0.030	0.030	< 0.01	< 0.01	mg/l	04/20/88

TABLE 3.3.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	04/20/88
BROMOFORM	< 1.0		< 1.0		ug/l	04/20/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	04/20/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	04/20/88
CHLOROFORM	< 1.0		< 1.0		ug/l	04/20/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	04/20/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	04/20/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	04/20/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	04/20/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	04/20/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	04/20/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	04/20/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	04/20/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	04/20/88
LINDANE	< 0.04	ug/l	04/20/88
METHOXYCHLOR	< 0.001	mg/l	04/20/88
TOXAPHENE	< 0.0005	mg/l	04/20/88
2,4-D	< 0.005	mg/l	04/20/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	04/20/88

3.4 SUMMARY OF RANCH WELL, DEWEY LAKE, ROUND THREE

Well Characteristics

Ranch Well is located approximately 3.2 miles south southwest of the center of the WIPP site at an elevation of 3,310 feet above MSL. This well is completed in the Dewey Lake Red Beds Formation. The total depth of this well is 166 feet BGS (Cooper and Glanzman, 1971). The water is pumped by an electric submersible pump.

Sampling Process

Samples were collected on 04/20/88, from a discharge pipe above a storage tank approximately 20 feet north of the well. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 7.3 SU, a specific conductance of 4,060 umhos/cm at 25°C, and a specific gravity of 1.001 at 25.1°C.

Alkalinity was analyzed at approximately 249 mg/l.

Chloride concentration averaged 453 mg/l.

Divalent cations were approximately 39 meq/l.

General Observations

This well supplies water for domestic livestock.

Tabular data from field analysis and ITAS final results are presented in Table 3.4.1.

No problems were encountered during the sampling process.

Field Parameter Comparisons With The Previous Rounds

Sampling parameters analyzed in the field laboratory exhibit variations between rounds. Round one sampling of this well was conducted similar to the WQSP wells in the vicinity of the WIPP site, including continuous pumping and serial sampling for various parameters. Sampling episodes two and three were conducted similar to other private wells in the private well program, by grab sampling. Over the three rounds of sampling pH values ranged from 6.9 to 7.5 SU, specific conductance ranged from 3,910 to 4,410 umhos/cm at 25°C, and chloride concentrations varied between 397 and 469 mg/l. Alkalinity was reported at 217, 40, and 250 mg/l for rounds one, two, and three, respectively. Round two ITAS final results report alkalinity at 250 mg/l, so the round two field result is suspect, possibly the result of mistakenly analyzing the wrong sample. Divalent cations and specific gravity values are in good agreement over all three rounds of sampling.

TABLE 3.4.1

FIELD AND ITAS ANALYSIS
RANCH WELL DEWEY LAKE ROUND THREE

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	249	248	mg/l	04/20/88
CHLORIDE	454	452	mg/l	04/20/88
DIVALENT CATIONS	39.0	38.8	meq/l	04/20/88
pH	7.3			04/20/88
SPECIFIC CONDUCTANCE	4060	@ 25 C	umhos/cm	04/20/88
SPECIFIC GRAVITY	1.001		@ 25.1 C	04/20/88

TABLE 3.4.1
(continued)

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
CHLORIDE	440		mg/l	04/20/88
COLOR	< 1		CU	04/20/88
LSI CORROSIVITY	0.02			04/20/88
FLUORIDE	0.9		mg/l	04/20/88
NITRATE	110		mg/l NO3-N	04/20/88
MBAS	0.070	0.050	mg/l	04/20/88
ODOR	1		T.O.N.	04/20/88
pH	7.04			04/20/88
RESIDUE, FILTERABLE @180 C	2900	3100	mg/l	04/20/88
SULFATE	1000		mg/l	04/20/88
TURBIDITY	2.0	2.2	NTU	04/20/88

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ARSENIC	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/20/88
BARIUM	0.0070	0.0070	< 0.005	< 0.005	mg/l	04/20/88
CADMIUM	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/20/88
CHROMIUM	0.040	0.060	< 0.01	< 0.01	mg/l	04/20/88
COPPER	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	04/20/88
IRON	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	04/20/88
LEAD	< 0.050	< 0.080	< 0.05	< 0.05	mg/l	04/20/88
MANGANESE	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	04/20/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	04/20/88
SELENIUM	0.055		< 0.005	< 0.005	mg/l	04/20/88
SILVER	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	04/20/88
ZINC	0.090	0.090	< 0.01	< 0.01	mg/l	04/20/88

TABLE 3.4.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	04/20/88
BROMOFORM	< 1.0		< 1.0		ug/l	04/20/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	04/20/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	04/20/88
CHLOROFORM	< 1.0		< 1.0		ug/l	04/20/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	04/20/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	04/20/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	04/20/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	04/20/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	04/20/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	04/20/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	04/20/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	04/20/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	04/20/88
LINDANE	< 0.04	ug/l	04/20/88
METHOXYCHLOR	< 0.001	mg/l	04/20/88
TOXAPHENE	< 0.0005	mg/l	04/20/88
2,4-D	< 0.005	mg/l	04/20/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	04/20/88

3.5 SUMMARY OF COMANCHE WELL, DOCKUM GROUP, ROUND TWO

Well Characteristics

Comanche Well is located approximately 8.6 miles east northeast of the center of the WIPP site. Very little is known about the completion of this well. The water is pumped using an electric jack pump. This well is thought to be completed in the Dockum Group.

Sampling Process

Water samples were collected on 06/28/88, from a spigot installed at the top of the well head. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected and analyzed in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 8.0 SU, a specific conductance of 568 umhos/cm at 25°C, and a specific gravity of 1.002 at 22.8°C.

Alkalinity was analyzed at approximately 228 mg/l.

Chloride concentration averaged 27 mg/l.

Divalent cations were approximately 3.5 meq/l.

General Observations

This well supplies water for livestock.

Tabular data from field analysis and ITAS final results are presented in Table 3.5.1.

No problems were encountered during the sampling process.

Field Parameter Comparison With The Previous Round

Parameters analyzed in the field show excellent agreement between each sampling episode. Values for all measured parameters in round two were nearly unchanged from those reported in the round one sampling.

TABLE 3.5.1

FIELD AND ITAS ANALYSIS
COMANCHE WELL DOCKUM ROUND TWO

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	228	227	mg/l	06/28/88
CHLORIDE	28	26	mg/l	06/28/88
DIVALENT CATIONS	3.5	3.5	meq/l	06/28/88
pH	8.0			06/28/88
SPECIFIC CONDUCTANCE	568		@ 25 C umhos/cm	06/28/88
SPECIFIC GRAVITY	1.002		@ 22.8 C	06/28/88

TABLE 3.5.1
(continued)

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
CHLORIDE	27		mg/l	06/28/88
COLOR	< 1	< 1	CU	06/28/88
LSI CORROSIVITY	0.36			06/28/88
FLUORIDE	2.3	2.2	mg/l	06/28/88
NITRATE	5.8		mg/l NO3-N	06/28/88
MBAS	0.070		mg/l	06/28/88
ODOR	< 1		T.O.N.	06/28/88
pH	7.26			06/28/88
RESIDUE, FILTERABLE @180 C	340	330	mg/l	06/28/88
SULFATE	66	63	mg/l	06/28/88
TURBIDITY	< 0.9	< 0.9	NTU	06/28/88

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ARSENIC	< 0.0050		< 0.005	< 0.005	mg/l	06/28/88
BARIUM	0.058	0.058	< 0.005	< 0.005	mg/l	06/28/88
CADMIUM	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	06/28/88
CHROMIUM	< 0.010	< 0.010	< 0.01	0.01	mg/l	06/28/88
COPPER	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	06/28/88
IRON	0.020	0.020	< 0.01	< 0.01	mg/l	06/28/88
LEAD	< 0.050	< 0.050	< 0.05	< 0.05	mg/l	06/28/88
MANGANESE	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	06/28/88
MERCURY	< 0.0002	< 0.0002	< 0.0002	< 0.0002	mg/l	06/28/88
SELENIUM	< 0.0050		< 0.005	< 0.005	mg/l	06/28/88
SILVER	< 0.010		< 0.01	< 0.01	mg/l	06/28/88
ZINC	0.44	0.45	< 0.01	< 0.01	mg/l	06/28/88

TABLE 3.5.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	06/28/88
BROMOFORM	< 1.0		< 1.0		ug/l	06/28/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	06/28/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	06/28/88
CHLOROFORM	< 1.0		< 1.0		ug/l	06/28/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	06/28/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	06/28/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	06/28/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	06/28/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	06/28/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	06/28/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	06/28/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	06/28/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	06/28/88
LINDANE	< 0.04	ug/l	06/28/88
METHOXYCHLOR	< 0.001	mg/l	06/28/88
TOXAPHENE	< 0.0005	mg/l	06/28/88
2,4-D	< 0.005	mg/l	06/28/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	06/28/88

3.6 SUMMARY OF CLIFTON WELL, DOCKUM GROUP, ROUND TWO

Well Characteristics

Clifton Well is located approximately 7.5 miles east southeast of the center of the WIPP site at an elevation of 3,630 feet above MSL. This well is probably completed in the Dockum Group. The total depth of this well is 550 feet BGS (Cooper and Glanzman, 1971). The water is pumped by an electric submersible pump.

Sampling Process

Water samples were collected on 06/29/88, from a discharge pipe above a storage tank located about 100 meters from the well. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 7.5 SU, a specific conductance of 1,150 umhos/cm at 25°C, and a specific gravity of 1.002 at 22.9°C.

Alkalinity was analyzed at 231 mg/l.

Chloride concentration was 49 mg/l.

Divalent cations were 2.8 meq/l.

General Observations

This well supplies drinking water for livestock.

Tabular data from field analysis and ITAS final results are presented in Table 3.6.1.

No problems were encountered during the sampling process.

Field Parameter Comparison With The Previous Round

Sampling parameters analyzed in the field laboratory are generally in good agreement between rounds one and two. Alkalinity was reported at 165 mg/l in round one and 230 mg/l in round two. All other parameters were virtually unchanged.

TABLE 3.6.1

FIELD AND ITAS ANALYSIS
CLIFTON WELL DOCKUM ROUND TWO

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	231	230	mg/l	06/29/88
CHLORIDE	49	48	mg/l	06/29/88
DIVALENT CATIONS	2.8	2.8	meq/l	06/29/88
pH	7.5			06/29/88
SPECIFIC CONDUCTANCE	1150	@ 25 C	umhos/cm	06/29/88
SPECIFIC GRAVITY	1.002		@ 22.9 C	06/29/88

TABLE 3.6.1
(continued)

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
CHLORIDE	50		mg/l	06/29/88
COLOR	(1		CU	06/29/88
LSI CORROSIVITY	0.60			06/29/88
FLUORIDE	1.5		mg/l	06/29/88
NI[illegible]	8.4		mg/l NO3-N	06/29/88
MBAS	0.070	0.070	mg/l	06/29/88
ODOR	(1		T.O.N.	06/29/88
pH	7.61	7.65		06/29/88
RESIDUE, FILTERABLE @180 C	780		mg/l	06/29/88
SULFATE	310		mg/l	06/29/88
TURBIDITY	(0.9		NTU	06/29/88

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ARSENIC	(0.0050	(0.0050	(0.005	(0.005	mg/l	06/29/88
BARIUM	0.013	0.014	(0.005	(0.005	mg/l	06/29/88
CADMIUM	(0.0050	(0.0050	(0.005	(0.005	mg/l	06/29/88
CHROMIUM	(0.010	0.010	0.01	0.01	mg/l	06/29/88
COPPER	(0.010	(0.010	(0.01	(0.01	mg/l	06/29/88
IRON	(0.010	(0.010	(0.01	(0.01	mg/l	06/29/88
LEAD	(0.050	(0.050	(0.05	(0.05	mg/l	06/29/88
MANGANESE	(0.0050	(0.0050	(0.005	(0.005	mg/l	06/29/88
MERCURY	(0.0002	(0.0002	(0.0002	(0.0002	mg/l	06/29/88
SELENIUM	0.065	0.070	(0.005	(0.005	mg/l	06/29/88
SILVER	(0.010	(0.010	(0.01	(0.01	mg/l	06/29/88
ZINC	0.22	0.22	(0.01	(0.01	mg/l	06/29/88

TABLE 3.6.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	06/29/88
BROMOFORM	< 1.0		< 1.0		ug/l	06/29/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	06/29/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	06/29/88
CHLOROFORM	< 1.0		< 1.0		ug/l	06/29/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	06/29/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	06/29/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	06/29/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	06/29/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	06/29/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	06/29/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	06/29/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	06/29/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	06/29/88
LINDANE	< 0.04	ug/l	06/29/88
METHOXYCHLOR	< 0.001	mg/l	06/29/88
TOXAPHENE	< 0.0005	mg/l	06/29/88
2,4-D	< 0.005	mg/l	06/29/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	06/29/88

3.7 SUMMARY OF FAIRVIEW WINDMILL, DEWEY LAKE, ROUND TWO

Well Characteristics

Fairview Windmill is located approximately 6.9 miles (on Figure 1.2) south southeast of the center of the WIPP site at an elevation of 3,480 feet above MSL. This well is completed in the Dewey Lake Red Beds. The total depth of the well is 361 feet BGS (Cooper and Glanzman, 1971). The water is pumped by a windmill.

Sampling Process

Water samples were collected on 07/06/88, from a small iron discharge pipe located about 10 feet west of the well. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 6.7 SU, a specific conductance of 3,450 umhos/cm at 25°C, and a specific gravity of 1.004 at 22.7°C.

Alkalinity was analyzed at approximately 116 mg/l.

Chloride concentration was 121 mg/l.

Divalent cations were 41.6 meq/l.

General Observations

This well supplies drinking water for livestock.

Tabular data from field analysis and ITAS final results are presented in Table 3.7.1.

No major problems were encountered during the sampling process.

Field Parameter Comparison With The Previous Round

Sampling parameters analyzed in the field compare very well with results from the previous sampling episode. Values for chloride, divalent cations, pH, specific conductivity, and specific gravity are nearly identical for the two rounds of sampling. Alkalinity varied from the 79 mg/l measured during round one to 115 mg/l reported for round two.

TABLE 3.7.1

FIELD AND ITAS ANALYSIS
FAIRVIEW WINDMILL DEWEY LAKE ROUND TWO

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	116	115	mg/l	07/06/88
CHLORIDE	121	120	mg/l	07/06/88
DIVALENT CATIONS	41.6	41.7	meq/l	07/06/88
pH	6.7			07/06/88
SPECIFIC CONDUCTANCE	3450	@ 25 C	umhos/cm	07/06/88
SPECIFIC GRAVITY	1.004		@ 22.7 C	07/06/88

TABLE 3.7.1
(continued)

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
CHLORIDE	140		mg/l	07/06/88
COLOR	(1		CU	07/06/88
LSI CORROSIVITY	-0.08		--	07/06/88
FLUORIDE	2.1		mg/l	07/06/88
NITRATE	1.4		mg/l NO3-N	07/06/88
MBAS	0.032		mg/l	07/06/88
ODOR	1		T.O.N.	07/06/88
pH	7.10	7.13	--	07/06/88
RESIDUE, FILTERABLE @180 C	3300		mg/l	07/06/88
SULFATE	1900		mg/l	07/06/88
TURBIDITY	1.0		NTU	07/06/88

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ARSENIC	(0.0050		(0.005	(0.005	mg/l	07/06/88
BARIUM	0.028	0.029	(0.005	(0.005	mg/l	07/06/88
CADMIUM	(0.0050		(0.005	(0.005	mg/l	07/06/88
CHROMIUM	(0.0050		(0.005	(0.005	mg/l	07/06/88
COPPER	0.11	0.12	(0.01	(0.01	mg/l	07/06/88
IRON	0.080	0.080	(0.01	(0.01	mg/l	07/06/88
LEAD	(0.0050		(0.005	(0.005	mg/l	07/06/88
MANGANESE	0.052	0.060	(0.005	(0.005	mg/l	07/06/88
MERCURY	0.0024		(0.0002	(0.0002	mg/l	07/06/88
SELENIUM	0.011		(0.005	(0.005	mg/l	07/06/88
SILVER	(0.0050		(0.005	(0.005	mg/l	07/06/88
ZINC	0.020	0.010	(0.01	(0.01	mg/l	07/06/88

TABLE 3.7.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	07/06/88
BROMOFORM	< 1.0		< 1.0		ug/l	07/06/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	07/06/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	07/06/88
CHLOROFORM	< 1.0		< 1.0		ug/l	07/06/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	07/06/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	07/06/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	07/06/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/06/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/06/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	07/06/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/06/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	07/06/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	07/06/88
LINDANE	< 0.04	ug/l	07/06/88
METHOXYCHLOR	< 0.001	mg/l	07/06/88
TOXAPHENE	< 0.0005	mg/l	07/06/88
2,4-D	< 0.005	mg/l	07/06/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	07/06/88

3.8 SUMMARY OF UNGER WINDMILL, DEWEY LAKE, ROUND TWO

Well Characteristics

Unger Well is located approximately 4.8 miles south of the center of the WIPP site at an elevation of 3,305 feet above MSL. This well is completed in the Dewey Lake Red Beds. The total depth of this well is 354 feet BGS (Cooper and Glanzman, 1971). The water is pumped by a windmill.

Sampling Process

Samples were collected on 07/06/88, from a discharge pipe emptying into a storage tank 20 feet northwest of the well. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 7.3 SU, a specific conductance of 3,390 umhos/cm at 25°C, and a specific gravity of 1.004 at 22.7°C.

Alkalinity was analyzed at approximately 134 mg/l.

Chloride concentration averaged 282 mg/l.

Divalent cations were 41 meq/l.

General Observations

This well supplies drinking water for livestock.

Tabular data from field analysis and ITAS final results are presented in Table 3.8.1.

No problems were encountered during the sampling process.

Field Parameter Comparison With The Previous Round

Sampling parameters analyzed in the field laboratory are generally in good agreement between rounds one and two. Reported alkalinity and chloride values were slightly greater in round two than in round one, by less than 10 mg/l in both instances. Divalent cations appeared to decrease slightly between rounds, from 45 to 41 meq/l. Other field parameters were virtually unchanged.

TABLE 3.8.1

FIELD AND ITAS ANALYSIS
UNGER WINDMILL DEWEY LAKE ROUND TWO

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	134	134	mg/l	07/06/88
CHLORIDE	281	283	mg/l	07/06/88
DIVALENT CATIONS	41.1	41.0	meq/l	07/06/88
pH	7.3			07/06/88
SPECIFIC CONDUCTANCE	3390	@ 25 C	umhos/cm	07/06/88
SPECIFIC GRAVITY	1.004		@ 22.7 C	07/06/88

TABLE 3.8.1
(continued)

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
CHLORIDE	280		mg/l	07/06/88
COLOR	< 1		CU	07/06/88
LSI CORROSIVITY	-0.30		--	07/06/88
FLUORIDE	2.1		mg/l	07/06/88
NITRATE	2.5		mg/l NO3-N	07/06/88
MBAS	< 0.025		mg/l	07/06/88
ODOR	1		T.O.N.	07/06/88
pH	6.97		--	07/06/88
RESIDUE, FILTERABLE @180 C	3200		mg/l	07/06/88
SULFATE	850		mg/l	07/06/88
TURBIDITY	2.0		NTU	07/06/88

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ARSENIC	< 0.0050		< 0.005	< 0.005	mg/l	07/06/88
BARIUM	0.015	0.046	< 0.005	< 0.005	mg/l	07/06/88
CADMIUM	< 0.0050		< 0.005	< 0.005	mg/l	07/06/88
CHROMIUM	< 0.0050		< 0.005	< 0.005	mg/l	07/06/88
COPPER	0.040	0.21	< 0.01	< 0.01	mg/l	07/06/88
IRON	0.040	0.11	< 0.01	< 0.01	mg/l	07/06/88
LEAD	< 0.0050		< 0.005	< 0.005	mg/l	07/06/88
MANGANESE	0.049	0.060	< 0.005	< 0.005	mg/l	07/06/88
MERCURY	< 0.0004		< 0.0002	< 0.0002	mg/l	07/06/88
SELENIUM	0.015		< 0.005	< 0.005	mg/l	07/06/88
SILVER	< 0.0050		< 0.005	< 0.005	mg/l	07/06/88
ZINC	0.18	0.19	< 0.01	< 0.01	mg/l	07/06/88

TABLE 3.8.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	07/06/88
BROMOFORM	< 1.0		< 1.0		ug/l	07/06/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	07/06/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	07/06/88
CHLOROFORM	< 1.0		< 1.0		ug/l	07/06/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	07/06/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	07/06/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	07/06/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/06/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/06/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	07/06/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/06/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	07/06/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	07/06/88
LINDANE	< 0.04	ug/l	07/06/88
METHOXYCHLOR	< 0.001	mg/l	07/06/88
TOXAPHENE	< 0.0005	mg/l	07/06/88
2,4-D	< 0.005	mg/l	07/06/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	07/06/88

3.9 SUMMARY OF WELL USGS-1, CULEBRA, ROUND TWO

Well Characteristics

Well USGS-1 is located approximately 8.9 miles southwest of the center of the WIPP site at an elevation of approximately 3,426 feet above MSL (Gonzales, 1989). The well was originally constructed as an observation and test hole as part of the Gnome Project underground nuclear test in 1961. Total depth of the drilled hole was 722 feet BGS, but after being cased the hole was plugged back to 566 feet BGS. The casing is perforated in one zone accessing the Culebra Dolomite Member of the Rustler Formation. The Culebra Dolomite occurs here at a depth interval of 517 to 549 feet BGS, and is the source of water sampled from this well (Cooper and Glanzman, 1971). Following activities at the Gnome site, and after several years of monitoring which indicated that no contamination was present, the well was released to local ranchers for their use. Water from this well is currently pumped by a windmill.

Sampling Process

Water samples were collected on 07/07/88, from a siphon set near the bottom of the storage tank. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 7.5 SU, a specific conductance of 4,800 umhos/cm at 25°C, and a specific gravity of 1.006 at 22.8°C.

Alkalinity was analyzed at approximately 103 mg/l.

Chloride concentration averaged 730 mg/l over two measurements.

Divalent cations were 41 meq/l.

General Observations

This well supplies drinking water for livestock.

Tabular data from field analysis and ITAS final results are presented in Table 3.9.1.

No problems were encountered during the sampling process.

Field Parameter Comparison With The Previous Round

Sampling parameters analyzed in the field laboratory are generally in good agreement between rounds one and two. Chloride values were greater in round two than in round one, 730 mg/l versus 672 mg/l. Specific gravity and pH values varied slightly between rounds. Other field parameters were virtually unchanged.

TABLE 3.9.1

FIELD AND ITAS ANALYSIS
USGS-1 CULEBRA ROUND TWO

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	102	103	mg/l	07/07/88
CHLORIDE	733	727	mg/l	07/07/88
DIVALENT CATIONS	41.1	41.1	meq/l	07/07/88
pH	7.5			07/07/88
SPECIFIC CONDUCTANCE	4800	@ 25 C	umhos/cm	07/07/88
SPECIFIC GRAVITY	1.006		@ 22.8 C	07/07/88

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	101		mg/l	07/07/88
ALKALINITY (CO3)	0		mg/l	07/07/88
BROMIDE	< 2	< 2	mg/l	07/07/88
CHLORIDE	680		mg/l	07/07/88
COLOR	< 1		CU	07/07/88
LSI CORROSIVITY	0.14		--	07/07/88
FLUORIDE	2.1	2.2	mg/l	07/07/88
IODIDE	< 2.0		mg/l	07/07/88
NITRATE	4.4		mg/l NO3-N	07/07/88
MBAS	0.027	0.032	mg/l	07/07/88
ODOR	< 1		T.O.N.	07/07/88
pH	7.20		--	07/07/88
PHENOLICS	0.006		mg/l	07/07/88
PHOSPHATE, TOTAL	0.02	0.02	mg/l T-PO4-P	07/07/88
RESIDUE, FILTERABLE @180 C	4000		mg/l	07/07/88
RESIDUE, NONFILTERABLE @105 C	26		mg/l	07/07/88
SPECIFIC CONDUCTANCE	5010		umhos/cm@25C	07/07/88
SULFATE	1600		mg/l	07/07/88
TOTAL ORGANIC CARBON	< 1.0	< 1.0	mg/l	07/07/88
TOTAL ORGANIC HALOGEN	0.09	< 0.05	mg/l	07/07/88
TURBIDITY	1.0		NTU	07/07/88

TABLE 3.9.1
(continued)

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	0.30	0.70	(0.1	(0.1	mg/l	07/07/88
ANTIMONY	0.080	0.45	(0.05	(0.05	mg/l	07/07/88
ARSENIC	(0.0050		(0.005	(0.005	mg/l	07/07/88
BARIUM	0.016	0.034	(0.005	(0.005	mg/l	07/07/88
BERYLLIUM	(0.0050	(0.0050	(0.005	(0.005	mg/l	07/07/88
BORON	0.68	0.68	0.02	(0.01	mg/l	07/07/88
CADMIUM	0.017	0.046	(0.005	(0.005	mg/l	07/07/88
CALCIUM	700	690			mg/l	07/07/88
CESIUM	(0.060	(0.060	(0.06	(0.06	mg/l	07/07/88
CHROMIUM	0.030	0.31	0.01	0.01	mg/l	07/07/88
COBALT	0.030	0.090	(0.01	(0.01	mg/l	07/07/88
COPPER	(0.010	0.21	0.01	0.01	mg/l	07/07/88
IRON	(0.010	(0.010	(0.01	(0.01	mg/l	07/07/88
LEAD	(0.0050		(0.005	(0.005	mg/l	07/07/88
LITHIUM	0.12	0.12	(0.01	(0.01	mg/l	07/07/88
MAGNESIUM	130	120			mg/l	07/07/88
MANGANESE	0.011	0.019	(0.005	(0.005	mg/l	07/07/88
MERCURY	0.0007		(0.0002	(0.0002	mg/l	07/07/88
MOLYBDENUM	(0.050	(0.050	(0.05	(0.05	mg/l	07/07/88
NICKEL	0.050	0.14	(0.03	(0.03	mg/l	07/07/88
POTASSIUM	13	13			mg/l	07/07/88
SELENIUM	(0.0050		(0.005	(0.005	mg/l	07/07/88
SILICA	14				mg/l	07/07/88
SILVER	0.010	0.13	(0.01	(0.01	mg/l	07/07/88
SODIUM	440	440			mg/l	07/07/88
STRONTIUM	7.0	7.0	(0.01	(0.01	mg/l	07/07/88
THALLIUM	(0.0050		(0.005	(0.005	mg/l	07/07/88
TITANIUM	0.080	1.6	(0.03	(0.03	mg/l	07/07/88
VANADIUM	0.080	0.13	(0.01	(0.01	mg/l	07/07/88
ZINC	0.36	0.37	(0.01	(0.01	mg/l	07/07/88

TABLE 3.9.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	07/07/88
BROMOFORM	< 1.0		< 1.0		ug/l	07/07/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	07/07/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	07/07/88
CHLOROFORM	1.3		< 1.0		ug/l	07/07/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	07/07/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	07/07/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	07/07/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/07/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/07/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	07/07/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/07/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	07/07/88
2,4,6-TRICHLOROPHENOL	< 10				ug/l	07/07/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	07/07/88
LINDANE	< 0.04	ug/l	07/07/88
METHOXYCHLOR	< 0.001	mg/l	07/07/88
TOXAPHENE	< 0.0005	mg/l	07/07/88
2,4-D	< 0.005	mg/l	07/07/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	07/07/88

TABLE 3.9.1
(continued)

ITAS ANALYSIS
SELECTED SEMIVOLATILE HAZARDOUS COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	07/07/88
ACENAPHTHYLENE	< 10		ug/l	07/07/88
ANTHRACENE	< 10		ug/l	07/07/88
BENZO(A)ANTHRACENE	< 10		ug/l	07/07/88
BENZO(A)PYRENE	< 10		ug/l	07/07/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	07/07/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	07/07/88
BENZOIC ACID	< 50		ug/l	07/07/88
BENZO(K)FLUORANTHENE	< 10		ug/l	07/07/88
BENZYL ALCOHOL	< 10		ug/l	07/07/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	07/07/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	07/07/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	07/07/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	07/07/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	07/07/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	07/07/88
4-CHLOROANILINE	< 10		ug/l	07/07/88
2-CHLORONAPHTHALENE	< 10		ug/l	07/07/88
2-CHLOROPHENOL	< 10		ug/l	07/07/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	07/07/88
CHRYSENE	< 10		ug/l	07/07/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	07/07/88
DIBENZOFURAN	< 10		ug/l	07/07/88
1,2-DICHLOROBENZENE	< 10		ug/l	07/07/88
1,3-DICHLOROBENZENE	< 10		ug/l	07/07/88
1,4-DICHLOROBENZENE	< 10		ug/l	07/07/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	07/07/88
2,4-DICHLOROPHENOL	< 10		ug/l	07/07/88
DIETHYL PHTHALATE	< 10		ug/l	07/07/88
2,4-DIMETHYLPHENOL	< 10		ug/l	07/07/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	07/07/88
2,4-DINITROPHENOL	< 50		ug/l	07/07/88
DIMETHYL PHTHALATE	< 10		ug/l	07/07/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	07/07/88
2,4-DINITROTOLUENE	< 10		ug/l	07/07/88
2,6-DINITROTOLUENE	< 10		ug/l	07/07/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	07/07/88

TABLE 3.9.1
(continued)

ITAS ANALYSIS
SELECTED SEMIVOLATILE HAZARDOUS COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	07/07/88
FLUORENE	< 10		ug/l	07/07/88
HEXACHLOROBENZENE	< 10		ug/l	07/07/88
HEXACHLOROBUTADIENE	< 10		ug/l	07/07/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	07/07/88
HEXACHLOROETHANE	< 10		ug/l	07/07/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	07/07/88
ISOPHORONE	< 10		ug/l	07/07/88
2-METHYLNAPHTHALENE	< 10		ug/l	07/07/88
2-METHYLPHENOL	< 10		ug/l	07/07/88
4-METHYLPHENOL	< 10		ug/l	07/07/88
NAPHTHALENE	< 10		ug/l	07/07/88
2-NITROANILINE	< 50		ug/l	07/07/88
3-NITROANILINE	< 50		ug/l	07/07/88
4-NITROANILINE	< 50		ug/l	07/07/88
NITROBENZENE	< 10		ug/l	07/07/88
2-NITROPHENOL	< 10		ug/l	07/07/88
4-NITROPHENOL	< 50		ug/l	07/07/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	07/07/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	07/07/88
P-CHLORO-M-CRESOL	< 10		ug/l	07/07/88
PENTACHLOROPHENOL	< 50		ug/l	07/07/88
PHENANTHRENE	< 10		ug/l	07/07/88
PHENOL	< 10		ug/l	07/07/88
PYRENE	< 10		ug/l	07/07/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	07/07/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	07/07/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	07/07/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	07/07/88

3.10 SUMMARY OF POKER TRAP WINDMILL, CULEBRA, ROUND TWO

Well Characteristics

Poker Trap Windmill is located approximately 12.2 miles southwest of the center of the WIPP site. Very little is known about the completion of this well. The water quality is very similar to that at H-08b (one mile east of Poker Trap) and it is thought that this well is completed in the Culebra Dolomite Member of the Rustler Formation. The water is pumped by a windmill.

Sampling Process

Water samples were collected on 07/07/88, from an iron discharge pipe that empties into a tank about 25 feet west of the well. Selected samples were filtered with a portable peristaltic sample pump. Samples were sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 7.7 SU, a specific conductance of 2,320 umhos/cm at 25°C, and a specific gravity of 1.004 at 22.7°C.

Alkalinity was analyzed at approximately 80 mg/l.

Chloride was reported at 31 mg/l.

Divalent cations were 30 meq/l.

General Observations

This well supplies drinking water for livestock.

Tabular data from field analysis and ITAS final results are presented in Table 3.10.1.

No problems were encountered during the sampling process.

Field Parameter Comparison With The Previous Round

Sampling parameters analyzed in the field compare very well with results from the previous sampling episode. Values for chloride, divalent cations, pH, specific conductivity, and specific gravity are nearly identical for the two rounds of sampling. Alkalinity varied from the 92 mg/l measured during round one to 80 mg/l reported for round two.

TABLE 3.10.1

FIELD AND ITAS ANALYSIS
POKER TRAP WINDMILL CULEBRA ROUND TWO

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	80.3	79.3	mg/l	07/07/88
CHLORIDE	31	30	mg/l	07/07/88
DIVALENT CATIONS	30.2	30.3	meq/l	07/07/88
pH	7.7			07/07/88
SPECIFIC CONDUCTANCE	2320	@ 25 C	umhos/cm	07/07/88
SPECIFIC GRAVITY	1.004		@ 22.7 C	07/07/88

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY (HCO3)	79		mg/l	07/07/88
ALKALINITY (CO3)	0		mg/l	07/07/88
BROMIDE	< 2		mg/l	07/07/88
CHLORIDE	31		mg/l	07/07/88
COLOR	< 1		CU	07/07/88
LSI CORROSIVITY	0.10		--	07/07/88
FLUORIDE	2.9		mg/l	07/07/88
IODIDE	< 2.0	< 2.0	mg/l	07/07/88
NITRATE	2.4	2.3	mg/l NO3-N	07/07/88
MBAS	< 0.025		mg/l	07/07/88
ODOR	1		T.O.N.	07/07/88
pH	7.45		--	07/07/88
PHENOLICS	0.073	0.063	mg/l	07/07/88
PHOSPHATE, TOTAL	0.04		mg/l T-PO4-P	07/07/88
RESIDUE, FILTERABLE @180 C	2200	2200	mg/l	07/07/88
RESIDUE, NONFILTERABLE @105 C	19	13	mg/l	07/07/88
SPECIFIC CONDUCTANCE	2450	2470	umhos/cm@25C	07/07/88
SULFATE	1300		mg/l	07/07/88
TOTAL ORGANIC CARBON	2.0	2.0	mg/l	07/07/88
TURBIDITY	1.0		NTU	07/07/88

TABLE 3.10.1
(continued)

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ALUMINUM	< 0.10	0.20	< 0.10	< 0.10	mg/l	07/07/88
ANTIMONY	0.050	0.10	< 0.05	< 0.05	mg/l	07/07/88
ARSENIC	< 0.0050		< 0.005	< 0.005	mg/l	07/07/88
BARIUM	0.010	0.015	< 0.005	< 0.005	mg/l	07/07/88
BERYLLIUM	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	07/07/88
BORON	0.34	0.36	< 0.01	< 0.01	mg/l	07/07/88
CADMIUM	< 0.0050	0.0080	< 0.005	< 0.005	mg/l	07/07/88
CALCIUM	450	420			mg/l	07/07/88
CESIUM	< 0.060	< 0.060	< 0.06	< 0.06	mg/l	07/07/88
CHROMIUM	0.030	0.060	< 0.01	< 0.01	mg/l	07/07/88
COBALT	< 0.010	0.050	< 0.01	< 0.01	mg/l	07/07/88
COPPER	< 0.010	0.030	< 0.01	< 0.01	mg/l	07/07/88
IRON	0.020	0.030	< 0.01	< 0.01	mg/l	07/07/88
LEAD	< 0.0050	< 0.050	< 0.005	< 0.005	mg/l	07/07/88
LITHIUM	0.080	0.080	< 0.01	< 0.01	mg/l	07/07/88
MAGNESIUM	81	71			mg/l	07/07/88
MANGANESE	0.010	0.011	< 0.005	< 0.005	mg/l	07/07/88
MERCURY	0.0007		< 0.0002	< 0.0002	mg/l	07/07/88
MOLYBDENUM	< 0.050	< 0.050	< 0.05	< 0.05	mg/l	07/07/88
NICKEL	< 0.030	< 0.030	< 0.03	< 0.03	mg/l	07/07/88
POTASSIUM	3.7	3.7			mg/l	07/07/88
SELENIUM	0.0090		< 0.005	< 0.005	mg/l	07/07/88
SILICA	14				mg/l	07/07/88
SILVER	0.010	0.010	< 0.01	< 0.01	mg/l	07/07/88
SODIUM	420	420			mg/l	07/07/88
STRONTIUM	4.9	4.9	0.01	0.01	mg/l	07/07/88
THALLIUM	< 0.0050		< 0.005	< 0.005	mg/l	07/07/88
TITANIUM	0.29	0.40	< 0.03	< 0.03	mg/l	07/07/88
VANADIUM	0.020	0.060	< 0.01	< 0.01	mg/l	07/07/88
ZINC	0.050	0.060	< 0.01	< 0.01	mg/l	07/07/88

TABLE 3.10.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	07/07/88
BROMOFORM	< 1.0		< 1.0		ug/l	07/07/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	07/07/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	07/07/88
CHLOROFORM	< 1.0		< 1.0		ug/l	07/07/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	07/07/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	07/07/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	07/07/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/07/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/07/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	07/07/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	07/07/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	07/07/88
2,4,6-TRICHLOROPHENOL	< 10				ug/l	07/07/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	07/07/88
LINDANE	< 0.04	ug/l	07/07/88
METHOXYCHLOR	< 0.001	mg/l	07/07/88
TOXAPHENE	< 0.0005	mg/l	07/07/88
2,4-D	< 0.005	mg/l	07/07/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	07/07/88

TABLE 3.10.1
(continued)

ITAS ANALYSIS
SELECTED SEMIVOLATILE HAZARDOUS COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ACENAPHTHENE	< 10		ug/l	07/07/88
ACENAPHTHYLENE	< 10		ug/l	07/07/88
ANTHRACENE	< 10		ug/l	07/07/88
BENZO(A)ANTHRACENE	< 10		ug/l	07/07/88
BENZO(A)PYRENE	< 10		ug/l	07/07/88
3,4-BENZOFLUORANTHENE	< 10		ug/l	07/07/88
BENZO(G,H,I)PERYLENE	< 10		ug/l	07/07/88
BENZOIC ACID	< 50		ug/l	07/07/88
BENZO(K)FLUORANTHENE	< 10		ug/l	07/07/88
BENZYL ALCOHOL	< 10		ug/l	07/07/88
BIS(2-CHLOROETHOXY)METHANE	< 10		ug/l	07/07/88
BIS(2-CHLOROETHYL)ETHER	< 10		ug/l	07/07/88
BIS(2-CHLOROISOPROPYL)ETHER	< 10		ug/l	07/07/88
BIS(2-ETHYLHEXYL)PHTHALATE	< 10		ug/l	07/07/88
4-BROMOPHENYL PHENYL ETHER	< 10		ug/l	07/07/88
BUTYL BENZYL PHTHALATE	< 10		ug/l	07/07/88
4-CHLOROANILINE	< 10		ug/l	07/07/88
2-CHLORONAPHTHALENE	< 10		ug/l	07/07/88
2-CHLOROPHENOL	< 10		ug/l	07/07/88
4-CHLOROPHENYL PHENYL ETHER	< 10		ug/l	07/07/88
CHRYSENE	< 10		ug/l	07/07/88
DIBENZO(A,H)ANTHRACENE	< 10		ug/l	07/07/88
DIBENZOFURAN	< 10		ug/l	07/07/88
1,2-DICHLOROBENZENE	< 10		ug/l	07/07/88
1,3-DICHLOROBENZENE	< 10		ug/l	07/07/88
1,4-DICHLOROBENZENE	< 10		ug/l	07/07/88
3,3'-DICHLOROBENZIDINE	< 20		ug/l	07/07/88
2,4-DICHLOROPHENOL	< 10		ug/l	07/07/88
DIETHYL PHTHALATE	< 10		ug/l	07/07/88
2,4-DIMETHYLPHENOL	< 10		ug/l	07/07/88
4,6-DINITRO-O-CRESOL	< 50		ug/l	07/07/88
2,4-DINITROPHENOL	< 50		ug/l	07/07/88
DIMETHYL PHTHALATE	< 10		ug/l	07/07/88
DI-N-BUTYL PHTHALATE	< 10		ug/l	07/07/88
2,4-DINITROTOLUENE	< 10		ug/l	07/07/88
2,6-DINITROTOLUENE	< 10		ug/l	07/07/88
DI-N-OCTYL PHTHALATE	< 10		ug/l	07/07/88

TABLE 3.10.1
(continued)

ITAS ANALYSIS
SELECTED SEMIVOLATILE HAZARDOUS COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
FLUORANTHENE	< 10		ug/l	07/07/88
FLUORENE	< 10		ug/l	07/07/88
HEXACHLOROBENZENE	< 10		ug/l	07/07/88
HEXACHLOROBUTADIENE	< 10		ug/l	07/07/88
HEXACHLOROCYCLOPENTADIENE	< 10		ug/l	07/07/88
HEXACHLOROETHANE	< 10		ug/l	07/07/88
INDENO(1,2,3-CD)PYRENE	< 10		ug/l	07/07/88
ISOPHORONE	< 10		ug/l	07/07/88
2-METHYLNAPHTHALENE	< 10		ug/l	07/07/88
2-METHYLPHENOL	< 10		ug/l	07/07/88
4-METHYLPHENOL	< 10		ug/l	07/07/88
NAPHTHALENE	< 10		ug/l	07/07/88
2-NITROANILINE	< 50		ug/l	07/07/88
3-NITROANILINE	< 50		ug/l	07/07/88
4-NITROANILINE	< 50		ug/l	07/07/88
NITROBENZENE	< 10		ug/l	07/07/88
2-NITROPHENOL	< 10		ug/l	07/07/88
4-NITROPHENOL	< 50		ug/l	07/07/88
N-NITROSODI-N-PROPYLAMINE	< 10		ug/l	07/07/88
N-NITROSODIPHENYLAMINE	< 10		ug/l	07/07/88
P-CHLORO-M-CRESOL	< 10		ug/l	07/07/88
PENTACHLOROPHENOL	< 50		ug/l	07/07/88
PHENANTHRENE	< 10		ug/l	07/07/88
PHENOL	< 10		ug/l	07/07/88
PYRENE	< 10		ug/l	07/07/88
1,2,4-TRICHLOROBENZENE	< 10		ug/l	07/07/88
2,4,5-TRICHLOROPHENOL	< 50		ug/l	07/07/88
2,4,6-TRICHLOROPHENOL	< 10		ug/l	07/07/88

POLYCHLORINATED BIPHENYLS

PARAMETER	VALUE	UNITS	DATE COLLECTED
PCB	< 1	ug/l	07/07/88

3.11 SUMMARY OF TWIN WELLS-PASTURE WELL, DEWEY LAKE, ROUND TWO

Well Characteristics

Twin Wells consists of two wells in close proximity, House Well and Pasture Well. This sampling involved Pasture Well which is located approximately 10 miles south of the center of the WIPP site. The elevation of Pasture Well is 3,523 feet above MSL. The total depth of this well is 152 feet BGS (Winstanley and Carrasco, 1986). The well is completed in the Dewey Lake Red Beds. The water is pumped by a windmill.

Sampling Process

Water samples were collected on 08/03/88, after accessing the discharge pipe at the base of the windmill. Selected samples were filtered with a portable peristaltic pump. Samples were collected and sent to ITAS, EEG, WAESD, and SNL. One sample was collected for analysis in the field chemistry laboratory.

Field Analytical Results

Procedures used in the field analyses are described in the WIPP Geotechnical and Geosciences Procedure Manual WP 7-2.

This water had a pH of 7.1 SU, a specific conductance of 600 umhos/cm at 25°C, and a specific gravity of 1.002 at 24.0°C.

Alkalinity was analyzed at approximately 215 mg/l.

Chloride concentration was approximately 400 mg/l.

Divalent cations were reported as approximately 40 meq/l.

General Observations

This windmill had been inoperable for several days just prior to the sampling episode. During sampling the flow output was variable due to light, intermittent winds.

Tabular data from field analysis and ITAS final results are presented in Table 3.11.1.

Field Parameter Comparison With The Previous Round

The first round sampling of Twin Pasture Well was completed in January 1986 as part of the WQSP. During round one, while the windmill was inoperable, a piston pump was lowered into the well and approximately 2,500 gallons of water were pumped prior to the first serial sample. The round one sampling conditions are in marked contrast to the round two sampling conditions where the windmill had not been pumping for several days and only pumped intermittently during sampling.

Sampling parameters analyzed in the field laboratory are not in good agreement between rounds one and two. Field concentration values for cloride and divalent cations are approximately 10 times greater for round two than round one. It is unlikely that the differences in sampling procedures can account for this wide variation in chloride and divalent cation field data. Because the field values for specific conductance and alkalinity appear consistent between rounds, and the chloride values from ITAS rounds one and two are consistent with the field choride from round one (47, 39, and 44 mg/l respectively), the round two field values for chloride and divalent cations are suspect.

TABLE 3.11.1

FIELD AND ITAS ANALYSIS
TWIN WELLS - PASTURE DEWEY LAKE ROUND TWO

FIELD CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
ALKALINITY	216	215	mg/l	08/03/88
CHLORIDE	400	398	mg/l	08/03/88
DIVALENT CATIONS	39.6	39.9	meq/l	08/03/88
pH	7.1			08/03/88
SPECIFIC CONDUCTANCE	600	@ 25 C	umhos/cm	08/03/88
SPECIFIC GRAVITY	1.002		@ 24.9 C	08/03/88

TABLE 3.11.1
(continued)

ITAS ANALYSIS
GENERAL CHEMISTRY

PARAMETER	VALUE	DUPLICATE VALUE	UNITS	DATE COLLECTED
CHLORIDE	39		mg/l	08/03/88
COLOR	< 1		CU	08/03/88
LSI CORROSIVITY	0.01			08/03/88
FLUORIDE	0.7		mg/l	08/03/88
NITRATE	6.2		mg/l NO3-N	08/03/88
MBAS	0.13	0.13	mg/l	08/03/88
ODOR	< 1		T.O.N.	08/03/88
pH	7.48			08/03/88
RESIDUE, FILTERABLE @180 C	390		mg/l	08/03/88
SULFATE	55		mg/l	08/03/88
TURBIDITY	< 1.0		NTU	08/03/88

ITAS ANALYSIS
SELECTED METALS

PARAMETER	VALUE	DUPLICATE VALUE	ACID BLANK	DI. WATER BLANK	UNITS	DATE COLLECTED
ARSENIC	0.0050		< 0.005	< 0.005	mg/l	08/03/88
BARIUM	0.13	0.13	< 0.005	< 0.005	mg/l	08/03/88
CADMIUM	< 0.0010		< 0.001	< 0.001	mg/l	08/03/88
CHROMIUM	< 0.0050		< 0.005	< 0.005	mg/l	08/03/88
COPPER	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	08/03/88
IRON	< 0.010	< 0.010	< 0.01	< 0.01	mg/l	08/03/88
LEAD	< 0.0050		< 0.005	< 0.005	mg/l	08/03/88
MANGANESE	< 0.0050	< 0.0050	< 0.005	< 0.005	mg/l	08/03/88
MERCURY	0.0004	0.0003	0.0003	0.0004	mg/l	08/03/88
SELENIUM	< 0.0050		< 0.005	< 0.005	mg/l	08/03/88
SILVER	< 0.0050		< 0.005	< 0.005	mg/l	08/03/88
ZINC	0.31	0.31	< 0.01	< 0.01	mg/l	08/03/88

TABLE 3.11.1
(continued)

ITAS ANALYSIS
SELECTED VOLATILE COMPOUNDS

PARAMETER	VALUE	DUPLICATE VALUE	TRIP BLANK	TRIP BLANK DUPLICATE	UNITS	DATE COLLECTED
BENZENE	< 1.0		< 1.0		ug/l	08/03/88
BROMOFORM	< 1.0		< 1.0		ug/l	08/03/88
CARBON TETRACHLORIDE	< 1.0		< 1.0		ug/l	08/03/88
CHLORODIBROMOMETHANE	< 1.0		< 1.0		ug/l	08/03/88
CHLOROFORM	< 1.0		< 1.0		ug/l	08/03/88
DICHLOROBROMOMETHANE	< 1.0		< 1.0		ug/l	08/03/88
P-DICHLOROBENZENE	< 1.0		< 1.0		ug/l	08/03/88
1,2-DICHLOROETHANE	< 1.0		< 1.0		ug/l	08/03/88
1,1-DICHLOROETHYLENE	< 1.0		< 1.0		ug/l	08/03/88
TETRACHLOROETHYLENE	< 1.0		< 1.0		ug/l	08/03/88
1,1,1-TRICHLOROETHANE	< 1.0		< 1.0		ug/l	08/03/88
TRICHLOROETHYLENE	< 1.0		< 1.0		ug/l	08/03/88
VINYL CHLORIDE	< 2.0		< 2.0		ug/l	08/03/88

ITAS ANALYSIS
PESTICIDES AND HERBICIDES

PARAMETER	VALUE	UNITS	DATE COLLECTED
ENDRIN	< 0.02	ug/l	08/03/88
LINDANE	< 0.04	ug/l	08/03/88
METHOXYCHLOR	< 0.001	mg/l	08/03/88
TOXAPHENE	< 0.0005	mg/l	08/03/88
2,4-D	< 0.005	mg/l	08/03/88
2,4,5-TP (SILVEX)	< 0.0005	mg/l	08/03/88

4.0 DISCUSSION

Approximately 100 ground-water samplings have been successfully accomplished by the WQSP since its initiation in January, 1985. This total includes nearly three complete sampling rounds of 23 WQSP pre-operational monitoring wells (the final two wells completing the three rounds were sampled in early 1989), approximately 20 privately owned well samplings, numerous wells sampled at the request of other on-going programs at the WIPP, and samples collected from the WIPP Air Intake Shaft. These data are published in several reports including Uhland and Randall (1986), Uhland et al. (1987), Randall et al. (1988), and this report. All field data sheets, logbooks, analytical laboratory data reports, and records pertaining to the WQSP are on file at the Regulatory and Environmental Programs Department, Waste Isolation Pilot Plant, near Carlsbad, New Mexico. Additionally, all published data have been entered into a computer data base format for storage and retrieval. These data serve as the basis for a pre-operational water quality baseline at the WIPP.

Sampling during the 1988 calendar year was characterized by numerous successes and few disappointments. The inability to collect complete final sample suites from wells H-15 (round two), WIPP-30 (round one), and H-01 (round one) was unfortunate. United Nuclear Corporation's analytical laboratory did not analyze the dissolved gas samples collected from wells H-07b1, WIPP-26, and DOE-2 (all round three) due to health and safety issues surrounding their analytical methodology. Close cooperation between the WQSP and UNC led to the fabrication of new, modified sample containers and modification of the analytical instrumental hardware. Analyses for dissolved gases then resumed.

An analytical-methods development program for improving trace-metal analysis accuracy and detection limits was initiated by the WQSP and conducted by the ITAS laboratory in 1988. As reported in Randall et al. (1988), there is a high degree of uncertainty regarding reported trace metal concentrations for ground waters near the WIPP. The great concentration (tens to hundreds of grams per liter) of total dissolved solids in many of the ground-water samples coupled with the relatively low concentration (micrograms per liter) of trace metal species leads to analytical difficulties in the laboratory. The samples must be diluted prior to introduction into the analytical instrument. Sample dilution and subsequent computation causes the lower limits of detection for many trace-metal species to increase into the milligram per liter range. Analytical enhancements, interferences, or suppression can also result when analyzing water of high dissolved solids, leading to erroneous trace metal values. As an alternative method of analysis the WQSP and ITAS laboratory adapted an ion-exchange method, which separates and concentrates transition-metal elements from alkali and alkaline-earth elements in seawater (Kingston et al., 1978) for use with the WIPP samples. Fifteen trace metals from the WQSP final sample parameter list were selected for study. Method-development testing began in the spring of 1988 utilizing briny water from well H-05b as the test sample matrix. Testing consisted of preparing a cation-exchange resin, spiking a sample with known concentrations of the metals of interest, passing the spiked sample through the resin column thereby loading the metals onto the resin and separating them from the sample matrix. Next the metals are stripped off the resin column into an acid solution where they are analyzed at increased relative concentration in a "cleaner" solution. Various spectrophotometric methods of analysis were investigated for different metal species where appropriate. Spike recoveries were calculated to determine the success of the separation and analysis procedure. Experimental parameters were varied during five iterations of the separation and analysis procedure to determine optimum conditions for the analysis. With few exceptions, spike recoveries were excellent for the 15 metals in the H-05b matrix. Samples from three wells, H-05b (round three), H-08b (round three), and WIPP-19 (round three) had the 15 trace metals analyzed utilizing this separation technique. The reproducibility of results was demonstrated during analysis of the H-08b analysis. Results from the ion-exchange metals analysis for the three wells are noted and reported in their respective subsections, Section 2.0, of this report. Generally, this technique reduced the lower limits of detection for 14 of the 15 trace metals by one or more orders of magnitude bringing the lower limit of detection back into the microgram per liter range. The selection of the three wells H-05b, WIPP-19, and H-08b represents a cross section of the water samples from WQSP wells in the WIPP vicinity which vary from greater to lesser total dissolved solids. Possibly the trace-metal analyses from these three wells where the ion-exchange separation technique was utilized will allow inferences to be made concerning trace-metal concentrations at other WQSP wells having similar total dissolved solids concentrations. Details of the ion-exchange experimental work are contained in periodic method-development progress reports and data reports from the ITAS laboratory and reside in the WQSP project files at the WIPP.

Since initiation of the WQSP in January 1985, the program has evolved and improved toward achievement of its goals. The collection of reproducible and representative ground-water samples from water-bearing zones in the WIPP vicinity can in part be assessed by comparing data gathered over the three rounds of sampling at various well locations. Comparative data from three sampling rounds for wells which were sampled for the third time in 1988 are presented in this report.

4.1 COMPARATIVE DATA

Comparisons of the average final days' serial sample field parameter values, alkalinity, chloride, divalent cations, and total iron, for WQSP wells sampled for the third time in 1988 are presented in Table 4.1. Generally, the trends show only slight variations in the four field parameters sampled over three rounds at any specific well location. Ending serial sample values for round three are often within a few percent of values for rounds one and two. This indicates successful reproducibility of field results over three rounds of sampling at many well locations. Notable exceptions include well WIPP-19 where all four listed field serial sampling parameters were significantly decreased at the end of each sampling round. Total iron values for nearly all the wells exhibit a high degree of scatter across the three rounds of sampling. Iron concentrations in the field samples may be related less to actual formation water conditions than to disturbance of the well casing during pump installation and corrosion or incrustation of the iron well casing by highly saline fluids.

Average concentration values for the major ions from final sample laboratory analyses, for WQSP wells sampled for the third time in 1988, are listed in Table 4.2.

TABLE 4.1

AVERAGE SELECTED LAST DAY SERIAL SAMPLE FIELD VALUES
WELLS SAMPLED FOR THE THIRD TIME IN 1988

	DOE-2	H-04c	H-05b	H-05c	H-06c	H-07b1	H-08b
ALKALINITY (HCO3) mg/l							
ROUND ONE	67.5	76.5	48.9	57.3	50.5	121	95.3
ROUND TWO	150	84.6	51.0	57.2	51.9	121	93.1
ROUND THREE	131	82.1	47.6	57.5	52.4	123	97.0
CHLORIDE mg/l							
ROUND ONE	32300	8360	83400	1050	418	309	32.8
ROUND TWO	32200	8400	84900	1040	420	301	36.0
ROUND THREE	31600	8310	85600	1030	408	293	39.0
DIVALENT CATIONS meq/l							
ROUND ONE	186	69.2	256	41.9	41.1	46.4	41.7
ROUND TWO	188	68.0	253	41.5	41.0	44.0	42.0
ROUND THREE	184	68.5	259	42.1	41.3	40.4	40.6
TOTAL IRON mg/l							
ROUND ONE	<0.02	1.85	2.81	2.26	0.38	0.12	0.09
ROUND TWO	0.21	0.22	4.01	0.29	0.19	0.08	0.13
ROUND THREE	0.35	0.18	2.15	0.69	0.34	0.07	0.05

	H-09b	H-12	H-15	P-14	WIPP-19	WIPP-25	WIPP-26
ALKALINITY (HCO3) mg/l							
ROUND ONE	116	52.5	41.7	106	84.0	127	119
ROUND TWO	112	62.0	41.3	103	68.2	126	112
ROUND THREE	118	51.1	40.9	107	60.9	125	114
CHLORIDE mg/l							
ROUND ONE	174	80500	132000	15300	62000	6190	8570
ROUND TWO	175	80000	134000	14300	48800	6100	5750
ROUND THREE	172	80100	135000	14700	44200	6410	5700
DIVALENT CATIONS meq/l							
ROUND ONE	41.2	243	287	255	286	81.5	100
ROUND TWO	44.0	260	299	251	241	81.0	85.0
ROUND THREE	41.3	250	282	256	208	82.8	87.3
TOTAL IRON mg/l							
ROUND ONE	0.18	1.18	2.99	2.08	1.80	0.49	0.10
ROUND TWO	0.16	2.44	3.60	2.50	1.31	0.41	0.06
ROUND THREE	0.12	2.11	2.88	2.00	0.80	0.73	0.04

TABLE 4.2

AVERAGE mg/l VALUES FOR THE MAJOR IONS
FINAL SAMPLE LABORATORY RESULTS
WELLS SAMPLED FOR THE THIRD TIME IN 1988

	SODIUM	CALCIUM	MAGNESIUM	POTASSIUM	CHLORIDE	SULFATE	ALKALINITY
DOE-2							
ROUND ONE	18000	2000	1100	410	35000	4000	NA
ROUND TWO	17000	1900	1100	420	32500	3700	160
ROUND THREE	17500	1700	955	460	29200	4500	130
H-04c							
ROUND ONE	7500	1100	470	135	11000	7850	100
ROUND TWO	7250	610	500	99	8400	6700	60
ROUND THREE	7150	650	435	100	7600	8300	74
H-05b							
ROUND ONE	47000	1300	1700	1300	87000	6300	47
ROUND TWO	53000	1400	2200	1100	90000	7000	46
ROUND THREE	52000	1500	1800	1340	84100	7000	42
H-05c							
ROUND ONE	1500	795	190	52	1600	4200	69
ROUND TWO	1420	560	180	39	1000	3800	55
ROUND THREE	1400	570	180	37	1000	3000	54
H-06c							
ROUND ONE	1100	620	170	26	430	2400	53
ROUND TWO	650	500	170	18	420	2400	52
ROUND THREE	635	590	170	18	390	2600	52
H-07b1							
ROUND ONE	210	540	130	7.0	700	2300	130
ROUND TWO	210	600	135	8.0	310	1700	130
ROUND THREE	200	565	125	8.3	290	2000	120
H-08b							
ROUND ONE	51	540	170	3.7	33	1650	94
ROUND TWO	55	560	160	4.1	36	1700	97
ROUND THREE	55	605	165	4.5	33	1900	95
H-09b							
ROUND ONE	150	560	140	7.6	200	1450	120
ROUND TWO	155	630	150	7.0	190	1700	120
ROUND THREE	140	645	130	8.1	180	1600	120
H-12							
ROUND ONE	44500	1850	1400	1500	80000	5900	56
ROUND TWO	51500	1550	2000	1600	78500	8200	66
ROUND THREE	44300	1700	1700	1340	78400	7500	47

TABLE 4.2
(continued)

	SODIUM	CALCIUM	MAGNESIUM	POTASSIUM	CHLORIDE	SULFATE	ALKALINITY
H-15							
ROUND ONE	84000	2000	2300	1800	140000	6300	36
ROUND TWO	78900	1400	2600	1800	134000	7500	32
ROUND THREE	71000	1600	2700	1850	135000	5600	38
P-14							
ROUND ONE	3750	3900	760	45	14000	1600	100
ROUND TWO	4100	3500	900	50	15000	1400	100
ROUND THREE	4600	3400	875	48	14300	1600	100
WIPP-19							
ROUND ONE	30000	1900	2400	850	58000	5400	73
ROUND TWO	26500	1600	1700	900	46100	5700	58
ROUND THREE	31100	1800	1500	750	38900	5550	61
WIPP-25							
ROUND ONE	3350	1150	340	105	6200	2400	120
ROUND TWO	3400	1100	335	120	6500	2350	100
ROUND THREE	3300	1100	330	150	6500	2600	130
WIPP-26							
ROUND ONE	4150	1800	375	350	9450	1950	130
ROUND TWO	2900	1100	330	210	3200	1900	110
ROUND THREE	2600	1150	330	190	5500	2400	110

4.2 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance and quality control practices are formalized and incorporated into every activity of the WQSP from calibrating measurement equipment to tabulating data. The specific quality assurance and quality control policies and practices guiding the WQSP are detailed in the WIPP Water Quality Sampling Manual WP 7-2 Revision 1, (October, 1987) and are not reiterated in this report. Regularly scheduled quality assurance audits verify that the WQSP field, laboratory, and data-compilation activities are in compliance with the WIPP Quality Assurance Program and applicable documents. Quality assurance audits are conducted in accordance with the WIPP Quality Program Manual.

One indicator of the success of WQSP quality assurance and quality control practices is reflected by the accuracy and precision of chemical analyses performed in the field during serial sampling operations. Measures of analytical accuracy and precision in the field are regularly made by the WQSP. Results for accuracy and precision measures from serial sampling are presented below.

Field Accuracy and Precision

Accuracy of the serial sample field parameter analyses for chloride, divalent cations, and total iron are regularly assessed by analyzing spiked samples and calculating the percent spike recoveries. Each WQSP well should have at least one sample spiked and analyzed for each parameter of interest. A tabulation of spike recoveries for chloride, divalent cations, and total iron from the WQSP wells sampled in 1988 is in Table 4.3. Average spike recoveries over all the wells in 1988 were excellent; 99.4 percent for chloride, 100.9 percent for divalent cations, and 99.4 percent for total iron. The sample standard deviations for the year's spike values were 2.4 for chloride, 2.1 for divalent cations, and 4.5 for total iron. The summary statistics indicate that overall the WQSP field analyses exhibit a high degree of accuracy.

The precision of serial sample field parameter analyses are evaluated utilizing duplicate sample analyses. Calculating the relative percent difference (RPD) between the sample and duplicate analysis values, for each days' serial sample analysis pair, indicates how repeatable or precise the measurements are. Relative percent difference values are calculated for each duplicate analysis pair (usually daily while serial sampling is in progress) for the

TABLE 4.3

MATRIX SPIKE PERCENT RECOVERIES
SERIAL SAMPLE FIELD PARAMETERS

WELL	ROUND	CHLORIDE	DIVALENT CATIONS	TOTAL IRON
H-15	2	97.2	100.8	93.9
H-14	2	101.2	100.8	98.8
WIPP-19	2	101.0	100.3	101.3
WIPP-30	1	98.5	102.4	98.6
H-05b	3	101.5	101.1	108.3
H-05c	2	97.7	99.0	102.7
P-14	3	102.0	102.4	96.4
WIPP-2	3	98.9	103.9	104.5
H-18	2	97.9	100.2	97.9
WIPP-26	3	98.7	103.2	96.5
H-07b1	3	100.6	96.6	104.3
DOE-2	3	101.7	98.3	97.2
H-08b	3	101.9	104.1	101.7
H-09b	3	99.1	102.5	96.3
H-04c	3	94.2	100.8	107.8
H-06c	3	98.4	102.9	100.8
H-05c	3	97.0	101.7	92.9
WIPP-19	3	101.3	97.6	99.1
H-15	3	103.2	98.5	97.5
H-12	3	95.0	100.6	90.5
AVERAGE		99.4	100.9	99.4
SD		2.4	2.1	4.5

parameters alkalinity, chloride, divalent cations, total iron, and ferrous iron. The RPD is calculated by subtracting the lesser analytical result from the greater, dividing that quantity by the average of the two analytical results, and multiplying by 100. A summary of average and sample standard deviations for RPDs compiled by averaging the daily RPDs at each well is presented in Table 4.4. The yearly averages at the bottom of the table indicate that for alkalinity, chloride, and divalent cations the field analyses are highly precise with overall RPDs less than one percent. The RPD averages for total and ferrous iron exhibit less precision than data from the other parameters. The yearly average RPD for total and ferrous iron are between approximately four and five percent with sample standard deviations in the three to four range. Typically, at wells with iron content near the lower limit of detection (0.02 mg/l) small differences in the duplicate analyses results yield high RPD values. These high RPD values (14.24 as an average for well H-08b, with a standard deviation of 13.76) are more an artifact of the decimal arithmetic than an indication of imprecision in the iron analyses.

Laboratory Accuracy and Precision

Each analytical laboratory contracted to analyze final sample parameters for the WQSP utilize their own internal Quality Assurance and Quality Control programs to ensure the accuracy and precision of analytical results. The ITAS laboratory analyzes a majority of the final sample parameters and the WQSP imposes additional quality assurance and quality control requirements upon the ITAS laboratory. These requirements are specified in the WIPP Water Quality Sampling Manual WP 07-2.

Accuracy of final sample parameter analyses by ITAS are regularly assessed by analyzing spiked samples and calculating the percent spike recoveries. These spike recovery data must fall within limits established by the U.S. Environmental Protection Agency (U.S. EPA, 1988 a and b) or corrective action and re-analysis of the sample is required.

The precision of final sample parameter analyses are evaluated utilizing duplicate (replicate) sample analyses. Data from duplicate sample analyses are reported in the well summary data tables, Section 2.0 and 3.0. At the ITAS laboratory, duplicate sample analyses must be with limits established by

TABLE 4.4

SUMMARY OF SERIAL SAMPLE RELATIVE PERCENT DIFFERENCE (RPD)
AVERAGE AND STANDARD DEVIATION BY WELL

			ALKALINITY		CHLORIDE		DIVALENT CATIONS		TOTAL IRON		FERROUS IRON	
WELL	ROUND	N	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD
H-15	2	3	1.39	0.29	0.26	0.13	0.64	0.17	5.09	1.89	2.69	0.94
H-14	2	7	0.90	0.49	0.32	0.25	0.37	0.18	5.29	4.78	6.07	6.85
WIPP-19	2	5	1.12	0.42	0.29	0.15	0.53	0.30	3.46	2.33	4.14	3.35
WIPP-30	1	6	0.86	0.67	0.73	0.24	0.47	0.23	2.56	1.33	3.90	2.83
H-05b	3	6	1.55	0.62	0.26	0.13	0.27	0.25	3.02	3.51	1.86	2.04
H-05c	2	4	0.88	0.28	0.19	0.24	0.42	0.36	3.15	2.77	6.46	5.59
P-14	3	5	0.60	0.48	0.71	0.01	0.31	0.25	1.63	1.66	1.59	1.07
WIPP-25	3	7	0.29	0.15	0.36	0.18	0.51	0.39	2.78	2.08	3.05	3.24
H-18	2	9	0.78	0.38	0.37	0.28	0.48	0.33	2.22	2.36	0.79	1.58
WIPP-26	3	5	0.55	0.24	0.57	0.20	0.34	0.24	0.00	0.00	0.00	0.00
H-07b1	3	6	0.47	0.28	0.40	0.45	0.34	0.26	8.16	8.99	16.19	18.22
DOE-2	3	10	0.35	0.21	0.54	0.29	0.37	0.25	3.34	3.50	6.07	4.81
H-08b	3	6	0.59	0.39	1.59	1.90	0.49	0.31	14.24	13.76	4.76	11.66
H-09b	3	6	0.65	0.29	0.20	0.30	0.44	0.36	9.62	11.26	6.14	6.75
H-04c	3	6	0.71	0.47	0.39	0.24	0.12	0.11	4.80	5.55	6.02	5.18
H-06c	3	5	1.04	0.44	0.39	0.22	0.24	0.24	3.88	5.02	2.69	2.74
H-05c	3	4	0.70	0.59	0.46	0.26	0.36	0.31	3.69	2.04	1.95	1.73
WIPP-19	3	6	1.30	1.16	0.57	0.40	0.58	0.57	4.74	3.33	1.97	1.00
H-15	3	7	1.52	0.91	0.41	0.17	0.94	0.79	2.60	4.04	2.91	3.47
H-12	3	9	1.96	1.54	0.50	0.45	0.71	0.50	2.42	1.80	0.64	0.67
AVERAGE			0.91	0.52	0.48	0.32	0.45	0.32	4.33	4.10	3.99	4.19
SD			0.44	0.34	0.30	0.39	0.18	0.15	3.17	3.48	3.51	4.31

the U.S. Environmental Protection agency (U.S. EPA, 1988 a and b) or corrective action and re-analysis of the sample is required.

Many of the analysis and duplicate analysis values reported by ITAS in Sections 2.0 and 3.0 for general chemistry, cations, and trace metal parameters are identical. This identity may appear implausible. However, water from numerous WIPP wells are high in total dissolved solids and must be diluted by factors ranging from 10 to 100 prior to instrumental analysis. After instrumental analyses of the diluted sample and duplicate sample are complete, the instrumental results are multiplied by the appropriate dilution factor and concentration values are calculated. The final concentration values are next rounded, frequently to two significant digits, and reported. These procedures of dilution and rounding can obscure variations in analytical results between the analysis value and duplicate value. For example, when the WQSP reports an ITAS sodium value of 22,000 mg/l and a sample duplicate value of 22,000 mg/l the actual analytical results prior to rounding may have fallen anywhere in the range of 21,500 to 22,499 mg/l. These variation are not evident in the reported data. Many trace metal values are reported less than some detection limit (<), and one expects the value and duplicate value to be identical in this case. Additionally, the WIPP well-water samples are analyzed for dissolved, not total, constituents and are not acid digested prior to analysis. This tends to minimize the variations between analysis and duplicate analysis values.

4.3 CONCLUSION

The data reported by the WQSP in this and previous reports indicate that serial sampling is a very useful tool in determining sample representativeness from wells in the WIPP vicinity. Serial sample field chemistry data are demonstrated to be highly accurate and precise as indicated by the excellent overall average percent spike recovery values and low RPD values reported for the sampling events. Serial sample field chemistry data and laboratory water quality parameter analyses gathered by the WQSP since January 1985 are the foundation for a pre-operational water quality baseline at the WIPP.

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APPENDIX A

A-1 ERRATA FROM THE ANNUAL WATER QUALITY DATA REPORT, MAY 1988

Please note the following corrections to the water quality data report from the previous year (Randall et al., 1988).

Pages 2-249 through 2-255, Tables 2.16.2, 2.16.3, and 2.16.4, the table titles should read H-03b1 MAGENTA, not H-03b1 CULEBRA.

Page 2-344, Table 2.22.1, "Sample Number" column for Sp.GRAVITY and Sp.COND. should read 05, not 02, for "Date Collected" of 11/04/87.

Page A-48, Table A.7, "Date Collected" column for Engle Well should read 12/08/87, not 12/19/87.

Listed in the following table, Table A-1, are additional data corrections to Randall et al. (1988). Regrettably, a few of these corrections are for rounding errors or typographical errors which defied correction prior to publication. The majority of corrections listed in Table A-1, however, resulted from the re-analysis of parameters requested by the WQSP from the ITAS laboratory which were performed but failed to supercede the data published in last year's report. These data are presented here and supercede the previously published data.

TABLE A-1

CORRECTIONS FOR ERRONEOUS VALUES
ANNUAL WATER QUALITY DATA REPORT
MAY, 1988

PAGE NUMBER	TABLE NUMBER	WELL	PARAMETER	ERRONEOUS REPORTED VALUES SAMPLE	ERRONEOUS REPORTED VALUES DUPLICATE SAMPLE	REPLACE WITH CORRECTED VALUES SAMPLE	REPLACE WITH CORRECTED VALUES DUPLICATE SAMPLE
2-56	2.4.2	H-07b1	POTASSIUM	7.7		8.0	
2-56	2.4.2	H-07b1	SODIUM	160	160	210	210
2-82	2.6.2	WIPP-29	POTASSIUM	20000		21000	
2-82	2.6.2	WIPP-29	SODIUM	89000		94000	
2-99	2.7.2	WIPP-26	POTASSIUM	190	190	210	210
2-114	2.8.2	WIPP-25	MAGNESIUM	340		330	
2-234	2.15.2	H-03b3	POTASSIUM	450		530	
2-331	2.21.2	H-17	ALUMINUM	<10	<10	2	3
2-331	2.21.2	H-17	ANTIMONY	<5	<5	2.5	2.5
2-331	2.21.2	H-17	BARIUM	<0.5	<0.5	0.12	0.13
2-331	2.21.2	H-17	BERYLLIUM	<0.5	<0.5	<0.05	<0.05
2-331	2.21.2	H-17	BORON	42	42	39	40
2-331	2.21.2	H-17	CADMIUM	<0.5	<0.5	0.24	0.25
2-331	2.21.2	H-17	CHROMIUM	1	1	1.1	1.2
2-331	2.21.2	H-17	COBALT	<1	<1	0.4	0.4
2-331	2.21.2	H-17	COPPER	<1	<1	0.6	0.6
2-331	2.21.2	H-17	IRON	<1	<1	1.2	1.2
2-331	2.21.2	H-17	LEAD	<5	<5	2	2.2
2-331	2.21.2	H-17	MANGANESE	<0.5	<0.5	0.16	0.17
2-331	2.21.2	H-17	MERCURY	0.0008		<0.0002	<0.0002
2-331	2.21.2	H-17	NICKLE	<3	<3	0.7	0.7
2-331	2.21.2	H-17	SILICA	<21	<21	12	13
2-331	2.21.2	H-17	SILVER	<1	<1	0.3	0.4
2-331	2.21.2	H-17	TITANIUM	<3	<3	1.3	1.4
2-331	2.21.2	H-17	VANADIUM	<1	<1	0.5	0.5
2-331	2.21.2	H-17	ZINC	<1	<1	0.2	0.2
A-20	A.3	CLIFTON	NITRATE	<1.9		1.9	
A-21	A.3	CLIFTON	CALCIUM	49	49	35	35
A-21	A.3	CLIFTON	MAGNESIUM	40	40	34	34
A-30	A.4	BARN	CALCIUM	71	71	59	59
A-30	A.4	BARN	MAGNESIUM	35	34	31	31

END

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