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Virus occurrence and transport in a cold-water sand and gravel aquifer Frenchtown Montana

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Virus Occurrence and Transport
in a Cold-Water, Sand and Gravel Aquifer,
Frenchtown, Montana

by
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B.S. Northern Arizona University, 1987
presented in partial fulfillment of the requirements
for the degree of
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Dean, Graduate School

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Virus Occurrence and Transport in an Unconfined, Sand and Gravel Aquifer, Western Montana

Committee Chair: Dr. William W. Woessner

Septic systems have the potential to introduce viruses into ground water, which can result in the transport of viruses downgradient from the source. Viruses may remain viable longer and be transported further in a coarse-grained, unconsolidated aquifer. However, few field-scale studies of virus transport in high hydraulic conductivity aquifers have been documented. For this study, the shallow groundwater in the vicinity of a 20,000 sq. ft septic drainfield was instrumented. Site characterization determined the shallow water table fluctuates between a depth of 7 and 14 ft, hydraulic conductivity ranges from 500 to 800 ft/day and the ground-water velocity approaches 7 ft/day.

Though no enteric viruses were detected in the groundwater above the detection limit of 1 virus/1000L, bacteriophage (virus) were observed in groundwater over 60 ft downgradient from the drainfield. A tracer experiment was conducted using slug sources of bromide and bacteriophage. Coliphage strains MS2 and PHIX-174 were seeded directly into groundwater at initial concentrations of 1.06E09 PFU/ml and 1.12E06 PFU/ml, respectively. In approximately 20 days, seeded viruses were detected at a downgradient distance of over 80 ft before exiting the tracer well network. Over this distance an 8 log reduction in virus concentration occurred. Analysis of breakthrough curves revealed times of peak concentrations of virus and the conservative bromide occurred at similar intervals. However, virus curves exhibited a pronounced tailing effect, suggesting significant attachment/detachment was occurring. Based on phage stability controls in the injection well, die-off is considered negligible in the 10° C groundwater during the seeding experiment. It appears attachment is an important mechanism controlling virus transport in a high velocity groundwater system. Nevertheless, a portion of the viruses initially attached are later released and remain viable for several months.

ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (CONT'D)

INTRODUCTION

In the past two decades, an increasing awareness has developed regarding the ability of infectious human viruses to survive and be transported in soil water and groundwater systems. Of particular concern are enteric viruses, which replicate in the intestinal tract of humans and other animals and are commonly found in raw sewage. Enteric viruses have been detected in soil water and groundwater at numerous sewage discharge, treatment and disposal facilities (Wellings, et al., 1975; Keswick and Gerba, 1980; Vaughn, et al., 1983; Jansons, et al., 1987). Once present in the groundwater system, enteric viruses have been shown to survive for days and months in some aquifer environments (Keswick, et al., 1982; Bitton, et al., 1983; Jansons, et al., 1989). Furthermore, enteric viruses that persist in some aquifers have been transported significant distances from the source area. Mack, et al., (1972). reported isolating enteric viruses in a well approximately 100 m from a wastewater drainfield in Michigan. In New York, Vaughn, et al., (1983) reported detecting enteric viruses at a distance of over 67 m down-gradient from a subsurface septic disposal system.

These early works prompted research focused on identifying the factors controlling the transport and survival of viruses in groundwater systems. Results of field and laboratory experiments suggested adsorption was the primary physical mechanism acting to inhibit enteric virus transport (Gilbert, et al., 1976; Gerba, 1984). Laboratory column experiments found that adsorption of viruses to soils was highly dependent on the strain of virus, and on the soil type (Goyal and Gerba, 1979). Others have reported the survival of viruses in soils and groundwater is related to a number of factors including soil type, temperature, pH, microbial load and dissolved oxygen (Keswick and Gerba, 1980; Jansons et al., 1989). Nevertheless, the quantitative aspects of transport and survival of enteric viruses in groundwater remain difficult to characterize. One challenge that needs to be resolved is the inability of researchers to detect low concentrations of enteric viruses (< 2 per 2000 L). In addition, field experiments using infectious enteric viruses have not been widely conducted due primarily to public health considerations, and few published works are available.

To circumvent some of these challenges, the last several years have seen the adoption of specific bacteriophage (coliphage) as safe surrogates for field studies of the behavior of infectious human viruses. Coliphage are often found in natural waters impacted by sewage wastes, and can be assayed by plaquing. Column experiments have been used to document the survival of coliphage in groundwater (Yahya et al., 1993) and the transport of bacteriophage in porous media (Grondin and Gerba, 1986; Bales, et al., 1989; Harvey, et al., 1993). Comparative rates of adsorption and the chemical factors controlling adsorption have been studied in column experiments (Goyal and Gerba, 1979; Bales, et al., 1993). Because coliphage are not infectious to humans, they have very recently been used in field experiments as models for the behavior of infectious enteric viruses in groundwater (Rossi, et al., 1994; Bales, et al., 1995).

According to Yates, et al., (1987) coliphage experiments have demonstrated that the fate of viruses in soils and groundwater is controlled by two primary processes: virus inactivation and the adsorption/desorption of viruses to substrate particles. Field and laboratory studies report specific chemical and physical factors which affect the ability of coliphage and enteric viruses to adhere to soil particles, including soil type, pH, ionic strength, dissolved oxygen, and hydrophobic effects (Gerba, 1984; Yates et al., 1987; Gerba, 1989; Bales, et al., 1993; Yahya, et al., 1993). Temperature was cited by Yates, et al., (1985) as "the single most important predictor of virus persistence in well water". Virus inactivation was found to be most significantly aided by increased temperature and decreased dissolved oxygen (Jansons, et al., 1989; Yahya, et al., 1993). Because colder water temperatures and well-oxygenated systems favor virus survival, it is expected that virus transport may be more extensive in a relatively cold and conductive, coarse-grained alluvial aquifer. However, additional field experiments are needed to document the transport of viruses in well-characterized hydrogeologic environments.

In light of limited research related to both enteric viruses and coliphage, and our inability to effectively detect the presence of enteric viruses in water at the low levels expected to pose a threat to human health, regulators face a difficult task in setting acceptable limits for pathogenic viruses in drinking water supplies. Under the draft Ground Water Rule (formerly the Draft Groundwater Disinfection Rule), the EPA has proposed that groundwater used for drinking water should be treated such that the level of pathogenic viruses (and Giardia) in the treated water would result in a risk of less than one infection per 10,000 persons per year (USEPA, 1992). This risk translates to a concentration of 1 virus particle in 10^7 L (10,000,000 liters). Alternatively, the GWR will allow a variance for water providers to avoid the costs associated with chemical disinfection provided they can demonstrate "natural disinfection" occurs between potential sources of fecal contamination and water wells. However, reviews of the natural disinfection criteria and models used to grant disinfection variances suggest that more research is needed in this area, particularly in understanding the fate of pathogenic viruses in various hydrogeologic environments (Yates, 1990).

PURPOSE AND OBJECTIVES

The purpose of this research is to establish the horizontal distance viruses originating from a large septic system are transported in a conductive, cold water, sand and gravel aquifer. The specific objectives of this study will be to:

1. Characterize the physical hydrogeologic system, including definition of the site stratigraphy and hydraulic properties.
2. Document the chemical, microbial and viral conditions present in the s0eptic system and shallow groundwater.
3. Conduct bromide and coliphage tracer tests within the shallow aquifer, and

4. Develop methods to predict the concentration and transport distances of human enteroviruses in similar groundwater systems.

ORGANIZATION OF THESIS

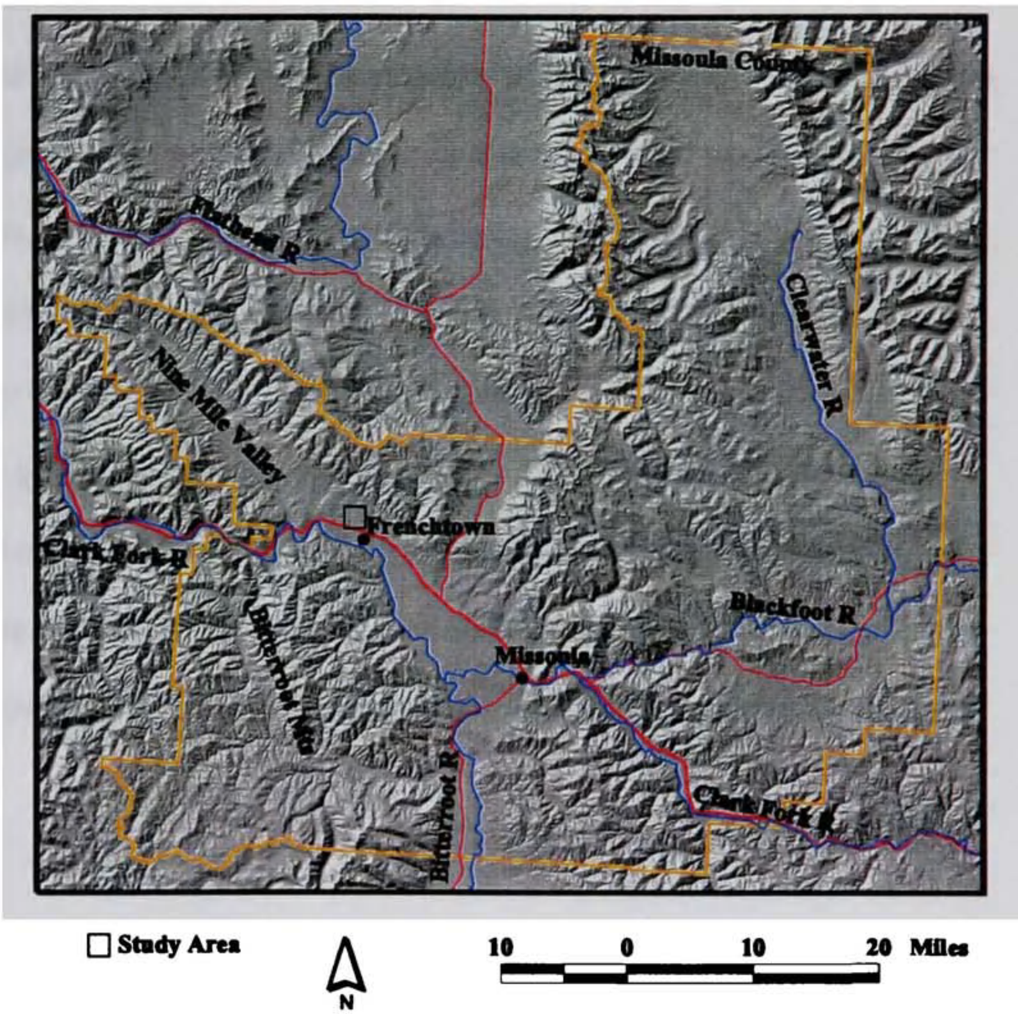
This thesis is organized under two major headings. Part I is the Hydrogeologic Site Characterization which describes the field and analytical methods used to characterize the site, presents the results of the investigation, and provides a discussion of the physical hydrogeology and ground-water quality of the site. Part II is the Coliphage Seeding Experiment which presents the methods and results of the virus seeding experiment, followed by a discussion and interpretation of the results of the experiment. All field and analytical data, and supporting documentation are included in the Appendices of the thesis.

PART I HYDROGEOLOGIC SITE CHARACTERIZATION

1.0 LOCATION AND SETTING

The Frenchtown High School (FHS) research site is located in western Montana, about 10 mi west of the city of Missoula (Figure 1). Frenchtown is a rural community with a population of about 2,000 people. The study site occupies the northwest end of the Missoula Valley, a broad west-northwest

FIGURE 1
VICINITY MAP



trending valley which is bounded to the north by the Nine Mile Divide and to the south by the Clark Fork River and the foothills of the Bitterroot Mountains. In the vicinity of Frenchtown, 9 to 18 ft of late Pleistocene alluvium composed of silty sands, sands and gravels form the valley floor (Smith, 1992). Underlying these alluvial deposits are 55 to 200 ft of Pleistocene sediments including about 100 to 120 ft of silty sands and interbedded clays, and a basal sand and gravel unit about 80 ft thick. These sediments unconformably overlie up to a few thousand feet of finer-grained Tertiary sediments (Geldon, 1979). Precambrian bedrock forms the valley bottom and surrounding mountains.

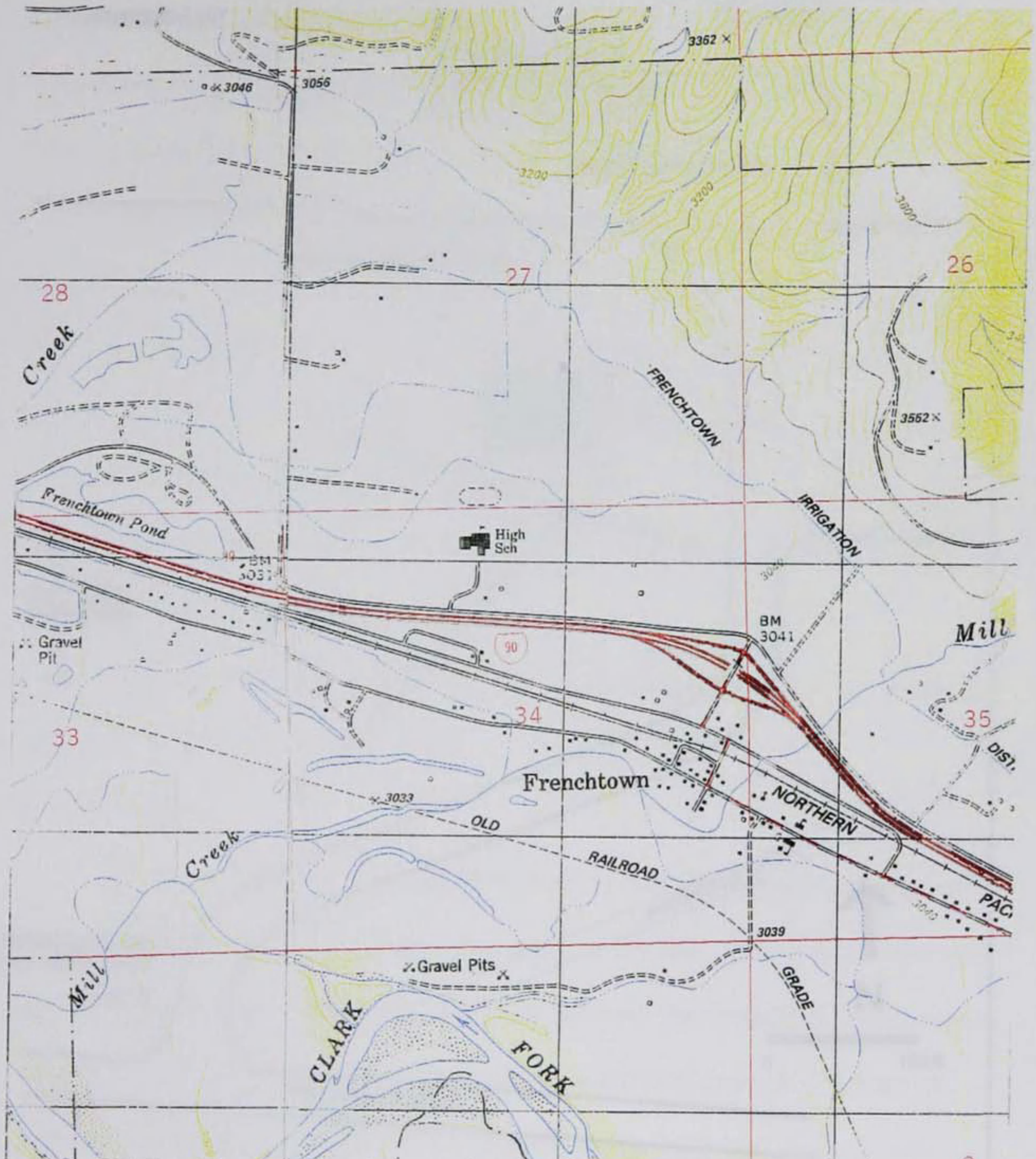
Shallow groundwater occurs in the vicinity of the site as an unconfined system in the surficial alluvium (0 to 30 ft). A deeper and separate regional confined aquifer is present in the basal gravels at a depth of about 170 to 250 ft. This basal aquifer is the primary source of domestic groundwater water supplies in the area.

Facility

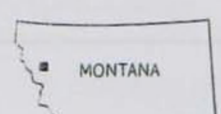
The location of the FHS is Township 15N Range 12W Section 34, NE1/4 of the NW1/4 (Figure 2). The FHS was constructed in 1980, immediately north of Interstate-90. Figure 3 is a site map.

The sewage and wastewater produced by approximately 350 students and staff is disposed of by a septic system located in front of and south of the school. The septic system consists of a 15,000 gal septic tank from which effluent is pumped up and gravity fed to a 20,000 ft^2 drainfield. The drainfield is

FIGURE 2
LOCATION MAP



USGS 7.5 Minute Quadrangle Maps
Frenchtown, MT and Huson, MT, 1984



QUADRANGLE LOCATION

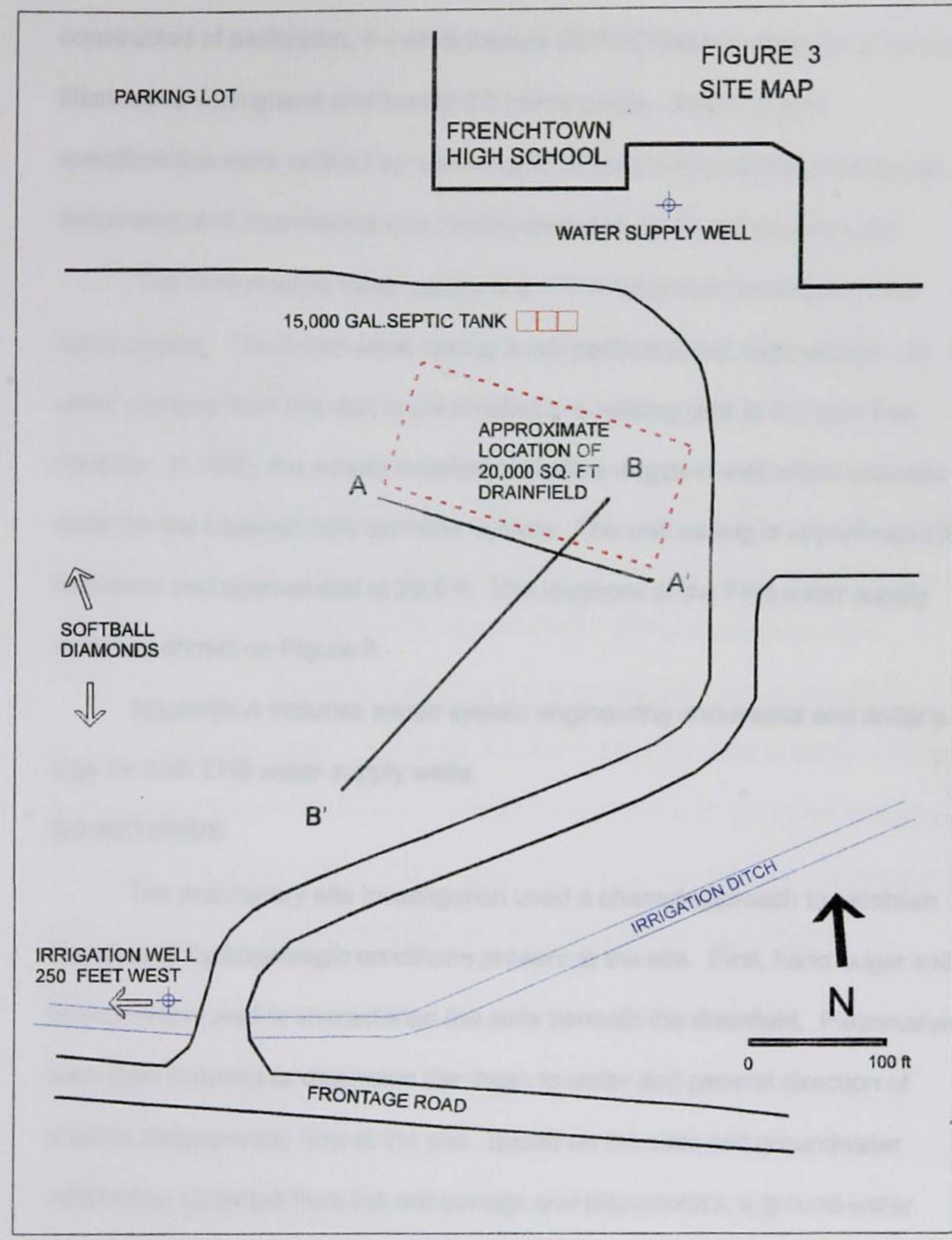


FIGURE 3
SITE MAP

constructed of perforated, 4-inch Schedule 20 PVC laterals nested in a trenches filled with 2-inch gravel and buried 2 ft below grade. Septic system specifications were verified by reviewing all available engineering and design documents and interviewing key construction and maintenance personnel.

The FHS potable water supply is a 177 ft deep well completed in the basal aquifer. The 6-inch steel casing is not perforated but open-ended. All water pumped from this well is chlorinated in a holding tank to 0.5 ppm free chlorine. In 1995, the school installed a shallow irrigation well which provides water for the baseball field sprinkler system. The well casing is unperforated 6-inch steel and open-ended at 25.5 ft. The locations of the FHS water supply wells are shown on Figure 3.

Appendix A includes septic system engineering documents and driller's logs for both FHS water supply wells.

2.0 METHODS

The preliminary site investigation used a phased approach to establish the general hydrogeologic conditions present at the site. First, hand auger soil borings were used to characterize the soils beneath the drainfield. Piezometers were then installed to determine the depth to water and general direction of shallow ground-water flow at the site. Based on the soils and groundwater information collected from the soil borings and piezometers, a ground-water monitoring well network was constructed. The monitoring wells were tested and sampled to characterize the physical and chemical properties of the aquifer.

Lastly, a network of closely-spaced wells was installed for the purpose of conducting ground-water tracer experiments. This section describes the field and analytical methods used to instrument and characterize the site. Figure 4 shows the locations of all soil borings, piezometers and ground-water monitoring wells constructed at the FHS.

2.1 Soils Investigation

Sample Collection

Ten (10) 3-in diameter hand auger borings (B1 through B10) were drilled to a depth of 8 to 10 ft below land surface, at which depth saturated soils and coarse gravels precluded further advancement. Soil grab samples were collected at 2.5 ft intervals. Soil samples were also collected during the installation of piezometers and ground-water monitoring wells at depth intervals of 2.5 or 5 ft. All soil samples were visually inspected and described using the Unified Soil Classification System (Figure 5). A log of boring was maintained for each soil boring, piezometer boring and monitor well boring (Appendix B).

Sieve Analysis

Standard sieve analyses were conducted on each of the soil samples collected. Sieve analyses and methodology are contained in an undergraduate thesis prepared by Swaren at The University of Montana (1995).

Soils were dried, split and weighed prior to being sieved through a set of six nested sieves ranging in size from -1 to 4 phi units (4 to 1/16 mm). For each

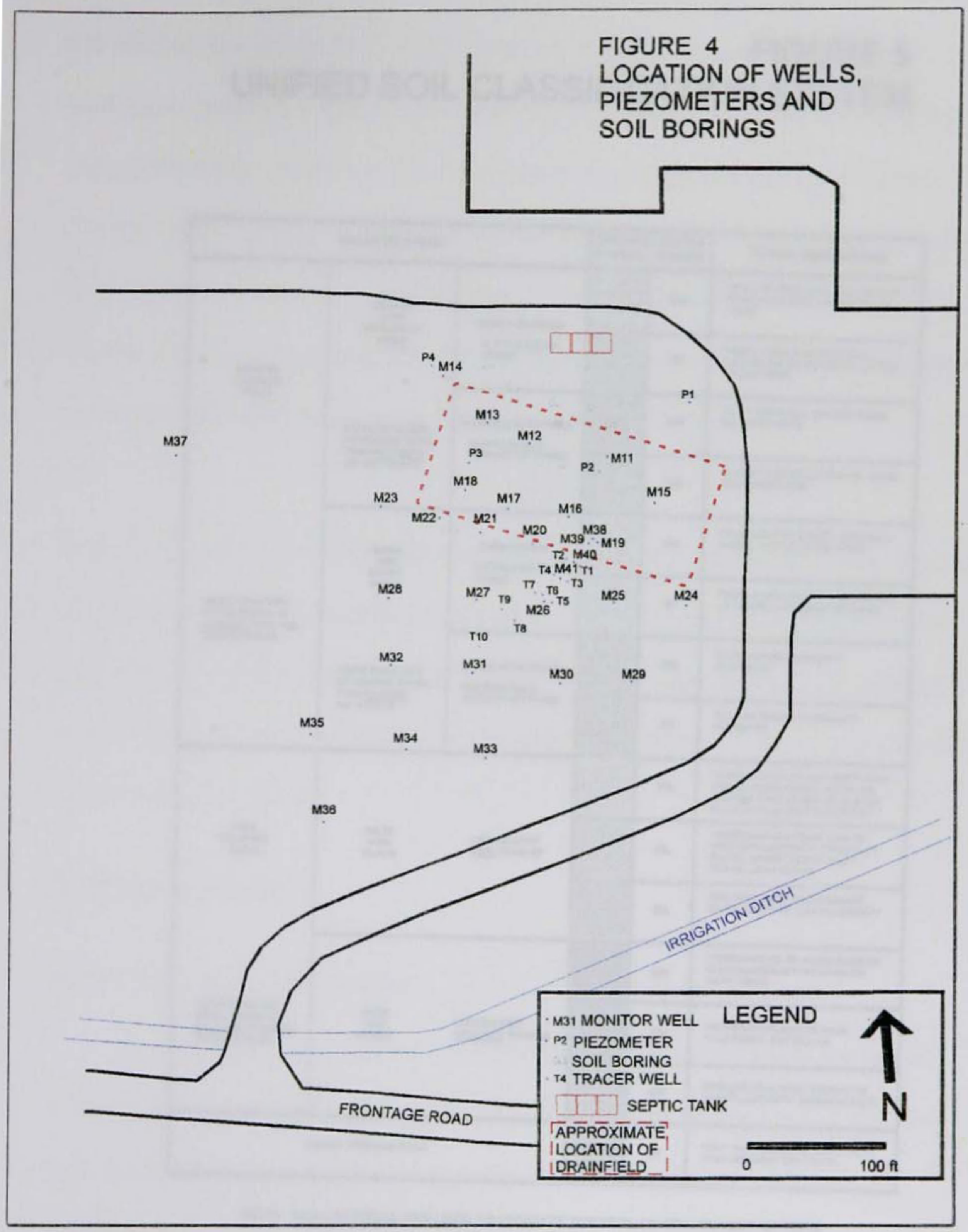


FIGURE 4
LOCATION OF WELLS, PIEZOMETERS AND SOIL BORINGS
P4
M14
P1
M13
M12
M37
P3
P2
M11
M18
M23
M17
M16
M15
M22
M21
M20
M38
M39
M19
T2
M40
T4
M41
T1
T3
M28
T7
T6
M27
T9
T5
M25
M24
M26
T8
T10
M32
M31
M30
M29
M35
M34
M33
M36
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
M31 MONITOR WELL
P2 PIEZOMETER
SOIL BORING
T4 TRACER WELL
SEPTIC TANK
APPROXIMATE LOCATION OF DRAINFIELD
0
100 ft
N

FIGURE 5
UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL GRADED GRAVELS, GRAVEL SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION <u>RETAINED</u> ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS <u>LARGER</u> THAN NO. 200 SIEVE SIZE				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION <u>PASSING</u> NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT <u>LESS</u> THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT <u>GREATER</u> THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
MORE THAN 50% OF MATERIAL IS <u>SMALLER</u> THAN NO. 200 SIEVE SIZE				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS soil sample, the distribution of grain size by weight was determined and a cumulative grain size distribution curve was generated. A statistical analysis was attempted to determine the mean grain size and the degree of sorting (Boggs, 1987). The grain size data were further used to estimate the distribution of hydraulic conductivity at the site using methods described by Hazen (1892). The Hazen Method relates hydraulic conductivity to the square of the effective grain size of a sediment sample using the following formula:

$$K = C(d_{10})^2$$

where K is hydraulic conductivity (cm/sec), C is coefficient based on the size and degree of sorting of the sediment particles, and d10 (cm) is the effective grain size. A value of C = 100 was used for this analysis, which roughly correlates to a medium to coarse, moderately-sorted sand according to Hazen's classification scheme (Fetter, 1994).

2.2 Instrumentation

Septic Effluent Pump Station

Wastewater generated at the school is pumped to a 15,000 gal septic tank. A pair of submersible pumps alternate lifting the effluent out of the tank and into the drain line where it is gravity fed to the drainfield. The effluent pumping system was instrumented with chart recorders to document effluent pumping cycles. Pump cycling data were combined with pumping curves to estimate daily effluent loading rates (Appendix C).

Piezometer Installation

The depth of the shallow water table and the approximate direction of groundwater flow were determined by installing four (4) piezometers (P1 through P4). Prior to piezometer installation, a 3-in diameter hand auger boring was advanced to a depth of 8 to 10 ft below grade. The piezometers were then installed within the soil boring using a jackhammer to advance 3/4-in diameter galvanized steel pipe to a depth of approximately 19 ft below grade. The bottom end of the galvanized pipe was equipped with a loosely fitting carriage bolt. Once the pipe was driven to the desired depth, the pipe was pulled back approximately 6 in to dislodge the carriage bolt and to allow water to enter the piezometer. The annulus was then backfilled with cuttings to a depth of 2 ft below grade and sealed with a 1.5 ft bentonite seal activated with water. Drill cuttings were placed around a 1 ft stickup and the drillsite was repaired to grade. The surface completion at each piezometer consists of a short, 3-inch diameter black steel protective casing with a lockable lid.

Ground-water Monitoring Well Installation

Based on the preliminary depth to water and grain size information collected, a ground-water monitoring well network was installed to characterize the physical properties of the aquifer and assess groundwater chemistry in the vicinity of, and immediately down-gradient from the septic drainfield. O'Keefe Drilling Company of Butte, Montana was contracted to perform auger drilling. A

Mobile B-61 truck-mounted hollow-stem auger rig was used to install thirty-one (31) 2-in diameter Schedule 40 PVC ground-water monitoring wells (M11 through M41). Well M37 is designated as a background well. It is located on-site but outside of the anticipated plume of septic impacted groundwater.

The well installation procedure was similar for each 2-in diameter monitoring well. At each well location, the drill rig advanced an 8-inch diameter boring to a total depth of 16 to20 ft below land surface. Soil grab samples were collected from drill cuttings at 5-ft depth intervals. Soil samples were logged and sieved as described above. Well casing and screen was lowered through the 4.5 inch diameter hollow stem of the auger, and as the augers were withdrawn, the unconsolidated formation collapsed back around the well casing and screen. Typically, the lower, saturated portion of the borehole collapsed and the upper, unsaturated formation remained open. Once the auger flights were removed from the borehole, the remainder of the open annulus was backfilled with cuttings to a depth of 2 ft below grade. A 1.5 ft bentonite seal was placed in the annulus and activated with water. Drill cuttings were placed around a small stick-up and the drillsite was repaired to grade.

Monitoring wells are completed to a depth of 15 to 20 ft. All wells are completed with 10 ft of .020 slot screen, except wells M38 through M41, which are completed with 5 ft of .020 slot screen. Each well is equipped with a PVC bottom cap and a PVC slip cap. A short length of 3-in diameter black steel equipped with a lockable lid was later added as a protective surface casing at each well. Appendix D contains a Monitor Well Construction Summary for each 2-in diameter well.

Each monitoring well was developed by swabbing, surging and bailing using a 1.6-in diameter Teflon or PVC bailer. A minimum of 25 gal of water was removed from each well during development. Additional well development was performed on wells M19, M26, M38, M39, M40 and M41 using a centrifugal pump to surge, swab and overpump at a rate of 15-20 gpm. Each of the six wells was developed for a minimum of 1 hr, until the well produced clear water even after vigorous surging. These more thoroughly developed wells were included in the groundwater tracer well network.

Tracer Well Network Installation

An array of ten small diameter wells (T1 through T10) were installed in the vicinity of the above-mentioned six wells for the purpose of conducting a groundwater tracer test and a virus seeding experiment (Figure 6). The tracer network is oriented parallel to the direction of ground-water flow at the downgradient edge of the drainfield and along the axis of the identified plume of septic impacted groundwater.

Seven wells (T1-T7) were installed to a depth of approximately 12 to 15 ft below land surface using a Geoprobe hydraulic press operated by West Central Environmental Consultants (WCEC) of Missoula, Montana. The wells are constructed of 1.25-in schedule 80 PVC and 2 ft of hand-slotted PVC screen.

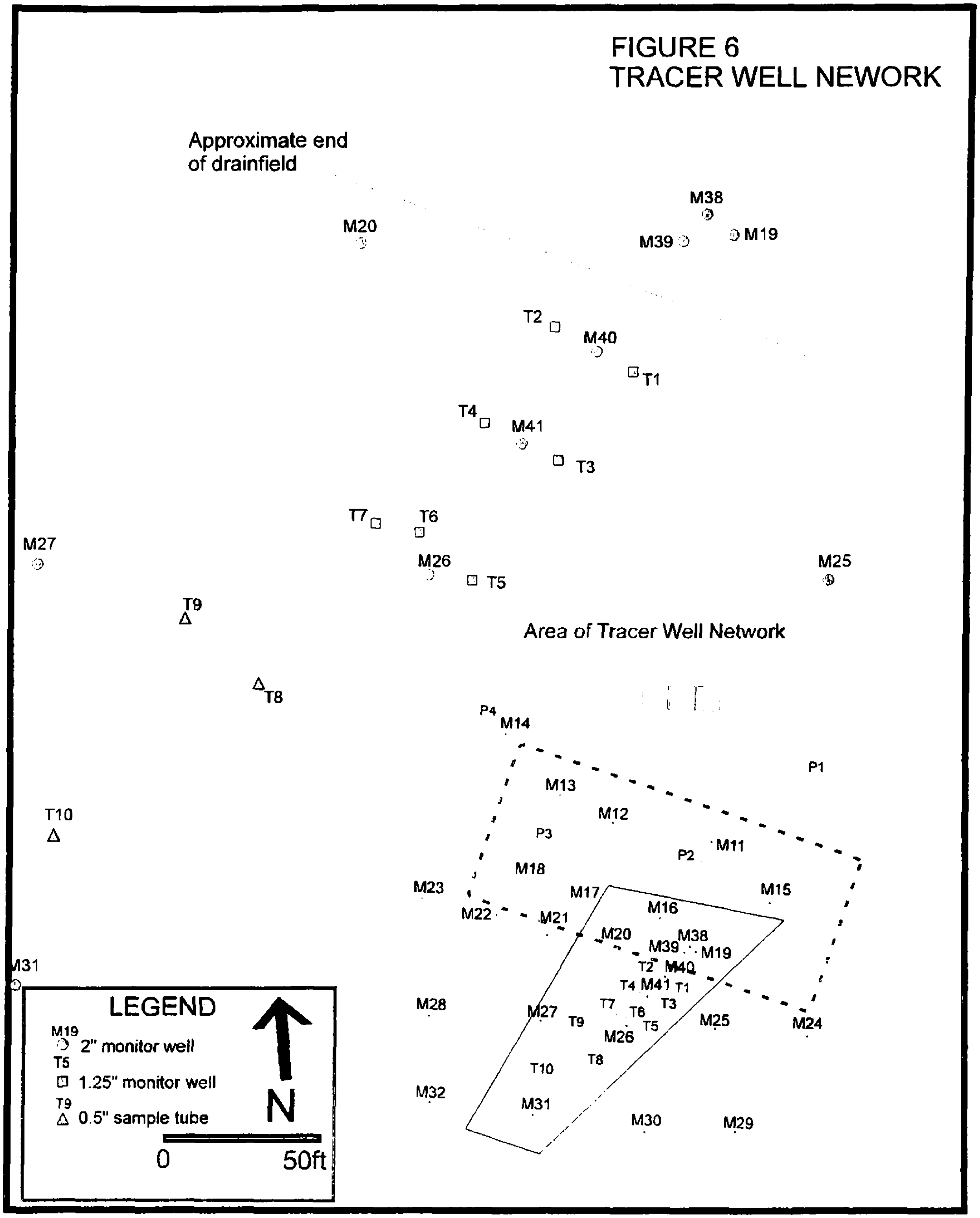


FIGURE 6
TRACER WELL NEWORK
Approximate end
of drainfield
M38
M20
M39
M19
T2
M40
T1
T4
M41
T3
T7
T6
M27
M26
T5
M25
T9
Area of Tracer Well Network
T8
P4
M14
P1
M13
M12
T10
P3
P2
M11
M18
M23
M17
M15
M22
M21
M16
M20
M38
M39
M19
T2
M40
T4
M41
T1
M31
T7
T3
M28
M27
T9
T6
M25
M24
T5
M26
T10
T8
M32
M31
M30
M29
LEGEND
M19
2" monitor well
T5
1.25" monitor well
T9
0.5" sample tube
N
0
50ft

Prior to casing installation, a 1.5 in diameter core barrel was advanced with the Geoprobe press. Once gravels were encountered, the casing was driven into the borehole to a maximum depth of 15 ft or until the casing could not be advanced further. The wells have a natural pack filter. The open annulus of each well was backfilled with cuttings. A bentonite seal was placed from a depth of 0.5 to 1 ft and activated with water. The wells are completed with a 3-in diameter black steel surface casing equipped with a lockable lid. Wells T1 though T7 were developed by pumping and surging with a 0.5 in polyethylene tube and a peristaltic pump.

Three additional small diameter sampling devices (T8, T9 and T10) were installed using a method similar to the method described for piezometer installation. A jackhammer advanced a 1-in diameter galvanized steel pipe to a depth of 12 to 14 ft. Once the pipe was driven to depth, a 0.5-in diameter polyethylene tube was lowered down the center of the pipe. The bottom 2 ft of the polyethylene tubing had been perforated with a hand drill and wrapped in a fine mesh nylon screen. The steel pipe was removed and the tubing was left in place. The sample tubes are protected with a short stickup of 2-in diameter, Schedule 40 PVC casing.

Table 1 summarizes the well construction for all wells and piezometers at the FHS site. Monitor well construction summaries for wells T1 through T10 are included in Appendix D.

Table 1
Summary of Piezometer and Monitoring Well Completions

WELL I.D.	MP ELEV (feet)	CASING DIAMETER (inches)	TOTAL DEPTH BGS (feet)	SCREENED INTERVAL (feet)	COMMENTS
P1	100	0.75 GALV.	19	OPEN ENDED	
P2	99.8	0.75 GALV.	19	OPEN ENDED	ABANDONED
P3	99.71	0.75 GALV.	19	OPEN ENDED	ABANDONED
P4	99.99	0.75 GALV.	19	OPEN ENDED	ABANDONED
M11	99.76	2" PVC	17.1	7.1 - 17.1	
M12	99.83	2" PVC	17.1	7.1 - 17.1	
M13	99.89	2" PVC	17.3	7.3 - 17.3	
M14	99.87	2" PVC	17.2	7.2 - 17.2	
M15	99.52	2" PVC	16.6	6.6 - 16.6	
M16	99.49	2" PVC	17.7	7.7 - 17.7	
M17	99.57	2" PVC	17.4	7.4 - 17.4	
M18	99.51	2" PVC	16.7	6.7 - 16.7	
M19	99.27	2" PVC	17.3	7.3 - 17.3	
M20	99.2	2" PVC	16.6	6.6 - 16.6	
M21	99.2	2" PVC	16.3	6.3 - 16.3	
M22	99.35	2" PVC	16.5	6.5 - 16.5	
M23	102.01	2" PVC	18.5	8.5 - 18.5	ABANDONED
M24	99.34	2" PVC	15.8	5.8 - 15.8	
M25	99.38	2" PVC	15.8	5.8 - 15.8	
M26	99.13	2" PVC	17.6	7.6 - 17.6	
M27	99.18	2" PVC	16.9	6.9 - 16.9	
M28	101.46	2" PVC	19.1	9.1 - 19.1	
M29	99.78	2" PVC	17.1	7.1 - 17.1	
M30	99.85	2" PVC	16.6	6.6 - 16.6	
M31	99.76	2" PVC	17.2	7.2 - 17.2	
M32	101.34	2" PVC	18.6	8.6 - 18.6	
M33	100.95	2" PVC	17.4	7.4 - 17.4	
M34	101.67	2" PVC	19.2	9.2 - 19.2	
M35	101.57	2" PVC	19.4	9.4 - 19.4	
M36	102.75	2" PVC	19.2	9.2 - 19.2	
M37	102.26	2" PVC	19.1	9.1 - 19.1	BACKGROUND WELL
M38	99.18	2" PVC	15.4	10.4 - 15.4	
M39	99.16	2" PVC	15.2	10.2 - 15.2	
M40	99.08	2" PVC	15.3	10.3 - 15.3	
M41	99.05	2" PVC	15.5	10.5 - 15.5	
T1		1" PVC	12.4	10.4 - 12.4	
T2		1" PVC	13.7	11.7 - 13.7	
T3		1" PVC	14.3	12.3 - 14.3	
T4		1" PVC	13.3	11.3 - 13.3	
T5		1" PVC	13.5	11.5 - 13.5	
T6		1" PVC	14.3	12.3 - 14.3	
T7		1" PVC	14.6	12.6 - 14.6	
T8		0.5" PVC	11.2	9.2 - 11.2	
T9		0.5" PVC	13.2	11.2 - 13.2	
T10		0.5" PVC	13.6	11.6 - 13.6	

2.3 Hydrogeologic Data Collection

Water Level Measurements

All piezometers and ground-water monitoring wells were surveyed for vertical control. The measuring point (MP) at each instrument is the top of the well or piezometer casing. Piezometer P1 was assigned an arbitrary elevation of 100.00 ft and was used as the survey benchmark. MP elevations were surveyed to 0.01 ft. Water level measurements were recorded to 0.01 ft using a Solinst electric sounder. Monthly water level measurements were recorded between September 1994 and July 1996 at piezometers and 2-in diameter monitoring wells to document the depth to groundwater, and the direction and gradient of ground-water movement throughout the course of the study. All water level data are included in Appendix E.

Slug Tests

In October 1995, a total of thirty-seven "rising-head" slug tests were performed at eleven of the 2-in diameter ground water monitoring wells to estimate the horizontal distribution of hydraulic conductivity in the sand and gravel below a depth of 10 ft. A 1.6-in diameter bailer was used to instantly remove 0.29 gal of well water while a pressure transducer and a Hermit SE1000C data logger (In-Situ, Inc. Laramie, WY) recorded the recovery of the water level in the well. Values of local hydraulic conductivity were approximated according to methods described by Bouwer and Rice (1976). The data were analyzed both manually and by using the software package AQTESOLV (Version 1.1), marketed by Geraghty and Miller, Inc (1991).

All slug test data, including Hermit .txt files and Aqtesolv .dat files are provided on computer disk in the back pocket of the thesis.

Pumping Tests

In April 1996, a constant rate discharge test were conducted on well M19 using a centrifugal pump and a 1.25-in diameter suction pipe. Well M19 was pumped at a rate of approximately 8.8 gpm for 34 min. Drawdown measurements were recorded in two observation wells (M38 and M39) located within 6 ft of well M26. Recovery data were collected at the observation wells. The aquifer test data was analyzed using the Cooper-Jacob method (1946) to directly estimate values of aquifer transmissivity and storativity. Values of hydraulic conductivity were approximated from calculated transmissivity values.

The constant rate discharge test and recovery plots are included in Appendix F.

Bromide Tracer Test

A groundwater tracer experiment was conducted within the tracer well network shown on Figure 6. Thirty-five gal of concentrated sodium bromide solution was injected at a depth of 12 ft below land surface into wells M19 and M38. The injection rate was roughly 1 gpm. The initial bromide concentration was 4,130 mg/L in well M19 and 5,250 mg/L in well M38. Wells in the tracer network were sampled for bromide over a period of 20 days. All samples were collected with a peristaltic pump and dedicated 0.5-in diameter polyethylene tubing. The sample tube inlet was positioned within the perforated interval of the well at a depth of 2 ft below the static water level in each well. Bromide analysis was done using ion chromatography as described below. All data collected during the bromide tracer test are included in Appendix G.

2.4 Water Quality Sampling

Water quality samples were collected from the monitoring wells and the septic tank using dedicated sampling equipment and a peristaltic pump. A 0.5-in diameter polyethylene tube was installed in each monitoring well and the septic tank. At each monitoring well, sample tube intakes were positioned about 2 ft below the measured water table. The sample tube intake in the septic tank was set at a depth of 10 ft below the top of the manhole of the final septic tank compartment, where the septic effluent is relatively reduced in solids. Standard ground-water sampling techniques were used (EPA, 1987). Each well was purged of approximately 0.5 gal of water prior to sample collection. During well evacuation, field measurements of temperature, pH, electrical conductivity and dissolved oxygen were recorded. All samples were immediately labeled with the sample name, date and time, and packed on ice in a cooler for transport to The University of Montana Department of Geology Aqueous Geochemistry Laboratory. The thick-wall silicon tubing used in the peristaltic pump head was decontaminated between each well by flushing thoroughly with deionized water.

Inorganic Samples

All 2-in diameter ground-water monitoring wells and the septic tank were sampled for the following anions: nitrate (NO_3 as N), chloride (Cl), sulfate (SO_4) and phosphate (PO_4). Samples were also collected and analyzed for alkalinity ($CaCO_3$) and ammonium (NH_4). Cation analyses included Al, As, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Si, Sr, Ti and Zn.

Inorganic water quality samples were collected in clean polyethylene containers. Samples to be analyzed for anions were filtered using a 0.45 micron filter. Samples to be analyzed for cations were filtered with a 0.45 micron filter and preserved with concentrated nitric acid (HNO_3). Ammonium samples were preserved with concentrated sulfuric acid (H_2SO_4).

Coliform Bacteria Samples

Samples were collected from all monitoring wells and the septic tank and analyzed for total coliform and fecal coliform bacteria. Groundwater and septic effluent samples were collected with dedicated equipment as described for collection of inorganic samples. The samples were not filtered. Coliform water samples were collected in EPA approved sterile 100 ml polyethelene containers. The thick-wall silicon tubing used in the peristaltic pump head was decontaminated between each well by flushing thoroughly with deionized water. All coliform water samples were immediately labeled with the sample name, date and time, and packed on ice in a cooler for immediate transport to The University of Montana Division of Biological Sciences (DBS) Bacteriology Laboratory.

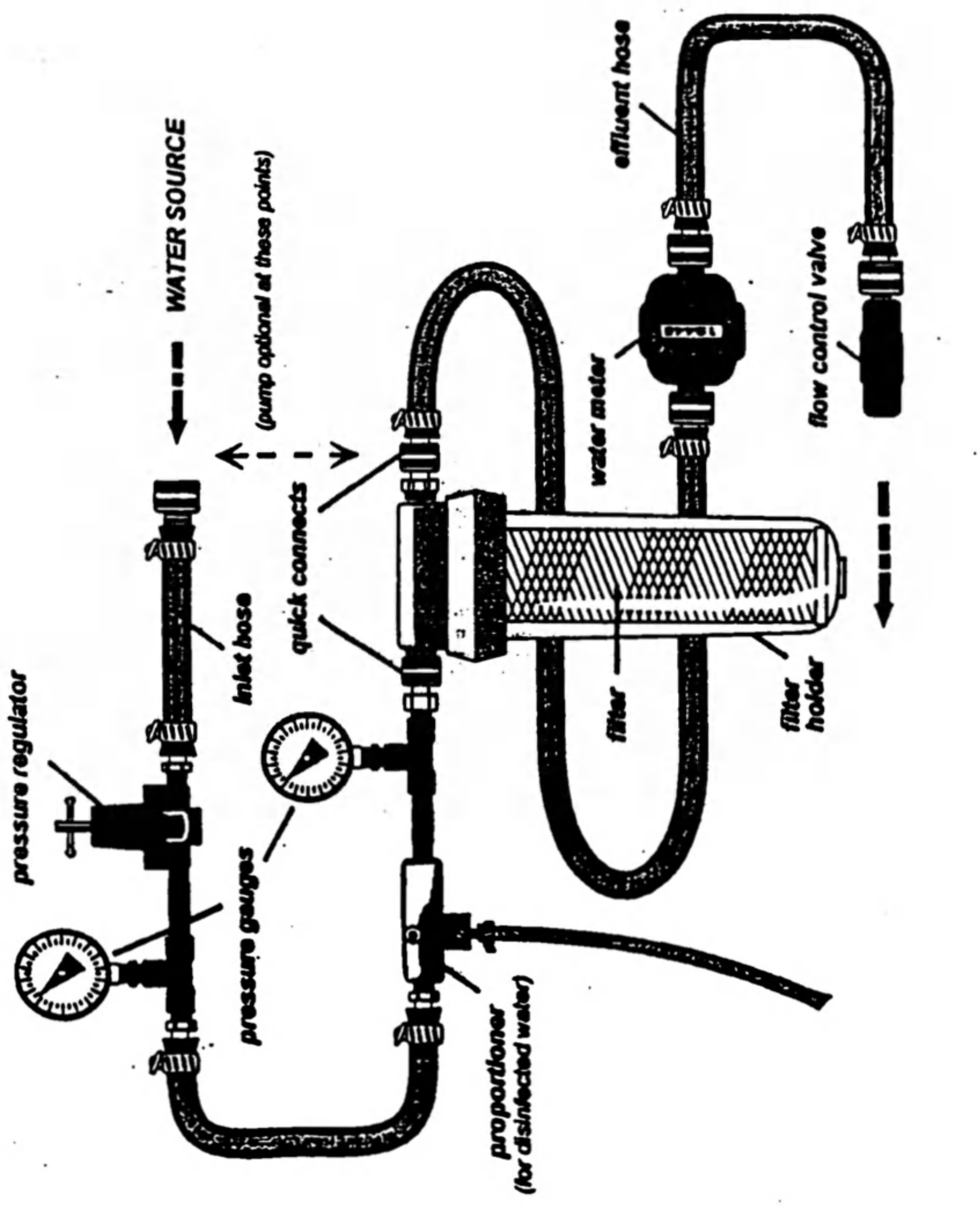
Virus Samples

Samples collected from all monitoring wells and the septic tank were analyzed for the presence of male-specific and somatic coliphage virus. Selected wells and the septic tank were sampled for the presence of human enterovirus. At each sampling location, coliphage samples were collected with sterile, dedicated equipment and a peristaltic pump. Special care was taken to prevent cross-contamination between sample collection locations, including using entirely dedicated equipment at each sampling location. Coliphage samples were limited in volume to 100 ml to 4 L. Sterile sample containers were filled completely to minimize head space. Samples were labeled and packed on ice for immediate or overnight delivery to The University of Montana DBS Virology Laboratory.

Sample collection and analysis of enterovirus in water and effluent is time consuming and relatively expensive. To maximize efficiency, enterovirus sampling was done only at the septic tank and at monitoring wells which, based on all other data collected, were likely to test positive for human enterovirus.

Enterovirus sampling equipment and methodologies were based on EPA guidelines (USEPA, 1994). In general, enterovirus assays required pumping 1,000 to 3,000 L of water or effluent through an autoclaved 1MDS Virusorb filter (CUNO, Meriden, CT) at a low flow rate (<7L/min). Where necessary, a polypropylene prefilter was used in-line before the 1MDS filter to remove suspended sediment. The sampling equipment is illustrated in Figure 7. The low rate of flow prevented the use of a totalizer to measure the volume of fluid pumped, so the total amount of fluid passing through the filter was calculated by frequently measuring the flow rate at the filter discharge with a 1 gal container and a stop watch. Filters were packed in ice and shielded from direct sunlight during sample collection to inhibit virus mortality. When sample collection was complete, excess water was drained from the filter cartridges and sterile aluminum foil was used to cover the filter cartridge openings. The filter cartridges were packed in ice for immediate delivery to The University of Montana DBS Virology Laboratory.

FIGURE 7
1-MDS VIRUSORB
SAMPLING
EQUIPMENT



2.5 Laboratory Methods

All water quality analyses were performed at The University of Montana. Samples of the groundwater and septic effluent from the septic tank were analyzed using standard methods to determine concentrations of inorganic, bacteriological and viral constituents. Quality assurance and quality control (QA/QC) analyses were performed to quantify error introduced in the data due to field and laboratory procedures. Laboratory QA/QC data are included in the appropriate appendix for each analysis.

Inorganic Chemistry

Inorganic analyses of groundwater and septic effluent included major cations and anions, alkalinity, and ammonia. Anions were analyzed in accordance with EPA Method 300 or 301 using a Dionex 2000I Ion Chromatograph (IC) equipped with Dionex AS4A separator columns. Cations analyses were performed using a Thermo-Jarrell Ash Atom Comp 800 Inductively Coupled Argon Plasma Emmission Spectrometer (ICP-ES) and in accordance with EPA Method 200.7. Quality assurance and quality control (QA/QC) procedures for anion and cation included the analyses of USGS standards, method blanks, and field and laboratory duplicates.

Alkalinity was determined using manual colorimetric utration to pH 4.5 in accordance with EPA 310.1. Ammonia concentrations were determined using an Orion 95-12 electrode in accordance with EPA 350.3, or by spectroscopy using a Milton Roy Spectronic 301 at 690 nm. Field duplicates and laboratory duplicates were run on approximately 10% of the samples analyzed for alkalinity and ammonia.

Coliform Bacteria

Bacterial assays were performed in the laboratory of Dr. Jim Gannon at The University of Montana DBS to document the presence or absence of fecal and total coliforms in groundwater and septic effluent. Analytical procedures were conducted in accordance with the American Public Health Association guidelines contained in "Standard Methods for Examination of Water and Wastewater" (1992). Total and fecal coliform bacteria were enumerated by the membrane filter (MF) technique. Total coliforms were cultured on m ENDO Broth MF (DIFCO Laboratories) and incubated at 35° C. Fecal coliforms were incubated on m FC Broth (DIFCO Laboratories) at 44.5° C. QA/QC included the analysis of field duplicates.

Viral Analyses

Samples of septic effluent and groundwater were analyzed for the occurrence of human enterovirus and coliphage using a variety of sampling and analytical techniques. All virus assays were performed by Dr. Dan DeBorde at The University of Montana Division of Biological Sciences in accordance with 40 CFR Part 141 and the USEPA Manual of Virological Methods (EPA, 1994), with some modifications.

Five of the enterovirus assays were performed using the 1MDS filtration apparatus as recommended in the USEPA ICR protocol. Within 4 to 8 hrs following collection, enteroviruses were eluted from the 1 MDS filter with a beef extract (3% BEG) and analyzed by plaquing or most probable number (MPN) analysis on Buffalo Green Monkey Kidney (BGM) cells. Three additional samples were assayed in a manner similar to the eluate from the 1MDS samples; two using unfiltered 1 L samples and one using a 10 L sample which was filtered through a negatively charged filter (Berg et al., 1984).

Grab samples for coliphage analysis were analyzed by either plaquing or MPN techniques on the appropriate bacterial host.

3.0 RESULTS

3.1 Physical Hydrogeology

Description of Soils

A total of ninety-three (93) soil samples were collected during the preliminary site characterization and subsequent installation of piezometers and ground-water monitoring wells. Sieve analyses were conducted on all soil samples as described in Section 2. Analysis of sieve data and cumulative grain size distribution curves were used to characterize the soils and estimate the distribution of hydraulic conductivity. The following is a general description of each of the soil types based on sieve analyses and descriptions and observations recorded on boring logs.

Soil Type A; Sandy gravel: 1 to 3-in diameter quartzitic and argilliitic gravels resembling Belt Supergroup clasts. Gravels are rounded to subangular, poorly to moderately sorted. Matrix of fine to coarse sand; predominantly poorly sorted medium to coarse sand comprising < 40% of sediment.

Soil Type B; Gravelly sand to clean sand: Fine to coarse sand, predominantly poorly sorted medium to coarse sand; <30% gravels, similar in composition to type A gravels, but smaller than 1-in diameter, moderately sorted, subangular to rounded. Locally fine, well sorted sands with no gravels and minor silt.

Soil Type C; Silty sands and silts: Mixtures of fine to medium sand and silt ranging from silty sand to silt. Light brown, tan. Little or no visible organic component.

Soil Type D; Topsoil: Black, organic-rich sandy loam, minor to moderate silt and clay.

Figures 8 and 9 are generalized lithologic cross sections of the upper 30 ft of alluvial deposits at the FHS site. Cross-section transects are shown on Figure 3.

Figure 8 is oriented west to east across the middle of the site (A to A'). Figure 9 is oriented parallel to the groundwater flow direction, from northeast to southwest (B to B'). Each lithologic cross section was prepared from sieve analyses and descriptions of soil samples collected during drilling. Drillholes constructed on site were advanced to a maximum depth of 20 ft; the nature of the alluvium from 20 to 30 ft depth is inferred from driller's logs of area water wells and verbal communications (Mr. Charles Hollensteiner, CKC Drilling, 8/19/95).

LATITUDINAL CROSS SECTION OF SELECTED WELLS

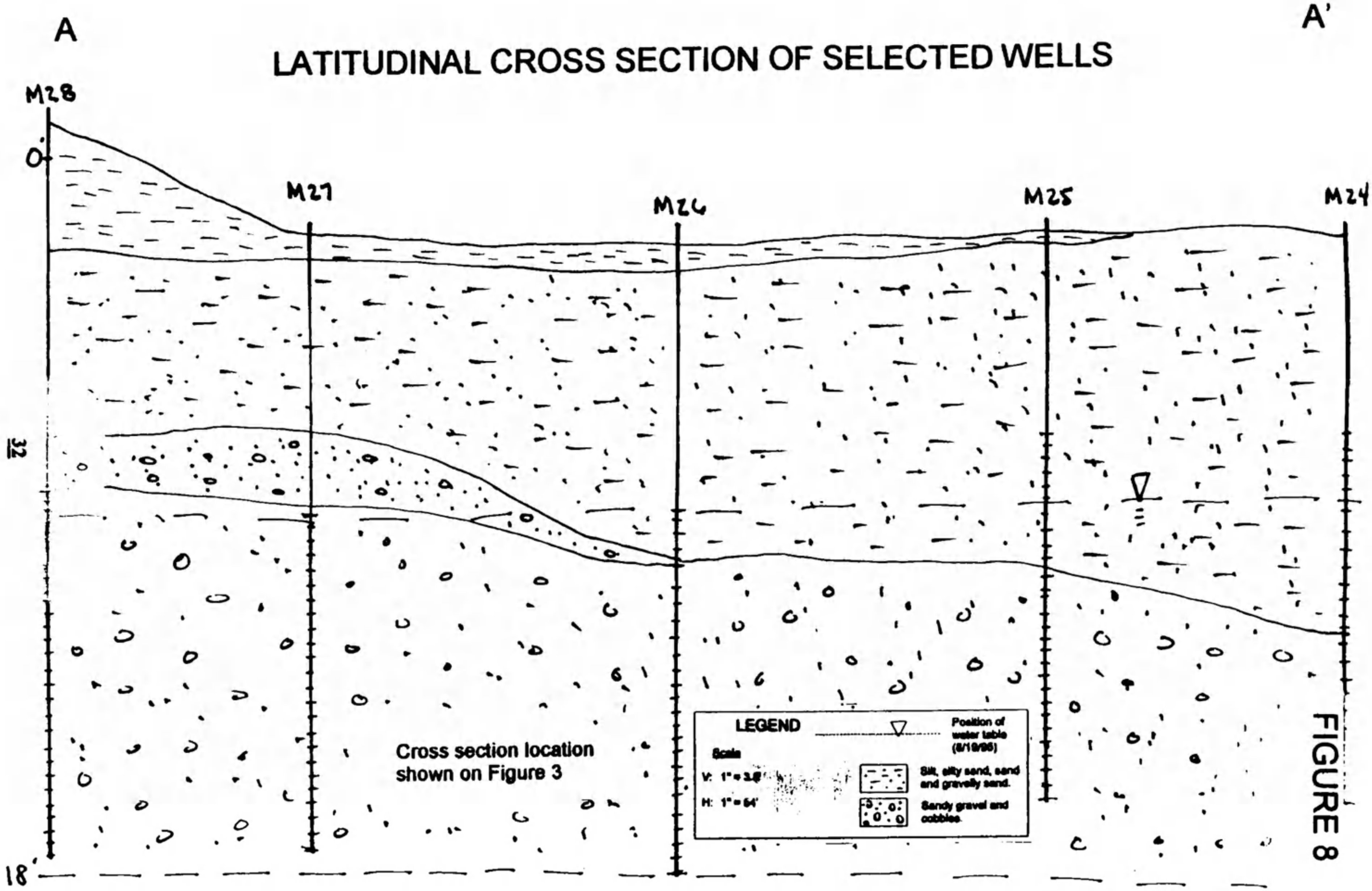


FIGURE 8

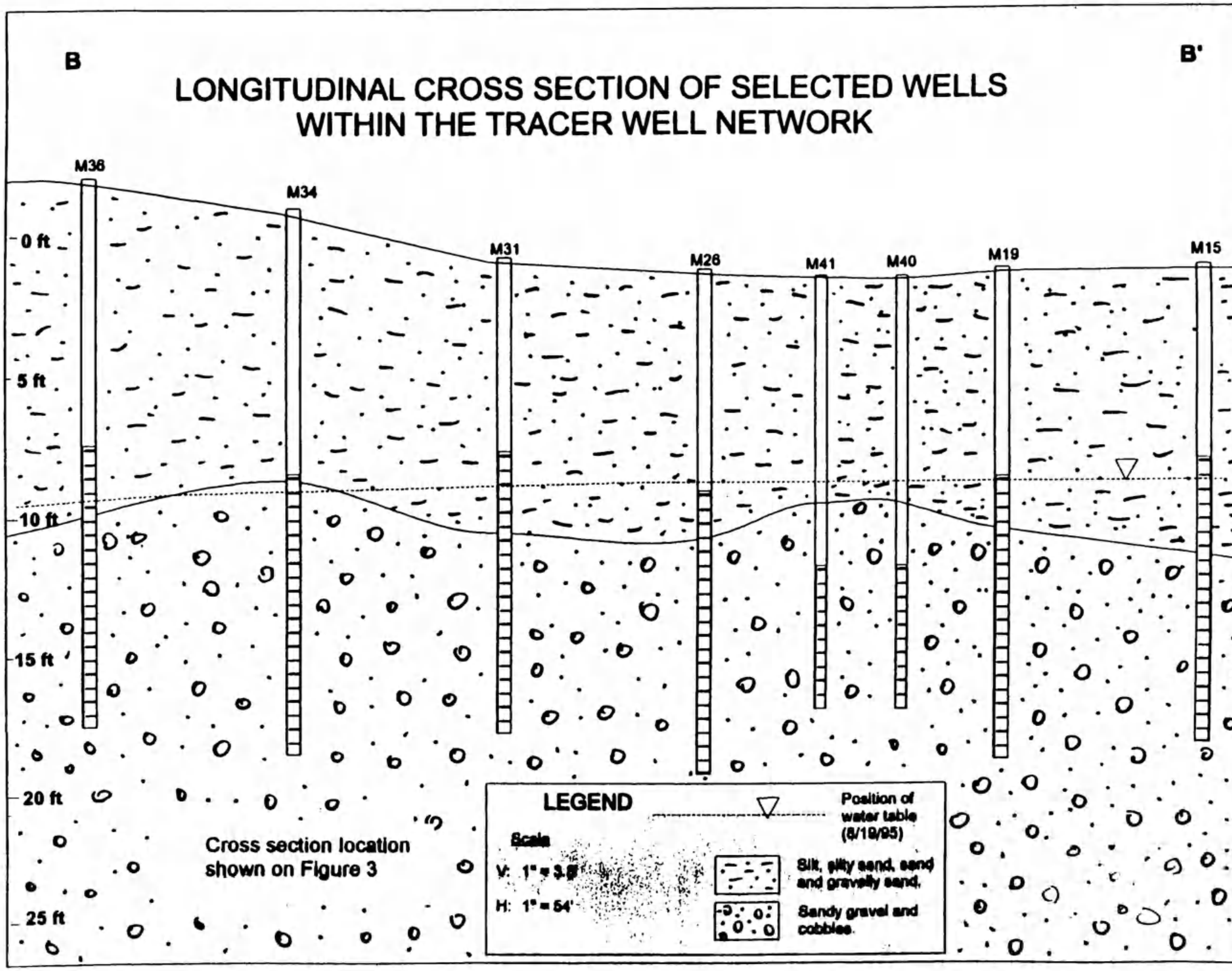

B
B'
LONGITUDINAL CROSS SECTION OF SELECTED WELLS
WITHIN THE TRACER WELL NETWORK
M36
M34
M31
M26
M41
M40
M19
M15
0 ft
5 ft
10 ft
15 ft
20 ft
25 ft
Cross section location
shown on Figure 3
LEGEND
Position of
water table
Scale
H: 1" = 54'
Silt, silty sand, sand
and gravelly sand.
Sandy gravel and
cobbles.

FIGURE 9

In general, the stratigraphy can be described as coarse sands and gravels (soil type A) from a depth of approximately 8 to 30 ft, overlain by well to poorly sorted sands and/or gravelly sands (soil type B), or silty sands and silts (soil type C) to near land surface. However, the site stratigraphy is laterally highly heterogeneous as would be expected in a fluvial depositional system.

The top 3 or 4 ft of soil in the vicinity of the drainfield is generally non-native or was disturbed by construction activities. A layer (6 in to 2 ft) of organic-rich topsoil (soil type D) covers much of the study area. This topsoil was placed during landscaping of the FHS, and thickens to the west, where an artificial topographic high was constructed for the softball fields.

Effluent Loading Rates

Effluent loading rates are approximately 3,500 gallons per day (gpd) when school is in session, and 600-900 gpd when school is closed during Summer and Christmas breaks, and on weekends. Individual effluent pumping events were approximately 160 gpm for a 2 min duration, for a total of 320 gal each. During the school day, loading events were observed to occur at irregular intervals throughout the day and generally did not occur at night. On weekends and during breaks, the loading events occurred less often but were observed to occur at any time during the day or night.

Potentiometric Data

Hydrographs of piezometer P1 from September, 1994 through July, 1996, and monitoring wells M35 and M37 from March 1995 through July, 1996 are shown as Figure 10. The water table began to rise when water from the Clark Fork River was turned in to the Frenchtown Irrigation District (FID) Canal in early May, and continued to rise through the irrigation season. When diversion ceased in early September, the water table abruptly began to decline. The water table continued a general declining trend throughout the Winter and into the Spring. While the water table of the shallow aquifer has been shown to rise and fall in response to recharge from local crop irrigation practices, it is reasonable to expect that the rising water table is due in part to upland recharge. The graph shows a slowing of the rate of water level decline in February of each year, and even a perceptible rise in the water table in March, 1996, possibly indicating the aquifer is being recharged from snowmelt or precipitation. The graph further shows the water level in the Spring of 1996 to be nearly 2 ft higher than the same time period in 1995, probably reflecting recharge to the shallow aquifer due to precipitation in the late 1995 and early 1996.

Figures 11 and 12 are potentiometric maps depicting the flow system of the shallow aquifer during annual lows and highs of the water table in the months of April and August, 1995, respectively. The hydrologic gradient measured across the site ranged from a low 0.0008 during April to a high of 0.002 measured in the month of August. Regardless of the elevation of the

HYDROGRAPH
PIEZOMETER P1 AND MONITORING WELLS M35 AND M37

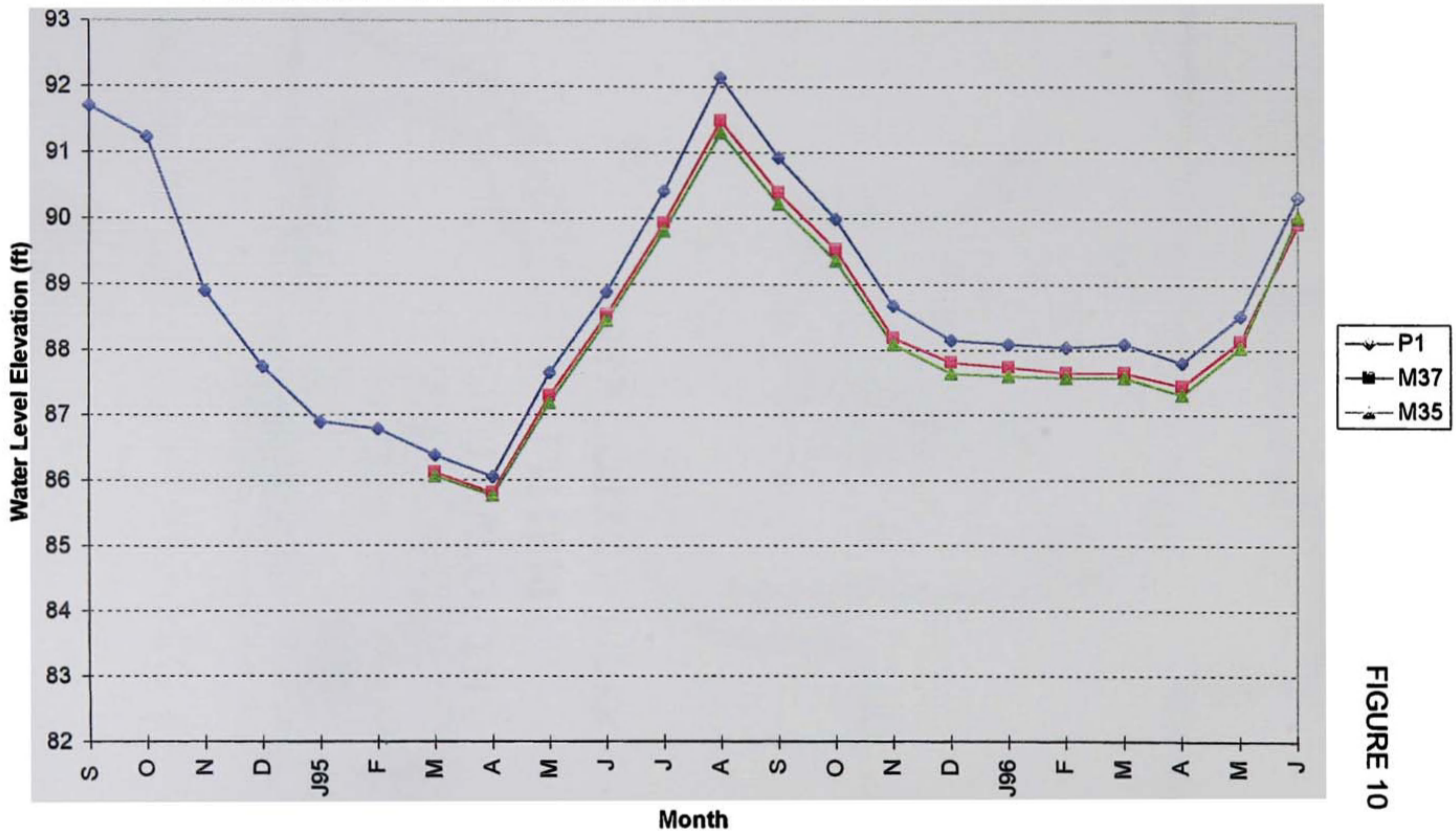


FIGURE 10

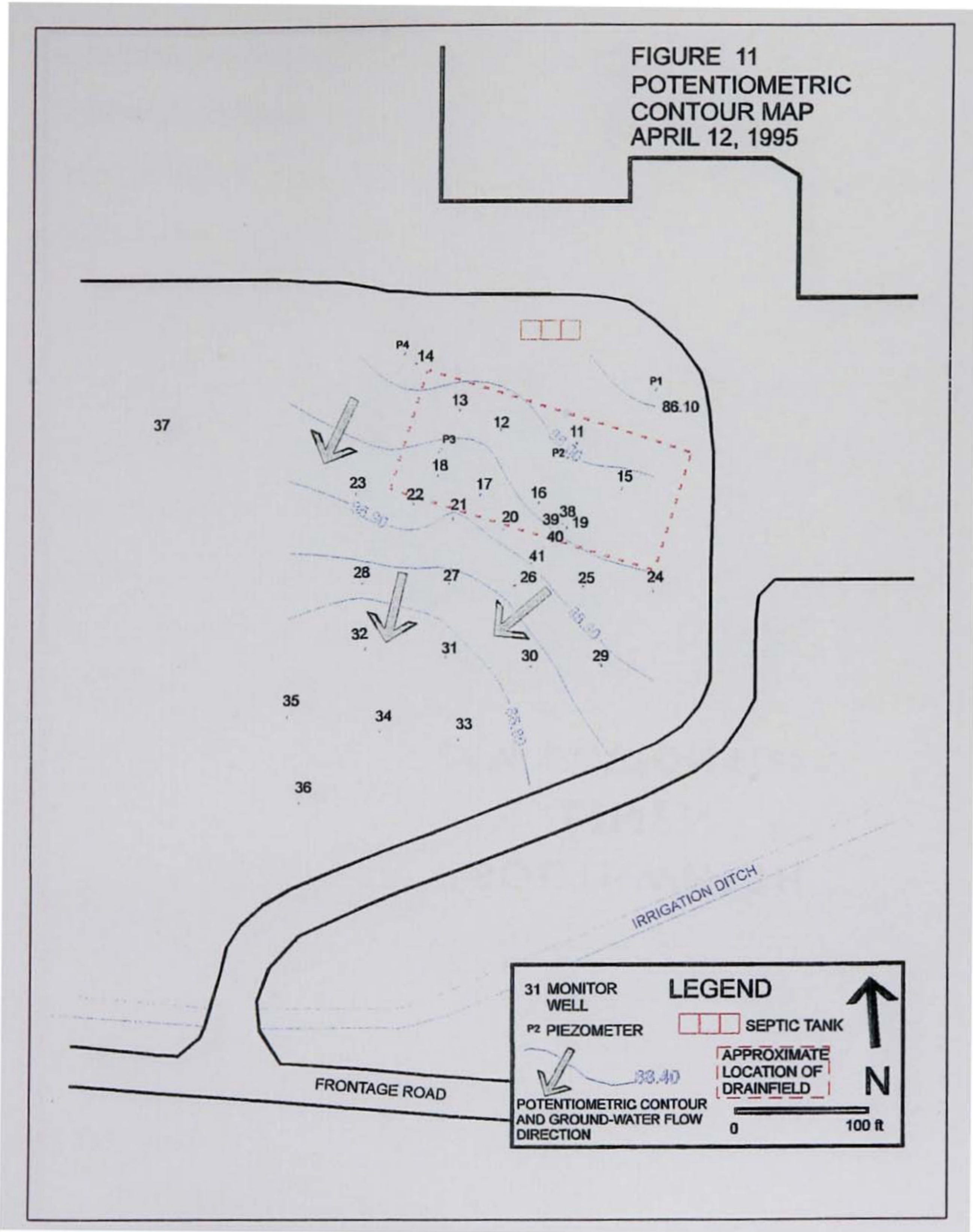


FIGURE 11
POTENTIOMETRIC
CONTOUR MAP
APRIL 12, 1995
P4 14
P1
86.10
13
37
12
11
P3
P2
18
15
23
22
17
16
21
20
39 38 19
40
41
28
27
26
25
24
32
31
30
29
35
34
33
36
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
31 MONITOR WELL
P2 PIEZOMETER
SEPTIC TANK
APPROXIMATE LOCATION OF DRAINFIELD
POTENTIOMETRIC CONTOUR AND GROUND-WATER FLOW DIRECTION
0
100 ft
N

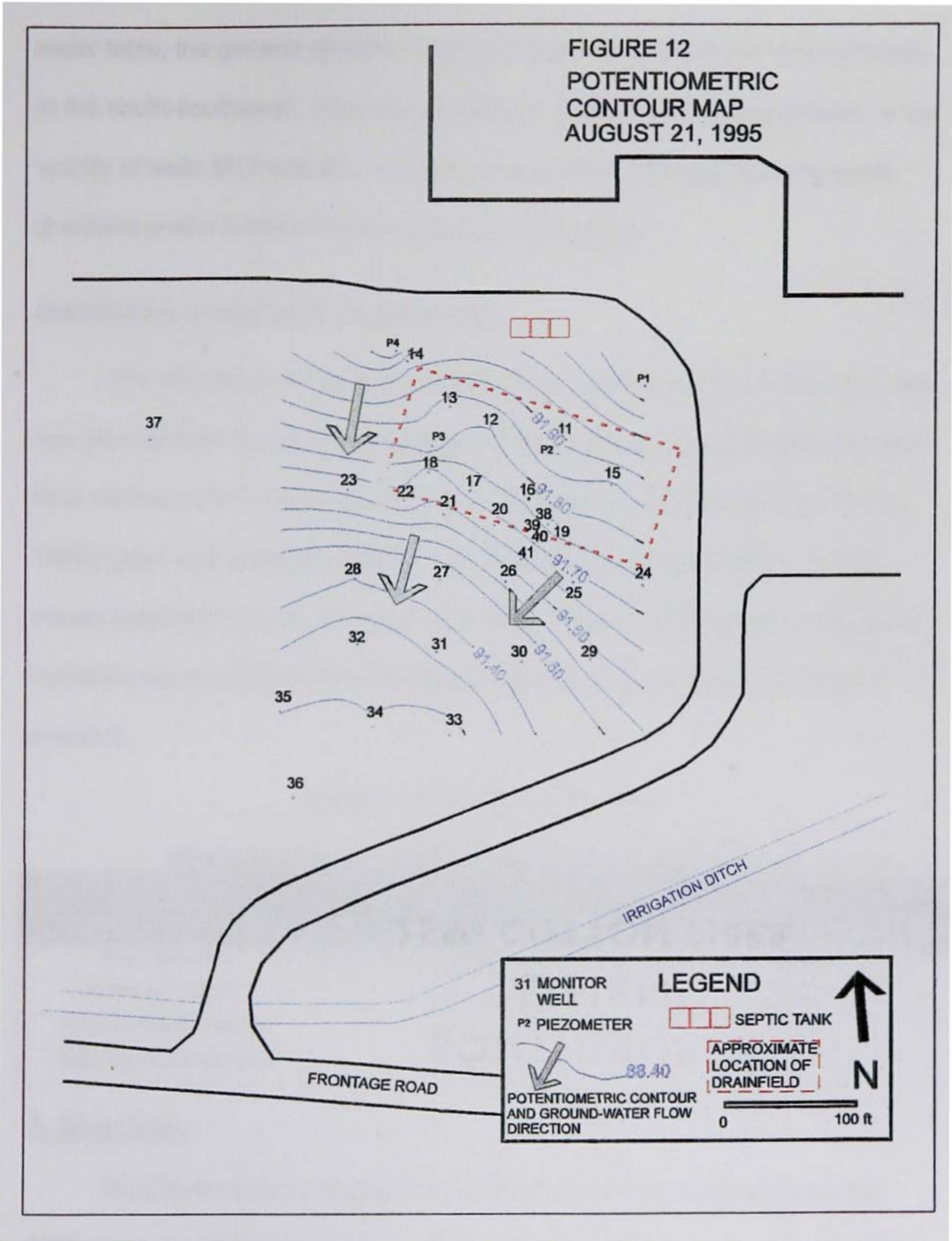


FIGURE 12
POTENTIOMETRIC
CONTOUR MAP
AUGUST 21, 1995
P4
14
P1
13
12
11
37
P3
P2
18
15
23
22
17
16
21
20
38
39
19
40
41
28
27
26
24
25
32
31
30
29
35
34
33
36
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
31 MONITOR WELL
P2 PIEZOMETER
SEPTIC TANK
APPROXIMATE LOCATION OF DRAINFIELD
POTENTIOMETRIC CONTOUR AND GROUND-WATER FLOW DIRECTION
N
0
100 ft

water table, the general direction of ground-water flow at the site is consistently to the south-southwest. The maps indicate a slight mound of groundwater in the vicinity of wells M17 and M21, possibly a function of recharge from the septic drainfield and/or localized lower hydraulic conductivity.

Distribution of Hydraulic Conductivity

The distribution of values of hydraulic conductivity (K) throughout the site was derived from four sources: analysis of slug test data using the Bouwer and Rice method (1976); time-drawdown plot of pumping test data (Cooper-Jacob, 1946); grain size analyses (Hazen, 1911) and back-calculation from velocity values obtained from the bromide tracer test. Table 2 lists a range of values of hydraulic conductivity for the coarse gravels obtained using each of the four methods.

Table 2. Summary of Results:

Hydraulic Conductivity of Coarse Sands and Gravels

Method and (Number of Analyses)	Range of Measured Hydraulic Conductivity (ft/day)	Average Hydraulic Conductivity (ft/day)
Slug Tests (37)	7-200	109
Pumping Tests (1)	675-1040	857
Bromide Tracer Test (1)	700-1000	750
Grain Size Analyses (21)	3-630	41

A. Slug Tests

Slug tests were conducted on a total of 11 monitor wells in November, 1995 when the shallow water table was within the coarse gravels. Calculated hydraulic conductivities ranged from 7 to 196 ft/day, with a mean value of 109 ft/day (Figure 13). It is expected that lower values of hydraulic conductivity obtained through slug tests at wells M15, M20 and M37 may be attributed to insufficient well development, or possibly irreparable disturbance to the formation incurred during drilling. The median and upper values seem more reasonable when compared to values found in the literature for similar sediments (Fetter, 1980).

B. Pumping Tests

Time-drawdown analyses of drawdown and recovery data collected during short-term, continuous discharge pumping test of well M19 yielded transmissivity (T) values ranging from 13,500 to 20,800 ft^2/day, and storativity (S) values of $1.9x10^{-5}$ to $6.6x10^{-2}$. Assuming a saturated thickness (b) of 20 ft, the calculated range of hydraulic conductivity values is 675 to 1,040 ft/day.

C. Bromide Tracer Test

Values of hydraulic conductivity can be back-calculated from groundwater velocity estimates determined from the bromide tracer test using the following equation:

$$V = (K(\Delta h/\Delta l))/n$$

where: V = average linear velocity
K = hydraulic conductivity
$\Delta h/\Delta l$ = gradient
n = average porosity

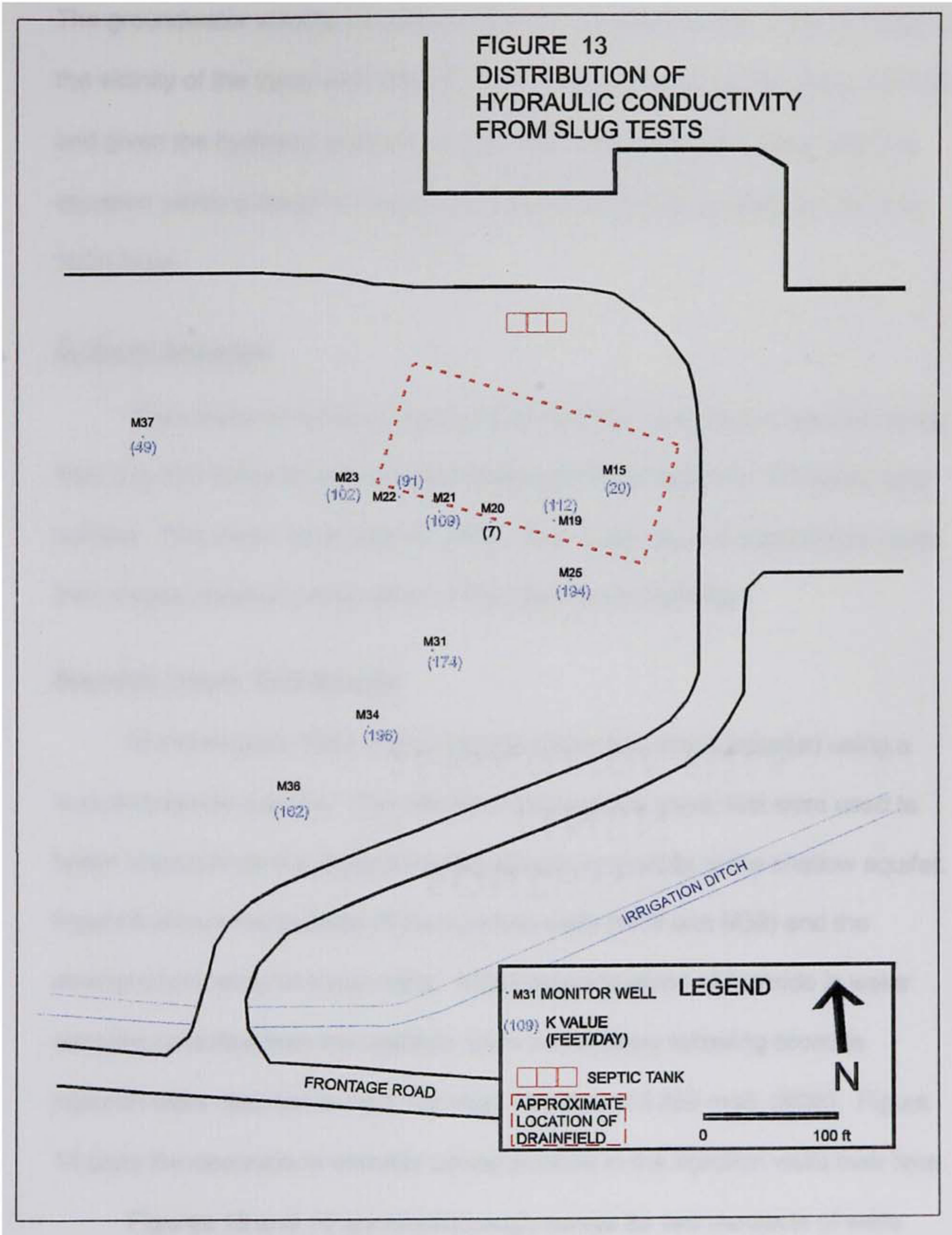


FIGURE 13
DISTRIBUTION OF
HYDRAULIC CONDUCTIVITY
FROM SLUG TESTS
M37
(49)
M23
(102)
M22
(91)
M21
(109)
M20
(7)
(112)
M19
M15
(20)
M25
(194)
M31
(174)
M34
(196)
M36
(162)
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
M31 MONITOR WELL
(109) K VALUE
(FEET/DAY)
SEPTIC TANK
APPROXIMATE
LOCATION OF
DRAINFIELD
0
100 ft
N

The groundwater velocity (V) was estimated to range between 7 and 10 ft/day in the vicinity of the tracer well network. Assuming an average porosity (n) of 0.20 and given the hydraulic gradient ($\Delta h/\Delta l$) was 0.002 during the tracer test, the equation yields a range of hydraulic conductivity (K) values between 700 and 1000 ft/day.

D. Sieve Analyses

The values of hydraulic conductivity obtained using sieve analysis range from 3 to 630 ft/day for soil samples collected from a depth of 15 ft below land surface. The mean value was 41 ft/day. This mean value is significantly lower than values obtained using either of the other three methods.

Bromide Tracer Test Results

In mid-August 1995, a groundwater tracer test was conducted using a sodium bromide solution. The results of the bromide tracer test were used to better characterize the physical hydrogeologic properties of the shallow aquifer. Figure 6 shows the location of the injection wells (M19 and M38) and the downgradient array of tracer wells. Initial concentrations of bromide in water samples collected from the injection wells immediately following bromide injection were reported to be 4,130 mg/L (M19) and 5,250 mg/L (M38). Figure 14 plots the decrease in bromide concentrations in the injection wells over time.

Figures 15 and 16 are breakthrough curves for two transects of wells located 23 and 37 ft downgradient from the injection wells, (Transect 1 and

DECREASE IN BROMIDE CONCENTRATIONS
INJECTION WELLS M19 AND M38

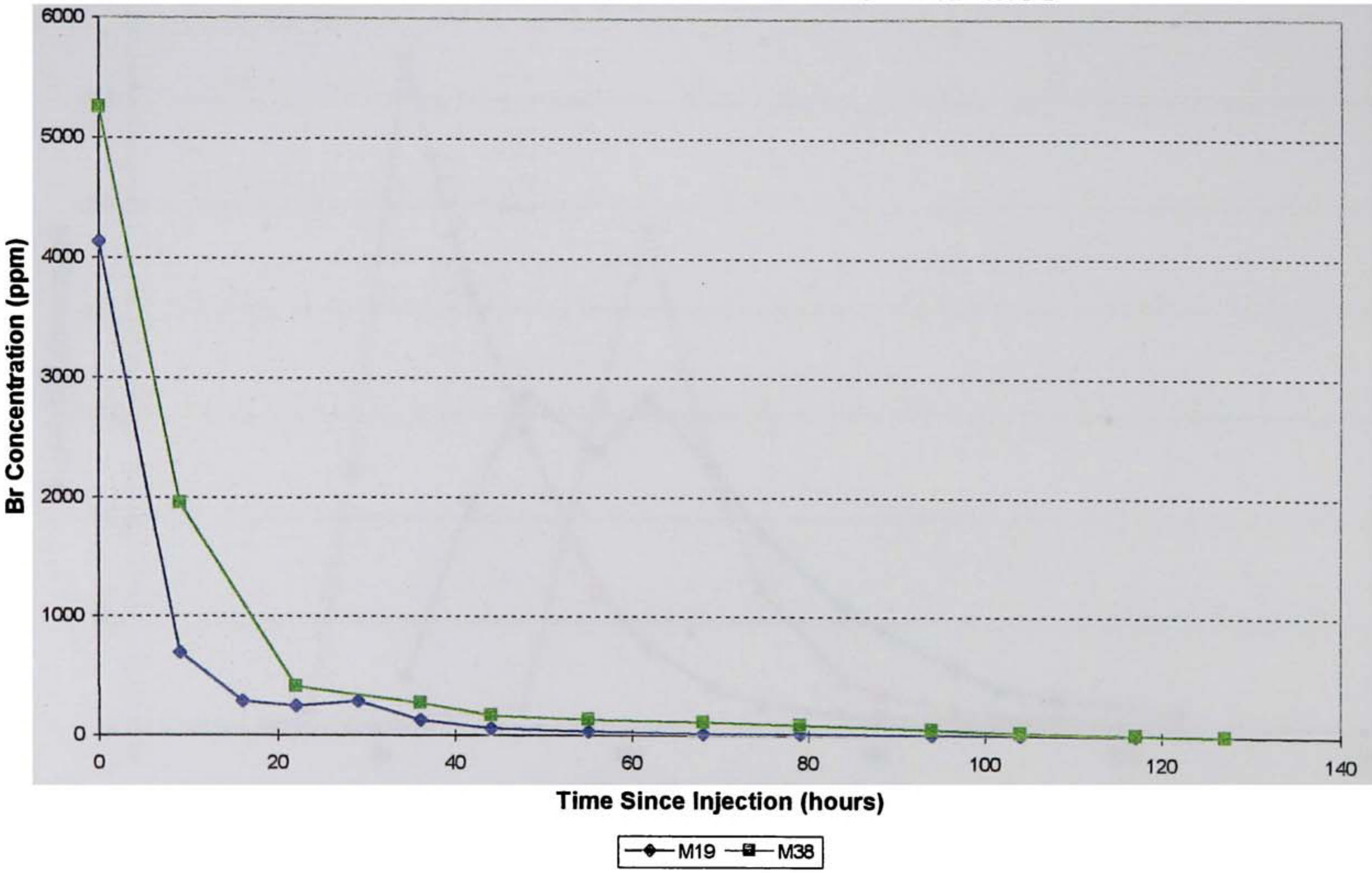


FIGURE 14

BROMIDE BREAKTHROUGH CURVES
WELL TRANSECT 1 @ 23 FT DOWNGRADIENT

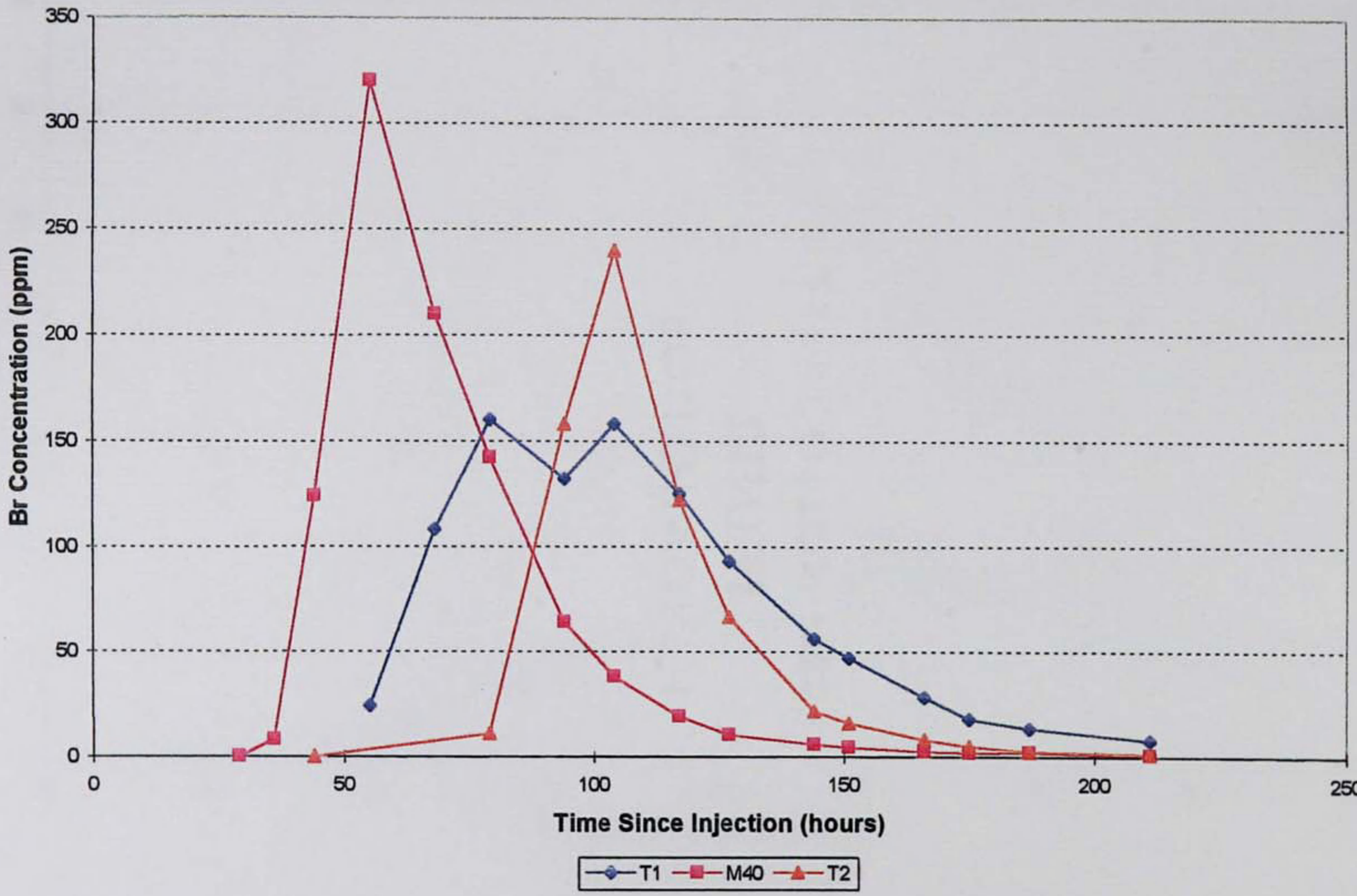


FIGURE 15

BROMIDE BREAKTHROUGH CURVES
WELL TRANSECT 2 @ 37 FT DOWNGRADIENT

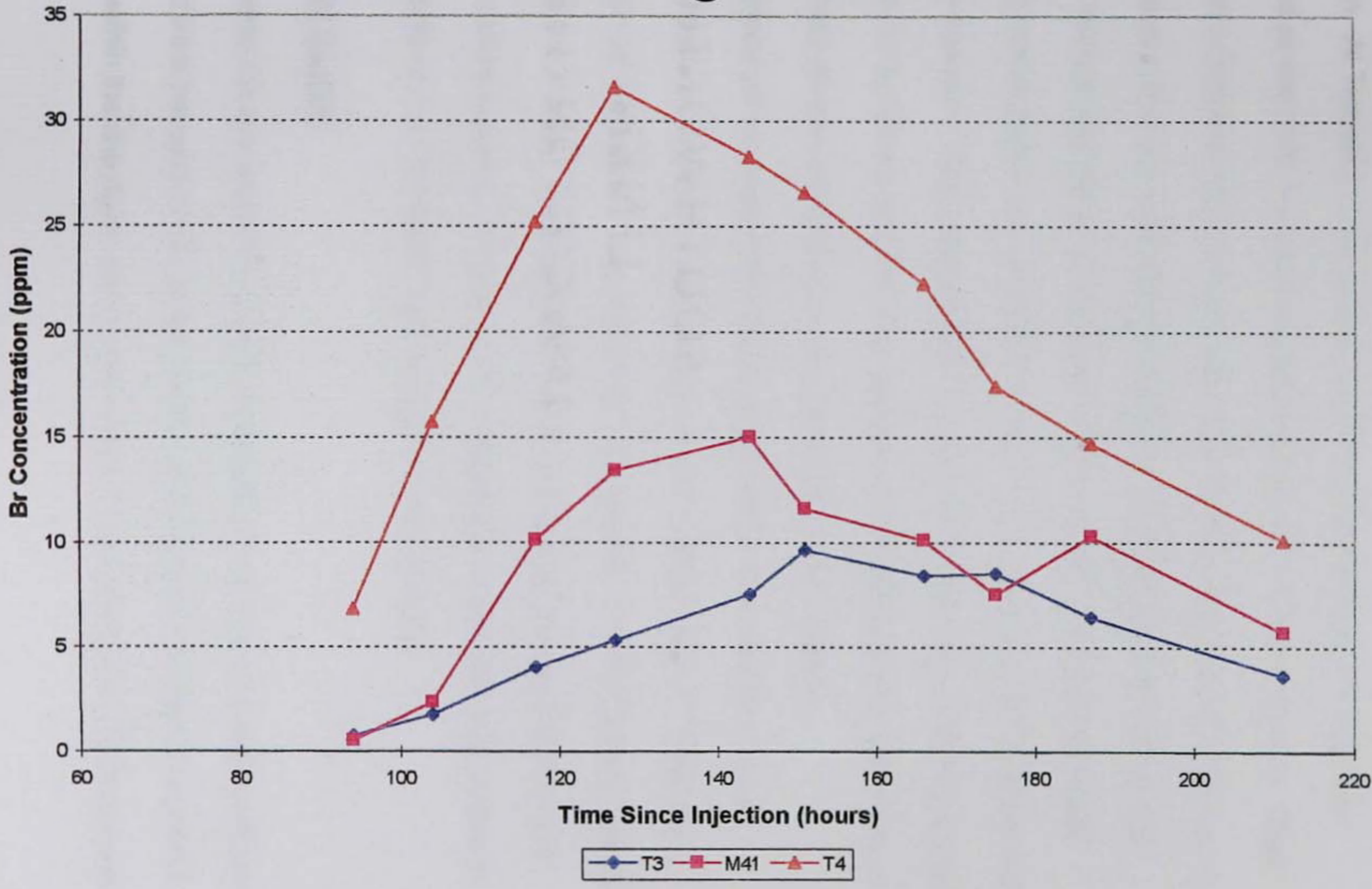


FIGURE 16

Transect 2, respectively). The breakthrough curves plot the measured concentration of bromide detected in wells as a function of time since tracer injection. At Transect 1, the greatest peak concentration of bromide was detected at well M40 in a water sample collected 55 hrs after injection. Peak exhibited a bimodal bromide peak; first at 79 hrs and then again at 104 hrs. It would appear from the data that the center of the main mass of the bromide passed through the center of Transect 1. At Transect 2, the greatest peak bromide concentration was detected at well T4 in a water sample collected 127 hrs after injection. Peak concentrations occurred in samples collected from wells M41 and T3 at 144 hrs and 151 hrs, respectively, suggesting the main mass of the bromide plume was moving to the west of the tracer network.

Based on the tracer test results, groundwater flow velocity from the injection wells to Transect 1 was approximately 10 ft/day, and 4.7 ft/day from Transect 1 to Transect 2. The calculated flow velocity from the injection wells to Transect 2 is 7 ft/day. As it appears that the tracer was exiting the tracer well network before reaching Transect 2, it is reasonable to estimate a groundwater flow velocity of 7 to 10 ft/day in the vicinity of the experiment.

3.2 Water Quality

Table 3 summarizes the results of inorganic analyses of a) septic effluent collected from the septic tank, b) the shallow groundwater sampled in well M15 located within the drainfield, and c) the shallow groundwater in background well

M37. The number of samples collected at each location are included in parentheses immediately next to the data. Complete inorganic water quality analytical data sets are included as Appendix H.

Table 3. Summary of Results: Inorganic Groundwater Chemistry

Analyte	Septic Effluent (Septic tank)	Well Screened beneath Drainfield (M15)	Background Well (M37)
Alkalinity-$CaCO_3$ (mg/L)	226 - 398 (8)	68 - 292 (11)	170 - 194 (7)
Ammonium-N (mg/L)	11.8 - 74.8 (3)	1.1 - 23.1 (4)	<0.1 (4)
Chloride (mg/L)	13.8 - 50.0 (10)	13.8 - 42.9 (12)	2.3 - 3.9 (8)
Nitrate-N (mg/L)	<0.05 - 0.1 (10)	0.2 - 21.2 (12)	0.8 - 1.1 (8)
Phosphate (mg/L)	<0.5 - 7.6 (10)	<0.5 - 0.9 (12)	<0.5 (8)
Sulfate (mg/L)	0.8 - 10.0 (10)	8.4 - 16.2 (12)	16.0 - 20.4 (8)
Sodium (mg/L)	28.9 - 59.6 (10)	23 - 60.1 (8)	7.0 - 9.8 (7)
pH (units)	6.7 - 7.3 (10)	6 - 6.4 (8)	6.6 - 7.2 (6)
E.C. (microMohs/cm^2)*	525 - 843 (10)	323 - 790 (8)	311 - 375 (6)
Temperature (Celsius)**	13.3 - 21.8 (10)	8.5 - 12.2 (8)	6.4 - 11.7 (6)
TDS (mg/L)	230 - 420 (4)	210 - 292 (2)	161 (1)
Dissolved Oxygen (mg/L)	0.2 - 3.1 (8)	<0.1 - 3.0 (6)	3.4 - 6.4 (5)

* Electrical conductance corrected for 25° C
**The reported range of groundwater temperature includes measurement error. The mean annual temperature of groundwater at the FHS site is believed to be approximately 9 -11 degrees Celsius.

The background water quality of the shallow ground water in the vicinity of FHS is generally bicarbonate. It is relatively high in TDS, primarily due to phosphate. The water has a neutral pH, is oxygenated and has an average temperature of about 9 °C.

Inorganic Chemisty

Nitrogen in the septic tank occurs primarily in the form of ammonium at reported concentrations of 37.8 to 74.8 mg/L. Both nitrate (0.2 to 21.2 mg/L) and ammonium (1.1 to 23.1 mg/L) were detected in groundwater beneath the septic drainfield (well M15). In the background well, nitrogen occurs as nitrate at concentrations consistently about 1 mg/L. Ammonium is not a significant form of nitrogen in the natural groundwater system. Chloride concentrations are elevated in the septic tank (13.8 to 50 mg/L) and the septic impacted groundwater in well M15 (13.8 to 42.9 mg/L) with respect to the background concentrations of 2 to 4 mg/L (well M37). Phosphate was generally not detected in the groundwater, but was present in the septic tank at concentrations ranging from 4.1 to 6.0 mg/L. Sulfate concentrations were highly variable in the tank, ranging from 0.8 to 10.0 mg/L. However, background sulfate concentrations in the groundwater were consistently between 8.4 and 20.4 mg/L. Sodium was the only cation reported to be significantly increased in the septic effluent (38.9 to 59.6 mg/L) and septic-impacted groundwater (23 to 60.1 mg/L) when compared to the background groundwater quality (7.0 to 9.8 mg/L).

Figures 17 through 21 depict the distribution of sodium, chloride and nitrate, ammonium and total nitrogen (nitrate + ammonium) concentrations in the shallow groundwater in the vicinity of the FHS septic system in May, 1996.

As shown in Table 3, ammonium concentrations are elevated in the septic tank with respect to the natural groundwater system. Unfortunately, few groundwater samples collected in the vicinity of the drainfield were analyzed for ammonium. Recognizing this gap in the data, attempts were made late in the study to document ammonium concentrations in the septic impacted

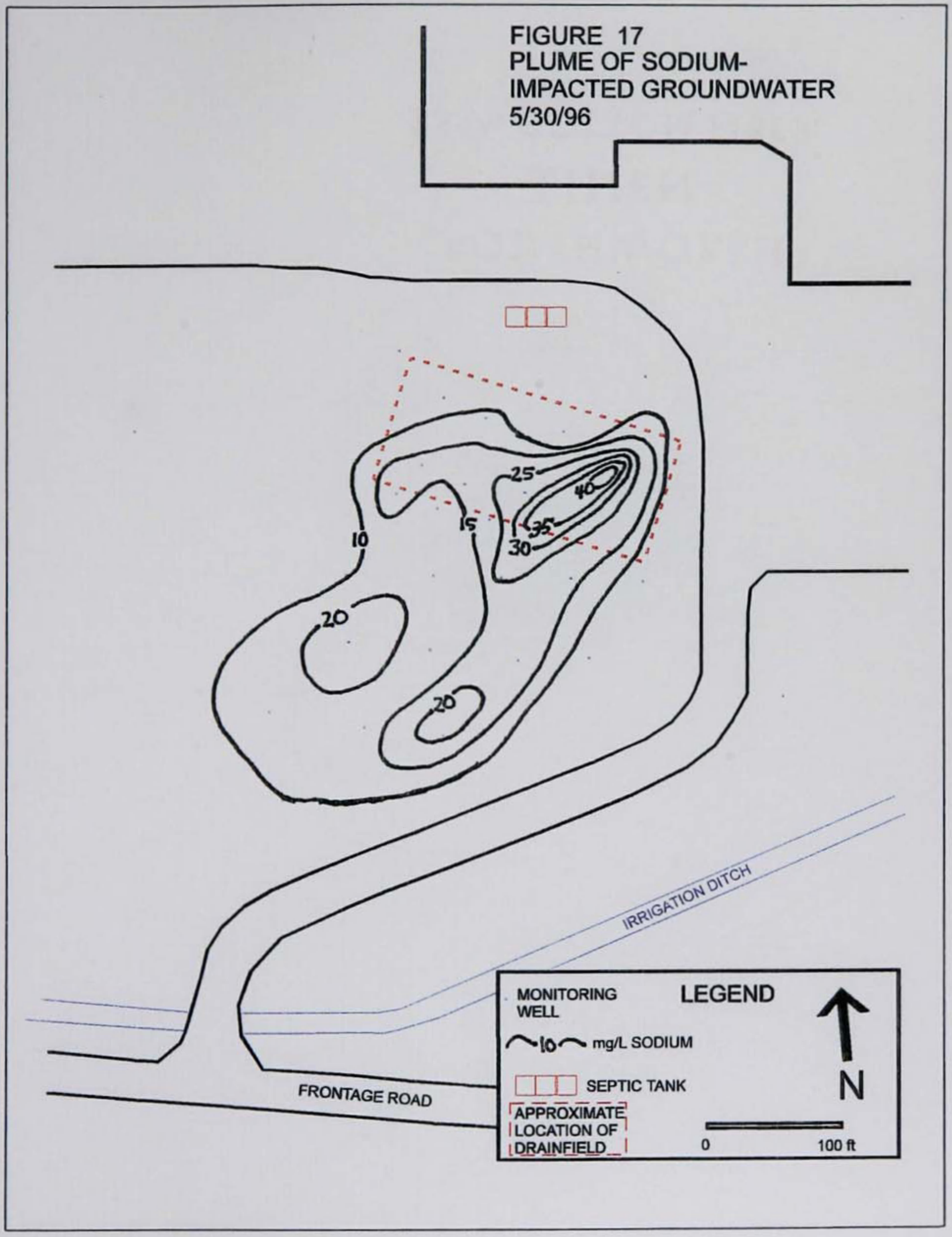


FIGURE 17
PLUME OF SODIUM-
IMPACTED GROUNDWATER
5/30/96
25
40
35
30
15
10
20
20
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
MONITORING
WELL
10 mg/L SODIUM
SEPTIC TANK
APPROXIMATE
LOCATION OF
DRAINFIELD
0
100 ft
N

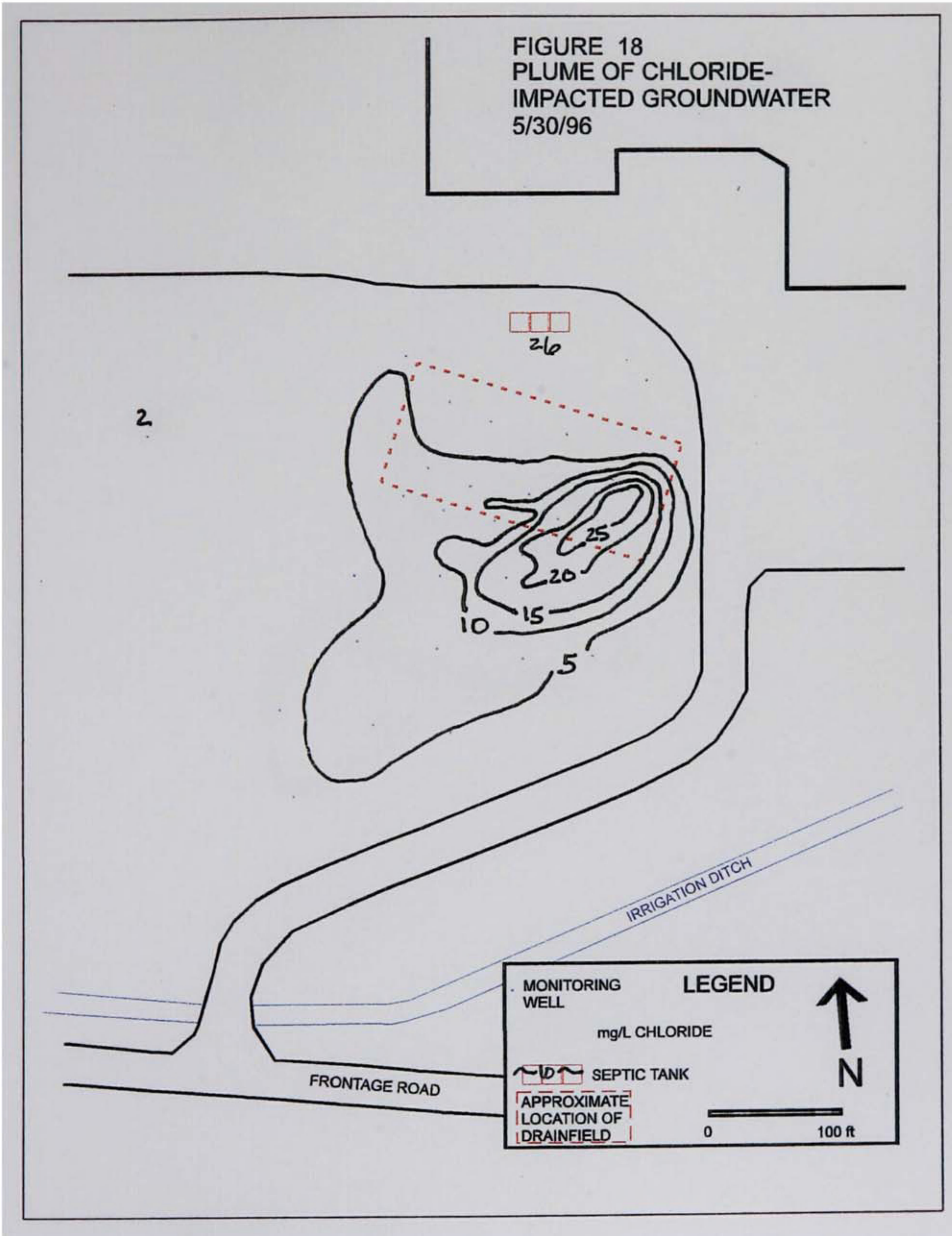


FIGURE 18
PLUME OF CHLORIDE-
IMPACTED GROUNDWATER
5/30/96
26
2
25
20
15
10
5
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
MONITORING WELL
mg/L CHLORIDE
SEPTIC TANK
APPROXIMATE LOCATION OF DRAINFIELD
0
100 ft
N

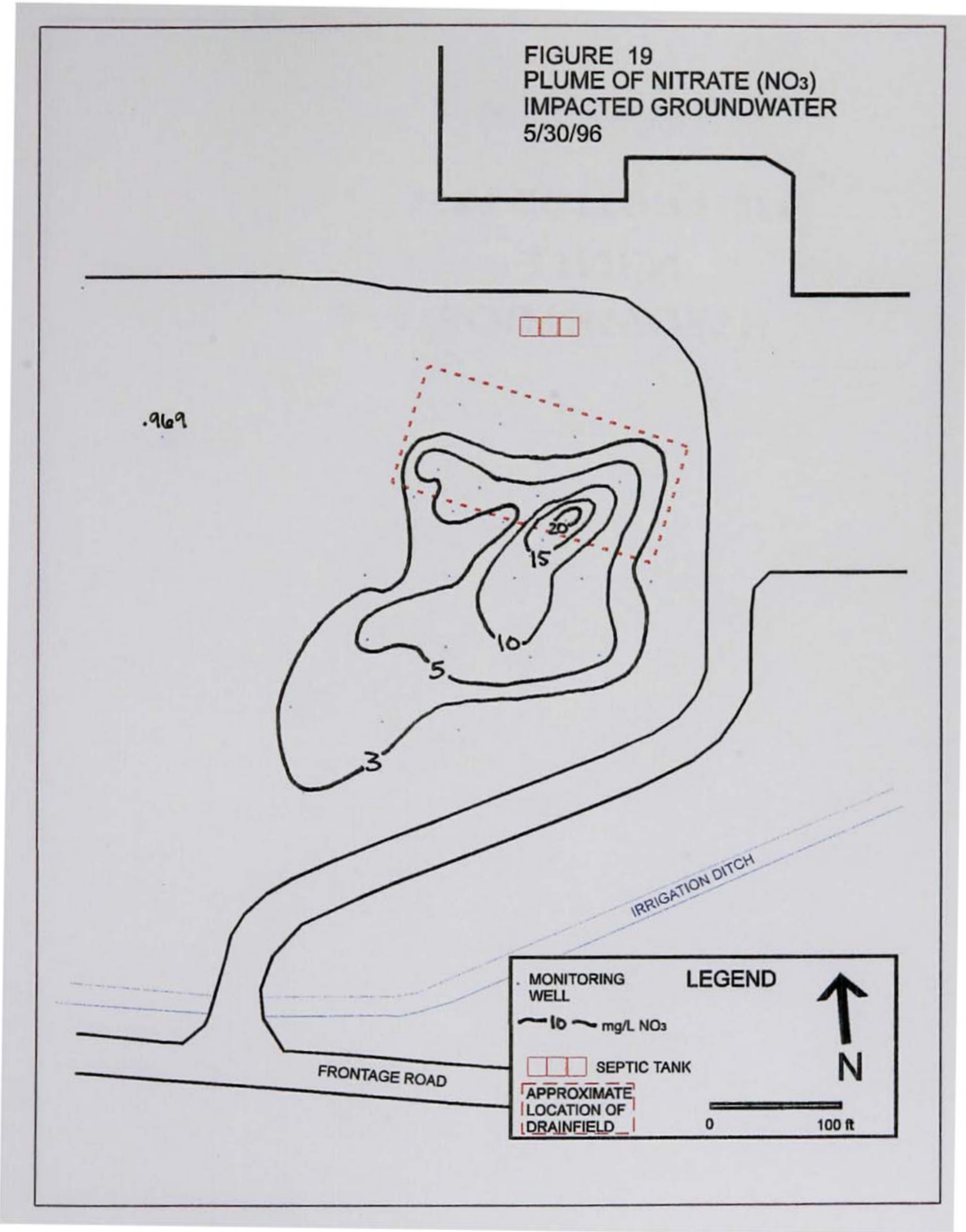


FIGURE 19
PLUME OF NITRATE (NO3)
IMPACTED GROUNDWATER
5/30/96
.969
20
15
10
5
3
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
MONITORING WELL
10 mg/L NO3
SEPTIC TANK
APPROXIMATE LOCATION OF DRAINFIELD
0
100 ft
N

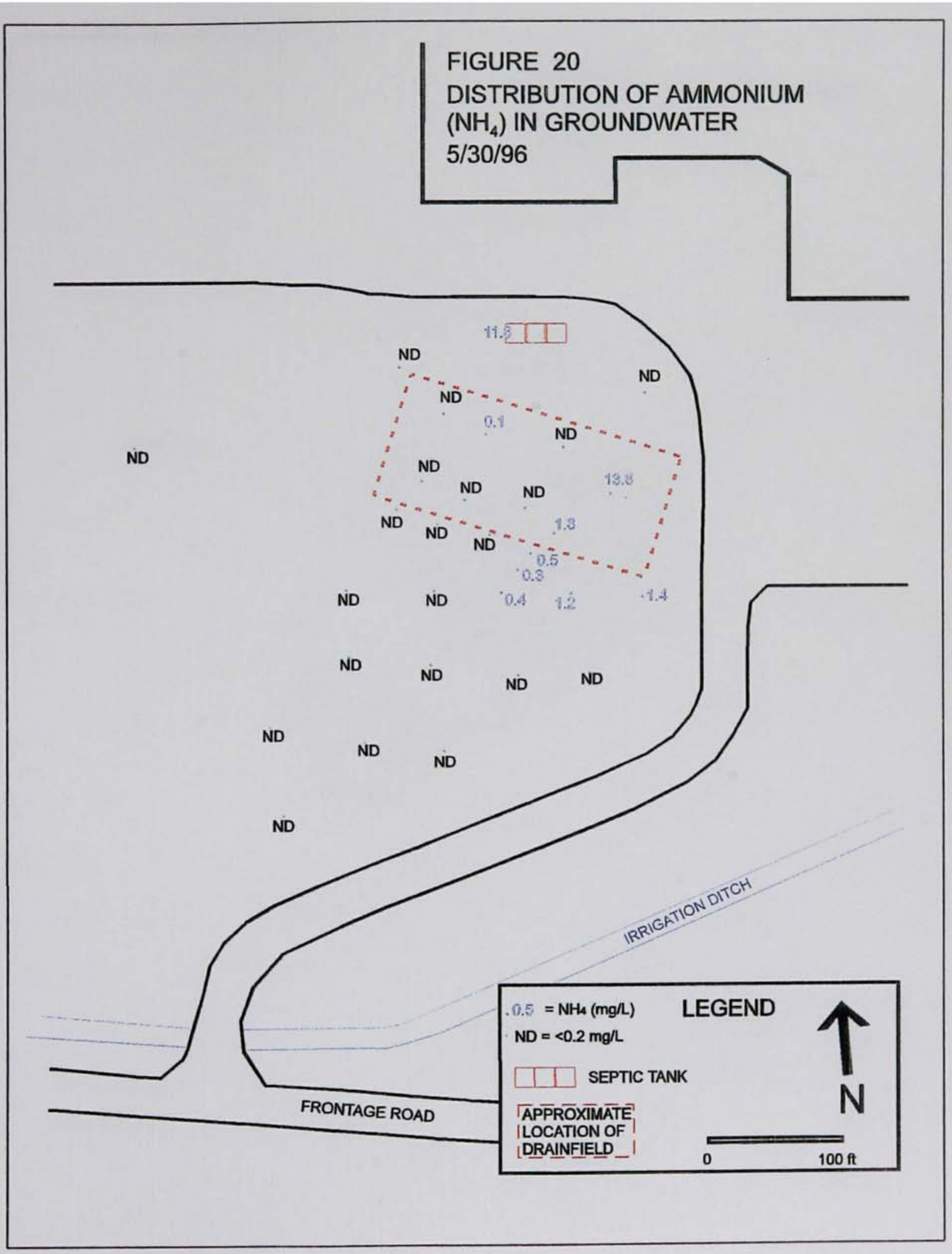


FIGURE 20
DISTRIBUTION OF AMMONIUM (NH_4) IN GROUNDWATER
5/30/96

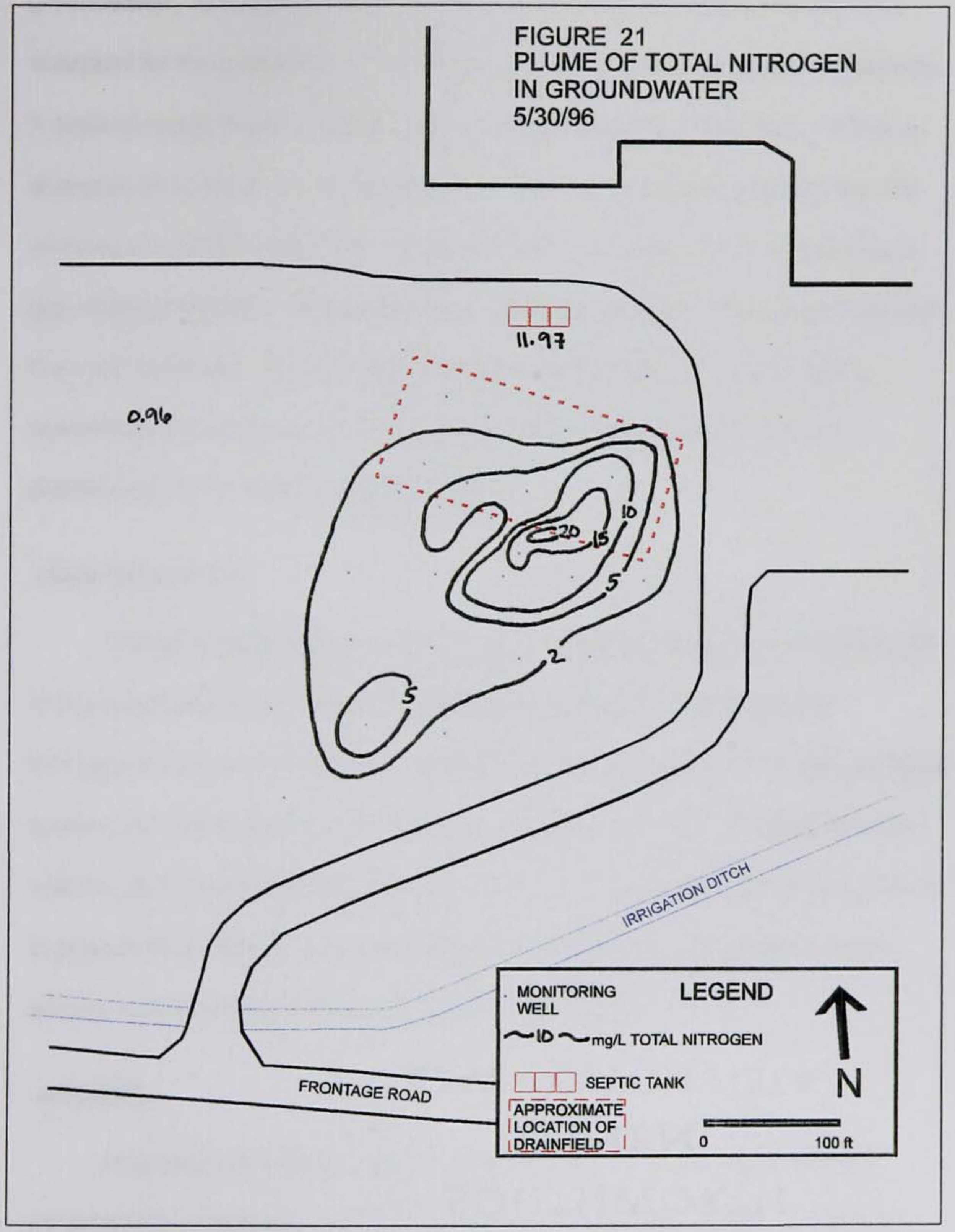


FIGURE 21
PLUME OF TOTAL NITROGEN
IN GROUNDWATER
5/30/96
11.97
0.96
20
15
10
5
2
5
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
MONITORING WELL
10 mg/L TOTAL NITROGEN
SEPTIC TANK
APPROXIMATE LOCATION OF DRAINFIELD
N
0
100 ft

groundwater. In October, 1995, samples of groundwater were collected and analyzed for the presence of ammonium using an ammonium specific electrode. A second round of groundwater samples were collected in late May, 1996 and analyzed for ammonium by spectroscopy, which proved more reliable than the ammonium specific electrode. Figure 22 plots concentrations of ammonium in groundwater samples collected in May, 1996 as a function of sampling distance from the drainfield. As expected, the data illustrates generally decreasing concentrations of ammonium in the groundwater downgradient from the drainfield and the origin of septic effluent.

Field Parameters

Values of temperature, pH, TDS, EC and DO measured in septic effluent and groundwater samples varied considerably spatially and temporally throughout the study (Table 3). Due to the buffering capacity of the groundwater system, pH, temperature and TDS were generally not useful in delineating the area of septic-impacted groundwater. However, measured values of EC and DO in groundwater appear to correlate with the presence of the inorganic plume issuing from the septic drainfield (Figures 23 and 24).

Alkalinity

Alkalinity (as $CaCO_3$) was detected in samples of the septic effluent collected from the septic tank at concentrations ranging from 226 to 398 mg/L. The average alkalinity concentration measured in the septic tank was 331 mg/L.

AMMONIUM CONCENTRATION IN GROUNDWATER
vs.
DISTANCE DOWNGRADIENT FROM DRAINFIELD

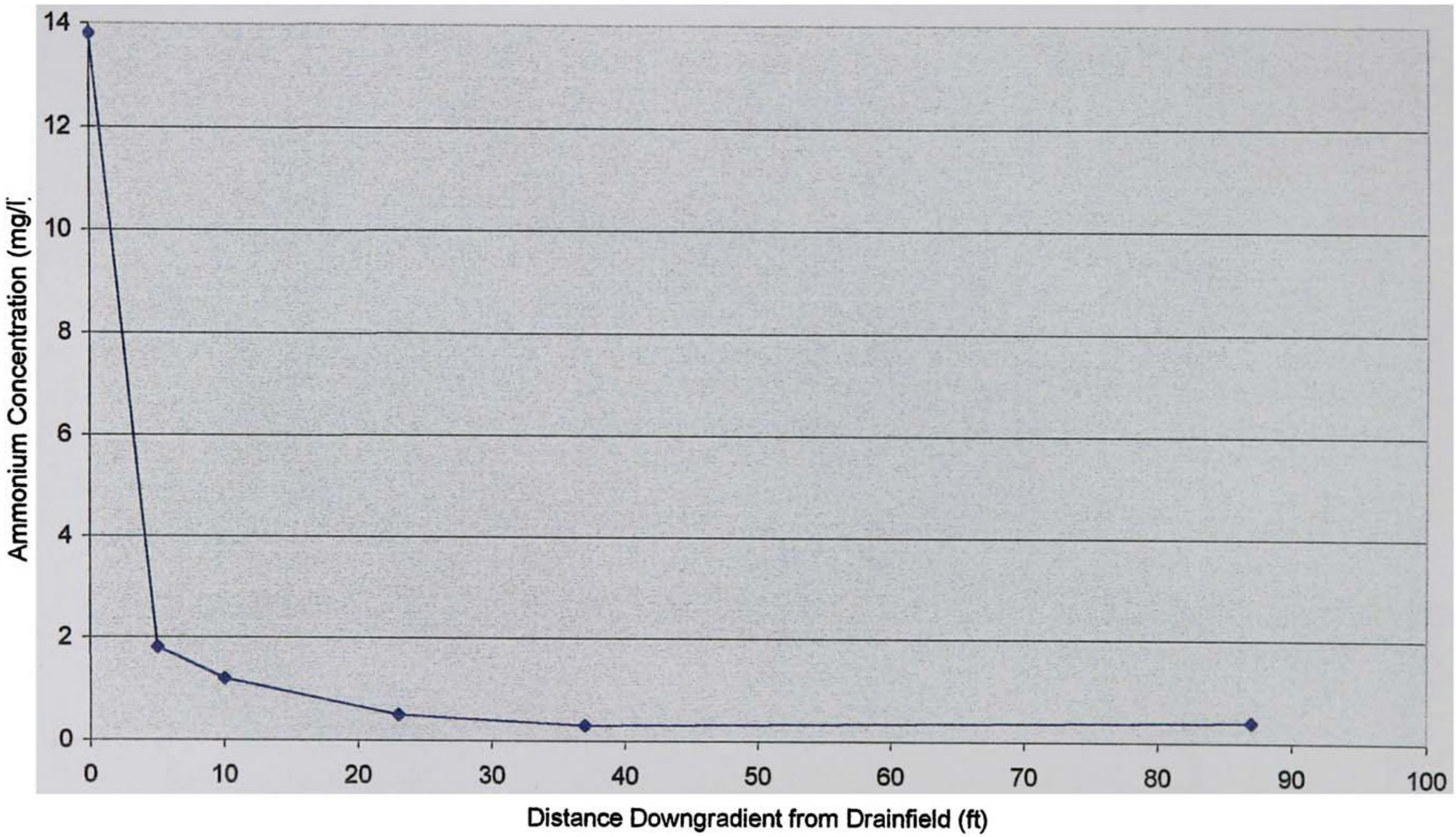


FIGURE 22

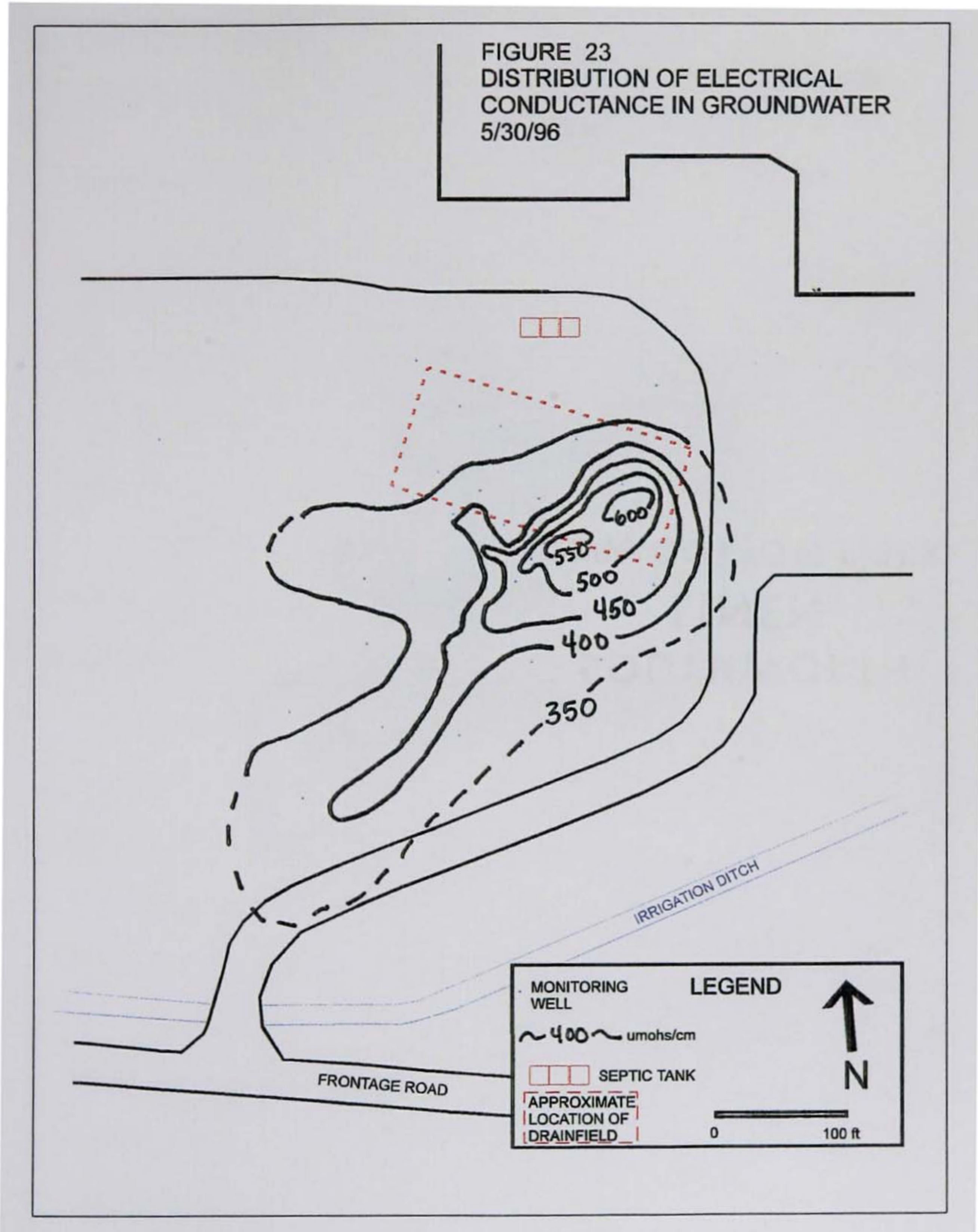


FIGURE 23
DISTRIBUTION OF ELECTRICAL
CONDUCTANCE IN GROUNDWATER
5/30/96
600
550
500
450
400
350
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
MONITORING WELL
400 umohs/cm
SEPTIC TANK
APPROXIMATE LOCATION OF DRAINFIELD
0
100 ft
N

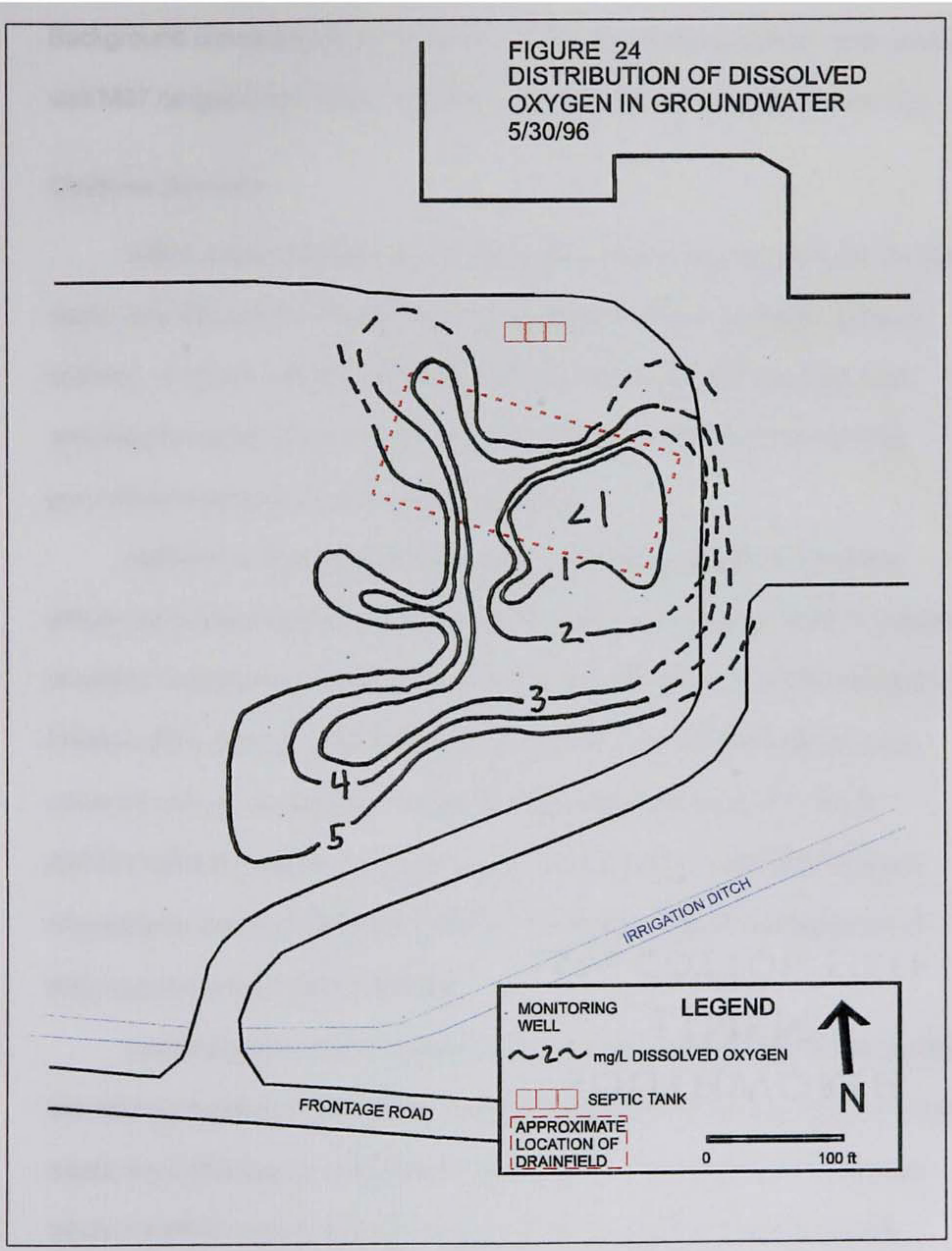


FIGURE 24
DISTRIBUTION OF DISSOLVED
OXYGEN IN GROUNDWATER
5/30/96
<1
1
2
3
4
5
IRRIGATION DITCH
FRONTAGE ROAD
MONITORING WELL
LEGEND
~2~ mg/L DISSOLVED OXYGEN
SEPTIC TANK
APPROXIMATE LOCATION OF DRAINFIELD
0
100 ft
N

Background concentrations of alkalinity in the shallow groundwater measured in well M37 ranged from 170 to 194 mg/L, with an average alkalinity of 184 mg/L.

Coliform Bacteria

Water quality samples were collected of the shallow groundwater and the septic tank effluent and analyzed for the presence of fecal and total bacteria coliform. A total of 103 groundwater samples and 12 effluent samples were analyzed for fecal coliform. Total coliform analyses were performed on 153 groundwater samples and 14 effluent samples.

Attempts to quantify the distribution of coliform bacteria in the septic effluent and shallow groundwater were generally unsuccessful. Initial monitoring of coliform transport in the ground water system was done using the membrane filtration (MF) technique for coliform enumeration. Inconsistent results were obtained using three different media: m ENDO Broth MF and m FC Broth (DIFCO Laboratories) for the enumeration of total coliform and fecal coliform respectively, and m-ColiBlue24™ (HACH Company) used for the detection of both total and fecal coliform bacteria.

In subsequent testing of these three media and the MF technique against the most probable number (MPN) method, it was determined that none of these media were effective for the positive differentiation of coliforms in this system. While the MPN method was 100% accurate in identifying coliforms, the MF technique proved unreliable. The standard media used in the filtration method are m ENDO and m FC. Approximately 20% of the positive isolates from these media proved to be either *Pseudomonas* spp. or *Bacillus* spp. The mColiBlue24™ was the least reliable, with 100% of the positive colonies selected for identification being *Bacillus* spp. In addition there was no growth on this medium when inoculated with samples from the tank even though all other media tested gave positive results at the same dilutions.

Figure 25 shows the well locations where total coliforms were detected in the shallow groundwater at any time during the course of the study. Figure 26 identifies well locations which tested positive for fecal coliforms at any time during the course of the study. Laboratory results of fecal and total coliform analyses are presented in Appendix I.

3.3 Endogenous Viruses

Coliphage

Coliphage were detected in all assays of 45 grab samples and 3 filtered 1-MDS samples of septic effluent collected from the septic tank from December, 1994 through September, 1995. Concentrations of male-specific coliphage found in the septic effluent were reported to range from 9.8×10^2 to 3.4×10^6 PFU/L, with a grand average of 674,000 PFU/L. Concentrations of somatic coliphage in the septic effluent ranged from 7.7×10^3 to 3.9×10^6 PFU/L, with a grand average of 466,000 PFU/L. Figure 27 shows the variation in reported

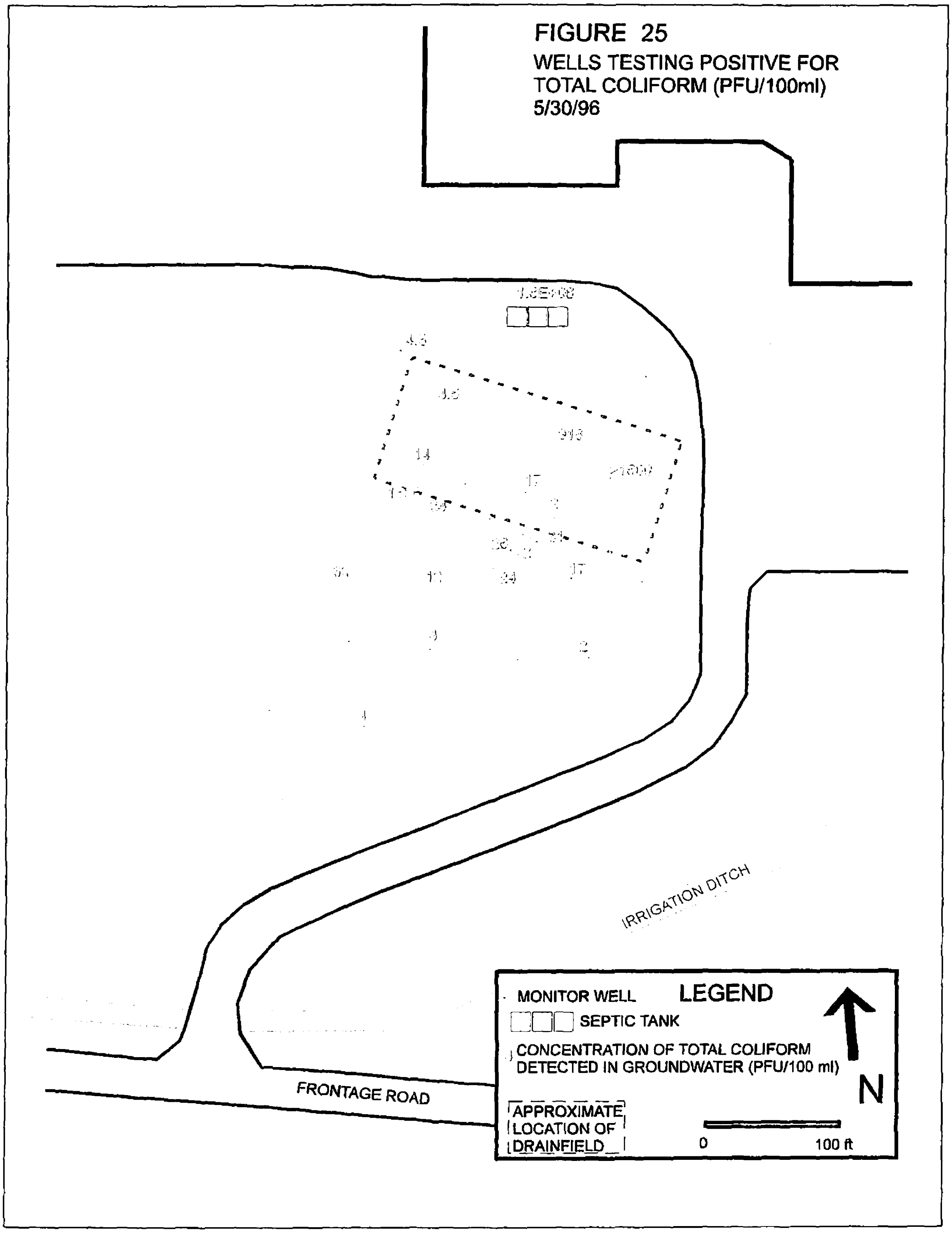
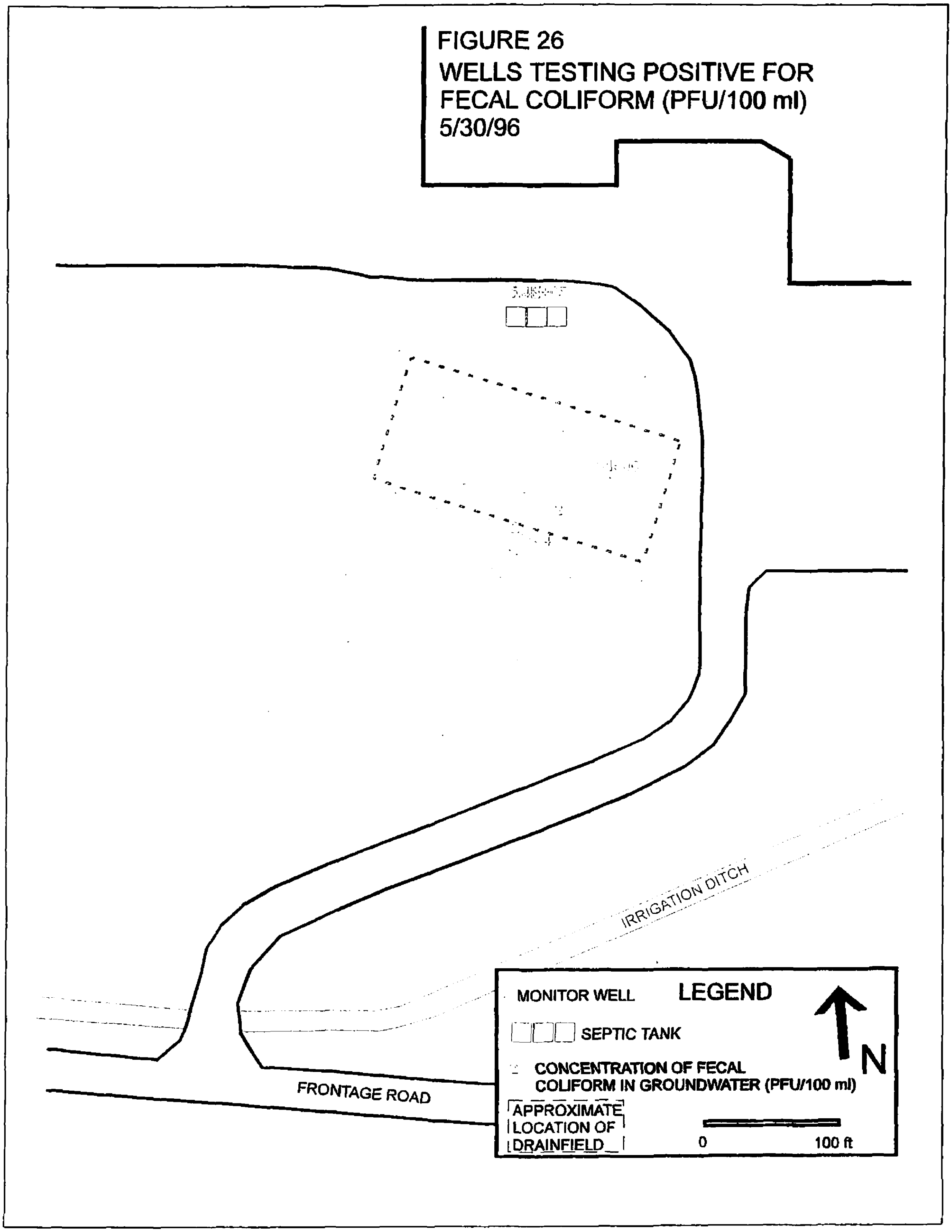


FIGURE 25
WELLS TESTING POSITIVE FOR TOTAL COLIFORM (PFU/100ml)
5/30/96

FIGURE 26
WELLS TESTING POSITIVE FOR FECAL COLIFORM (PFU/100 ml)
5/30/96



VARIATION OF COLIPHAGE DETECTED IN THE FHS SEPTIC TANK DECEMBER 1994 TO JUNE 1995

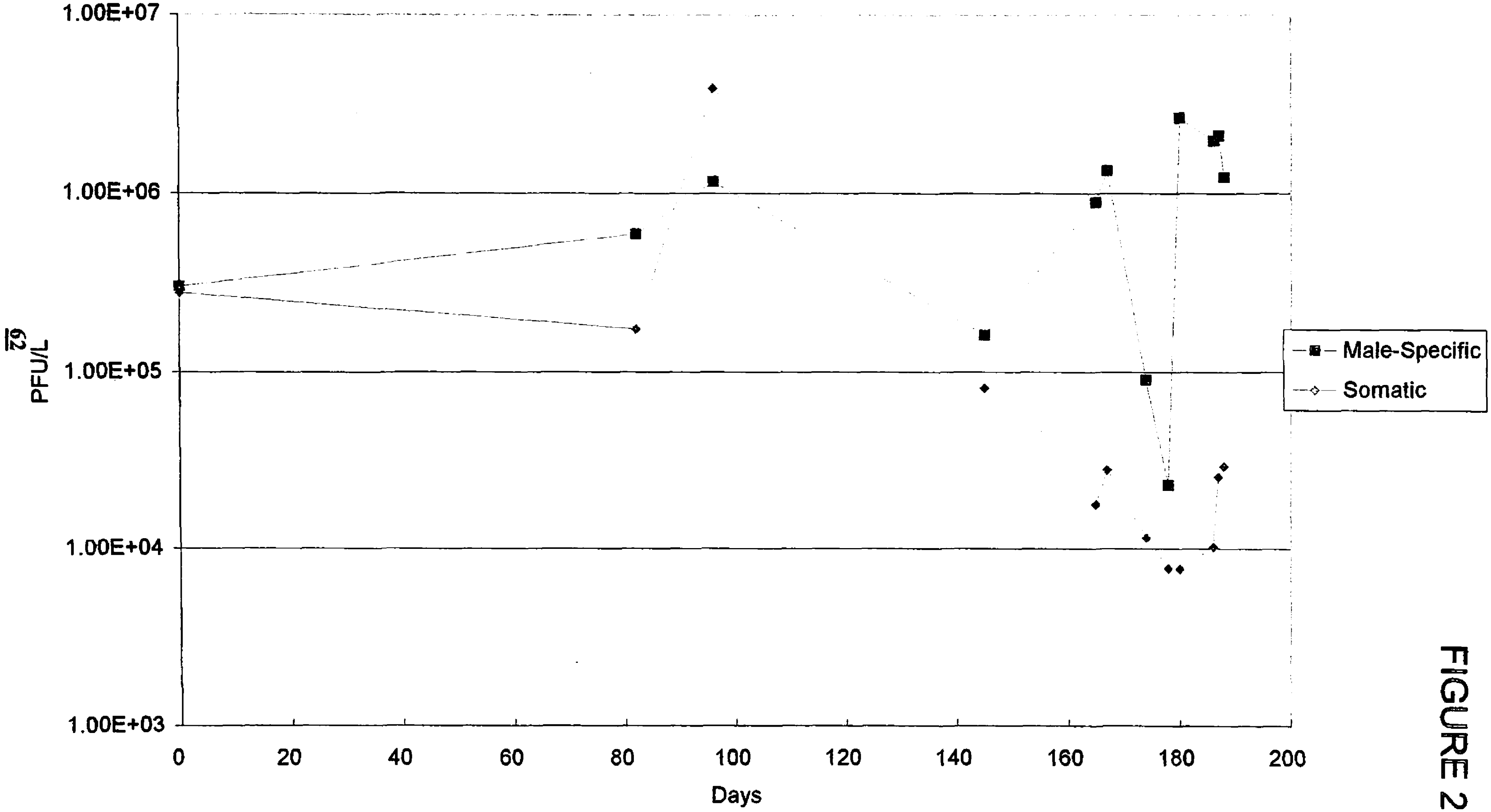


FIGURE 27

male specific and somatic coliphage populations in the septic tank from December 1994 to June 1995.

To document the short term variation of coliphage populations in the septic tank, samples of septic effluent were collected at least once a day during a 2-week interval from August 26 to September 8, 1995, (school resumed on August 30). Concentrations of both male-specific and somatic coliphage in the septic effluent were reported to increase by two orders of magnitude as school begins; male-specific coliphage concentrations increased from 2.6×10^4 to 3.4×10^6 PFU/L; somatic coliphage concentrations increased from 2.5×10^4 to 1.2×10^6 PFU/L.

From March 1, 1995 to May 30, 1996 a total of 108 grab samples of groundwater from 31 wells and 2 piezometers were collected and analyzed for the presence of male-specific and somatic coliphage using both plaquing and MPN techniques. Reported male-specific coliphage concentrations in groundwater ranged from a maximum of 56 PFU/ml (well M16) to a background minimum of <1 PFU in 3330 ml. Somatic coliphage concentrations ranged from 71.5 PFU/ml (well M16) to a background concentration of <1 PFU in 3330 ml. Table 4 summarizes the results of the ground-water coliphage sampling over the course of the study. Coliphage were detected in at least one groundwater sample collected from each of the wells which appear in bold print in Table 4. However, it is suspected that the initial coliphage sampling of monitoring wells

Table 4. Summary of Results: Coliphage in Groundwater

Well or Piezometer	Male-Specific Coliphage	Somatic Coliphage	Number of Samples
M11	<1 in 3330ml to <1 in 3 ml	<1 in 3330 ml to <1 in 3 ml	2
M12	<1 in 3330 ml to 5/ml	<1 in 3330 ml to 1/ml	3
M13	0.00066/ml to 29.5/ml	0.00066/ml to 45/ml	2
M14	0.00031/ml to <0.333/ml	<1 in 3330 ml to 0.5/ml	2
M15	0.9/ml to 20/ml	0.2/ml to 29/ml	13
M16	0.019/ml to 56/ml	0.018/ml to 71.5 /ml	12
M17	0.004/ml to 5/ml	0.0014/ml to 2.5/ml	2
M18	<1 in 3330 ml to <1 in 3 ml	<1 in 3330 ml to <1 in 3 ml	2
M19	0.2/ml to 100/ml	0.2/ml to 23/ml	18
M20	0.0003/ml	0.005/ml	1
M21	<1 in 3330 ml to <1 in 3 ml	0.001/ ml to <1 in 3 ml	2
M22	<1 in 3330 ml to <1 in 3 ml	<1 in 3330 ml to <1 in 3 ml	2
M23	<1 in 3ml	<1 in 3ml	1
M24	0.015/ml to <0.333/ml	0.002/ml to <0.333/ml	2
M25	0.009/ml to <0.333/ml	0.001/ml to <0.333/ml	2
M26	0.2 /ml to <1 in 1100 ml	0.0014/ml to <1 in 1100 ml	9
M27	0.003/ml to <0.333ml	0.083/ml to <0.333/ml	2
M28	<1 in 3330 ml to <1 in 3 ml	<1 in 3330 ml to <1 in 3 ml	2
M29	<1 in 3330 ml to <1 in 3 ml	0.00031/ml to <0.333/ml	2
M30	<1 in 3330 ml to <1 in 3 ml	<1 in 3330 ml to <1 in 3 ml	2
M31	<1 in 3330 ml to <1 in 3 ml	0.017/ml to <1 in 2000 ml	3
M32	<1 in 3330 ml to <1 in 3 ml	<1 in 3330 ml to <1 in 3 ml	2
M33	<1 in 3330 ml to <1 in 3 ml	<1 in 3330 ml to <1 in 3 ml	2
M34	<1 in 3330 ml to <1 in 3 ml	<1 in 3330 ml to <1 in 3 ml	2
M35	<1 in 3330 ml to <1 in 3 ml	<1 in 3330 ml to <1 in 3 ml	2
M36	<1 in 3330 ml to 0.33/ml	<1 in 3330 ml to <1 in 3 ml	2
M37	0.00031/ml to <1 in 3ml	<1 in 3330 ml to <1 in 3 ml	3
M38	0.09/ml	0.1/ml	1
M39	0.03/ml	0.03/ml	1
M40	7.5/ml to 0.007/ml	0.007/ml to 0.009/ml	2
M41	14 in 3330 ml to 0.001/ml	0.006/ml to 0.001/ml	2
P1	<1 in 3330 ml to 0.33/ml	<1 in 3330 ml to <1 in 3 ml	2
P4	<1 in 3ml	<1 in 3ml	1

conducted March 1, 1995 may have yielded false positives due to contamination introduced during well drilling and construction.

On May 30, 1996, twenty-eight monitoring wells and 2 piezometers were sampled for the presence of both male-specific and somatic coliphage. Table 5 presents the coliphage results. Wells which tested positive for coliphage are shown in bold print. Figure 28 illustrates wells which tested positive for coliphage. Absolute values listed in the table represent direct counts obtained using plaquing techniques. Where a result of "< 1 in 3,330 ml" appears, it indicates MPN analysis was performed.

Human Enterovirus

A total of 7 samples of septic effluent were collected from the septic tank and assayed for human enterovirus. Enterovirus were isolated in two of seven samples collected of septic effluent in the septic tank. Both positives were collected using the 1MDS filtration apparatus. All other samples of the septic effluent tested negative for the presence of human enterovirus. Table 6 summarizes the results of sampling septic effluent for the presence of human enterovirus.

Wells M15, M16, M19, M25, M26, M31 and M37 were each sampled for human enterovirus using the 1MDS filtration apparatus. No enterovirus were detected

Table 5. Results of Groundwater Coliphage Sampling May 30, 1996

Well or Piezometer	Male-Specific Coliphage	Somatic Coliphage
M11	<1 in 3330 ml	<1 in 3330 ml
M12	<1 in 3330 ml	<1 in 3330 ml
M13	0.00066/ml	0.00066/ml
M14	0.00031/ml	<1 in 3330 ml
M15	20/ml	29/ml
M16	0.019/ml	0.018/ml
M17	0.004/ml	0.0014/ml
M18	<1 in 3330 ml	<1 in 3330 ml
M19	100/ml	23/ml
M20	0.0003/ml	0.005/ml
M21	<1 in 3330 ml	0.001/ml
M22	<1 in 3330 ml	<1 in 3330 ml
M23	N.A.	N.A.
M24	0.015/ml	0.002/ml
M25	0.009/ml	0.001/ml
M26	0.2/ml	0.0014/ml
M27	0.03/ml	0.083/ml
M28	<1 in 3330 ml	<1 in 3330 ml
M29	<1 in 3330 ml	0.00031/ml
M30	<1 in 3330 ml	<1 in 3330 ml
M31	<1 in 3330 ml	0.017/ml
M32	<1 in 3330 ml	<1 in 3330 ml
M33	<1 in 3330 ml	<1 in 3330 ml
M34	<1 in 3330 ml	<1 in 3330 ml
M35	<1 in 3330 ml	<1 in 3330 ml
M36	<1 in 3330 ml	<1 in 3330 ml
M37	0.00031/ml	<1 in 3330 ml
M38	N.A.	N.A.
M39	N.A.	N.A.
M40	7.5/ml	0.007/ml
M41	14/ml	0.006/ml
P1	<1 in 3330 ml	<1 in 3330 ml
P4	N.A.	N.A.

N.A. = Not Analyzed

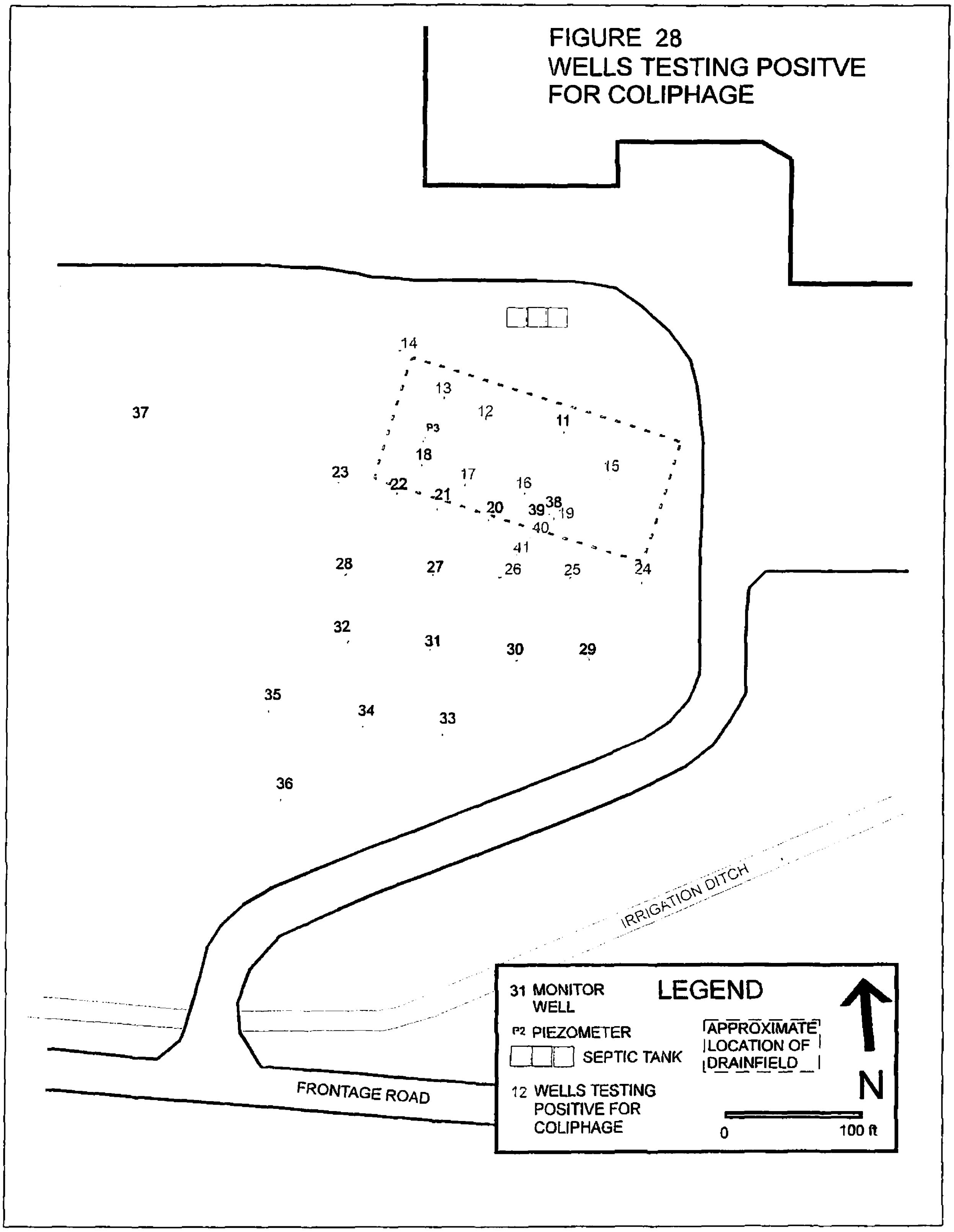


FIGURE 28
WELLS TESTING POSITVE
FOR COLIPHAGE
14
13
12
11
37
P3
18
15
23
22
17
16
21
20
39
38
19
40
41
28
27
26
25
24
32
31
30
29
35
34
33
36
IRRIGATION DITCH
FRONTAGE ROAD
LEGEND
31 MONITOR WELL
P2 PIEZOMETER
SEPTIC TANK
12 WELLS TESTING POSITIVE FOR COLIPHAGE
APPROXIMATE LOCATION OF DRAINFIELD
N
0
100 ft

Table 6. Summary of Results: Human Enterovirus Detected in Septic Effluent

Sample Date	Collection Method	Volume (liters)	Results MPN	Plaquing
9/13/94	1MDS Filtration	140	4.42 virus/L	N.A.
12/9/94	1MDS Filtration	180	N.A.	None in 45 L
12/9/94	grab sample	1	N.A.	None in 0.26 L
3/15/95	1MDS Filtration	342	None in 134 L	None in 134 L
6/1/95	1MDS Filtration	95	N.A.	None in 31 L
6/7/95	1MDS Filtration	90	0.25 virus/L	N.A.
6/7/95	grab sample	1	None in 0.38 L	N.A.

Table 7. Summary of Results: Human Enterovirus in Groundwater

Well	Date	Volume Filtered (Liters)	Results MPN	Plaquing
M15	3/15/95	1927	None in 733 L	None in 733 L
M16	3/1/95	726	None in 1429 L	N.A.
M19	5/31/95	1941	N.A.	None in 638 L
M25	3/15/95	2139	None in 823 L	None in 823 L
M26	3/1/95	603	None in 247 L	None in 82 L
M31	8/1/95	2709	None in 1440 L	N.A.
M37	8/1/95	2635	None in 1496 L	N.A.

in groundwater filtered at any of the FHS monitoring wells above a detection limit of approximately 1 virus/2,000 liters. Table 7 summarizes those sampling events.

4.0 DISCUSSION

4.1 Source History Complexities

The primary purpose of the site characterization was to investigate the shallow groundwater system in the vicinity of the FHS septic drainfield in order to identify the hydrogeologic and geochemical factors that might influence the occurrence and transport of viruses in groundwater. While the investigation was successful in characterizing several such aspects of the site, it also revealed inherent heterogeneities and complexities of the site and the septic disposal system which complicate the ability to identify factors controlling virus occurrence and transport in the shallow groundwater system.

The heterogeneities in the upper alluvium as described in Section 3.1 appear to be one reason for spatial variation in the delivery of septic effluent to the shallow groundwater. Analysis of nitrate, chloride and sodium water quality data consistently indicates that the plume of septic impacted groundwater originates in the southeastern portion of the drainfield, in the vicinity of wells M15 and M19. This would suggest that the drainfield is delivering the majority of effluent to the eastern half of the drainfield. It is believed that percolation of effluent delivered to the western half of the drainfield, in the vicinity of wells M21 and M22, is being retarded by the presence of shallow, finer-grained soils.

Three pieces of evidence support this interpretation. Firstly, engineering drawings indicate that the north end of the drainfield is constructed with four concrete distribution boxes within the drainline manifold to facilitate even distribution of effluent across the width of the drainfield. (The system is then designed to gravity feed effluent down the drainline laterals where much of the percolation is expected to occur at the southern end of the drainfield). Secondly, patterns of snowmelt observed during the winter months, and vegetation growth in the spring months, mimicked the position of the drainfield laterals and suggested effluent was being distributed to the entire drainfield. Lastly, sewage was occasionally observed to surface in the northwest corner of the drainfield, probably indicating a backup of the system in the extremities of the western drainlines. Thus, it is likely that the finer-grained soils act to retard the downward migration of septic wastes, resulting in decreased impacts to ground-water quality beneath the western portion of the drainfield.

Another mechanism that affects the source history of septic effluent is the fluctuating water table, which provides for greater and lesser degrees of sewage treatment in the vadose zone. During the study, the depth of the shallow water table was observed to fluctuate by as much as 6 ft throughout the year, largely in response to the local irrigation schedule. The water table is the highest in July and August when comparatively little septic disposal occurs. As school resumes in September, irrigation is shut off and the water table declines, providing a greater vadose zone for septic waste treatment. The water table continues to decline until the Spring, when natural recharge and irrigation again cause the water table to rise. School recesses for the Summer and the cycle continues.

In addition to spatial variation in the distribution of septic effluent to the shallow groundwater caused by heterogeneities in the soils, temporal variation in the source history is introduced through the sporadic pumping schedule of the septic lift station. Pumping of effluent occurs as individual events dispersed throughout the day. Loading rates measured during the weekday, when school was in session, are nearly five times greater than those measured during the weekend. Also, loading rates are decreased when school is recessed nearly three months during the summer and about two weeks during the New Year. The erratic loading rate schedule suggests the septic source might be better conceptualized as numerous, irregularly spaced slug sources rather than a continuous source.

It is expected that the actual variation in wastewater chemistry would further complicate the source history. Analysis of the septic effluent and groundwater samples collected from well M15 (representing septic-impacted groundwater) confirms significant variation in the chemical composition of the septic effluent, and the resultant plume of septic-impacted groundwater. For instance, throughout the study, groundwater chloride concentrations ranged from <13.8 to 50 mg/L in the septic tank and 13.8 to 42.9 mg/L in groundwater collected at well M15. It is possible that more frequent sampling would have demonstrated even greater temporal variations in the chemistry of the septic effluent.

4.2 Aquifer Heterogeneity

Regardless of the source history, once septic effluent reaches the shallow groundwater, the transport of septic impacted groundwater will be controlled largely by the physical characteristics of the aquifer.

The top of the coarse sand and gravel unit is an irregular boundary occurring between a depth of 8 and 11 ft below land surface throughout the site. These sediments can be characterized as being uniformly more coarse than the overlying sediments. However, significant heterogeneity exists within the coarse sand and gravel system, both laterally and vertically, which adds heterogeneity to the aquifer system. This heterogeneity affects the distribution of septic impacted groundwater.

During the bromide tracer test, ground-water flow velocities were calculated to be approximately 10 ft/day within the first 23 ft of the tracer well network, between well M19 and well M40. During the same time period, and under similar gradients (.002), the calculated ground-water flow velocity decreased to 4.6 ft/day between well M40 and well T4, and 3.3 ft/day between wells T4 and T7. Such changes in ground-water flow velocities over a distance of 60 ft are likely to be related to varying values of hydraulic conductivity or, to a lesser extent, changes in porosity.

Slug test data appear to point to a range of hydraulic conductivities within the sand and gravel unit (7 to 196 ft/day). In general, it is likely that values of hydraulic conductivity obtained through slug tests performed in highly transmissive aquifers may significantly underestimate the actual hydraulic conductivity because they do not adequately stress the aquifer. Additionally, slug tests are inherently limited because they only assess the character of the aquifer immediately adjacent to the well. Even in light of the limitations of slug tests, it can be said that each of the slug tests were comparable; they were all conducted using similar methods, on wells which were installed using the same method and of similar construction. This suggests that the spatial variations in hydraulic conductivity values determined from multiple slug tests conducted at numerous wells is real.

As stated in Section 3.0, estimated values of hydraulic conductivity derived from the sieve analyses were lower than estimates calculated from slug tests or back calculated from the bromide tracer experiment. These lower results may be explained by methodology (Swaren, 1995). The nested sieves ranged in mesh size from -1 to 4 phi, resulting in the exclusion of size fractions larger than coarse sand in the sieve analysis. (This omission is apparent when reviewing the bore logs completed during drilling.) Excluding gravels and pebbles from the sieve analysis decreases the d10 value, and effectively lowers the calculated value of hydraulic conductivity. In addition, the Hazen method is most applicable to sands (Fetter, 1994). Boring logs indicated that soils below 10 ft were predominantly sandy gravels, or gravelly sands. Therefore, the values of hydraulic conductivity obtained from sieve analysis should be viewed with skepticism.

Unfortunately, soil samples collected from drill cuttings at depths of 10 and 15 ft in well borings are not useful in observing variations in such sedimentary structures and stratigraphy which might cause changes in porosity and/or hydraulic conductivity values. Documenting variations in the sand and gravel unit was further complicated by the omitting the larger clasts in the grain size analysis, effectively ignoring grain size characteristics which could significantly affect aquifer transport properties.

4.3 Inorganic Plume

A plume of septic impacted water extends at least 300 feet downgradient from the drainfield. The plume is elongated and relatively narrow, indicating a point source which is being transported with the groundwater flow system. The plume is elevated in sodium, chloride, and total nitrogen (nitrate and ammonium). Of these constituents, nitrate is the primary health concern in drinking water supplies. At the source of septic impacted water, in the vicinity of well M15, concentrations of nitrate were found to be elevated well above background levels measured in well M37. However, as the plume disperses and is diluted downgradient, nitrate levels decrease and are only marginally above background levels at well M36, and well below regulatory standards for drinking water. Sodium and chloride, which are of lesser concern, are also diluted and dispersed downgradient. Identification of the plume was useful not only in characterizing the water quality conditions present in the vicinity of the drainfield, but helped guide virus sampling efforts. The longitudinal axis of the plume also provided a logical location to construct the tracer well network and conduct the virus seeding experiment.

4.4 Absence of Human Enterovirus

The FHS was chosen as the study site for several reasons, one of the most important being that instrumenting a drainfield servicing a large population would improve the possibility of detecting human enterovirus in the septic system and shallow groundwater. Unfortunately, efforts to isolate virus from the septic tank were largely unsuccessful. There are a number of factors which might explain the inability to document the presence of enterovirus more frequently, or in greater numbers in the septic tank.

Firstly, the community of Frenchtown is a relatively closed population, and individuals may not be exposed to viruses as frequently as in a larger community. Additionally, human enterovirus would only be detected in the septic system if a sample were collected near the time when someone at FHS was infected and used the septic disposal system. Perhaps the timing of septic tank sampling events may not have been frequent enough to coincide with an occurrence of enterovirus. Another reasonable explanation is that an individual who was infected and feeling ill may not attend school.

Another limiting factor is the inability of human enterovirus to survive in the relatively inhospitable environment of septic wastewater in the septic tank.

Elevated effluent temperatures measured in the septic tank are not ideal for enterovirus survival. Also, viricidal chemicals and compounds, such as inorganic and organic cleaners, solvents and laboratory reagents are routinely discharged into the school's waste stream. Another possible explanation is that the school's water supply is chlorinated to a concentration of 0.5 mg/L. However, this is judged to be insignificant (verbal communication with Dr. Charles Gerba, April, 1995). All factors considered, the septic tank is considered a hostile environment for human enterovirus.

Finally, it has been demonstrated that the sampling efficiency of the 1MDS filtration method and subsequent assay is low, especially when used on septic effluent. Dr. DeBorde conducted experiments in which a known number of the attenuated polio virus was added to both unimpacted groundwater and to septic effluent and processed using 1MDS filtration and assay techniques. Enterovirus recovery was found to be 30 to 50% for unimpacted groundwater and less than 10% for septic effluent. It appears our ability to detect human enterovirus using 1MDS techniques may be limited.

Given the low numbers of enterovirus detected in the septic tank, it is not surprising that no enterovirus were detected in the shallow groundwater in the vicinity of the septic drainfield. The results of coliphage sampling indicate bacteriophage concentrations decreased by three orders of magnitude from the septic tank to the shallow groundwater beneath the drainfield. Assuming a similar fate of enterovirus, that same proportional reduction in enterovirus populations associated with the septic disposal system would result in ground-water enterovirus concentrations of several orders of magnitude below 1MDS detection limits.

4.5 Endogenous Coliphage

Male-specific and somatic coliphage were found in the septic tank at similar average concentrations, on the order of 10^3 PFU/L to 10^6 PFU/L. Samples of septic impacted water also assayed positive for coliphage, but at concentrations averaging 3 orders of magnitude less than in the septic tank.

Notably, there was a strong correlation between the location of the inorganic groundwater plume and the occurrence of endogenous coliphage; the highest concentrations of coliphage were associated with maximum concentrations of inorganic septic constituents.

Endogenous coliphage were regularly detected in groundwater samples of 4L or less collected from wells M19, M40, M41 and M26. These wells are located in the tracer well network; downgradient from the source of septic waste and within 37 ft of the drainfield. Larger sample volumes may have yielded positive assays of coliphage further downgradient.

Along this flowpath endogenous coliphage were reported to decrease in concentration at a rate of approximately 1 order of magnitude for every 15 ft of lateral transport. However, because of the complex source history of the septic effluent, endogenous coliphage have limited use as indicators of rates of virus transport.

5.0 CONCLUSIONS

The FHS hydrogeologic site characterization provides the following conclusions:

1) The area of the FHS drainfield is underlain by heterogeneous sediments; fluvial sands and gravels. A shallow unconfined aquifer is present to a depth of roughly 30 ft. The position of the water table fluctuates between approximately 7 and 15 ft below land surface, largely in response to local irrigation practices. Hydraulic conductivity of the sandy gravel below a depth of 10 ft is estimated to be 800 ft/day. Ground-water flow is to south-southwest at an overall velocity of approximately 7 ft/day.

2) The FHS wastewater disposal system is a 20,000 ft^2 drainfield which receives approximately 3,000 gal of effluent per day during the school year. A plume of septic-impacted groundwater elevated in nitrate, chloride and sodium originates in the southeastern portion of the drainfield and extends downgradient from the drainfield at least 300 ft.

3) Fecal coliform bacteria were detected in the groundwater nearly 200 ft downgradient from the drainfield.

4) Human enterovirus were isolated in samples of septic effluent collected from the septic tank, although only sporadically and at low concentrations (< 6 viruses/ liter). No human enterovirus were detected in the shallow groundwater in the vicinity of the drainfield.

5) Male-specific and somatic coliphage were detected in the septic tank at average concentrations of 674,000 PFU/L and 466,000 PFU/L, respectively. Coliphage concentrations in the septic tank were observed to fluctuate by several orders of magnitude over short periods of time.

6) Average coliphage concentrations in the shallow groundwater were 3 orders of magnitude less than average septic tank concentrations. Coliphage were detected in the shallow groundwater system a maximum of 57 ft downgradient from the edge of the drainfield.

PART II COLIPHAGE SEEDING EXPERIMENT

On August 26, 1995, one week following the bromide tracer injection, a coliphage seeding experiment was begun within the tracer well network at the FHS site. The purposes of the experiment were to:

1. Document the horizontal transport and survival of coliphage in groundwater in this particular hydrogeologic environment, and

2. Relate the results of the coliphage seeding experiment to the results of the relatively conservative bromide tracer test in order to compare the transport of virus to the physical groundwater flow system.

6.0 METHODS

Immediately prior to seeding, groundwater samples were collected from wells M19, M38, M40, M41, and T7 to establish baseline coliphage concentrations. Baseline coliphage concentrations had been previously determined at wells M31 and M34. Wells T8, T9 and T10 were constructed after the seeding experiment commenced and no baseline coliphage data were collected.

Approximately 36 gal of well water was pumped from well M19 and used as the suspending medium for male-specific MS2 and somatic ΦX174 coliphage. Over a 20 min period, the seeding solution was siphoned back into the well at a depth of 12 ft below land surface; approximately 4 ft below the water table. The coliphage seed is considered a slug source. The water in the well casing was surged for a short time using a PVC bailer. Samples were immediately taken of the well water in well M19 using a peristaltic pump. Initial concentrations of male-specific and somatic coliphage were assayed by plaquing and reported to be 1.06 x 10^9 PFU/ml and 1.12 x 10^6 PFU/ml, respectively.

Samples of groundwater were collected from wells in the tracer well network for a total of 33 days following seeding using a peristaltic pump and dedicated sampling equipment as described in Section 2.4. Sample sizes ranged from 100 to 1250 ml. Field measurements of pH, temperature, electrical conductance and dissolved oxygen were recorded. Samples were also collected for fecal and total coliform as described in Section 2.4. All water quality samples were labeled and stored on ice for immediate transport to the analytical laboratory.

An attempt was made to document the rate of survival of the seeded coliphage under the conditions present in the injection well. Two 30 ml Oakridge centrifuge tubes were filled with water collected from the injection well immediately after seeding. One tube was sealed with a rubber stopper and used as a control. The other was equipped with a dialysis membrane which allowed free chemical exchange between the seed water in the tube and the water in the well. The tubes were suspended below the water table in injection well M19. Over the course of the seeding experiment, 0.5 ml samples were periodically collected from the vials using a sterile syringe and analyzed for the presence of male-specific and somatic coliphage. A second sample of the seeded groundwater in well M19 was held in the laboratory at 4°C and assayed for male-specific and somatic coliphage periodically throughout the seeding experiment.

All coliphage and coliform water quality samples were analyzed by The University of Montana DBS as described in Section 2.5 .

7.0 RESULTS OF COLIPHAGE SEEDING EXPERIMENT

One consideration in quantifying coliphage concentrations during the tracer experiment was the presence of resident, or endogenous coliphage populations within the shallow groundwater system. Figure 29 compares the levels of endogenous male-specific and somatic coliphage documented to be present in the system in the vicinity of the tracer well network (wells M19, M40, M41 and T7) to maximum concentrations observed in those wells during the coliphage seeding experiment. It can be seen that the levels of both male-specific and somatic coliphage introduced into injection well M19 were 6 to 10 orders of magnitude greater than endogenous coliphage concentrations. Maximum observed coliphage concentrations observed in tracer wells during the seeding experiment were also several orders higher than the levels of endogenous populations. It seems logical that the seeding experiment was not biased by the presence of resident coliphage.

It is interesting to note that similar concentrations of endogenous populations of somatic and male-specific coliphage were found in the shallow

COMPARISON OF ENDOGENOUS AND SEEDED COLIPHAGE IN TRACER WELL NETWORK

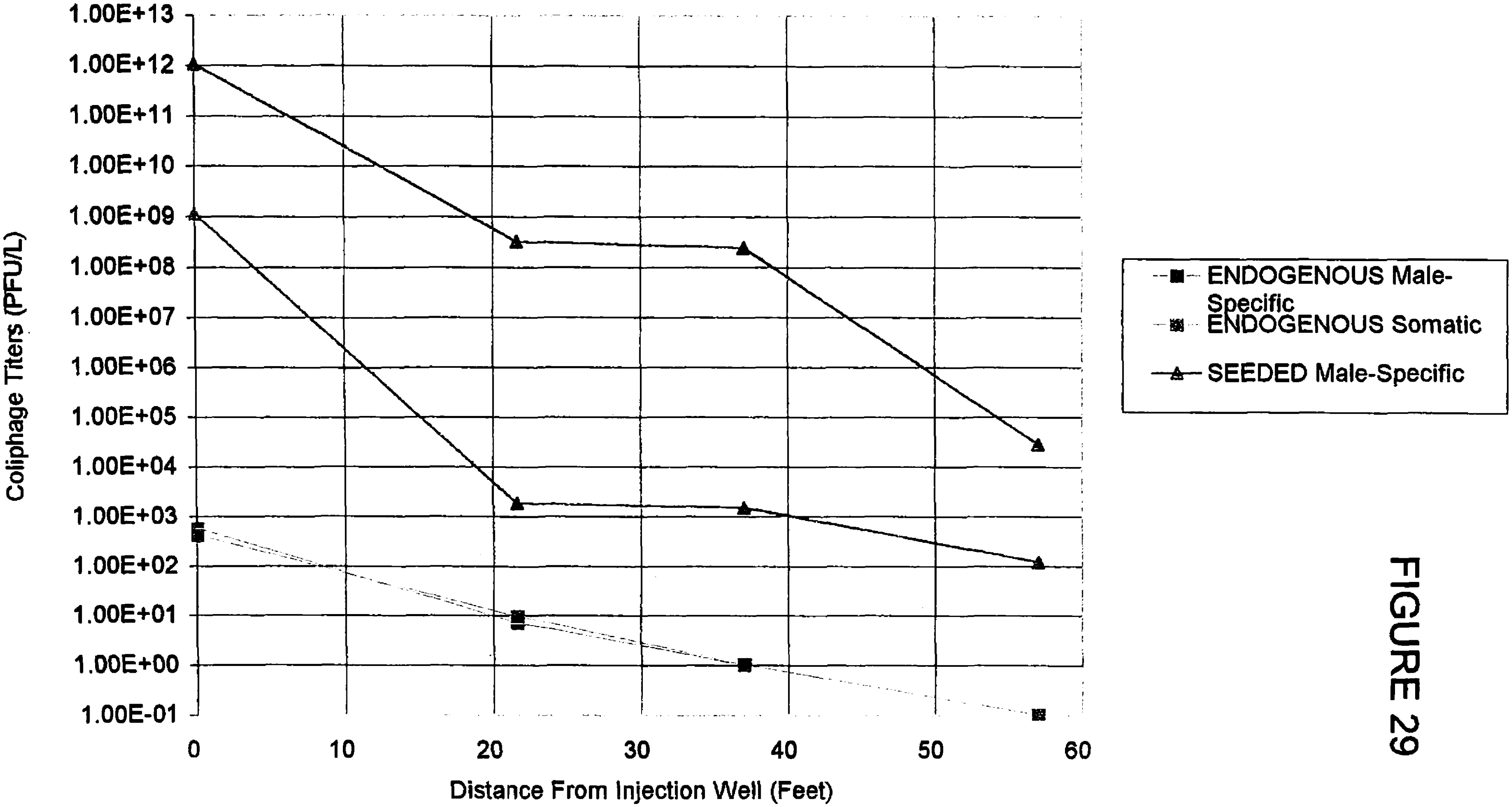


FIGURE 29

aquifer. Furthermore the concentrations of endogenous coliphage were documented to decrease with distance downgradient from the septic drainfield.

Breakthrough Curves

Figures 30 and 31 are breakthrough curves for MS2 and ΦX174 coliphage, respectively, in groundwater at wells M40, M41, T7 and T8, located downgradient from the injection well (M19). All groundwater coliphage concentrations are reported as average plaque forming units per milliliter (PFU/ml). The timing of peak coliphage seed concentrations reported in groundwater samples collected from each of the wells in the tracer network are summarized in Table 8.

Table 8. Summary of Results: Coliphage Seed Breakthrough Curves

		MS2 Coliphage		ΦX174 Coliphage	
Well	Distance Downgradient from Injection Well (ft)	Peak (PFU/ml)	Elapsed Time (hours)	Peak (PFU/ml)	Elapsed Time (hours)
M40	23	$3.18x10^5$	48	1.8	48
M41	37	$2.4x10^5$	132	1.5	108
T7	57	28.9	240	0.121	240, 312
T8	82	0.2	579	$9.53x10^{-4}$	480, 579
T10	112	0.02	603	$8.9x10^{-4}$	648
M31	126	0.002	744	$8.9x10^{-4}$	648

At well M40, located 23 ft downgradient from the injection well, peak concentrations of both MS2 (3.18×10^5 PFU /ml) and ΦX174 (1.8 PFU/ml) were reported in groundwater samples collected 48 hrs after coliphage injection.

MS2 BREAKTHROUGH CURVES
WELLS M40, M41, T7 AND T8

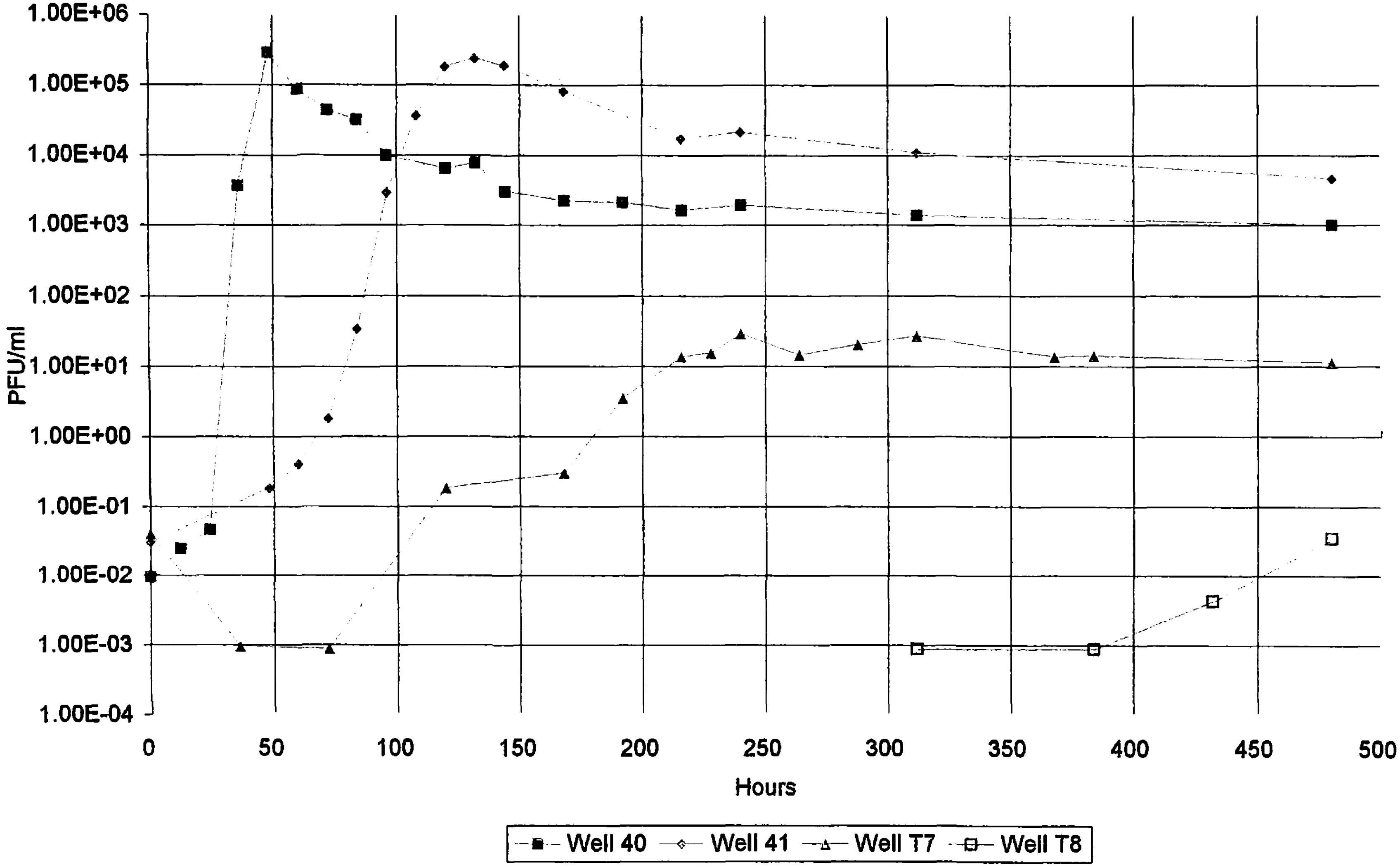


FIGURE 30

PhiX174 BREAKTHROUGH CURVES WELLS M40, M41, T7 AND T8

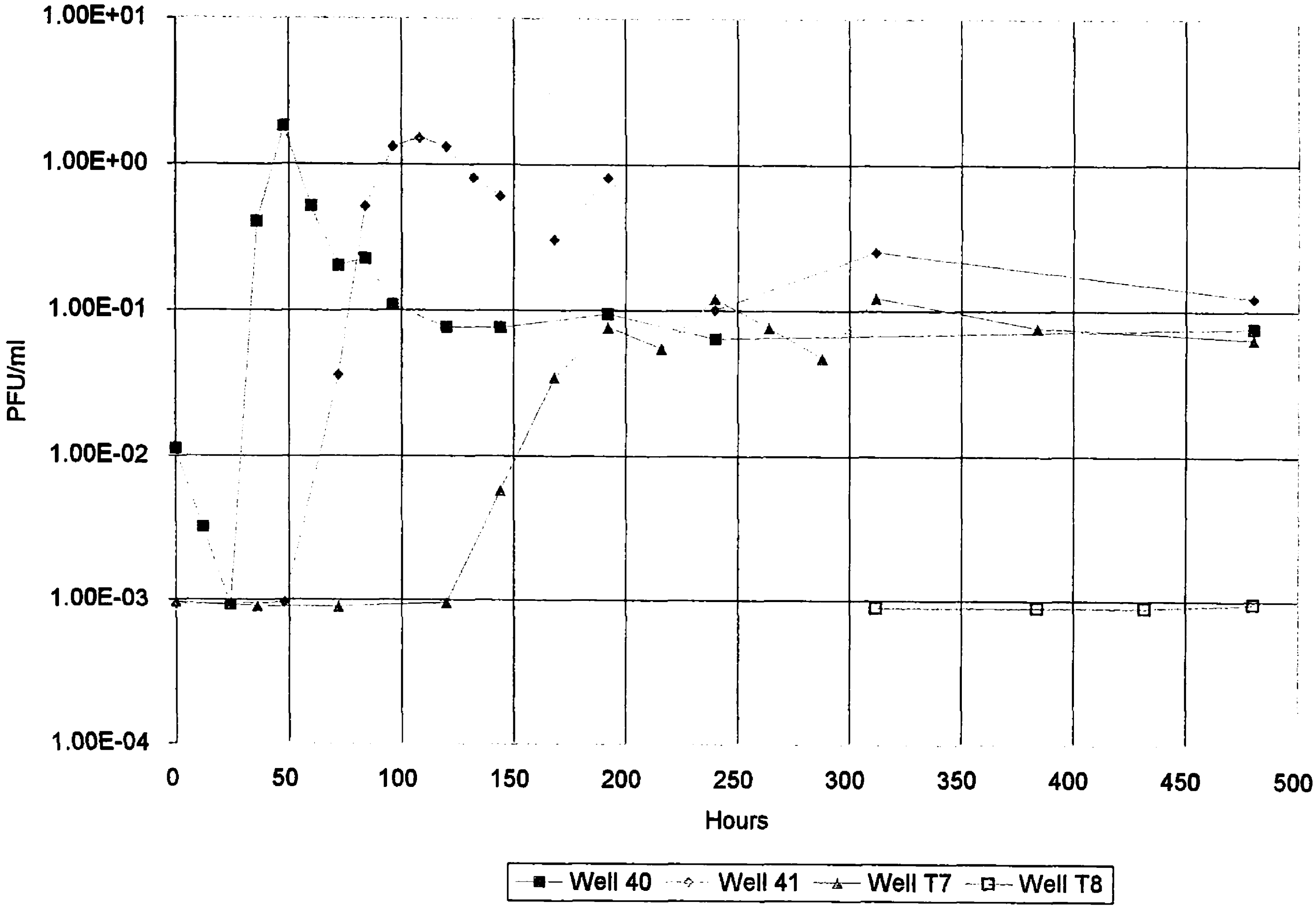


FIGURE 31

At well M41, located 37 ft downgradient from the injection well, the peak MS2 concentration (2.4×10^5 PFU/ml) was reported in the groundwater sample collected 132 hours after injection. ΦX174 peaked at a reported concentration of 1.5 PFU/ml in the groundwater sample collected 108 hrs after injection. Fifty-seven ft downgradient from the injection well at well T7, a peak MS2 concentration of 28.9 PFU/ml was reported in the groundwater sample collected 240 hrs (10 days) following injection. The concentration of ΦX174 in groundwater peaked at 0.121 PFU/ml at 240 hrs (10 days), and again at 312 hrs (13 days).

At well T8, located 82 ft downgradient from the injection well, the peak concentration of MS2 (0.2 PFU/ml) in groundwater was reported to occur 579 hrs (approximately 24 days) after injection. ΦX174 peaked twice at a concentration of 9.53×10^{-4} PFU/ml; first in the groundwater sample collected at 480 hrs (20 days) and again 579 hrs (approximately 24 days) after injection.

At well T10 (112 ft downgradient) the peak MS2 concentration (0.02 PFU/ml) occurred at 603 hours (approximately 25 days) after injection. A peak MS2 concentration of 0.002 PFU/ml) was reported to occur after 744 hrs (31 days) at well M31, located 126 ft downgradient. Resolution is lost at wells T10 and M31, and it appears as though a concentration of 0.00089 PFU/ml may represent background conditions at those wells.

Figure 32 shows the decline in coliphage seed concentrations in groundwater at the injection well M19. The groundwater concentrations of MS2

INJECTION WELL M19
CONCENTRATIONS OF MS2, PhiX174 AND BROMIDE

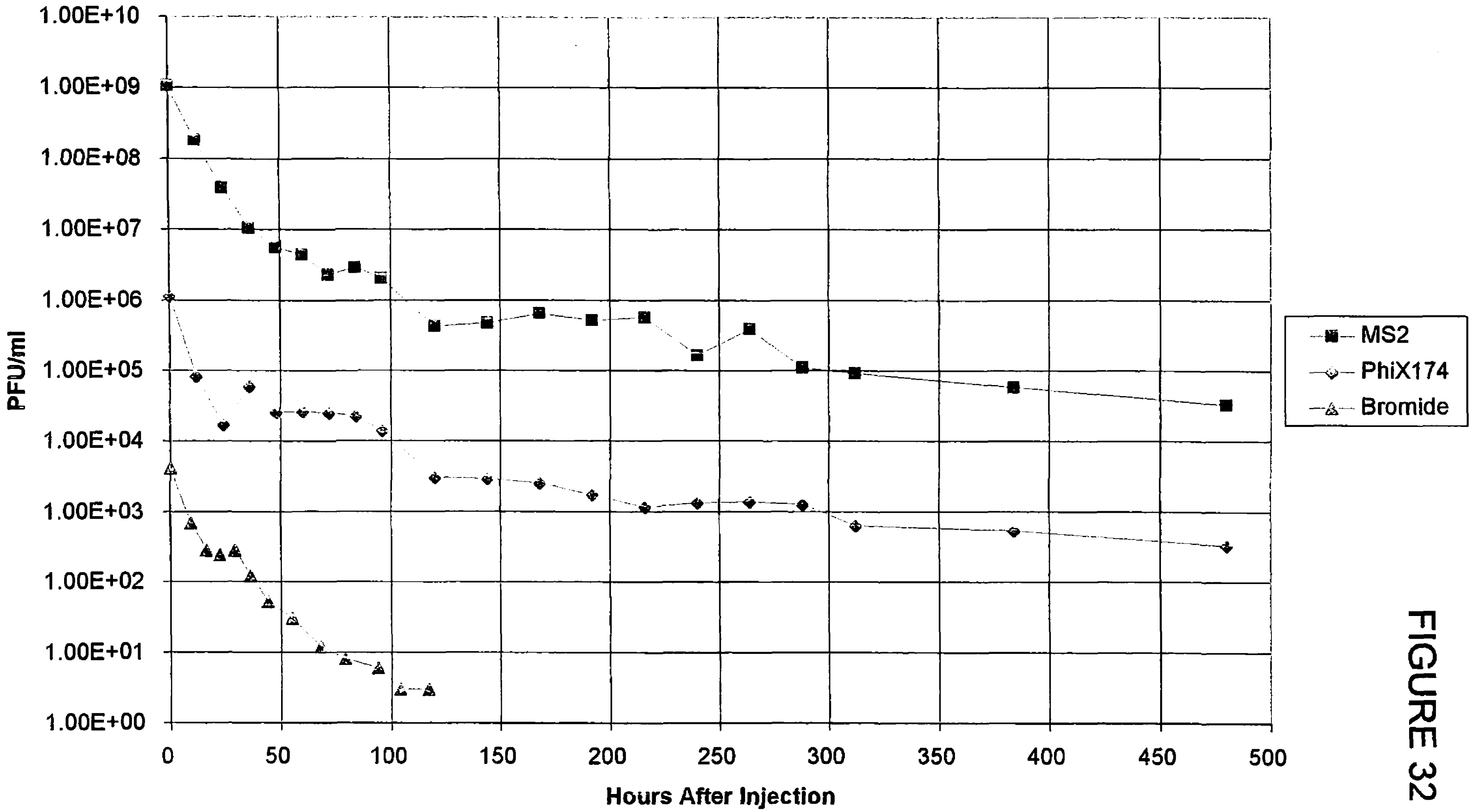


FIGURE 32

in injection well M19 reportedly decreased by six orders of magnitude (from 1.06 x 10^9 to 9880 PFU/ml) during the first 33 days (792 hrs) of the seeding experiment. During that same time period, the concentration of ΦX174 in groundwater at well M19 was reported to decrease by four orders of magnitude, from 1.12 x 10^6 to 269 PFU/ml.

Table 9 summarizes the range of recorded values of pH, temperature, electrical conductance and dissolved oxygen measured in groundwater at wells M19, M40, M41, T7 and T8 during the coliphage seeding experiment.

Table 9. Summary of Results:
Field Parameters Measured During the Coliphage Seeding Experiment

Well	pH (units)	Temperature (Celsius)	D. O. (mg/L)	E.C. (umhos/cm)
M19	6.2 - 7.3	12.7 - 16.2	0.8 - 1.8	305 - 360
M40	6.3 - 7.1	11.9 - 15.5	0.8 - 1.9	287 - 372
M41	6.2 - 6.9	13.2 - 15.4	0.8 - 1.8	299 - 372
T7	6.0 - 6.7	12.8 - 16.3	1.5 - 3.5	330 - 382
T8	6.3 - 7.0	13.4 - 15.5	2.7 - 3.8	273 - 325

Virus Mortality

Figure 33 charts coliphage concentrations in both the solution of seeded groundwater enclosed in an Oakridge tube which was suspended in the groundwater in injection well M19 and the laboratory control held at 4 °C. Unfortunately, the Oakridge tube equipped with the dialysis membrane appeared to rupture after about 2 days and was subsequently discontinued.

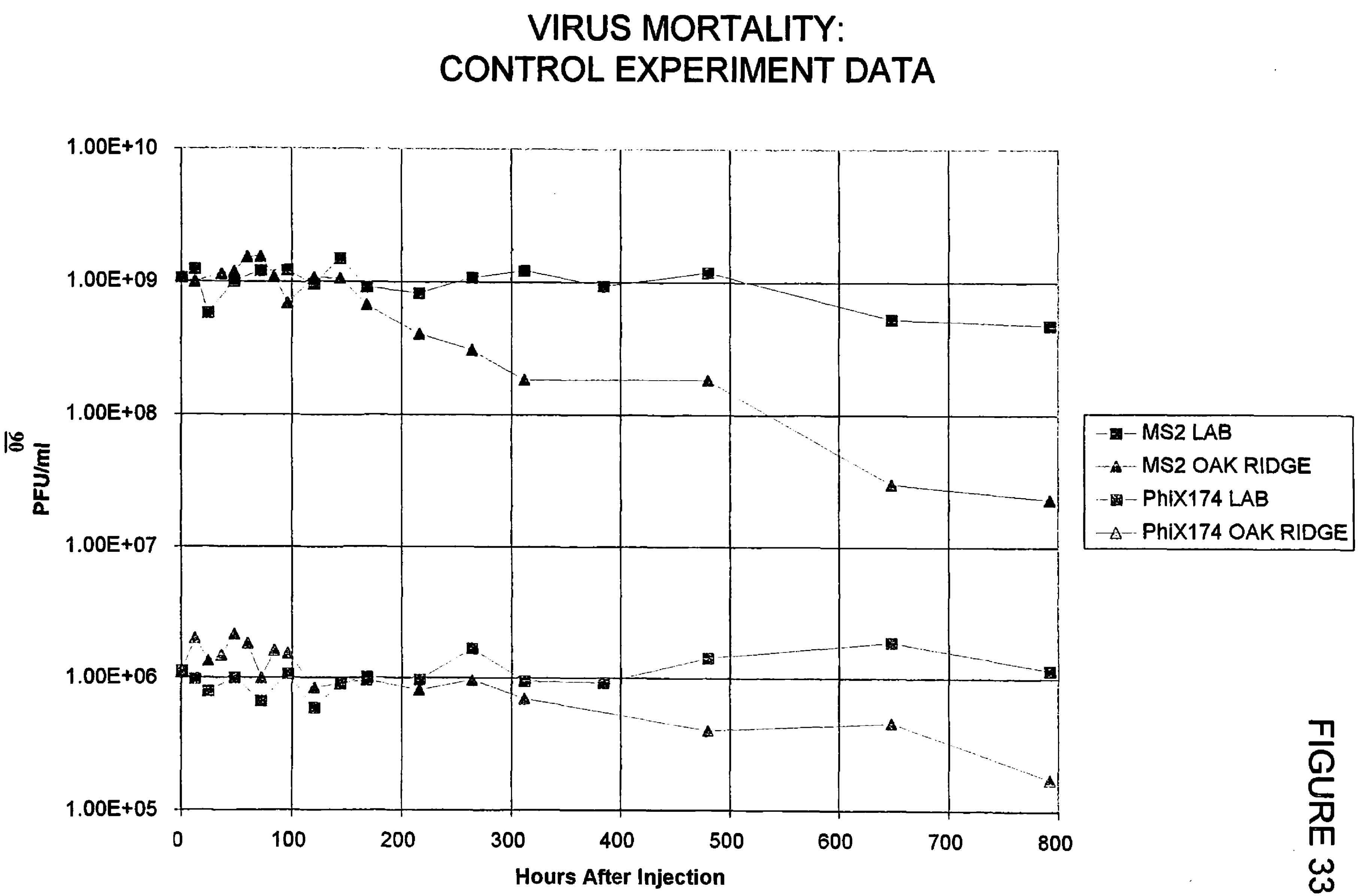

VIRUS MORTALITY:
CONTROL EXPERIMENT DATA
1.00E+10
1.00E+09
1.00E+08
1.00E+07
1.00E+06
1.00E+05
PFU/ml
0
100
200
300
400
500
600
700
800
Hours After Injection
MS2 LAB
MS2 OAK RIDGE
PhiX174 LAB
PhiX174 OAK RIDGE

FIGURE 33

During the first 33 days of the seeding experiment, MS2 concentrations in the sealed tube decreased from 1.06×10^9 to 2.28×10^7 PFU/ml and ΦX174 concentrations decreased from 1.12×10^6 to 1.71×10^5 PFU/ml. Assays of the laboratory control samples of the seeded groundwater held at 4 °C reported a lesser coliphage die-off rate. Over the same 33 day period, the concentration of MS2 decreased from 1.06×10^9 to 4.72×10^8 PFU/ml. The concentration decrease of ΦX174 was negligible; the initial concentration was 1.12×10^6 PFU/ml and after 33 days the concentration was reported to be 1.15×10^6 PFU/ml. All field and laboratory data collected during the coliphage seeding experiment are presented in Appendix J.

8.0 DISCUSSION

The coliphage seeding experiment was marked by both successes and failures. In retrospect, the experiment could have been improved in a number of ways. Firstly, the tracer well network was not optimally placed along the axis of groundwater flow; the main mass of the coliphage plume exited the tracer network near the second transect of wells and traveled to the west of the wells. Long screen lengths and varied well completions did not allow the vertical distribution of the tracers to be documented. Also, the number of samples collected and assayed was limited due largely to uncertainties in effectively storing groundwater samples for extended periods of time. However, despite these deficiencies several conclusions can be drawn from the results of the coliphage seeding experiment.

8.1 Virus Survival

The results of the coliphage seeding experiment confirmed that viruses may remain viable for a long period time in a cold water aquifer. As shown in Figure 32, during the seeding experiment, coliphage concentrations in the injection well M19 remain elevated several logs above background for 33 days after injection. In fact, coliphage concentrations above background were reported in groundwater samples collected from well M19 nine months after the injection of the coliphage seed.

The survivability of viruses in this cold-water aquifer is further indicated by the control experiment. Assays of the enclosed Oakridge tube suspended in the injection well M19, indicated a reduction in viral concentrations of only 1 to 2 logs over a 33 day interval, suggesting that virus mortality in a cold aquifer system is not a primary mechanism for the removal of viable virus as transport occurs. The laboratory control viruses archived at 4 °C fared even better, with no appreciable decrease in virus concentrations over the same time period. It is concluded that for tracer tests such as this, where high concentrations of coliphage are used as a seed, it would be acceptable to collect a large number of samples at frequent intervals during the tracer test, refrigerate the samples and perform assays later, as scheduling and data analyses dictate.

8.2 Transport Distance

The seeding experiment demonstrated that virus introduced into this hydrogeologic environment can be transported significant distances downgradient from the source. Ultimately, concentrations of MS2 coliphage above background levels were reported in well M31, 126 ft downgradient from the injection well.

However, it is likely that the coliphage seed was transported further downgradient than the results indicate. Because peak coliphage concentrations were greater in well T4 than in well M41, it is believed that the main mass of the coliphage seed moved to the west of the tracer network near Transect 2. This suggests that the peak concentrations of coliphage detected in well M31 do not represent the main mass of the coliphage seed, but rather the edge or shoulder of the coliphage seed. Therefore, it is possible that the coliphage seed was transported even further downgradient in the groundwater to the west of the tracer network.

8.3 Comparison of Coliphage Seed and Bromide Tracer Test Results

Rates of Travel

The breakthrough curves shown as Figures 34, 35 and 36 illustrate that the coliphage seed was transported downgradient at least the same rate as the conservative bromide tracer, if not faster. Similar times were required for the main mass of both the coliphage seed and the bromide tracer to arrive at well

WELL M40 BREAKTHROUGH CURVES
MS2, PhiX174 AND BROMIDE

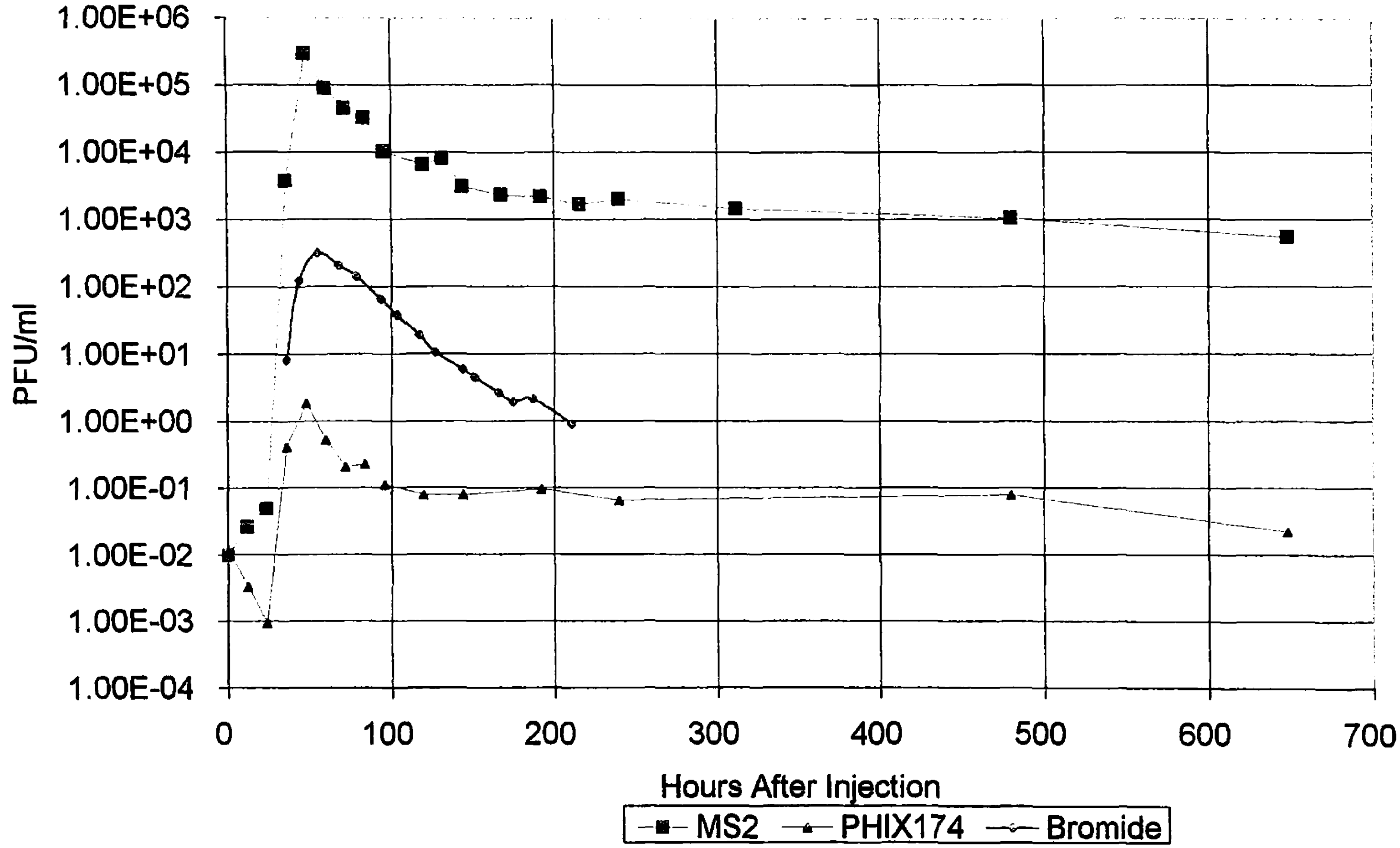


FIGURE 34

WELL M41 BREAKTHROUGH CURVES
MS2, PhiX174 AND BROMIDE

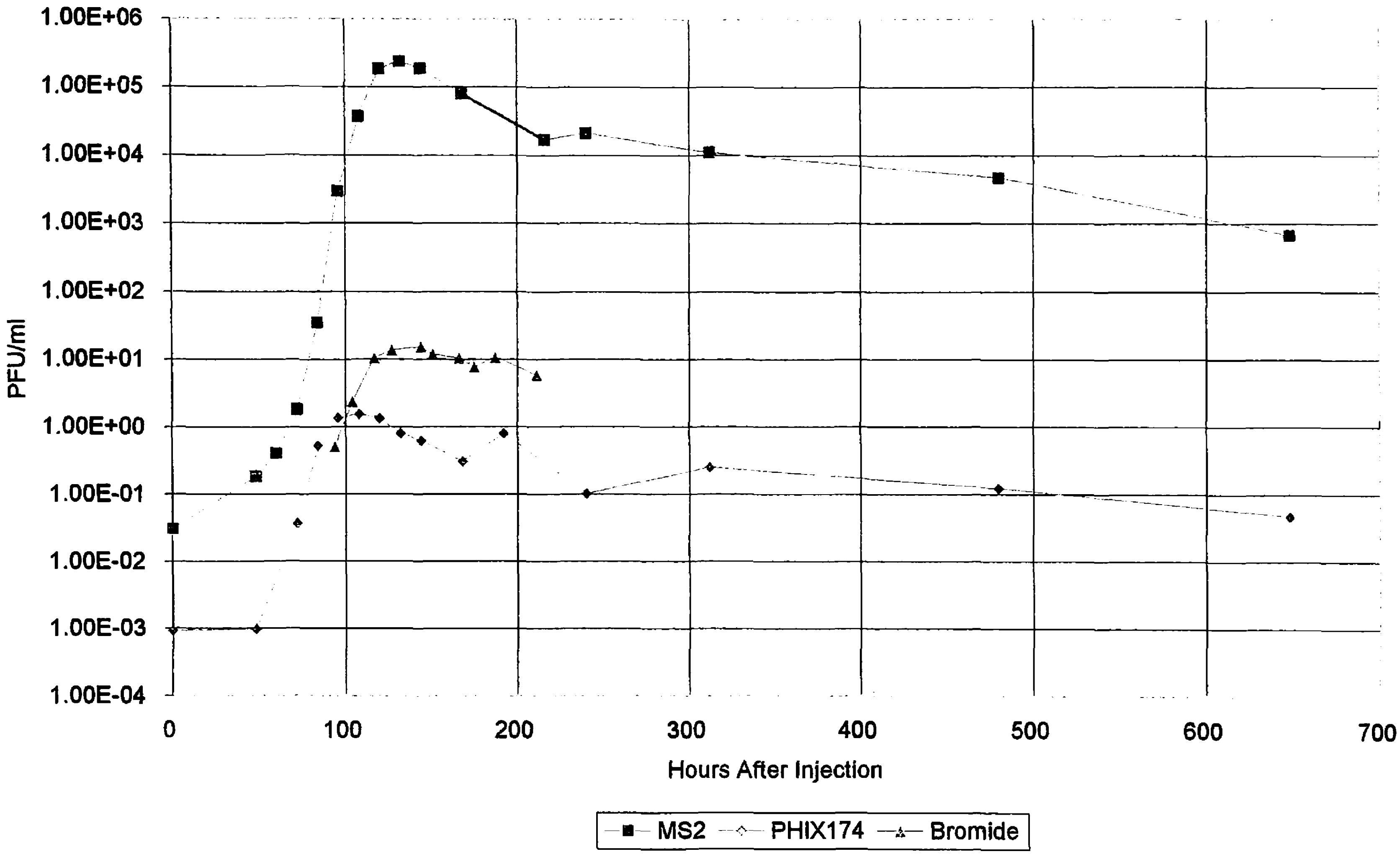


FIGURE 35

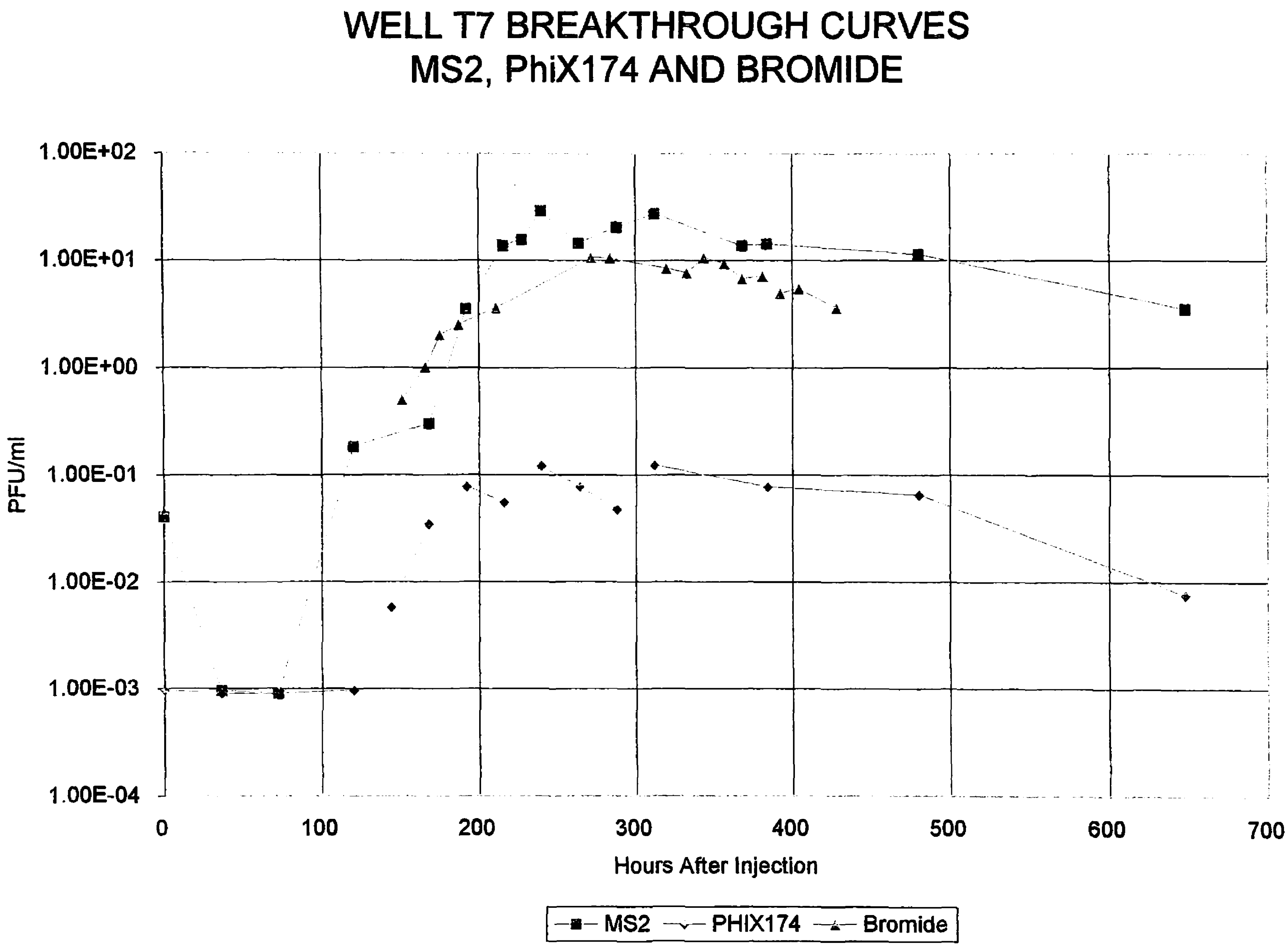

WELL T7 BREAKTHROUGH CURVES
MS2, PhiX174 AND BROMIDE
1.00E+02
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
PFU/ml
0
100
200
300
400
500
600
700
Hours After Injection
MS2
PHIX174
Bromide

FIGURE 36

M40, in Transect 1. At well M41 in Transect 2, it appears that while peak concentrations of MS2 and bromide arrive at approximately the same time, the main mass of PhiX174 arrived several hours earlier. At well T7, in Transect 3, the breakthrough curves are not sharply defined, but it could be argued that peak concentrations of both MS2 and PhiX174 arrived ahead of the bromide slug.

Three possible explanations are offered for the observed results. First, the various "peak" concentrations are all dependent on the sampling interval, and it is probable that the true peak concentration (representing the main mass) for each constituent at each well sampled did not coincide with the collecting of a sample. A more rigorous sampling interval might provide a more accurate assessment of the comparative rates of travel for each of the tracers. Secondly, as was previously mentioned, it is likely that the tracer network was not optimally positioned to intercept the main mass of the tracers, and it is not appropriate to compare the apparent travel times. A third possibility is that the coliphage travel at rates faster than the bromide because their larger size results in a more direct route of travel. However, even if the last explanation were correct, it seems likely that such effects would be overshadowed by the sorptive characteristics of coliphage.

Coliphage Tailing Effect

Analysis of Figures 34, 35 and 36 also reveals that unlike the bromide tracer, the breakthrough curves for both MS2 and ΦX174 exhibited pronounced tailing effects after the peak concentration had occurred. That is, the coliphage concentrations in the groundwater remained elevated once the main mass had moved beyond each of the tracer wells. This phenomenon manifests itself in the injection well (M19) as a slow decrease in coliphage concentrations over time. These concentration tails suggest the coliphage is not acting conservatively, as the bromide does, but are influenced by factors which do not affect the bromide tracer.

As discussed in the Introduction, the transport of viruses is largely controlled by sorption. The tailing effect seen in the breakthrough curves is probably due to the continuous processes of coliphage sorbing to aquifer materials and then desorbing, and being returned to the water column where they continue to be transported within the ground-water flow system.

8.4 Regulatory

As regulators wrestle with the complex issues associated with promulgating water quality standards for viruses in drinking water, a balance needs to be struck between what is acceptable, based on human health considerations, and what can reasonably be done by water providers and users to comply with such a health based standard. The technology to adequately isolate viruses in groundwater is still being developed, and the costs of chlorination (both monetary and potential health risks) precludes setting rigorous treatment guidelines. As explained in the Introduction, under the natural disinfection criteria proposed by the EPA in the Draft Groundwater Disinfection Rule (DGDR), water utilities would be exempted from treatment requirements provided it can be demonstrated that natural disinfection will result in prevention of viral contamination of drinking water supplies.

Based upon the results of this pilot coliphage seeding experiment, it appears that a highly conductive, cold-water aquifer such as is present at the FHS represents a worst case scenario, Viruses introduced into the aquifer system survive for extended periods of time and remain available to be transported in groundwater.

Furthermore, although coliphage can be used to simulate the transport of human enterovirus, they cannot at this time be used as reliable indicators of the presence or absence of infectious virus; coliphage can be detected where human enterovirus cannot, and infectious virus may be present in the absence of coliphage. Regulators may have to adopt coliphage as an indicator of the potential presence of infectious virus for the time being.

9.0 CONCLUSIONS

Based upon observations made during the coliphage seeding experiment, and comparison of those observations with results of the bromide tracer experiment, the following conclusions are made:

1) Seeded coliphage were observed to survive for several months in the cold groundwater conditions present at the FHS site. Laboratory studies verified the low mortality rate of virus.

2) Thirty-three days after seeding, the coliphage seed was detected in the shallow groundwater more than 120 ft downgradient from the injection well. It is likely the coliphage was transported even further, beyond the tracer well network.

3) Within the temporal constraints of the sampling schedule, the coliphage seed appeared to move at the same rate or slightly faster than the conservative bromide tracer over a lateral distance of approximately 57 ft.

4) Unlike bromide, coliphage breakthrough curves exhibited a tailing effect in which concentrations of coliphage remain elevated and slowly decline as the main mass of coliphage moves beyond the well. Tailing effects are believed to represent the process of virus sorption to the aquifer material.

5) Although no human enterovirus were detected in the shallow groundwater in the vicinity of the FHS, the cold-water, highly transmissive characteristics of the shallow groundwater represent a worst case scenario in which viruses introduced into the aquifer can survive for extended periods of time and be transported significant distances from a source.

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APPENDIX A

Septic System Specifications
and
FHS Water Supply Wells
Driller's Logs

WELL LOG REPORT

State law requires that this form be filed by the water well driller within 60 days after completion of the well.

1. WELL OWNER
Name: FRENCHTOWN HIGH SCHOOL

2. CURRENT MAILING ADDRESS
School Dist 40
Frenchtown, MT 59834

3. WELL LOCATION

SW¼ NE ¼ ___ ¼ ___ ¼ : Section 27 34
Township 15 N N/S Range 21 W E/W
County Missoula
Lot ___ Block ___
Subdivision ___
Well Elevation ___
Accuracy: ___ ± 10'; ___ ± 50'; ___ ± 100';

4. DRILLING METHOD ___ cable, ___ bored, x forward rotary, ___ reverse rotary, ___ jetted, other (specify) ___

5. WELL CONSTRUCTION AND COMPLETION

Size of drilled hole	Size and weight of casing	From (feet)	To (feet)	Perforations / Screen: Kind Size	From (feet)	To (feet)
6"	6" ID 17 lb per ft.	+3'9"	177			

Was casing left open end? x Yes ___ No
Was a packer or seal used? ___ Yes x No
If so, what material ___
Was the well gravel packed? ___ Yes x No
Was the well grouted? ___ Yes x No
To what depth? ___
Material used in grouting ___
Well head completion: Pitless adapter ___
12 in. above grade ___, other 3' 9"
(If other, specify) above ground level
Pump horsepower [ ], pump type ___
Pump intake level ___ feet below land surface
Power (electric, diesel, etc.) ___

6. WATER LEVEL
Static water level [11] feet below land surface
If flowing, closed-in pressure ___ psi
___ gpm flow through ___ inch pipe
Controlled by: ___ valve, ___ reducers, ___ other
(If other, specify) ___

7. WELL TEST DATA ___ pump ___ bailer x other
(If other, specify) Air Compressor
Pumping level below land surface:
100 ft. after 1 hrs. pumping [200] gpm
___ ft. after ___ hrs. pumping ___ gpm

8. WAS WELL PLUGGED OR ABANDONED? ___ Yes x No
If yes, how? ___

9. DATE STARTED May 21, 1979
DATE COMPLETED June 13, 1980

10. WELL LOG

Depth (ft.) From	To	Formation
0	3	Sandy Clay
3	17	Sandy Clay, Sand & Gravel
17	23	Sand, Gravel & Water
23	59	Sand & Water
59	76	Tan Clay
76	88	Sand & Water
88	97	Gray Clay
97	122	Sand & Water
122	160	Gray Clay
160	165	Sand & Water
165	174	Sand, Small Gravel & Water
174	177	Gravel, Sand & Water

(use separate sheet if necessary)

11. DRILLER'S CERTIFICATION
This well was drilled under my jurisdiction and this report is true to the best of my knowledge.
June 13, 1980
Date
CAMP WELL DRILLING & PUMP SUPPLY
Firm Name
1522 So. 14th W., Missoula, MT 59801
Address
[signature]
Signature
License No.

MONTANA DEPARTMENT OF NATURAL RESOURCES & CONSERVATION **DNRC**
32 SOUTH EWING HELENA, MONTANA 59601 449-3634

WELL OWNER COPY

Form No. 603 (R 2-89)

WELL LOG REPORT

File No. ____

State law requires that the Bureau's copy be filed by the water well driller within 60 days after completion of the well.

1. WELL OWNER
Name School District 40

2. CURRENT MAILING ADDRESS
P.O. Box 117
Frenchtown, Montana 59834

3. WELL LOCATION
SW ¼ NE ¼ NW ¼ Section 34
Township 15N N/S Range 21W E/W County Missoula
Gov't Lot ____ or Lot ____ Block ____
Subdivision Name ____
Tract Number ____

4. PROPOSED USE: Domestic ☐ Stock ☐ Irrigation ☒
Other ☐ specify ____

5. TYPE OF WORK:
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

6. DIMENSIONS: Diameter of Hole
Dia. 6 in. from 0 ft. to 25¼ ft.
Dia. ____ in. from ____ ft. to ____ ft.
Dia. ____ in. from ____ ft. to ____ ft.

7. CONSTRUCTION DETAILS:
Casing; Steel Dia. 6" from +2¼ ft. to 25¼ ft.
Threaded ☐ Welded ☒ Dia. ____ from ____ ft. to ____ ft.
Type A-53B Wall Thickness .250
Casing; Plastic Dia. ____ from ____ ft. to ____ ft.
Weight ____ Dia. ____ from ____ ft. to ____ ft.
PERFORATIONS: Yes ☐ No ☒
Type of perforator used ____
Size of perforations ____ in. by ____ in.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.
____ perforations from ____ ft. to ____ ft.
SCREENS: Yes ☐ No ☒
Manufacturer's Name ____
Type ____ Model No. ____
Dia. ____ Slot size ____ from ____ ft. to ____ ft.
Dia. ____ Slot size ____ from ____ ft. to ____ ft.
GRAVEL PACKED: Yes ☐ No ☒ Size of gravel ____
Gravel placed from ____ ft. to ____ ft.
GROUTED: To what depth? 18 ft.
Material used in grouting bentonite

8. WELL HEAD COMPLETION:
Pitless Adapter ☐ Yes ☒ No

9. PUMP (if installed)
Manufacturer's name ____
Type ____ Model No. ____ HP ____

10. WELL TEST DATA
The information requested in this section is required for all wells. All depth measurements shall be from the top of the well casing.
All wells under 100 gpm must be tested for a minimum of one hour and provide the following information:
a) Air ____ Pump XX Bailer ____
b) Static water level immediately before testing 10 ft. If flowing; closed-in pressure ____ psi. ____ gpm.
Flow controlled by: ____ valve, ____ reducers, other, (specify) ____
c) Depth at which pump is set for test 20'
d) The pumping rate: 50 gpm.
e) Pumping water level 15 ft. at 1 hrs. after pumping began.
f) Duration of test: Pumping time 1 hrs.
g) Recovery time .1 hrs.
h) Recovery water level ____ ft. at .1 hrs. after pumping stopped.

Wells intended to yield 100 gpm or more shall be tested for a period of 8 hours or more. The test shall follow the development of the well, and shall be conducted continuously at a constant discharge at least as great as the intended appropriation. In addition to the above information, water level data shall be collected and recorded on the Department's "Aquifer Test Data" form.

NOTE: All wells shall be equipped with an access port ½ inch minimum or a pressure gauge that will indicate the shut-in pressure of a flowing well. Removable caps are acceptable as access ports.

11. WAS WELL PLUGGED OR ABANDONED? ____ Yes XX No
If yes, how? ____

12. WELL LOG

Depth (ft.) From	To	Formation
0	1	Topsoil
1	11	Sand, gravel and clay
11	25¼	Sand, gravel and water

ATTACH ADDITIONAL SHEETS IF NECESSARY

13. DATE COMPLETED August 19, 1995

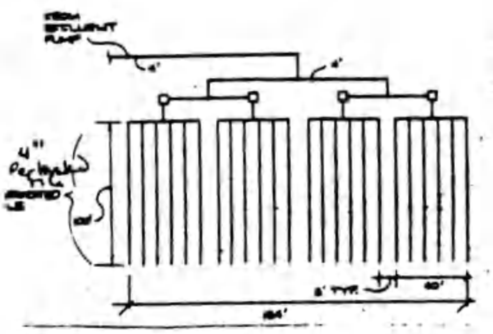
14. DRILLER/CONTRACTOR'S CERTIFICATION
This well was drilled under my jurisdiction and this report is true to the best of my knowledge.

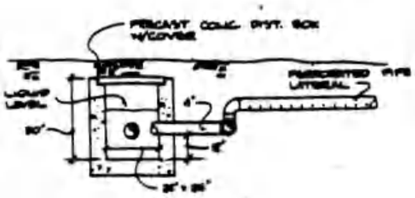
August 29, 1995
Date

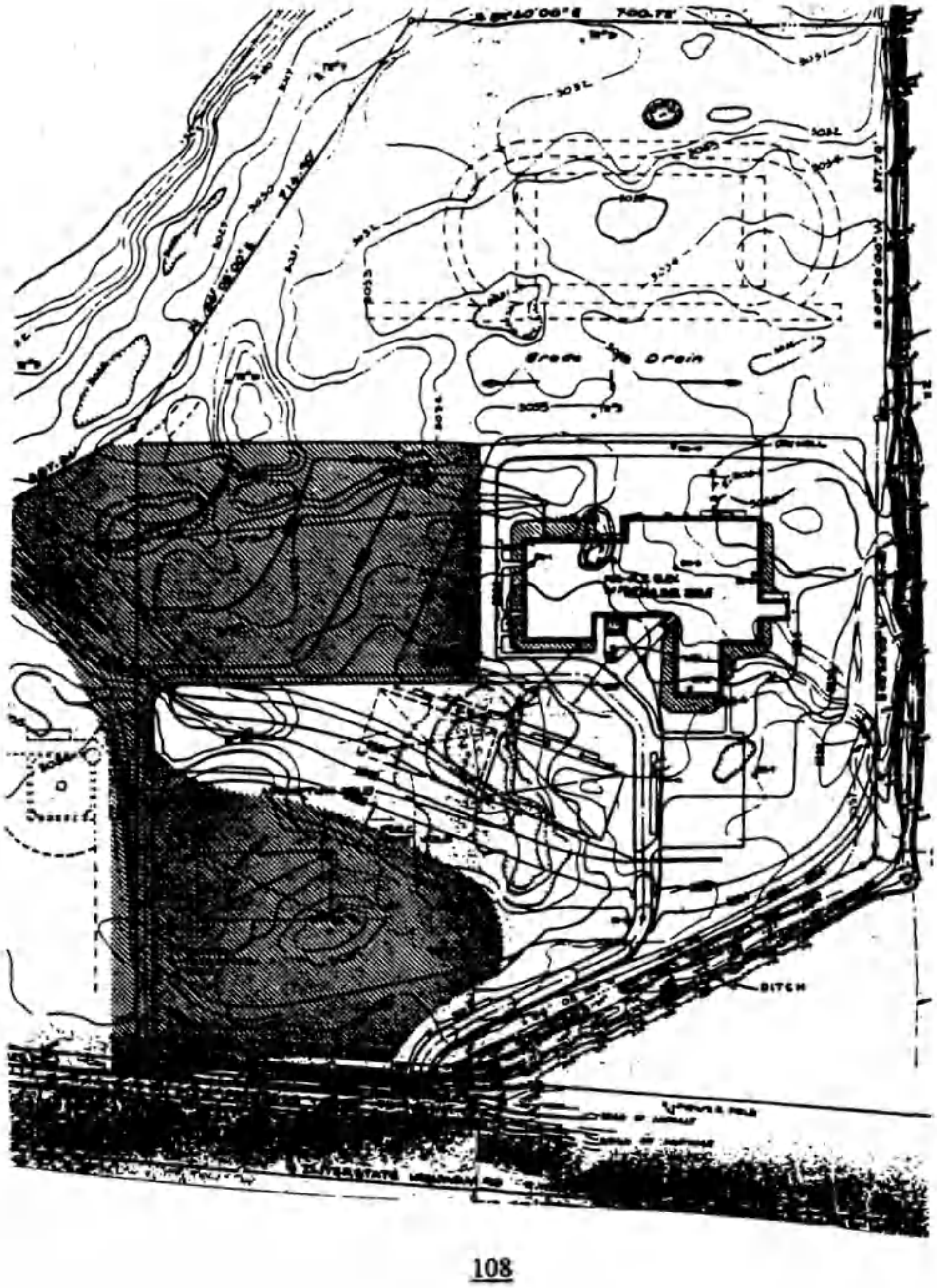
C.K.C. Drilling
Firm Name

10475 Hiway 10 W., Missoula, MT 59802
Address

(signature) 185
Signature License No.






Grade To Drain
DITCH

REINFORCEMENT:

Floor (cast in place) - one mat of #5 rebar 12" a.c.e.w. in lower ½ level

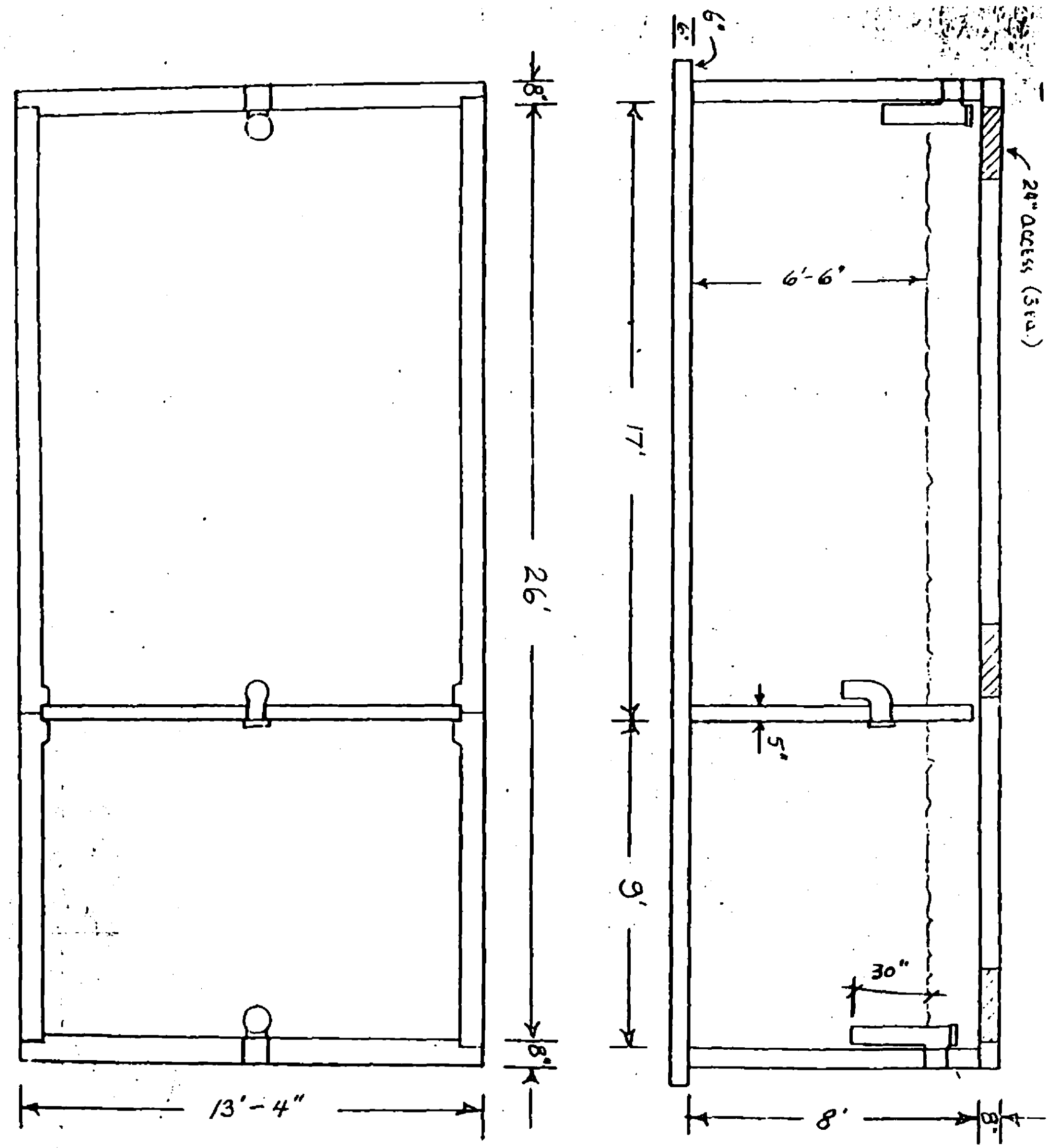
Walls & Roof (precast panels) 2 mats of #5 rebar 12" a.c.e.w. in upper & lower ½ levels of slabs.

Notes:

Panels are keyed together, welded, and sealed with non-shrink grout.

Manhole extensions and bolt down gas tight covers as needed - (not shown)

MISSOULA CONCRETE CONST
BOX 3326 Msla MT 5980
5/15/79 Dick Mozer



ENGINEERING DETAILS - SK75/100

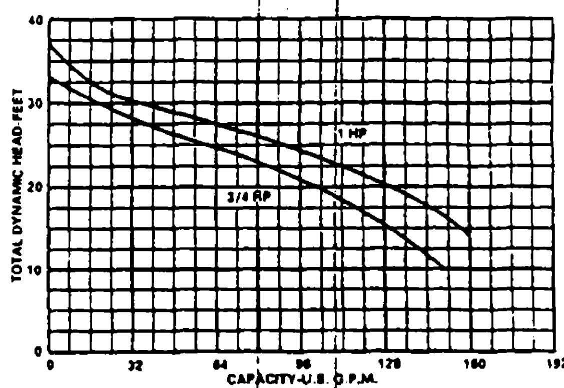
Pump Characteristics

Pump/Motor Unit	Submersible					
Manual Models	M7	M2	M6	M3	M4	M5
Horsepower	3/4					
Full Load Amps	10.4	9.0	4.0	3.5	1.8	1.5
Manual Models	M7	M2	M6	M3	M4	M5
Horsepower	1					
Full Load Amps	11.5	10.0	5.0	4.4	2.2	1.7
Motor Type	Cap.		Three-Phase			
R.P.M.	1750					
Phase Ø	1		3			
Voltage	200	230	200	230	460	575
Hertz	60					
Temperature	140°F Ambient					
[illegible] Design	A					
Insulation	Class A					
Discharge Size	2" NPT std. (3" opt.)					
Solids Handling	2"					
Unit Weight	76 lbs.					
Power Cord	16/3, STWA, 10, 20' std. 16/4, STWA, 30, 20' std.					

Materials of Construction

Handle	Steel
Lubricating Oil	Dielectric Oil
Motor Housing	Cast Iron
Pump Casing	Cast Iron
Shaft	Stainless Steel
Mechanical Shaft Seal	Seal Faces: Carbon/Ceramic Seal Body: Brass Spring: Stainless Steel Bellows: Buna-N
Impeller	Cast Iron
Upper Bearing	Single Row Ball Bearing
[illegible] Bearing	Single Row Ball Bearing
Fasteners	Stainless Steel

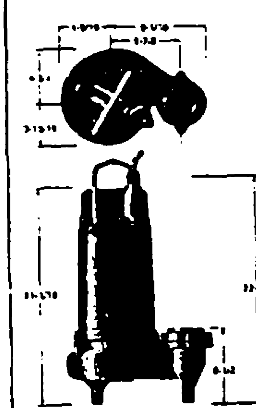
Performance Data



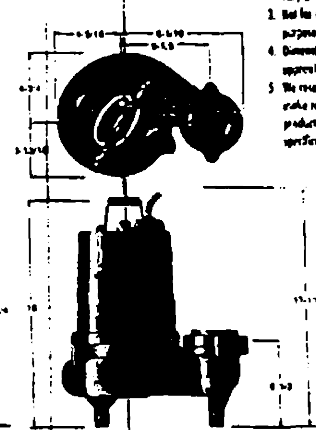
Total Head (feet)		12	16	20	24	28	32	36	38
GPM	3/4 HP	140	124	102	70	33	8	0	-
	1 HP	160	150	129	96	57	19	4	0

Dimensional Data

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]



Single-Phase



Three-Phase

AURORA/HYDROMATIC Pumps, Inc.
1840 Baney Road, Ashland, Ohio 44805
(419) 289-3042

APPENDIX B

Soil Boring Logs

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FIts

DRILLING METHOD:	BORING NO.
Hand auger and drive point	B-1
SAMPLING METHOD:	SHEET 1 of 1
Grab	DRILLING

WATER LEVEL					START TIME	FINISH TIME
TIME					DATE	DATE
DATE					8/19/94	
CASING DEPTH						

DATUM — ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		topsoil
						1		
G			1 / 2.5			2		silty sand, minor small gravels
						3	SM	20% silt, 70% fine to medium sand
						4		10% gravels < 1/2" diameter subrounded to subangular
G			2 / 5			5		AA, decreasing gravel, decreasing silt
						6		
G			3 / 7.5			7		gravelly sand, coarse sand, larger gravel
						8	SP	75% med. coarse sand; 1" diameter subrounded to
						9		25% gravels → subangular
G			4 / 10			10		TD of hand auger = 10' bls (saturated)
						1		2" PVC well installed to 10' bls.
						2		See monitor well construction summary.
						3		M-1
						4		
						5		
						6		
						7		
						8		
						9		
						0		

DRILLING CONTR. None

No215432

BY B Lanman DATE 8/19/94 CHK'D BY

LOCATION OF BORING

JOB NO.	CLIENT	LOCATION
		F14S

DRILLING METHOD: Hand auger and drive point

BORING NO. B-2

SHEET 1 OF 1

SAMPLING METHOD: Grab

DRILLING	START	FINISH
TIME		
DATE	10/10/94	

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM — ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1	SM	silty sand
G			1 / 2.5			2		20% silt, 80% fine to medium sand, primarily fine sand
						3		
						4		
G			2 / 5			5		AD, decreasing silt, increasing coarse sand and pebbles
						6	SP	
G			3 / 7.5			7		AD, increasingly coarse, minor small gravels
						8		TD of hand auger: 8' bls (saturated)
						9		
						10		1.5" PVC well installed to 10.5' bls.
						1		See monitor well construction summary. M-2
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

BY B. Lavernus DATE 10/10/94 CHK'D BY ______

No215432 DRILLING CONTR. Moore

No215432

BY: B. Lowerman DATE: 10/10/94 CHK'D BY:

DRILLING CONTR: None

LOCATION OF BORING

JOB NO.	CLIENT	LOCATION: FHS
DRILLING METHOD: Hand auger and drive point		BORING NO.: B-3
SAMPLING METHOD: Grab		SHEET 1 OF 1

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME		
DATE	10/10/94	

DATUM ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		Tan, silty sand, no gravels
G			1 / 2.5			2	SM	25% silt
						3		75% fine to v. fine sand
						4		fine to coarse sand, minor pebbles, rounded
G			2 / 5			5	SP	poorly sorted, fine to med. sand
						6		
G			3 / 7.5			7		AA, minor subrounded-subangular gravels <1" diameter
						8		TD of hand auger = 8' bls.
						9		(saturated)
						10		1.5" PVC monitor well installed to
						1		10.5' bls.
						2		See monitor well construction summary
						3		M-3
						4		
						5		
						6		
						7		
						8		
						9		
						0		

No215432

BY: B. Lawrence DATE: 10/10/94 CHK'D BY:

DRILLING CONTR.: None

JOB NO.	CLIENT	LOCATION
		FHS

DRILLING METHOD: Hand auger and drive point

BORING NO.: B-4

SHEET: 1 of 1

SAMPLING METHOD: Grab

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME		
DATE	10	10/94

LOCATION OF BORING:

DATUM: ELEVATION:

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		topsoil
						1		
G			1 / 2.5			2	SM	fine sand, minor silt
						3		
						4		AA, increasing silt - silty sand
G			2 / 5			5		
						6		
G			3 / 7.5			7	SP	fine to coarse sand, minor pebbles poorly sorted fine to med. sand
						8		
						9		TD of hand auger = 8' bls. (saturated)
						10		1.5" PVC monitor well installed to
						1		10.5' bls.
						2		see monitor well construction summary
						3		M-4
						4		
						5		
						6		
						7		
						8		
						9		
						0		

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: Hand auger w/ drive point	BORING NO. B-5
	SHEET 1 OF 1
SAMPLING METHOD: Grab	DRILLING
	START / FINISH
WATER LEVEL	TIME / TIME
TIME	
DATE	DATE 10/10/94 / DATE
CASING DEPTH	

DATUM — ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		topsoil
						1		
G			1 / 2.5			2	SM	silty, gravelly sand
						3		poorly sorted 75% fine-med. sand
								20% silt
						4	SP	5% small gravels
G			2 / 5			5		gravelly sand, no silt
						6		85% fine to coarse sand (med)
								15% gravels < 1" subrounded - subangular
G			3 / 7.5			7	SM	finer, no gravels, silty fine sand
						8		
						9		TD of hand auger: 8' bls. (saturated)
						10		1.5" PVC monitor well installed to
						1		10.5' bls.
						2		See monitor well construction summary.
						3		M-5
						4		
						5		
						6		
						7		
						8		
						9		
						0		

BY B. Lawrence DATE 10/10/94 CHK'D BY ______ DRILLING CONTR. None

№215432

No215432

BY B. Lawrence DATE 10/25/94 CHK'D BY

DRILLING CONTR. None

LOCATION OF BORING

JOB NO.	CLIENT	LOCATION
		FHS

DRILLING METHOD: Hand auger and drive point	BORING NO. B-6
	SHEET 1 of 1
SAMPLING METHOD: Grab	DRILLING
	START TIME - / FINISH TIME

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING START DATE	DRILLING FINISH DATE
10	25/94

DATUM

ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		
G			1 / 2.5			2	SP	gravelly sand
						3		80% + fine to coarse (med) sand; 20% gravels
						4		<1" diameter; subrounded - subangular
G			2 / 5			5		AA, gravels larger
						6		
						7		gravelly sand or sandy gravel
G			3 / 7.5			8		nearly = parts med. - coarse sand w/
						9	SP	gravels 1" diameter, subrounded
G			4 / 10			10		Sandy gravel, 70% gravel 2" diameter rounded to subrounded, stratified; 30% med - coarse sand
						1		
						2		TD of hand auger 11' bls.
						3		2" PVC monitor well installed to
						4		10.2' bls.
						5		See monitor well construction summary
						6		M-6
						7		
						8		
						9		
						0		

No215432

BY: B. Lawerman

DATE: 10/25/94 CHK'D BY:

DRILLING CONTR.: None

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD:	Hand auger and drive point
BORING NO.	B-7
SHEET	1 of 1
SAMPLING METHOD:	Grab
WATER LEVEL	
TIME	
DATE	
CASING DEPTH	
DRILLING START TIME	
DRILLING FINISH TIME	
DRILLING START DATE	10/25/94
DRILLING FINISH DATE	
DATUM	
ELEVATION	

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		topsoil
						1		
G			1 / 2.5			2	SM	Sandy silt, 80% silt, 20% fine - v. fine sand
						3		
						4		
G			2 / 5			5		fine to medium sand, no silt, poorly sorted
						6		
G			3 / 7.5			7		Sandy silt, as at 2.5'
						8	SW	
						9		medium sand, no silt
G			4 / 10			10		(saturated)
						1		TD of hand auger = 10.5' bls
						2		2" PVC monitor well installed to
						3		11' bls.
						4		See monitor well construction summary
						5		M-7
						6		
						7		
						8		
						9		
						0		

No215432

BY B. Lueemar DATE 10/25/94 CHK'D BY

DRILLING CONTR. None

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			F1+S
	DRILLING METHOD: Hand auger and drive point		BORING NO. B-8
			SHEET 1 of 1
	SAMPLING METHOD: Grab		DRILLING
			START TIME / FINISH TIME
	WATER LEVEL / TIME / DATE / CASING DEPTH		DATE 10/25/94 / DATE
DATUM	ELEVATION		

SURFACE CONDITIONS: grassy Field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	
						0		topsoil
						1		
G			1 / 2.5			2	SM	silty, gravelly sand possibly not native (from drainfield construction) poorly sorted
						3		
						4		
G			2 / 5			5		Sandy silt, silt, minor v. fine sand
						6		
						7		Sandy silt, fine - v. fine sand, minor silt
G			3 / 7.5			8		
						9		Sand v-fine to medium sand (fine)
G			4 / 10			10		(Saturated)
						1		TD of hand auger = 11' bls
						2		2" PVC monitor well installed to
						3		12.2' bls.
						4		See monitor well construction summary
						5		M-8
						6		
						7		
						8		
						9		
						0		

No215432

BY: B Laverne (?) DATE: 10/25/94 CHK'D BY:

DRILLING CONTR.: none

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: Hand auger and drive point

BORING NO.: B-9

SHEET: 1 of 1

SAMPLING METHOD: Grab

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME		
DATE	10/25/94	

DATUM:

ELEVATION:

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		topsoil
						1		poorly sorted silty gravels and sand
G			1 / 2.5			2		(possibly drainfield material)
						3		Sandy silt, mostly silt, minor v. fine sand
						4		
G			2 / 5			5	SM	AA, increasing fine sand
						6		
G			3 / 7.5			7		AA, " " "
						8		
						9		
G			4 / 10			10	SP	Gravelly sand, 85% med. to coarse sand, 15% gravels, subrounded (?), 1-2" diameter
						1		(saturated)
						2		TD of hand auger = 11' bls
						3		2" PVC Monitor well installed to
						4		12.5' bls
						5		See monitor well construction summary
						6		M-9
						7		
						8		
						9		
						0		

No215432

BY: B Laverman   DATE: 10/25/94   CHK'D BY:

DRILLING CONTR.: none

LOCATION OF BORING:

JOB NO.:   CLIENT: LOCATION: FHS

DRILLING METHOD: Hand Auger and drive point

BORING NO.: B-10

SHEET: 1 of 1

SAMPLING METHOD: Grab

DRILLING START: TIME: / DATE: 10/25/94 — FINISH: TIME: / DATE:

WATER LEVEL / TIME / DATE / CASING DEPTH:

DATUM: ELEVATION:

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		topsoil
						1		
G			1 / 2.5			2		silty sand, minor pebbles
						3	SM	
						4		
G			2 / 5			5		AA, increasing v fine - fine sand)
						6		
G			3 / 7.5			7		AA, silty
						8		80%
						9	SP	Gravelly sand, fine to coarse sand (md) 20% gravel 1-2" diameter
G			4 / 10			10		TD of hand auger = 10' bls
						1		(saturated)
						2		2" PVC monitor well installed
						3		to 10.3' bls
						4		see monitor well construction summary
						5		M-10
						6		
						7		
						8		
						9		
						0		

By: B. Lowerman Date: 8/27/94 Chk'd by:

No215432 Drilling Contr: None

Location of Boring	Job No.	Client	Location
			FHS

Boring No.: P-1

Sheet: 1 of 1

Drilling Method: Hand auger to 8'; Driven pipe to 19.5'

Sampling Method: grab

Drilling — Start Time: / Finish Time:

Date: / Date: 8/27/94

Water Level: / Time: / Date: / Casing Depth:

Datum: Elevation:

Surface Conditions: grassy field

Sampler Type	Inches Driven / Inches Recovered	Depth of Casing	Sample No. / Sample Depth	Blows/ft Sampler	Number of Rings	Depth in Feet	Soil Graph	Description
						0		Topsoil
						1		
G			1 / 2.5			2		tan, fine to medium sand, mostly fine sand
						3		
						4	SM	
G			2 / 5			5		fine sand, moderately sorted
						6		
						7		v fine sand, well sorted
G			3 / 7.5			8		TD of hand auger, saturated
						9		
						10		
						11		No samples collected past depth of 7.5'. Use jackhammer to drive 3/4" galvanized steel to TD = 19.5'. 6" stickup. Open-ended piezometer.
						12		
						13		
						14		
						15		
						16		
						17		
						18		
						19		T.D. of piezometer
						20		

BY: B Laverman DATE: 8/27/94 CHK'D BY:

No215432 DRILLING CONTR.: None

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: Hand auger to 8'; Driven pipe to 19.5

BORING NO.: P-2

SHEET: 1 OF 1

SAMPLING METHOD: Grab

DRILLING START TIME: — FINISH TIME: —

DATE: 8/27/94

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM: ELEVATION:

SURFACE CONDITIONS: Grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		
G			1 / 2.5			2	SM	gravelly sand, 75% fine to coarse sand, predominantly medium sand
						3		
						4		25% gravels < 1" diameter sub rounded to subangular
G			2 / 5			5		AB, decreasing gravel
						6		
						7		AB, gravel increasing again
G			3 / 7.5			8		T.D. of hand auger, saturated
						9		
						10		No soil samples collected
						1		below 7.5' Use jackhammer
						2		to advance 3/4" galvanized steel
						3		to TD: 19.5'. 6" stickup
						4		open-ended piezometer
						5		
						6		
						7		
						8		
						9		
						20		

BY: B. Lawerman DATE: 8/27/94 CHK'D BY:

No215432 DRILLING CONTR.: None

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			F148

DRILLING METHOD: Hand auger to 8' / Driven Steel to 19.5'

BORING NO.: P-3

SHEET: 1 of 1

SAMPLING METHOD: Grab

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME		
DATE	8/27/94	

DATUM ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		topsoil
						1		
G			1 / 2.5			2		silty sand, silt and v. fine sand
						3		
						4	SM	
G			2 / 5			5		AA, medium to coarse sand
						6		
G			3 / 7.5			7		AA, medium sand, minor small gravels
						8		TD. of hand auger (saturated)
						9		No samples collected below depth
						10		of 8'. Use jackhammer to advance
						1		3/4" galvanized steel to TD = 19.5'.
						2		6" stickup
						3		Open-ended piezometer.
						4		
						5		
						6		
						7		
						8		
						9		TD of piezometer
						20		

No 215432

DRILLING CONTR.: None

BY: B. Lawrence DATE: 8/27/94 CHK'D BY:

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION: F14S

DRILLING METHOD: Hand auger to 8'; Driven steel to 19.5'

SAMPLING METHOD: Grab

BORING NO.: P-4

SHEET: 1 of 1

DRILLING	START	FINISH
TIME		
DATE	8/27/94	

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM: | ELEVATION:

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Top soil
						1		Silty sand, minor gravel
G			1 / 2.5			2		25% silt, 70% fine to medium sand, <5% fine gravel < 1/2" diameter subrounded to subangular
						3		
						4	SM	AA, decreasing silt, sand finer
G			2 / 5			5		
						6		AA, some silt, and increased coarse sand
G			3 / 7.5			7		
						8		T.D. of hand auger (saturated)
						9		No soil samples collected below
						10		depth of 8'. Jackhammer used
						1		to advance 1 1/4" galvanized steel to
						2		TD = 19.5'
						3		Open-ended piezometer
						4		
						5		
						6		
						7		
						8		
						9		TD of piezometer
						20		

BY: B [illegible] DATE: 1-27-95 CHK'D BY:

No215432 DRILLING CONTR.: O'Keefe, Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD:	8" HS Auger
SAMPLING METHOD:	Grab
BORING NO.	M-11
SHEET	1 OF 1
DRILLING START DATE	1/27/95
DRILLING FINISH DATE	

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM: ELEVATION:

SURFACE CONDITIONS: Grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		
						2		
						3		
						4	SM	
G			1 / 5			5		Gravelly Sand, 80% fine to coarse sand, predominantly med. sand; 20% gravel ≤ 1" diameter, subrounded to subangular
						6		
						7		
						8		gravel encountered
						9	SP	
G			2 / 10			10		Sandy gravel, 60% coarse gravel, 1-2" diameter, subr to sub[illegible]; 40% fine to coarse sand
						1		
						2	▽	
						3		
						4	GM	
G			3 / 15			15	GP	AA, decreasing sand (wet)
						6		
						7		
						8		TD = 18'
						9		2" PVC Monitor Well Installed
						0		

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD:	BORING NO.
8" H.S. Auger	M-12
SAMPLING METHOD:	SHEET 1 OF 1
Grab	DRILLING

WATER LEVEL					START TIME	FINISH TIME
TIME						
DATE					DATE	DATE 1/27/95
CASING DEPTH						

DATUM ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		
G			1 / 2.5			2		Hit septic drainfield lateral. Sch 20 PVC drainfield in coarse 2-3" d. subangular gravels
						3		
						4		
G			2 / 5			5		Silty sand, minor gravels 20% silt
						6	SP	80% fine to coarse sand (med) minor small gravels and pebbles rounded to subrounded
						7		
						8		Clean sand - medium
						9		
G			3 / 10			10		Sandy gravel 50% gravels 1" diam. subrounded to subangular 50% fine to coarse sand
						1		
						2		
						3		
						4		
G			4 / 15			15	GP	As, decreasing sand, (wet)
						6		
						7		
						8		TD = 18'
						9		2" PVC Monitor Well Installed
						0		

DRILLING CONTR. O'Keefe Butte, MT

No215432

BY B Lawrence DATE 1/27/95 CHK'D BY

No215432

DRILLING CONTR. O'Keefe Butte, MT

BY B. Levering CHK'D BY

DATE 1/27/95

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: 8" H.S. Auger

BORING NO. M-13

SAMPLING METHOD: Grab

SHEET 1 OF 1

DRILLING	START	FINISH
TIME		
DATE	1/27/95	

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM

ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Top soil
						1		
						2		
						3		
						4		
G			1/5			5	SM	Silty sand, minor pebbles and gravels
						6		20% silt
						7		70% fine to coarse sand predominantly med. sand
						8		10% gravels and pebbles <1" diam rounded to subangular
						9		
G			2/10			10	SP	Sandy gravel
						1		60% gravel 1-2" diam. subangular to subrounded
						2		40% fine to coarse sand
						3		
						4		
G			3/15			15	GP	AA, decreasing sand. (wet)
						6		
						7		
						8		TD = 18'
						9		2" PVC Monitor Well Installed
						0		

No215432

DRILLING CONTR. O'Keefe
Butte, MT

BY B. L[illegible] DATE 1/27/95 CHK'D BY

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: 8" HS Auger

BORING NO. M-14

SHEET 1 OF 1

SAMPLING METHOD: Grab

DRILLING: START TIME / FINISH TIME; DATE 1/27/95 / DATE

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM

ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		top soil
						1		
						2		
						3		
						4		
G			1 / 5			5		gravelly sand, moist, 30% fine to coarse sand
						6	SP	20% gravels 1-1.5" diameter subrounded to subangular
						7		
						8		
						9		
G			2 / 10			10	GP	Sandy gravel 70% gravels 2"+ diameter rounded to subangular
						1		30% medium to coarse sand
						2	▽	
						3		
						4		
G			3 / 15			15	GP	A/A, sandy gravel (wet)
						6		
						7		
						8		TD = 18'
						9		2" PVC Monitor Well Installed
						0		

BY B. Lauerman DATE 1/27/95 CHK'D BY

No215432 DRILLING CONTR O'Keefe Butte, MT

LOCATION OF BORING

JOB NO.	CLIENT	LOCATION FH8

DRILLING METHOD: 8" H.S. Auger	BORING NO. M-15
	SHEET 1 of 1
SAMPLING METHOD: Grab	DRILLING
	START TIME / FINISH TIME
WATER LEVEL	
TIME	
DATE	DATE 1/27/95 / DATE
CASING DEPTH	

DATUM ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		silty loam
						2		
						3		
						4		
G			1 / 5			5	SM	Silty Sand, minor pebbles
						6		70% fine to medium sand 30% silt and fine sand
						7		minor pebbles, < 1" diameter rounded to subrounded
						8	SP	clean sand
						9		
G			2 / 10			10	GP	Sandy gravels 60-70% gravels
						1		1-2" diameter, subrounded to subangular
						2	▽	30-40% medium to coarse sand
						3		
						4		
G			3 / 15			15	GP	As above, decreasing sand (wet)
						6		
						7		
						18		
						9		TD = 18'
						0		2" PVC Monitor Well Installed

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: 8" H.S. Auger	BORING NO. M-16
	SHEET 1 of 1
SAMPLING METHOD: Grab	DRILLING

					START	FINISH
WATER LEVEL					TIME	TIME
TIME						
DATE					DATE	DATE
CASING DEPTH					1/27/95	

DATUM ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Top soil
						1		
						2		Septic drainfield encountered 4" SCH 20 PVC located in 2-3" gravels
G			1 / 2.5			3		
						4		
G			2 / 5			5		gravelly silts and sand
						6	SP	60% sand fine to coarse; 20-30% silt; 10-20% gravels, small ≤1" diameter rounded to subangular
						7		
						8		
						9		
G			3 / 10			10	GP	Sandy gravel. 60-70% gravels ≤2" diameter, poorly sorted
						11		
						12	▽	30-40% fine to coarse sand, predom. med. sand
						13		
						14		
G			4 / 15			15	GP	A/A, sandy gravel, (wet)
						16		
						17		
						18		TD = 18'
						19		2" PVC Monitor Well Installed
						20		

DRILLING CONTR. ___ Butte, MT

N02154327

BY D. Lawrence DATE 1/27/95 CHK'D BY

No215432

BY: B. Lawrman   DATE: 1/27/95   CHK'D BY:

DRILLING CONTR.: O'Keefe

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			F145

DRILLING METHOD:	8" H.S. Auger
SAMPLING METHOD:	Grab
BORING NO.	M-17
SHEET	1 of 1
DRILLING START DATE	1/27/95

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM | ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLE NO. / SAMPLE DEPTH	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
	0		
	1		topsoil and fill black silty (brown)
	2		non-native
	3		
	4		
1 / 5	5	SM	Silty sand minor pebbles
	6	SM	(60% sand) fine to coarse; 30-40% silt; minor small granules and pebbles ≤1"; subangular to rounded, poorly sorted
	7		
	8		
	9		
2 / 10	10	GP	Sandy gravel.
	11	GP	60% + angular 1-2" diameter, subangular to subrounded
	12	▽	40% sand fine to coarse (med)
	13		
	14		
3 / 15	15	GP	AA, decreasing sand (wet)
	16		
	17		
	18		
	19		TD ≈ 18'
	20		2" PVC Monitor Well Installed

BY: [illegible] DATE: 1/27/95 CHK'D BY: ______

No 2154327

DRILLING CONTR.: [illegible] Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION: FH,S
	DRILLING METHOD: 8" H.S. Auger		BORING NO. M-18
	SAMPLING METHOD: Grab		SHEET 1 of 1
	WATER LEVEL / TIME / DATE / CASING DEPTH		DRILLING START / FINISH — DATE 1/27/95
DATUM	ELEVATION		

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		
						1		black silty loam
						2		fill and topsoil - non native soils
						3		
						4		
G			1 / 5			5		silty sand -
						6	SM	85% medium to coarse sand, minor silt, <15%
						7		
						8		
						9		
G			2 / 10			10		Sandy gravel — 60% gravel ~1" diam, subangular to subrounded
						1	GP	
						2	▽	40% fine to coarse sand
						3		
						4		
G			3 / 15			15	GP	AA, decreasing sand (wet)
						6		
						7		
						8		
						9		TD: 18'
						0		2" PVC Monitor Well Installed

BY: B. Lauerman DATE: 1/27/95 CHK'D BY:

No215432

DRILLING CONTR.: O'Keefe, Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION: FHS
	DRILLING METHOD: 8" H.S. Auger		BORING NO.: M-19
	SAMPLING METHOD: Grab		SHEET 1 OF 1
	WATER LEVEL / TIME / DATE / CASING DEPTH		DRILLING START TIME / FINISH TIME / DATE 1/27/95 / DATE

DATUM: ELEVATION:

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		Sandy loam and silt
						2		
						3		
						4		
G			1 / 5			5	SM	Sand, minor silt
						6		Nearly 100% fine to medium sand, (predominantly fine)
						7		
						8		gravels encountered
						9		
G			2 / 10			10	GP	Sandy gravels
						1		60+% gravels <1" - 2" diameter
						2		poorly sorted, rounded to subangular
						3		30% (fine) to medium sand
						4		
G			3 / 15			15	GP	A/A, sandy gravels (wet)
						6		
						7		
						18		TD = 18'
						9		2" PVC Monitor Well Installed
						0		

BY: D. Lovermor   DATE: 1/27/95   CHK'D BY:

No215432   DRILLING CONTR.: O'Keefe, Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD:	BORING NO.
3" H.S. Auger	M-20
	SHEET: 1 of 1
SAMPLING METHOD: grab	DRILLING

WATER LEVEL					START TIME	FINISH TIME
TIME						
DATE					DATE	DATE
CASING DEPTH					1/27/95	

DATUM   ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		silty sand, loam w/ granules
						2		fill ?
						3		
						4		
G			1 / 5			5		Silty sand, minor pebbles
						6	SM	70-80% fine to medium sand; 20-30% silt
						7		minor rounded to subrounded pebbles
						8		granules encountered
						9		
G			2 / 10			10	GP	Sandy gravel
						1		60-70% gravels <1" to 2" d. subangular to subrounded
						2	▽	30-40% fine to coarse, predominantly med to coarse sand
						3		
						4		
G			3 / 15			15	GP	A/A, decreasing sand. (Wet)
						6		
						7		
						18		TD = 18'
						9		2" PVC Monitor Well Installed
						0		

No215432

BY: B. Lawrence DATE: 1/27/95 CHK'D BY:

DRILLING CONTR: O'Keefe, Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION: FHS

DRILLING METHOD: 8" HS Auger

BORING NO.: M-21

SHEET: 1 of 1

SAMPLING METHOD: Grab

DRILLING START DATE: 1/27/95

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM / ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	SAMPLE NO. / SAMPLE DEPTH	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
		0		Topsoil
		1		Silty sandy loam - black, minor gravels
		2		
		3		fill? non-native
		4		
G	1 / 5	5	SM	Silty sand, 70% sand, fine to med, 30% silt
		6		
		7		AA
		8		
		9	GP	
G	2 / 10	10		Gravelly sand 80% med - coarse sand, 20% gravels 1-2" d subrounded to subangular
		1		
		2		
		3		
		4	GP	
G	3 / 15	15		Sandy gravel 60% gravel AA, 30-40% sand, med-coarse (wet)
		6		
		7		
		18		TD: 18'
		9		2" PVC Monitor Well Installed
		0		

No215432

Drilling Cont'r: O'Keefe, Butte, MT

By: [illegible] Date: 1/27/95 Chk'd by:

Location of Boring	Job No.	Client	Location: FHS
	Drilling Method: 9" H.S. Auger		Boring No.: M-22
			Sheet: 1 of 1
	Sampling Method: Grab		Drilling Start / Finish
	Water Level / Time / Date / Casing Depth		Date: 1/27/95
Datum	Elevation		

Surface Conditions: grassy field

Sampler Type	Inches Driven / Inches Recovered	Depth of Casing	Sample No. / Sample Depth	Blows/Ft Sampler	Number of Rings	Depth in Feet	Soil Graph	Description
						0		Topsoil
						1		
						2		Septic line trench encountered. Broken rock, large gravels at 2' with septic odor
						3		
						4		
G			1 / 5			5		Silty sand 50-60% fine sand, 40-50% silt
						6	SM	
						7		AA
						8		
						9		Gravelly sand 80% med to coarse sand, 20-25% gravels 1-2" diameter, sub angular to sub rounded
G			2 / 10			10	GP	
						1		
						2	▽	
						3		
						4		
G			3 / 15			15	GP	Sandy gravel 60-70% gravel, AA
						6		(wet) 30-40% med to coarse sand
						7		
						18		TD = 18'
						9		2" PVC Monitor Well Installed
						0		

No215432

BY: IS Loverman DATE: 1/28/95 CHK'D BY:

DRILLING CONTR: O'Keefe, Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: H.S. Auger

BORING NO.: M-23

SHEET: 1 of 1

SAMPLING METHOD: Grab

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	
START	FINISH
TIME	TIME
DATE	DATE
1/28/95	

DATUM: ELEVATION:

SURFACE CONDITIONS: grassy field - W side, elevated

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Top soil
						1		
						2		2" PVC monitor well installed.
						3		
						4		
						5		
						6		
						7	SP	
						8		
						9		
G			1 / 10			10		silty, gravelly sand 60% v. fine sand 30% silt 10% small gravels and pebbles
						1		
						2		
						3	▽	
						4		
G			2 / 15			15		AA, silt, sand and gravel, wet
						6		
						7		
						8	GP	~~TD = 20'~~
						9		silty, sandy gravels, fine-med sand
G			3 / 20			20		large gravels 1-2" diameter, subangular

LOCATION OF BORING

JOB NO.	CLIENT	LOCATION: FHS

DRILLING METHOD: 8" H.S. Auger

BORING NO.: M-24

SHEET 1 OF 1

SAMPLING METHOD: Grab

DRILLING START / FINISH — TIME / TIME — DATE / DATE: 1/28/95

WATER LEVEL / TIME / DATE / CASING DEPTH

DATUM ELEVATION

DRILLING CONTR. O'Keefe, Butte, MT

N0215432

BY: JS Lawrence DATE: 1/28/95 CHK'D BY

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Top soil
						1		
						2		
						3		
						4		
G			1 / 5			5		Sand, minor silt and pebbles
						6		
						7	SP	
						8		
						9		
G			2 / 10			10		Clean sand, v. fine to fine sand
						1		
						2	▽	
						3		wet
						4		
G			3 / 15			15		gravelly sand 70% fine - med sand
						6	SP	30% gravels < 1" diameter subrounded
						7		
						18		TD: 18'
						9	GP	
						0		2" PVC Monitor well installed.

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

BORING NO. M-25

SHEET 1 of 1

DRILLING METHOD: 8" H.S. Auger

SAMPLING METHOD: Grab

DRILLING START DATE: 1/28/95

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM — ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		
						2		
						3		
						4		
G			1 / 5			5	SM	sand - v. fine to medium sand (med) minor silt
						6		
						7		
						8		
						9		
G			2 / 10			10	SP	AB, minor pebbles and gravels <1" d.
						1		
						2		
						3		
						4		
G			3 / 15			15	GP	Sandy gravels, wet 40% fine to coarse sand 60% gravels 2" diameter rounded to subrounded
						6		
						7		
						8		TD = 18'
						9		
						0		2" PVC monitor well installed

DRILLING CONTR O'Keefe Butte, MT

No2154321

BY B. Lauerman DATE 1/28/95 CHK'D BY

[redacted]

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FItS

DRILLING METHOD: 8" H.S. Auger	BORING NO. M26
	SHEET 1 OF 1
SAMPLING METHOD: Grab	DRILLING

					START TIME	FINISH TIME
WATER LEVEL						
TIME					0840	0910
DATE					DATE	DATE
CASING DEPTH					1/28/95	

DATUM — ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		topsoil Silt, brown dry
						1		
						2		
						3		
						4		
G			1 / 5			5	SM	Silty sands
								90% fine to v. fine sand (fine)
						6		10% + silt
						7		
						8		
						9		Gravels encountered
								Sand and gravel
G			2 / 10			10	GP	50/50 fine to medium sand and
						1		gravels 1/4 - 2" diam
						2		
						3		
						4		
G			3 / 15			15	GP	Sandy gravel, wet
								70% coarse gravels 1/2 - 1 1/2" subrounded
						6		30% fine to med. sand to rounded
						17		
						8		TD: 17'
						9		2" PVC well installed
						0		

DRILLING CONTR O'Keefe Butte, MT

No215439

BY: B. Lauerman DATE 1/28/95 CHK'D BY

BY: B. Lawerman DATE: 1/28/95 CHK'D BY:

No215432 DRILLING CONTR: O'Keefe, Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FITS

DRILLING METHOD:	BORING NO.
8" H.S. Auger	M-27
SAMPLING METHOD:	SHEET
Grab	1 of 1

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DRILLING	
START	FINISH
TIME	TIME
DATE	DATE
1/28/95	

DATUM ELEVATION

SURFACE CONDITIONS: grassy Field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		
						2		
						3		
						4	SM	
G			1 / 5			5		Silty sand 90% fine-med sand (fine)
						6		10% silt
						7		
						8		
						9		
G			2 / 10			10	SP	gravelly sand 75% fine to med. sand
						1		25% small gravels <1 diameter rounded to subrounded)
						2		
						3	▽	
						4	GP	
G			3 / 15			15		Sandy gravels, wet 60% coarse gravels 1-2" diameter subrounded)
						6		
						7		
						8		40% fine to coarse sand (medium)
						9		TD = 18'
						0		2" PVC Monitor Well Installed

No215432

DRILLING CONTR. O'Keefe, Butte, MT

BY B. Lauerman DATE 1/28/95 CHK'D BY

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION: FH5
	DRILLING METHOD: 8" H.S. Auger		BORING NO. M-28
	SAMPLING METHOD: Grab		SHEET 1 OF 1
	WATER LEVEL / TIME / DATE / CASING DEPTH		DRILLING START DATE 1/28/95

DATUM / ELEVATION

SURFACE CONDITIONS: grassy field W. side - elevated

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Topsoil
						1		
						2		2" PVC monitor well installed
						3		
						4		
						5		
						6		
						7		
						8	SP	
						9		
G			1 / 10			10		Gravelly sand 75% fine to medium sand 25% small subrounded - subangular gravels <1" diameter
						1		
						2		
						3		
						4	▽	
G			2 / 15			15		AA, increasing gravels, wet larger diameter gravels
						6		
						7	GP	
						8		
						9		AA, sandy gravel - gravelly sands
G			3 / 20			20		TD = 20'

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: 8" H S Auger	BORING NO. M-29
SAMPLING METHOD: Grab	SHEET 1 OF 1
WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME / FINISH TIME; DATE 1/28/95

DATUM ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Top soil
						1		
						2		
						3		
						4		
G			1 / 5			5	SP	Gravelly sand,
						6		80% fine to medium sand; 20% subrounded gravels <1" d.
						7		
						8		
						9		
G			2 / 10			10		AA, gravelly sand
						1		
						2		
						3		
						4		AA, increasing gravels, wet
G			3 / 15			15	GP	gravelly sand / sandy gravels
						6		gravels increasing in size
						7		
						8		
						9		TD = 18'
						20		2" PVC Monitor well installed

No215432 DRILLING CONTR. O'Keefe Butte, MT

BY K Lemmon DATE 1/28/95 CHK'D BY

No215432

BY: B Lawerman DATE: 1/28/95 CHK'D BY:

DRILLING CONTR.: O'Keefe, Butte, MT

LOCATION OF BORING:

JOB NO.	CLIENT	LOCATION

DRILLING METHOD: 8" H.S. Auger

SAMPLING METHOD: Grab

BORING NO.: M-30

SHEET: 1 of 1

DRILLING — START: DATE 1/28/95; FINISH: DATE

WATER LEVEL / TIME / DATE / CASING DEPTH:

DATUM: ELEVATION:

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Top soil
G			1 / 5			5	SP	Gravelly Sand, 85% fine to medium sand, 15% subrounded gravels 1-2" d.
G			2 / 10			10	SP	AA, gravelly sand, coarser
						13	▽	
G			3 / 15			15	GP	Sandy gravels, wet, 70% gravels, AA, 30% fine to med. sand
						18		TD = 18'
						19		2" PVC Monitor Well Installed

By: IS. Lawrence DATE: 1/28/95 CHK'D BY:

No 215432

DRILLING CONTR.: O'Keefe, Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION: FHS
	DRILLING METHOD: 8" H.S. Auger		BORING NO.: M-31
	SAMPLING METHOD: Grab		SHEET: 1 OF 1
	WATER LEVEL / TIME / DATE / CASING DEPTH		DRILLING START DATE: 1/28/95

DATUM ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Top Soil
						1		
						2		
						3		
						4		
G			1 / 5			5	SM	Silty sand, minor gravel
						6		75% fine to v. fine sand; 20% silt; 5% pebbles w small gravels
						7		
						8		
						9		
G			2 / 10			10		gravelly sands
						1	SP	80% fine to medium sand; 20% small gravels w pebbles <1" d.
						2		
						3	▽	
						4		wet
G			3 / 15			15	GP	Sandy gravels 60-70% gravels 1-2" d. subrounded
						6		30-40% fine-med sand
						7		
						18		TD = 18'
						9		
						0		2" PVC Monitor Well Installed

BY B. Lawerman DATE 1/28/95 CHK'D BY

No215432

DRILLING CONTR. O'Keefe, Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION FHS
	DRILLING METHOD: 8" HS Auger		BORING NO. M-32
	SAMPLING METHOD: Grab		SHEET 1 of 1
DATUM	ELEVATION		DRILLING START DATE 1/28/95

	WATER LEVEL				
TIME					
DATE					
CASING DEPTH					

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		top soil
						1		
						2		2" PVC Monitor Well Installed
						3		
						4	SM	
						5		
						6		
						7		
						8		
						9		
G			1/10			10	SP	Sandy gravels 50/50 fine to med. sand
						1		gravels 1-2" d. subrounded to subangular
						2		
						3	▽	(wet)
						4		
G			2/15			15	GP	AA, increasing gravels, decreasing sand gravels consistently 1-2+" d.
						6		
						7		
						8		TD - 20'
						9		
G			3/20			20		AA, Sandy gravels coarse gravels

BY B Lauerman DATE 1/28/95 CHK'D BY

No215432 DRILLING CONTR. O'Keefe Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			F-145

DRILLING METHOD:	8" H.S. Auger
SAMPLING METHOD:	Grab
BORING NO.	M-33
SHEET	1 of 1
DRILLING START TIME	
DRILLING FINISH TIME	
START DATE	1/28/95
FINISH DATE	
WATER LEVEL	
TIME	
DATE	
CASING DEPTH	

DATUM

ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		topsoil
						1		
						2		
						3		
						4		
G			1 / 5			5	SM	Silty sand 75+% fine to v. fine sand, 25% silt
						6		
						7		
						8		
						9		
G			2 / 10			10	SP	AA, minor gravels; gravels <1" d. subrounded
						1		
						2		
						3	▽	wet
						4		
G			3 / 15			15	GP	Sandy gravel and pebbles; 60% coarse gravel 2+" d. and pebbles subangular/subround; 40% fine to med. sand
						6		
						7		
						18		TD = 18'
						9		
						0		2" PVC Monitor Well Installed

LOCATION OF BORING

JOB NO.

CLIENT

LOCATION: FHS

DRILLING METHOD: 8" H.S. Auger

BORING NO. M-34

SHEET 1 OF 1

SAMPLING METHOD: Grab

DRILLING	START	FINISH
TIME		
DATE	1/28/95	

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM

ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	
						0		Topsoil
						1		
						2		
						3		
						4		
G			1/5			5	SM	Silty sand 80% v. fine to fine sand, 20% silt
						6		
						7		
						8		
						9		
G			2/10			10	SP	Silty gravelly sand 70% fine sand, 15% gravels, 15% silt
						1		gravels are < 1" diameter, subrounded
						2		
						3	▽	(wet)
						4		
G			3/15			15	GP	Sandy gravel 70% gravels 1-2" dl subrounded to subangular
						6		
						7		30% fine to coarse sand (med)
						8		
						9		2" PVC Monitor well Installed
						20		TD = 20'

BY B. Lawrence DATE 1/28/95 CHK'D BY

N0215432

DRILLING CONTR O'Keefe Butte, MT

BY B. Lanerman DATE 1/28/95 CHK'D BY

No215432 DRILLING CONTR. O'Keefe Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD:	8" H.S. Auger
BORING NO.	M-35
SHEET	1 of 1
SAMPLING METHOD:	grab
DRILLING START TIME / FINISH TIME	
DATE (START)	1/28/95
DATE (FINISH)	
WATER LEVEL / TIME / DATE / CASING DEPTH	

DATUM ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		top soil
						1		
						2		
						3		
						4		
G			1 / 5			5	SM	silty sand 75% sand v fine-fine
						6		25% silt
						7		
						8		
						9		
G			2 / 10			10	SP	gravelly sand 75% sand fine-med
						1		25% gravels
						2		gravels are 1-1.5" Ø. subrounded to subangular
						3	▽	
						4		(wet)
G			3 / 15			15	GP	Sandy gravels 70% gravel, AA
						6		30% fine to coarse sand
						7		(medium sand)
						8		TD = 20'
						9		2" PVC Monitor Well Installed
						20		

BY: B. Lawrence DATE 1/28/95 CHK'D BY

No 215439

DRILLING CONTR O'Keefe Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION: FHS
	DRILLING METHOD: 8" HS Auger		BORING NO. M-36
	SAMPLING METHOD: Grab		SHEET 1 of 1
	WATER LEVEL / TIME / DATE / CASING DEPTH		DRILLING START TIME 1600, FINISH TIME 1635; DATE 1/28/95
DATUM	ELEVATION		

SURFACE CONDITIONS: Grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Sandy silt, brown, dry topsoil
						1		90% silt, 10% fine to coarse sand
						2		
						3		
						4		
G			1 / 5			5		AA, increasing sands
						6	SM	
						7		
						8		
						9		
G			2 / 10			10		Sandy silts or silty sands
						1		50/50 silt and fine sand
						2		
						3	▽	Gravels encountered ~12'
						4		
G			3 / 15			15	SP	Gravelly sands, wet
						6		70% fine to coarse sand (mostly fine) 33% small gravels subrounded to rounded
						7		1/4-3/4", moderately sorted
						8		
						19		TD = 20' 2" PVC well installed
						20		

No215432

BY: B. Lowerman
DATE: 1/28/95 CHK'D BY:
DRILLING CONTR: O'Keefe, Butte, MT

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION: FHS
	DRILLING METHOD: 8" H.S. Auger		BORING NO.: M-37
	SAMPLING METHOD: grab		SHEET: 1 of 1
	WATER LEVEL / TIME / DATE / CASING DEPTH		DRILLING START TIME / FINISH TIME; DATE: 1/28/95 / DATE

DATUM — ELEVATION — SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		top soil
						1		
						2		
						3		
						4		
G			1 / 5			5		Sand, minor silt
						6	SM	95% fine - v. fine sand, ±5% silt
						7		
						8		
						9		
G			2 / 10			10		AA, clean, fine sand, minor silt
						1		
						2		
						3		
						4	▽	
G			3 / 15			15		AA, clean fine sand, minor silt
						6	SP	(wet)
						7		
						8		
						9		TD = 20'
						20		2" PVC monitor well installed

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: 8" H.S. Auger

BORING NO. M 38

SHEET 1 OF 1

SAMPLING METHOD: Grab / Auger inspect

DRILLING	
START	FINISH
TIME	TIME
1645	1705
DATE	DATE
7/13/95	

WATER LEVEL				
TIME				
DATE				
CASING DEPTH	16.35			

DATUM — ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Silt, brown, dry
						1		
						2		
						3		
						4		
G			1 / 5			5	SP	Clean sand 100% fine to medium sand (fine)
						6		
						7		
						8		Gravels encountered
						9	▽	
G			2 / 10			10	SP	Sandy gravels (wet) 60-70% gravels 1/2-1 1/2" subangular and rounded 30% fine to medium sand (fine)
						1		
						2		
						3		
						4		
G			3 / 15			15	GP	~~Gravelly Sands~~ / Sandy gravels AA
						6		
						17		TD = 17'
						8		2" PVC well installed
						9		
						0		

No 215439

DRILLING CONTR. O'Keefe

B. Hke, Hvt

LOGGED BY: B. Lanerman DATE 7/13/95 CHK'D BY:

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			Flts

DRILLING METHOD: 8" H.S. Auger

BORING NO.: M 39

SHEET: 1 OF 1

SAMPLING METHOD: Grab / auger inspect

DRILLING — START TIME: 1915 — FINISH TIME: 1735

START DATE: 7/13/95

WATER LEVEL				
TIME				
DATE				
CASING DEPTH	16.4			

DATUM — ELEVATION

DRILLING CONT'R: O'Keefe, Butte, MT

No215439

BY: B. Lauerman — DATE: 7/13/95 — CHK'D BY:

SURFACE CONDITIONS: Grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		Silt, dry, brown
						1		
						2		
						3	SM	
						4		
G			1 / 5			5		Clean Sands 100% fine to medium Sand (fine)
						6	SP	
						7		
						8		Gravels encountered
						9	∇	
G			2 / 10			10		Sand and gravel (wet) 50/50 fine to med Sand and gravels 1/2 - 1 1/2" moderately sorted subrounded
						1		
						2		
						3		
						4		
G			3 / 15			15	GP	Sandy gravels
						6		75% gravels AA 25% fine - med sands AA
						17		
						8		TD = 17' 2" PVC well installed
						9		
						0		

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
			FHS

DRILLING METHOD: 8" HS Auger

BORING NO.: M 40

SHEET: 1 OF 1

SAMPLING METHOD: Grab / auger inspect

DRILLING: START TIME 1740, FINISH TIME 1805; DATE 7/13/95

WATER LEVEL / TIME / DATE / CASING DEPTH

DATUM / ELEVATION

SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		silt, dry, brown
						1		
						2		
						3		
						4		
G			1 / 5			5	SM	silty sand
						6		70% fine to med sand (fine) 25% silt
						7		
						8		gravel encountered
						9	▽	
G			2 / 10			10		Sandy gravel, wet
						1	SP	70% gravel 1/2 - 1½" diameter subrounded moderately sorted
						2		30% fine to med sand (fine)
						3		
						4		
G			3 / 15			15	GP	AA, Sandy gravel wet
						6		
						17		TD = 17'
						8		2" PVC well installed
						9		
						0		

DRILLING CONTR: O'Keefe, Butte, MT

No215439

BY: B Lawrence DATE 7/13/95 CHK'D BY

[redacted]

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION: FHS

- DRILLING METHOD: 8" HS Auger
- BORING NO.: M41
- SHEET: 1 OF 1
- SAMPLING METHOD: Grab/auger inspect
- DRILLING START: TIME 1815, DATE 7/13/95
- DRILLING FINISH: TIME 1835, DATE 7/13/95
- WATER LEVEL:
- TIME:
- DATE:
- CASING DEPTH: 16.0
- DATUM:
- ELEVATION:
- SURFACE CONDITIONS: grassy field

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
						0		silt, minor sand, dry
						1		
						2		
						3		
						4	SM	
G			1 / 5			5		silty sand; 75% fine to med sand (fine)
						6		25% silt
						7		
						8		gravels encountered
						9	▽	
G			2 / 10			10		sandy gravels, wet
						1	GP	70-80% gravels 1/2 - 1 1/2" moderately rounded to subrounded sorted
						2		20% fine to medium sand (fine)
						3		
						4		
G			3 / 15			15		A/A, sandy gravels, wet
						6		
						17		TD = 17'
						8		2" PVC well installed
						9		
						0		

No 215439

DRILLING CONTR. O'Keefe, Butte, MT

BY: B. Lanerman

DATE 7/13/95 CHK'D BY

APPENDIX C

Septic Effluent Loading Rates

APPENDIX C
EFFLUENT LOADING RATES

DATE	WEEKDAY	PUMP CYCLES PUMP 1	PUMP 2	TOTAL	EFFLUENT DELIVERED TO DRAINFIELD (gal)
1995					
12-Apr	W	5	4	9	2880
13-Apr	TH	3	2	5	1600
18-Apr	TU	4	3	11	3520
19-Apr	W	6	5	11	3520
20-Apr	TH	4	5	9	2880
21-Apr	F	5	5	10	3200
22-Apr	S	1	1	2	640
23-Apr	SU	1	0	1	320
24-Apr	M	5	5	10	3200
27-Apr	TH	7	6	13	4160
28-Apr	F	5	6	11	3520
29-Apr	S	4	3	7	2240
30-Apr	SU	2	1	3	960
1-May	M	11	11	22	7040
2-May	T	6	7	13	4160
3-May	W	6	5	11	3520
12-May	F	6	6	12	3840
13-May	S	3	3	6	1920
14-May	SU	1	2	3	960
15-May	M	7	6	13	4160
16-May	T	7	7	14	4480
17-May	W	7	7	14	4480
18-May	TH	7	7	14	4480
20-May	S	4	4	8	2560
21-May	SU	2	2	4	1280
22-May	M	7	7	14	4480
29-May	M	6	6	12	3840
30-May	T	7	6	13	4160
2-Jun	F	7	7	14	4480
16-Jun	F	1	1	2	640
17-Jun	S	1	2	3	960
18-Jun	SU	2	2	4	1280
19-Jun	M	2	2	4	1280
20-Jun	T	1	1	2	640
21-Jun	W	2	2	4	1280
22-Jun	TH	1	1	2	640
23-Jun	F	1	1	2	640
24-Jun	S	2	2	4	1280
25-Jun	SU	2	1	3	960
26-Jun	M	2	2	4	1280
27-Jun	T	1	1	2	640
28-Jun	W	1	1	2	640
29-Jun	TH	1	2	3	960
1-Jul	S	1	1	2	640
2-Jul	SU	0	1	1	320
3-Jul	M	1	1	2	640
1996					
4-Jul	T	1	0	1	320
5-Jul	W	1	1	2	640
6-Jul	TH	1	1	2	640
7-Jul	F	1	1	2	640
9-Jul	SU	1	0	1	320
10-Jul	M	1	1	2	640
11-Jul	T	1	1	2	640
12-Jul	W	1	1	2	640
13-Jul	TH	1	1	2	640
14-Jul	F	1	1	2	640
15-Jul	S	0	1	1	320
22-Aug	T	3	2	5	1600
23-Aug	W	2	2	4	1280
24-Aug	TH	3	2	5	1600
25-Aug	F	3	3	6	1920
26-Aug	S	1	2	3	960
27-Aug	SU	3	3	6	1920
28-Aug	M	3	4	7	2240
29-Aug	T	5	4	9	2880

APPENDIX C
EFFLUENT LOADING RATES

DATE	WEEKDAY	PUMP CYCLES PUMP 1	PUMP 2	TOTAL	EFFLUENT DELIVERED TO DRAINFIELD (gal)
30-Aug	W	6	6	12	3840
31-Aug	TH	7	6	13	4160
3-Sep	SU	1	1	2	640
5-Sep	T	6	5	11	3520
7-Sep	TH	6	6	12	3840
9-Sep	S	3	3	6	1920
10-Sep	SU	1	0	1	320
11-Sep	M	5	5	10	3200
14-Sep	TH	5	6	11	3520
15-Sep	F	6	5	11	3520
16-Sep	S	1	1	2	640
23-Sep	SU	2	1	3	960
25-Sep	M	6	5	11	3520
26-Sep	T	6	5	11	3520
27-Sep	W	5	5	10	3200
28-Sep	TH	7	6	13	4160
29-Sep	F	6	5	11	3520
30-Sep	S	0	1	1	320
1-Oct	SU	1	1	2	640
7-Oct	S	1	1	2	640
8-Oct	SU	0	1	1	320
9-Oct	M	6	5	11	3520
10-Oct	T	5	5	10	3200
11-Oct	W	5	6	11	3520
12-Oct	TH	7	7	14	4480
13-Oct	F	6	6	12	3840
18-Oct	W	5	5	10	3200
1996					
19-Oct	TH	1	2	3	960
20-Oct	F	1	1	2	640
23-Oct	M	4	5	9	2880
24-Oct	T	5	5	10	3200
25-Oct	W	5	4	9	2880
26-Oct	TH	5	6	11	3520
27-Oct	F	4	4	8	2560
28-Oct	S	5	5	10	3200
30-Oct	M	19	18	37	11840
31-Oct	T	29	28	57	18240
1-Nov	W	7	8	15	4800
2-Nov	TH	6	5	11	3520
3-Nov	F	7	8	15	4800
4-Nov	S	2	2	4	1280
13-Nov	M	4	4	8	2560
14-Nov	T	5	5	10	3200
15-Nov	W	5	5	10	3200
16-Nov	TH	5	5	10	3200
17-Nov	F	5	5	10	3200
18-Nov	S	3	3	6	1920
19-Nov	SU	1	1	2	640

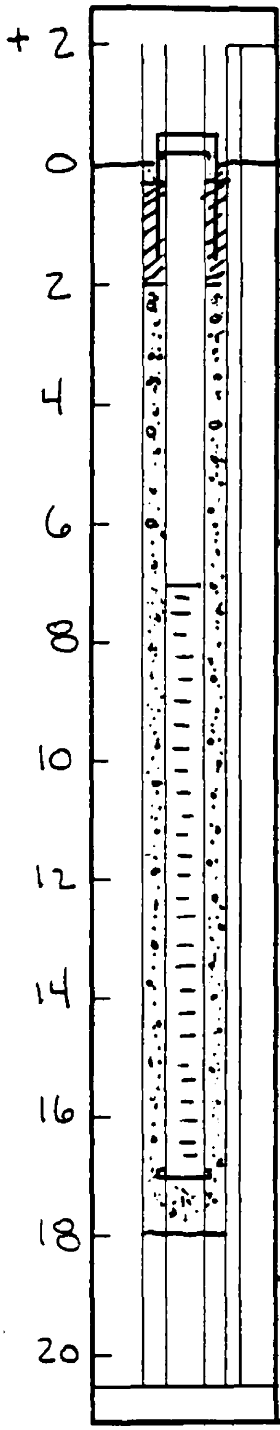
APPENDIX D

Monitoring Well Construction Summaries

Well No. M-11

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing 99.76

SITE NAME FHS

LOCATION Frenchtown, MT

Drilling Summary:

Total Depth 18'
Borehole Diameter 8"
Casing Stick-up Height .1'
Driller O'Keefe Drilling
Butte, MT
Rig Mobile B-61
Bit(s) Hollow Stem Auger
Drilling Fluid None
Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____
Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.1 - 7.2	C2
7.2 - 17.2	S1

Casing: C1 3" black steel w/cap
C2 2" SCH 40 PVC blank
Screen: S1 2" SCH 40 PVC .020 Slot
S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug
0.5 - 2'

Well Development:

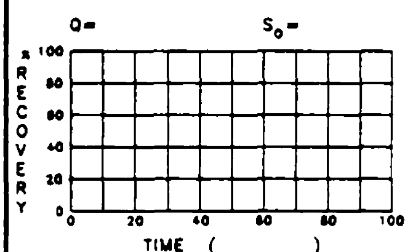
Swabbed and bailed

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=



SUPERVISED BY B. Lawrence

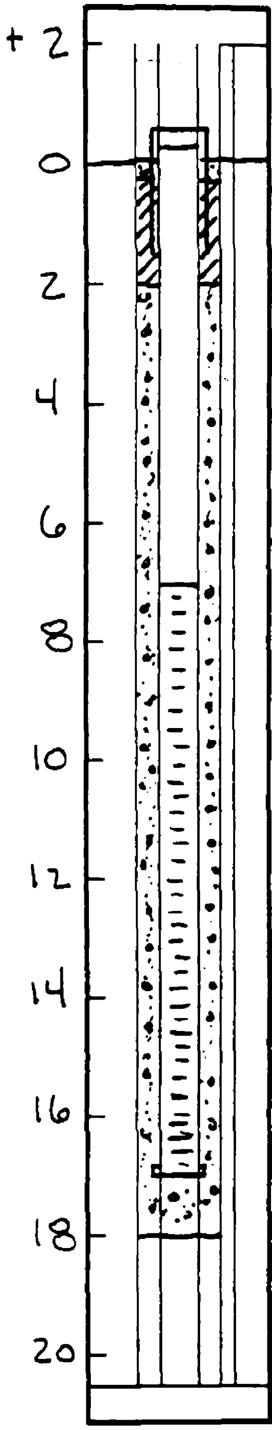
DATE 1/27/95

Comments: TD = 17.2' below TOC 2" PVC

Well No. M-12

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing 99.83

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .2'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Anger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.2 - 7.3	C2
7.3 - 17.3	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 Slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

Swabbed and bailed

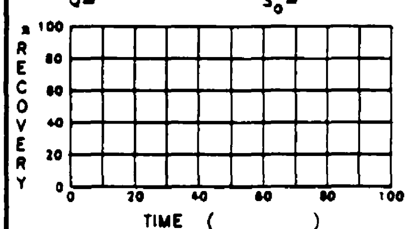
Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q=

S_o=



Comments:

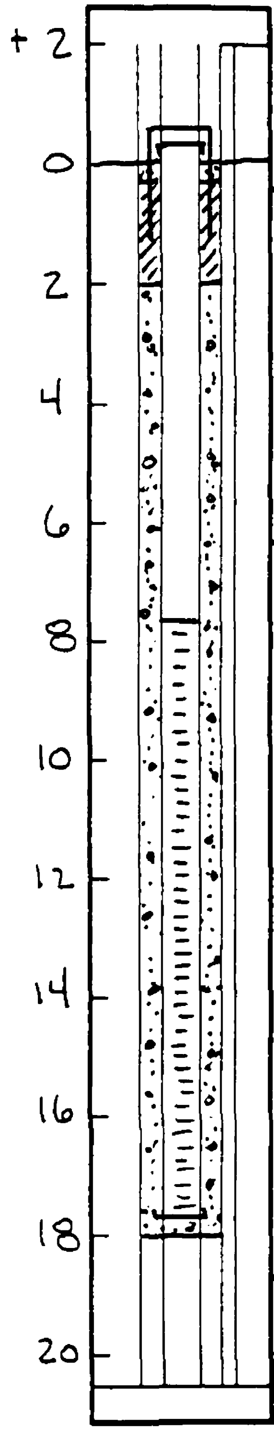
TD = 17.3' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lowermore

DATE 1/27/95



Well No. M-13

Boring No. X-Ref: ____

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: ____

Elevation Ground Level ____

Top of Casing 99.89

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .4

Driller O'Keefe Drilling Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Depth
+.5 - 1.5	C1	-
+.4 - 7.7	C2	-
7.7 - 17.7	S1	-
-		-
-		-

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2 ____

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=

% RECOVERY 100, 80, 60, 40, 20, 0

TIME ( ) 0, 20, 40, 60, 80, 100

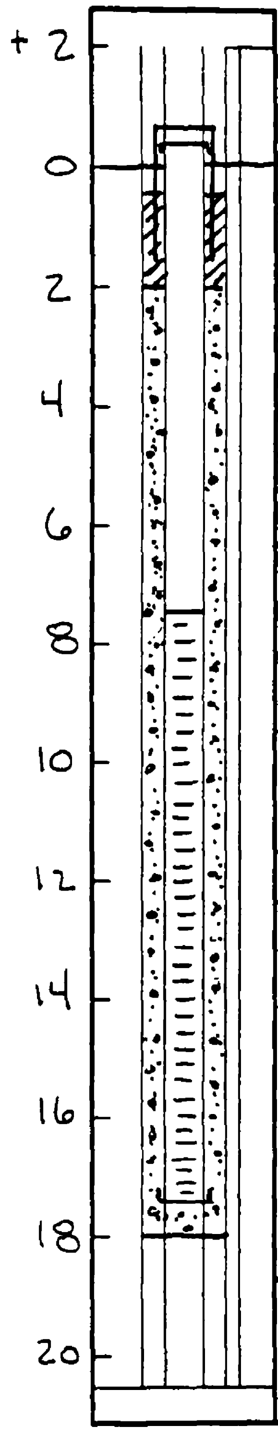
Comments: TD = 17.7' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lauerman

DATE 1/27/95



Well No. M-14

Boring No. X-Ref: ____

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: ____

Elevation Ground Level ____

Top of Casing 99.87

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .3'

Driller O'Keefe Drilling Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.3 - 7.5	C2
7.5 - 17.5	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2 ____

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

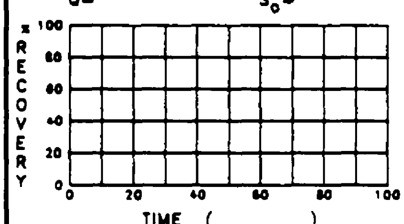
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



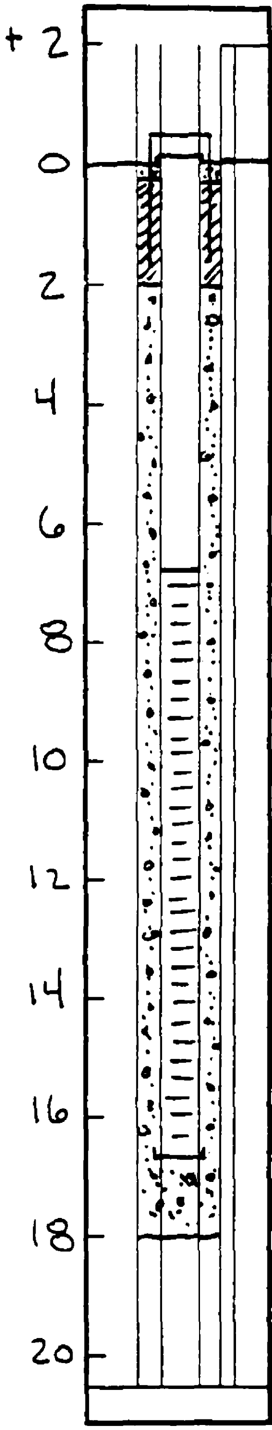
Comments: TD = 17.5' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lowermeyer

DATE 1/27/95



Well No. M-15

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.52

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .1'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___
Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.1 - 6.7	C2
6.7 - 16.7	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 Slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

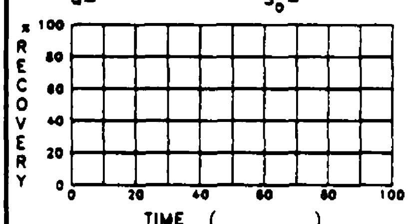
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=



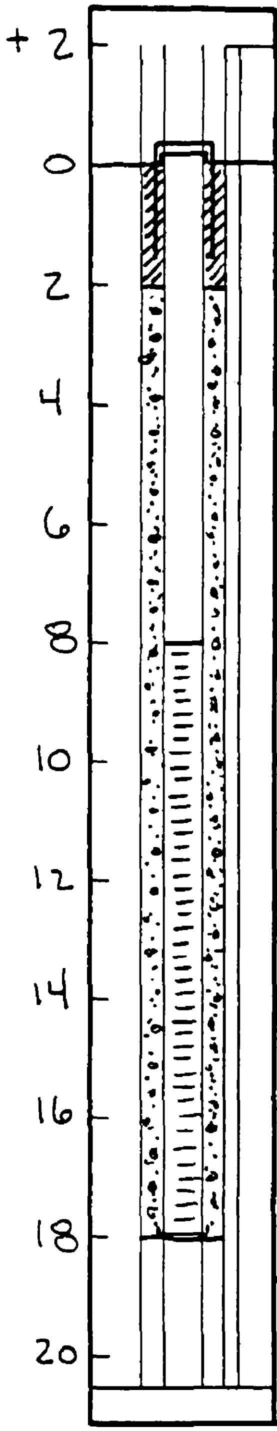
Comments: TD = 16.7' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lauerman

DATE 1/27/95



Well No. M-16

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.49

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .3'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.3 - 8	C2
8 - 18	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=

% RECOVERY 0–100; TIME ( ) 0–100

Comments: TD = 18' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

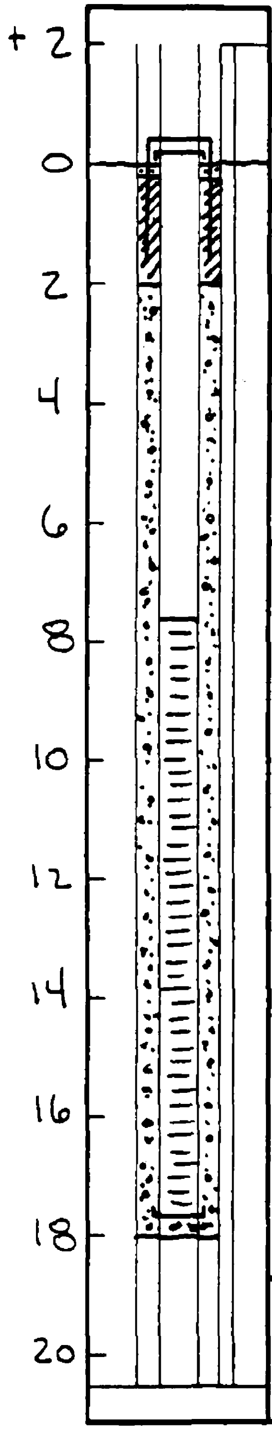
SUPERVISED BY B. Lauersman

DATE 1/27/95

Well No. M-17

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing 99.57

Drilling Summary:

Total Depth 18'
Borehole Diameter 8"
Casing Stick-up Height .3'
Driller O'Keefe Drilling
Butte, MT
Rig Mobile B-61
Bit(s) Hollow Stem Auger
Drilling Fluid None
Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___
Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.3 - 7.7	C2
7.7 - 17.7	S1

Casing: C1 3" black steel w/cap
C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 Slot
S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug
0.5 - 2'

Well Development:

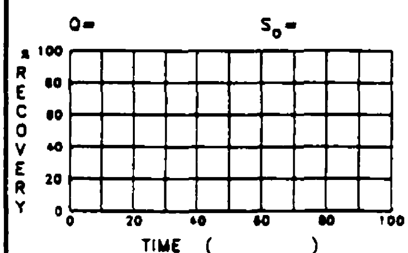
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=



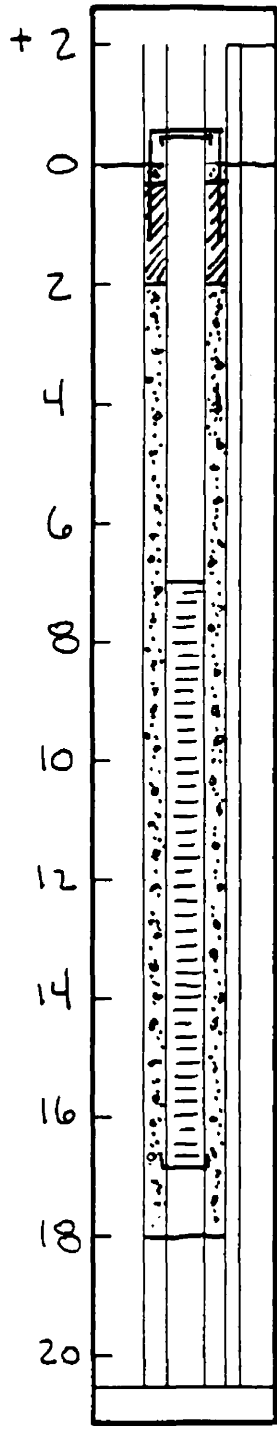
Comments: TD = 17.7' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lauerman

DATE 1/27/95



Well No. M-18

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.51

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .4'

Driller O'Keefe Drilling Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)
0.5 - 1.5	C1
.4 - 7.1	C2
7.1 - 17.1	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=

% RECOVERY 0 20 40 60 80 100

TIME ( ) 0 20 40 60 80 100

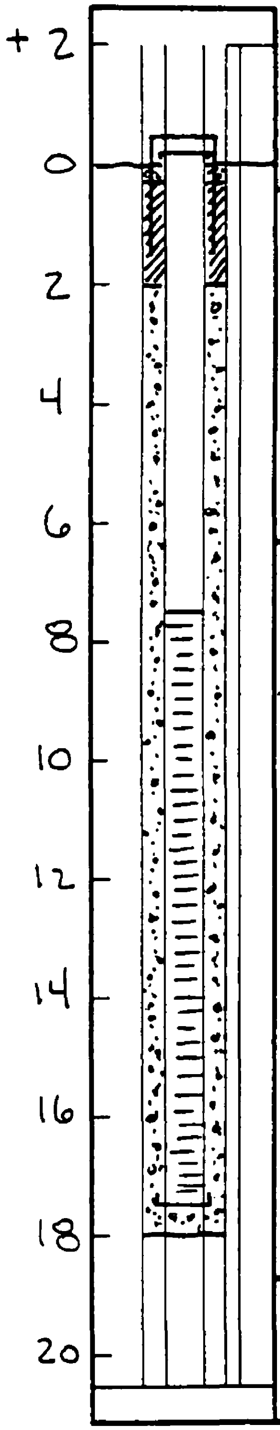
Comments: TD = 17.1' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lowermaker

DATE 1/27/95



Well No. M-19

Boring No. X-Ref: injection well

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: ____________

Elevation Ground Level ____________

Top of Casing 99.27

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .2'

Driller O'Keefe Drilling Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Depth
+0.5 - 1.5	C1	-
+.2 - 7.5	C2	-
7.5 - 17.5	S1	-
-		-
-		-

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2 ____________

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

Swabbed and bailed.

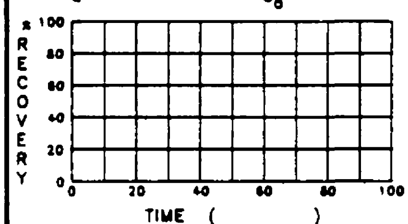
~~Then pumped & surged w/ contractor's pump.~~

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



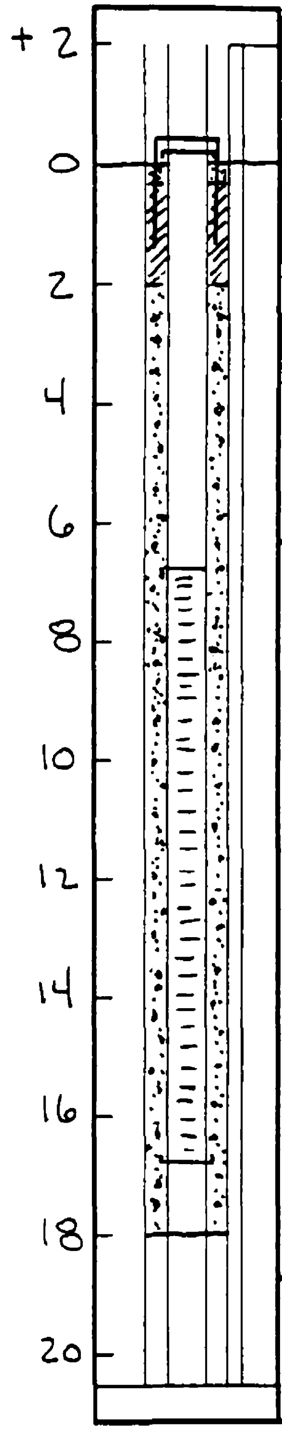
Comments: TD = 17.5' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lawrence

DATE 1/27/95



Well No. M-20

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.20

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height 2'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Depth	String(s)
0.5 - 1.5	C1	-	
.2 - 6.75	C2	-	
6.75 - 16.75	S1	-	
-		-	
-		-	

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

Swabbed and bailed.

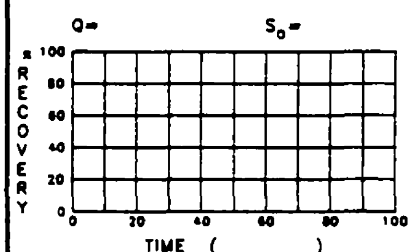
Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q=

S_0=



Comments: TD = 16.75' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

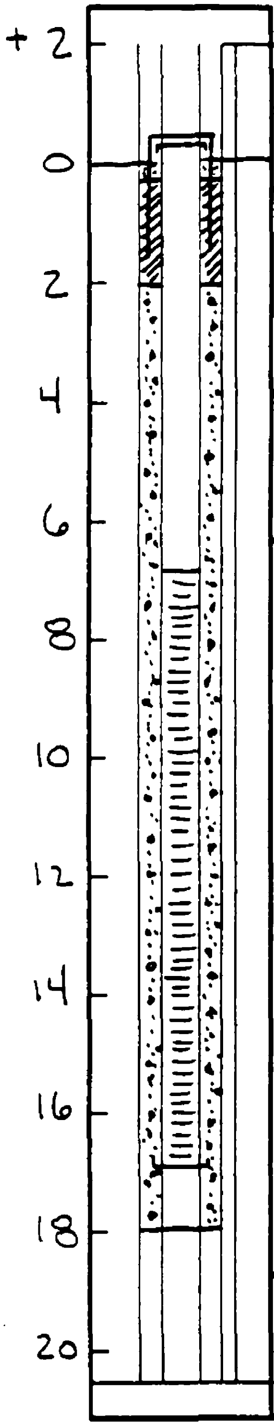
SUPERVISED BY B. Lowerman

DATE 1/27/95

Well No. M-21

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing 99.20

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .5'

Driller O'Keefe Drilling Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+1 - 1	C1
+0.5 - 6.8	C2
6.8 - 16.8	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

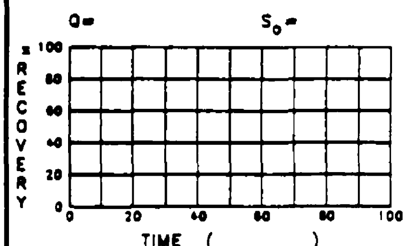
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



Comments: TD = 16.8' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

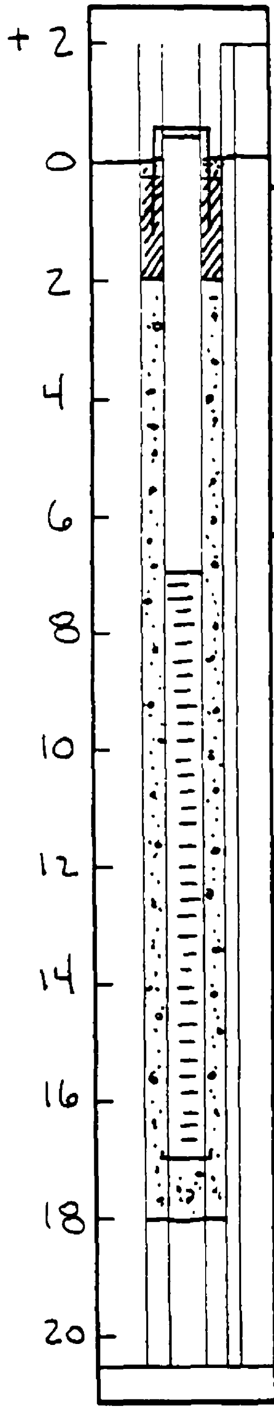
SUPERVISED BY B. Lauerman

DATE 1/27/85

Well No. M-22

Boring No. X-Ref: ______

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords: ______

Elevation Ground Level ______

Top of Casing 99.35

Drilling Summary:

Total Depth 17'
Borehole Diameter 8"
Casing Stick-up Height .5
Driller O'Keefe Drilling
Butte, MT
Rig Mobile B-61
Bit(s) Hollow Stem Auger
Drilling Fluid None
Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Depth
+1.0 - 1.0	C1	-
.5 - 7	C2	-
7 - 17	S1	-
-		-
-		-

Casing: C1 3" black steel w/cap
C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 Slot
S2 ______

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=

% RECOVERY 0 20 40 60 80 100

TIME ( )

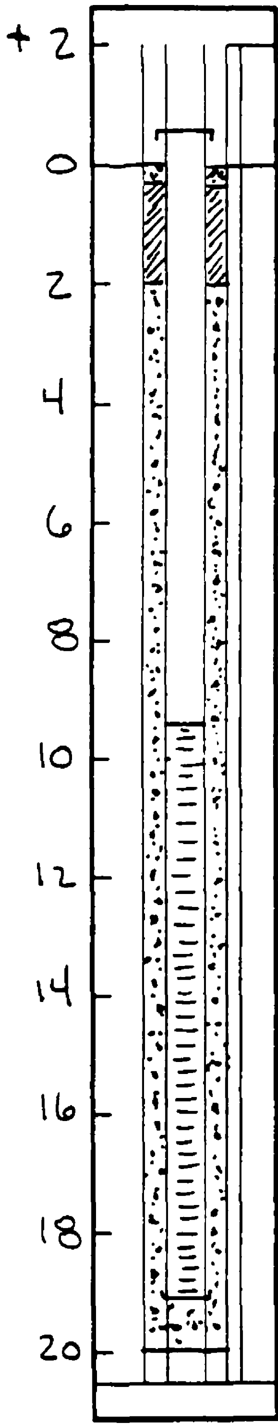
Comments: TD = 17' below TOC 2" PVC.

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lowerman

DATE 1/27/95



Well No. M-23 "

Boring No. X-Ref: *

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: ______

Elevation Ground Level ______

Top of Casing below grade *

Drilling Summary:

Total Depth 20'
Borehole Diameter 8"
Casing Stick-up Height .5 originally
Driller O'Keefe Drilling
Butte, MT
Rig Mobile B-61
Bit(s) Hollow Stem Auger
Drilling Fluid None
Protective Casing ~~2"~~ none

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___
Casing String (s): C = Casing S = Screen.

Depth	String(s)	
none	C1	
+.5 - 9.5	C2	originally
9.5 - 19.5	S1	

Casing: C1 3" black steel w/cap
C2 2" SCH40 PVC blank
Screen: S1 2" SCH40 PVC .020 slot
S2 ______
Filter Pack: Natural pack
Grout Seal: None
Bentonite Seal: Hole plug
0.5 - 2'

Well Development:

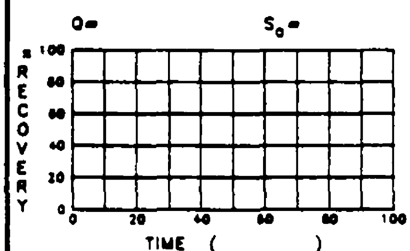
Swabbed and bailed

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

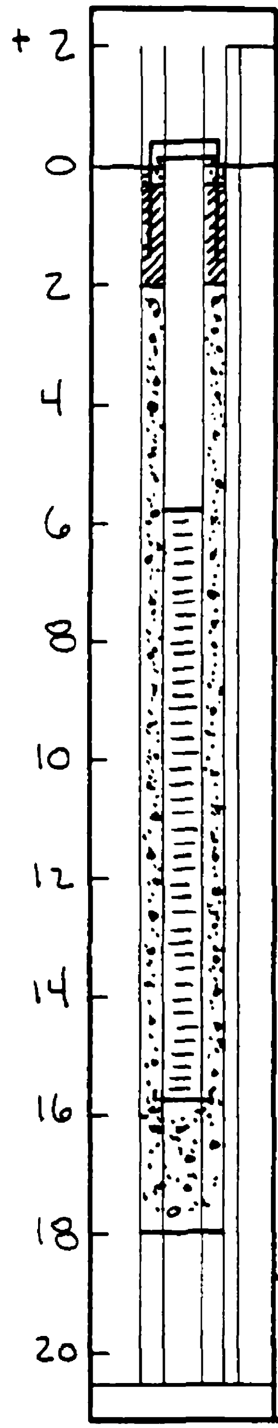
Recovery Data:

Q= S₀=



Comments: TD = 19.5 below TOC 2" PVC (originally)
*
Well decommissioned 11/95. 2" PVC cut and capped 1.5' below grade. Steel plate buried 1' below grade for locating.

SITE NAME FHS
LOCATION Frenchtown, MT
SUPERVISED BY B. Lauermann
DATE 1/28/95



Well No. M-24

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.34

SITE NAME FHS

LOCATION Frenchtown, MT

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height None

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Anger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Depth
+0.5 - 1.5	C1	-
0 - 5.8	C2	-
5.8 - 15.8	S1	-
-		-
-		-

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug

0.5 - 2'

Well Development:

Swabbed and bailed.

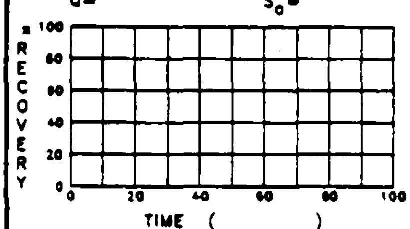
Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q=

S_o=



Comments: TD= 15.8' below TOC I" PVC

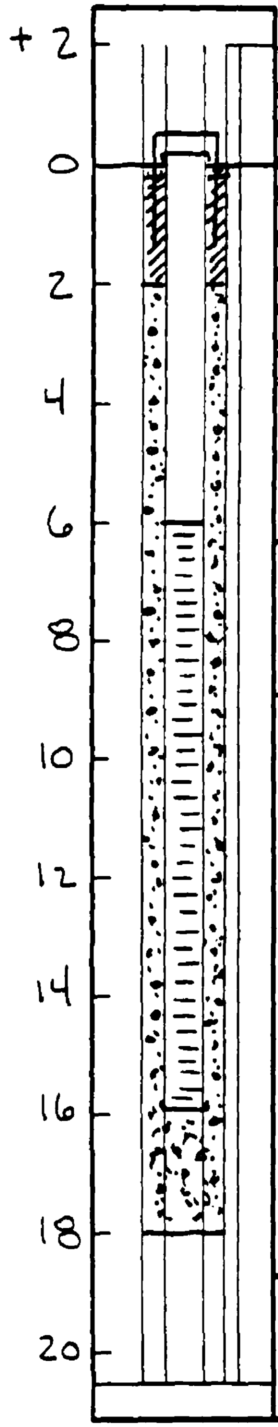
SUPERVISED BY B. Lauerman

DATE 1/28/95

Well No. M-25

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing 99.38

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .2'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging				
Casing				
Filter Placement				
Cementing				
Development				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)	
+0.5 - 1.5	C1	-
+.2 - 6	C2	-
6 - 16	S1	-
-		-
-		-

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

Swabbed and bailed.

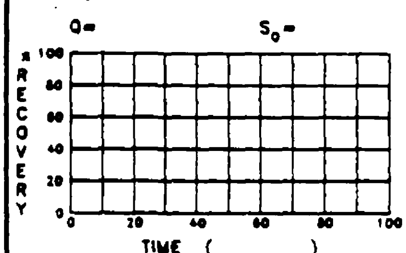
Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q=

S_0=



Comments:

TD = 16' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

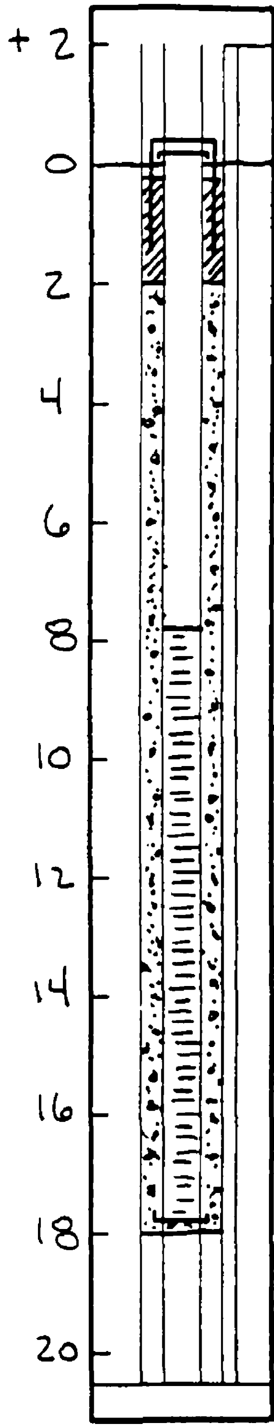
SUPERVISED BY B. Lawrence

DATE 1/28/95

Well No. M-26

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing 99.13

SITE NAME FHS

LOCATION Frenchtown, MT

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .2

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.2 - 7.8	C2
7.8 - 17.8	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug ▨

0.5 - 2'

Well Development:

Swabbed and bailed.

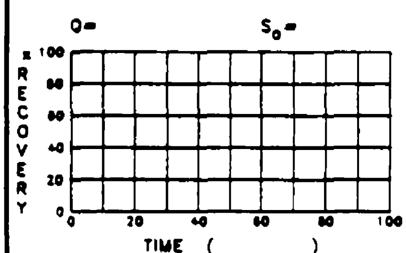
~~Then pumped and surged with Contractor's pump.~~

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=

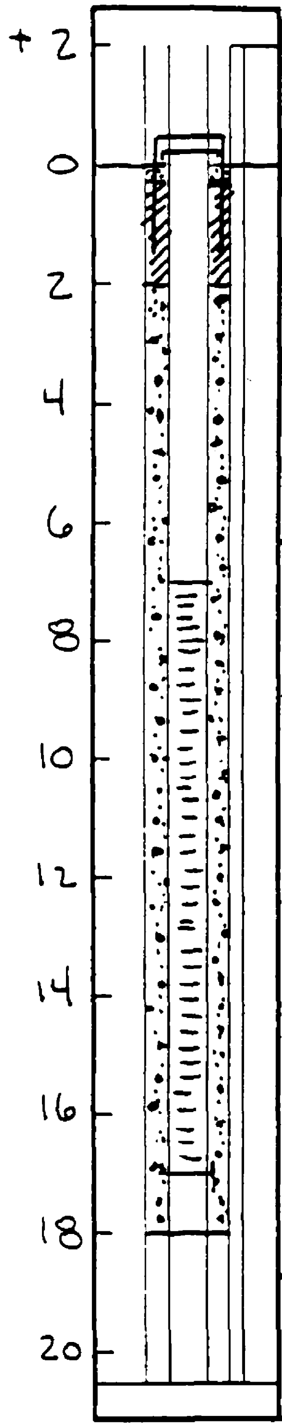


Comments:

TD = 17.8' below TOC 2" PVC

SUPERVISED BY B. Lowerance

DATE 1/28/95



Well No. M-27

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.18

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height .2'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.2 - 7.1	C2
7.1 - 17.1	S1

Casing: C1 3" black steel w/cap

C2 2" SCH 40 PVC blank

Screen: S1 2" SCH 40 PVC .020 Slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

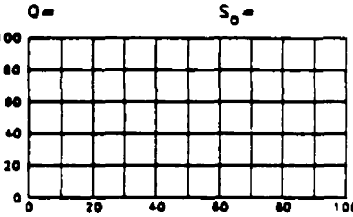
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



Comments:

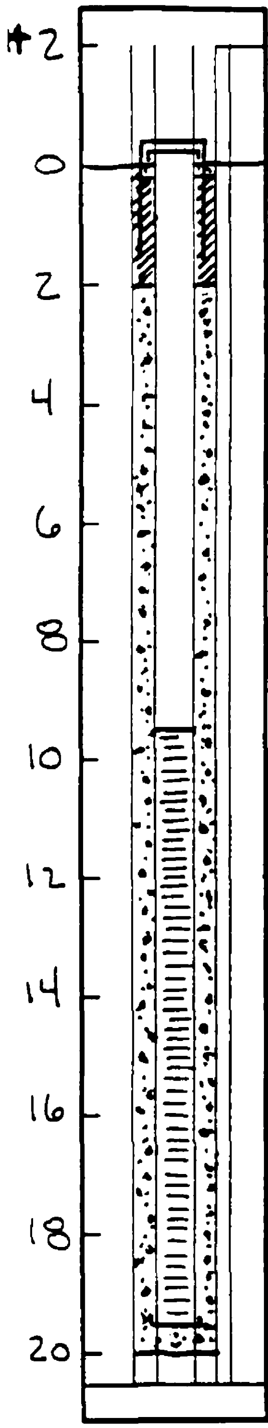
TD = 17.1' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lawrence

DATE 1/28/95



Well No. M-28

Boring No. X-Ref: ________

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: ________

Elevation Ground Level ________

Top of Casing 101.46

Drilling Summary:

Total Depth 20'
Borehole Diameter 8"
Casing Stick-up Height .4'
Driller O'Keefe Drilling
Butte, MT
Rig Mobile B-61
Bit(s) Hollow Stem Auger
Drilling Fluid None
Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Depth
+.5 - 1.5	C1	
+.4 - 9.5	C2	
9.5 - 19.5	S1	

Casing: C1 3" black steel w/cap
C2 2" SCH 40 PVC blank

Screen: S1 2" SCH 40 PVC .020 Slot
S2 ________

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug ▨
0.5 - 2'

Well Development:

Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=

% RECOVERY 100 80 60 40 20 0

0 20 40 60 80 100

TIME ( )

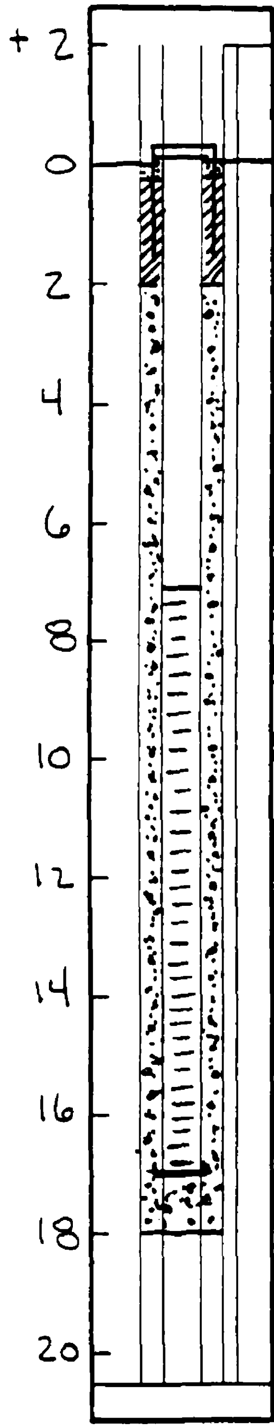
Comments: TD = 19.5' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lawrence

DATE 1/23/95



Well No. M-29

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.78

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height None

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Depth
+.5 - 1.5	C1	-
0 - 7.1	C2	-
7.1 - 17.1	S1	-
-		-
-		-

Casing: C1 3" black steel w/cap

C2 2" SCH 40 PVC blank

Screen: S1 2" SCH 40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug ▨

0.5 - 2'

Well Development:

Swabbed and bailed.

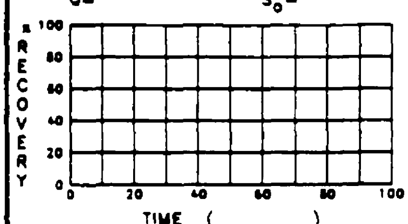
Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q=

S_o=



Comments:

TD = 17.1' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lowen[illegible]

DATE 1/23/95

Well No. M-30

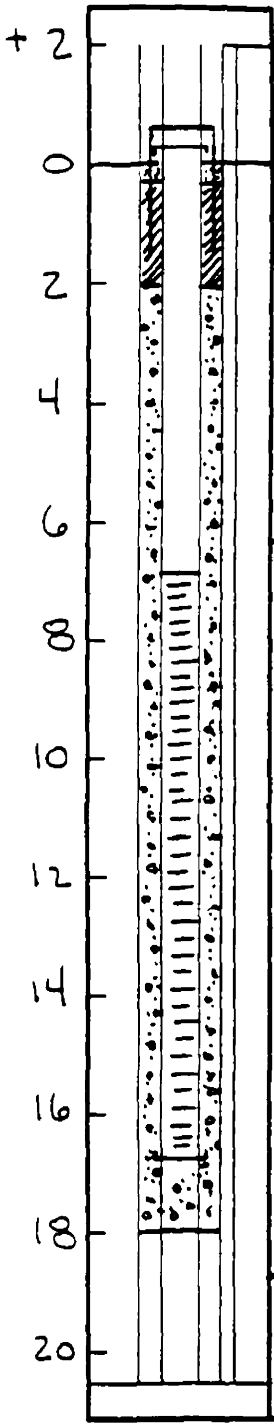
Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.85



Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height 2'

Driller O'Keefe Drilling Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.2 - 6.8	C2
6.8 - 16.8	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

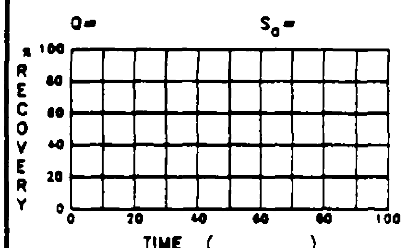
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=



Comments:

TD = 16.8' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lauermann

DATE 1/28/95

Well No. M-31

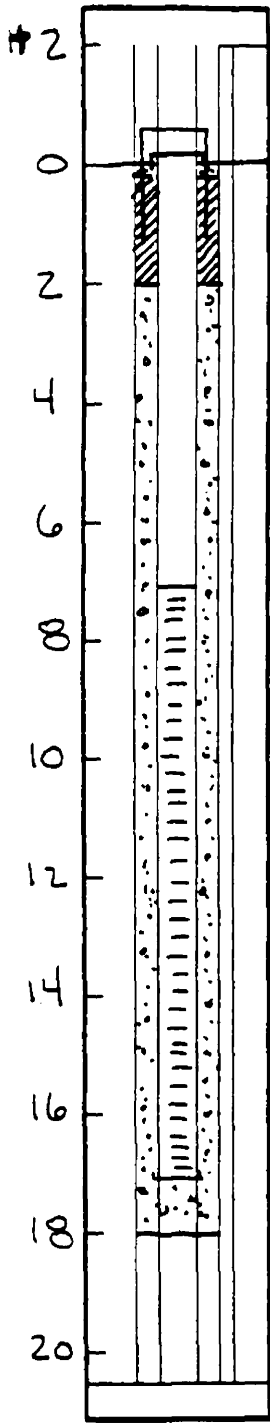
Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.76



Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height none

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.1 - 7.2	C2
7.2 - 17.2	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug

.5 - 2'

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Development:

Swabbed & bailed.

Then pumped and surged with contractor's pump.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q=

S_o=

% RECOVERY: 0, 20, 40, 60, 80, 100

TIME ( ): 0, 20, 40, 60, 80, 100

Comments:

TD = 17.2' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lauerman

DATE 1/28/95

Well No. M-32

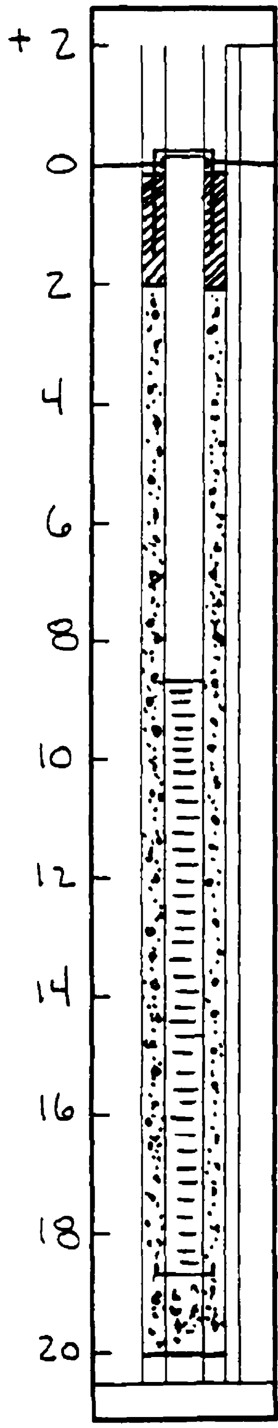
Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 101.34



Drilling Summary:

Total Depth 20'
Borehole Diameter 8"
Casing Stick-up Height none
Driller O'Keefe Drilling
Butte, MT
Rig Mobile B-61
Bit(s) Hollow Stem Auger
Drilling Fluid None
Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging				
Casing				
Filter Placement				
Cementing				
Development				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___
Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
0 - 8.6	C2
8.6 - 18.6	S1

Casing: C1 3" black steel w/cap
C2 2" SCH40 PVC blank
Screen: S1 2" SCH40 PVC .020 slot
S2
Filter Pack: Natural pack
Grout Seal: None
Bentonite Seal: Hole plug ▨
0.5 - 2'

Well Development:

Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=

% RECOVERY 0 20 40 60 80 100

TIME ( ) 0 20 40 60 80 100

Comments:

TD = 18.6' below TOC 2" PVC

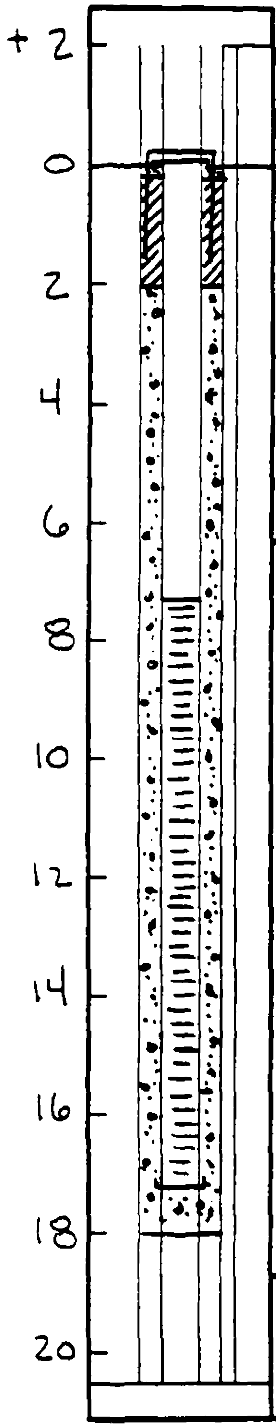
SITE NAME FHS
LOCATION Frenchtown, MT

SUPERVISED BY B. Lauerman
DATE 1/28/95

Well No. M-33

Boring No. X-Ref: ____

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords: ____

Elevation Ground Level ____

Top of Casing 100.95

Drilling Summary:

Total Depth 18'

Borehole Diameter 8"

Casing Stick-up Height none

Driller O'Keefe Drilling Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ____
Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
0 - 7.4	C2
7.4 - 17.4	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 Slot

S2 ____

Filter Pack: Natural pack ...

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

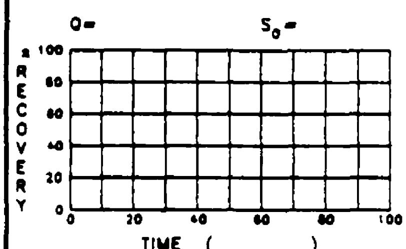
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=



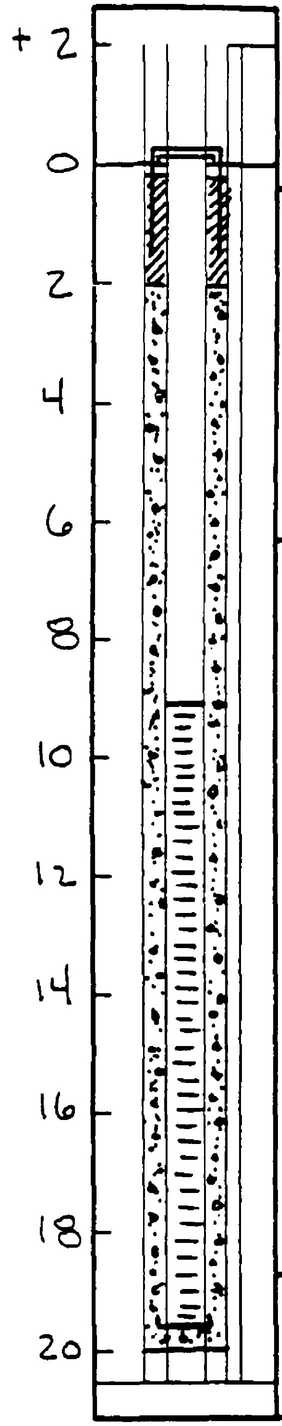
Comments: TD = 17.4' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lawrence

DATE 1/28/95



Well No. M-34

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 101.67

Drilling Summary:

Total Depth 20'

Borehole Diameter 8"

Casing Stick-up Height .1'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.1 - 9.3	C2
9.3 - 19.3	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

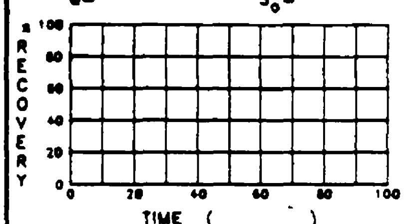
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



Comments: TD: 19.3' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

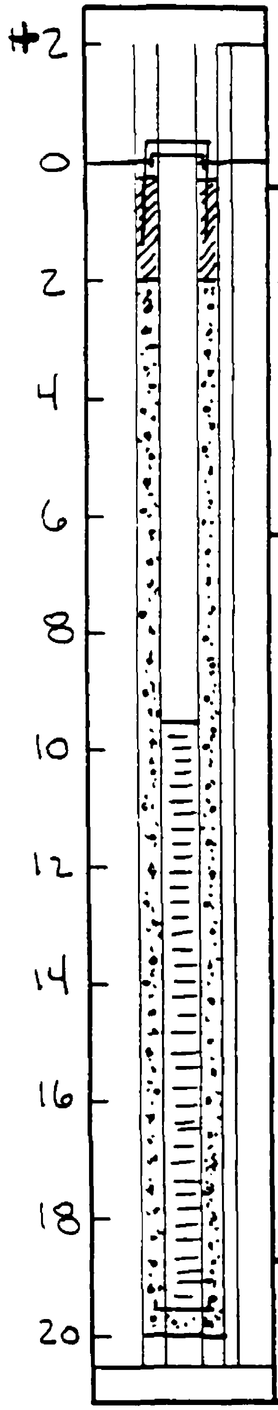
SUPERVISED BY B. Lowerman

DATE 1/28/95

Well No. M-35

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing 101.57

Drilling Summary:

Total Depth 20'

Borehole Diameter 8"

Casing Stick-up Height 0.1'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)	
+.5 - 1.5	C1	-
+.1 - 9.5	C2	-
9.5 - 19.5	S1	-
-		-
-		-

Casing: C1 3" black steel w/cap

C2 2" SCH 40 PVC blank

Screen: S1 2" SCH 40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

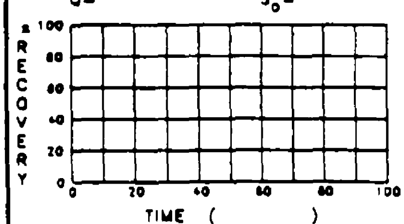
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



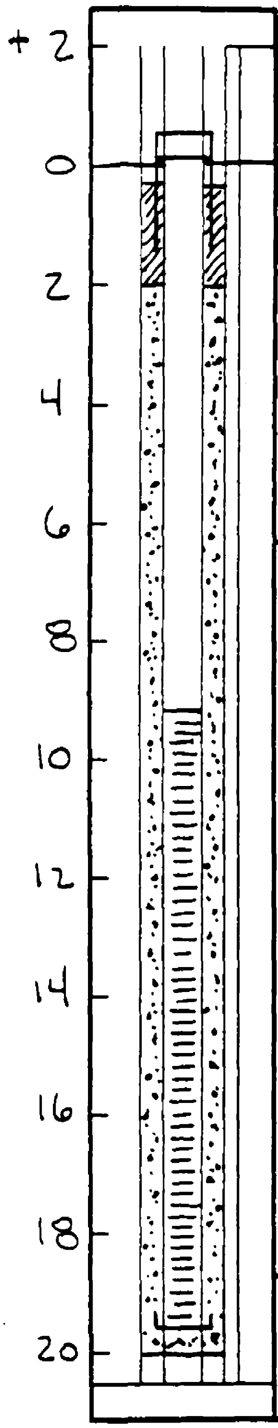
Comments: TD = 19.5' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lauerman

DATE 1/28/95



Well No. M-36

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 102.75

Drilling Summary:

Total Depth 20'

Borehole Diameter 8"

Casing Stick-up Height 1'

Driller O'Keefe Drilling
Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Depth	String(s)
+.5 - 1.5	C1	-	
+.1 - 9.3	C2	-	
9.3 - 19.3	S1	-	
-		-	
-		-	

Casing: C1 3" black steel w/cap

C2 2" SCH 40 PVC blank

Screen: S1 2" SCH 40 PVC .020 Slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug .5-2'

Well Development:

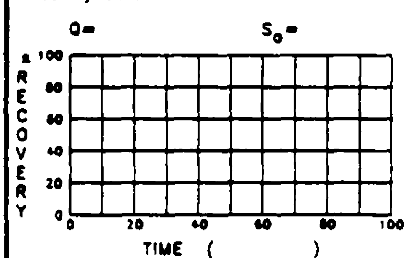
Swabbed and bailed.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



Comments:

TD = 19.3' below TOC 2" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

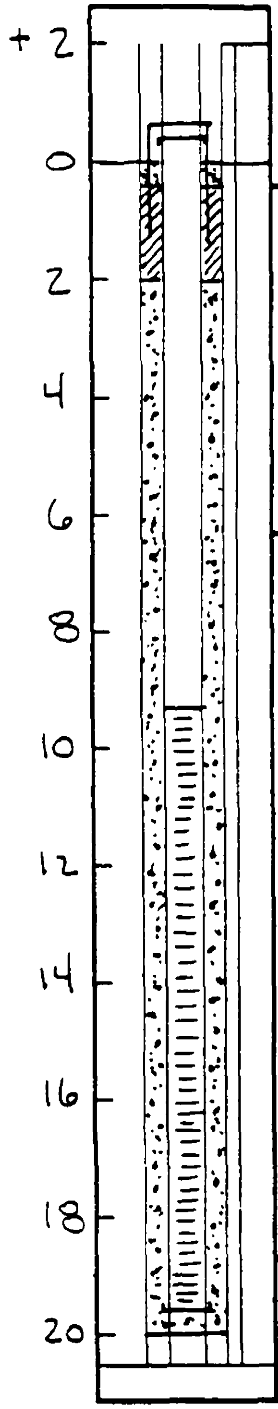
SUPERVISED BY B. Lawrence

DATE 1/28/95

Well No. M-37

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing 102.26

Drilling Summary:

Total Depth 20'

Borehole Diameter 8"

Casing Stick-up Height +.3

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.3 - 9.4	C2
9.4 - 19.4	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 Slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug 0.5 - 2'

Well Development:

Swabbed and bailed.

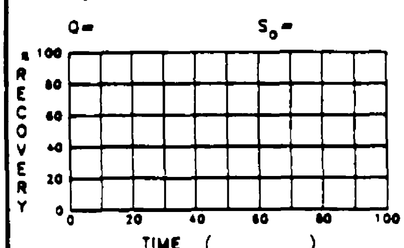
Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q=

S_o=



Comments: TD= 19.4' below TOC 2" PVC.

SITE NAME FHS

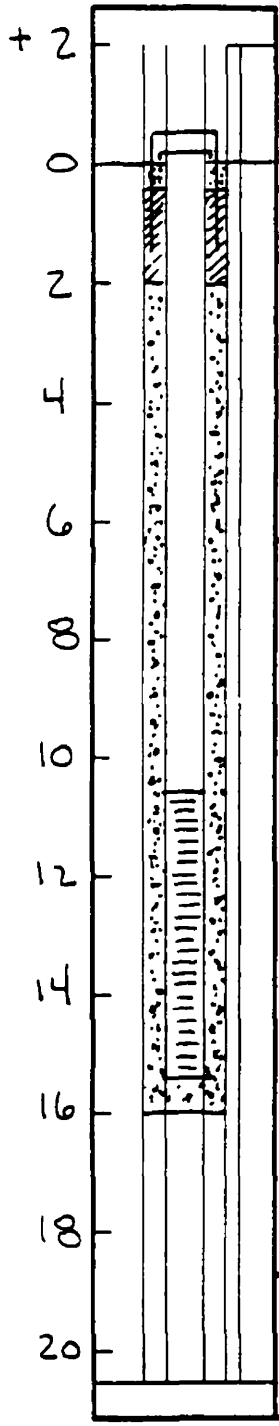
LOCATION Frenchtown, MT

SUPERVISED BY B. Lauerman

DATE 1/28/95

Well No. M-38
Boring No. X-Ref: injection well

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords: ______

Elevation Ground Level ______
Top of Casing 99.18

Drilling Summary:

Total Depth 16'
Borehole Diameter 8"
Casing Stick-up Height .1
Driller O'Keefe Drilling
Butte, MT
Rig Mobile B-61
Bit(s) Hollow Stem Auger
Drilling Fluid None
Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___
Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 – 1.5	C1
+.1 – 10.5	C2
10.5 – 15.5	S1

Casing: C1 3" black steel w/cap
C2 2" SCH 40 PVC blank
Screen: S1 2" SCH 40 PVC .020 slot
S2 ______
Filter Pack: Natural pack
Grout Seal: None
Bentonite Seal: Hole plug .5 - 2'

Well Development:

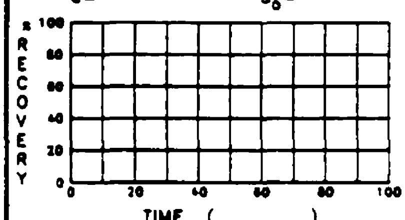
Swabbed and bailed
Then pumped and surged w/ contractor pump.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

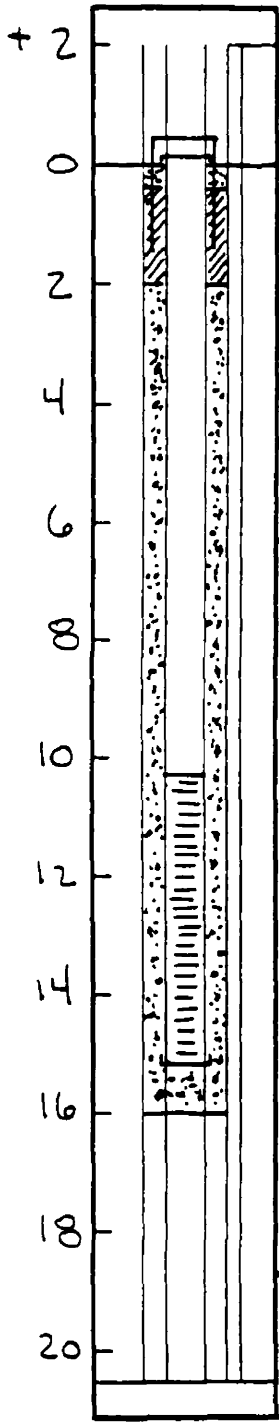
Q= S_0=



Comments:

TD = 15.5' below TOC 2" PVC.

SITE NAME FHS
LOCATION Frenchtown, MT
SUPERVISED BY B. Lauerman / W. Woessner
DATE 7/13/95



Well No. M-39

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.16

Drilling Summary:

Total Depth 16'

Borehole Diameter 8"

Casing Stick-up Height ~.81'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 - 1.5	C1
+.1 - 10.3	C2
10.3 - 15.3	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug .5 - 2'

Well Development:

Swabbed and bailed.

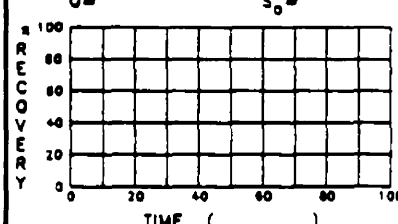
Then pumped and surged w/ contractors pump.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



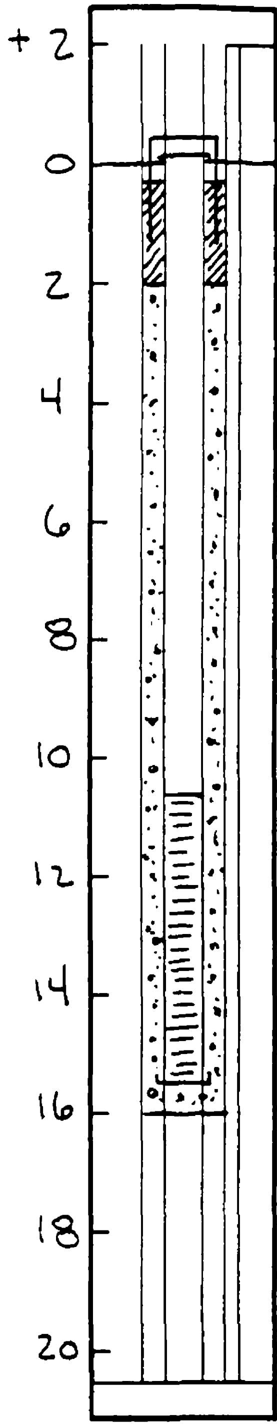
Comments: TD = 15.3' below TOC 2" PVC.

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lowermen / W. Woessner

DATE 7/13/95



Well No. M-40

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.08

Drilling Summary:

Total Depth 16'

Borehole Diameter 8"

Casing Stick-up Height 0.1'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)	
+.5 - 1.5	C1	
+.1 - 10.4	C2	
10.4 - 15.4	S1	

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug .5 - 2'

Well Development:

Swabbed and bailed.

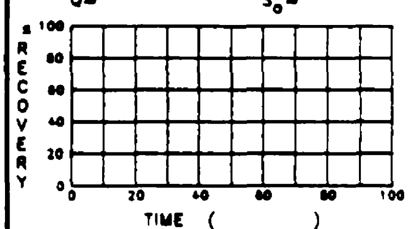
Then pumped and surged w/ contractor's pump.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q=　　S_o=



Comments:

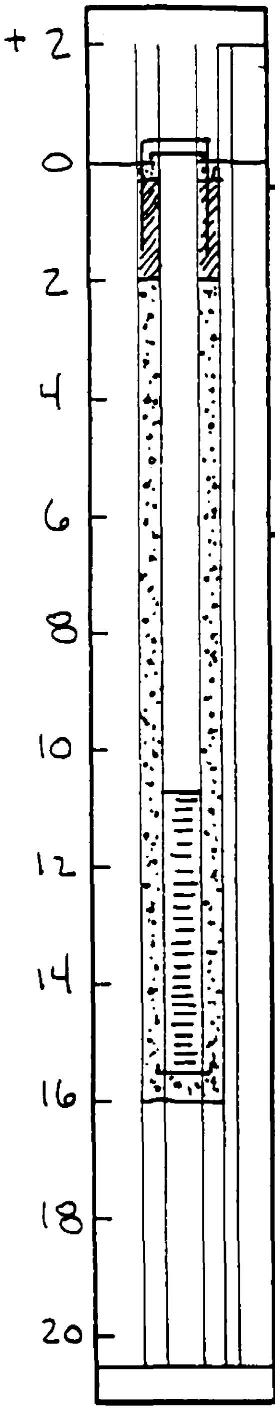
TD = 15.4' below TOC 2" PVC.

SUPERVISED BY B. Lauerman / W. Woessner

DATE 7/13/95

SITE NAME FHS

LOCATION Frenchtown, MT



Well No. M-41

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing 99.05

Drilling Summary:

Total Depth 16'

Borehole Diameter 8"

Casing Stick-up Height 1'

Driller O'Keefe Drilling

Butte, MT

Rig Mobile B-61

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth	String(s)
+.5 – 1.5	C1
+.1 – 10.6	C2
10.6 – 15.6	S1

Casing: C1 3" black steel w/cap

C2 2" SCH40 PVC blank

Screen: S1 2" SCH40 PVC .020 slot

S2

Filter Pack: Natural pack

Grout Seal: None

Bentonite Seal: Hole plug .5 – 2'

Well Development:

Swabbed and bailed

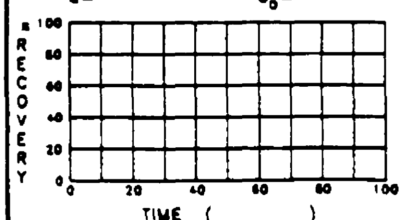
then pumped and surged w/ contractor's pump.

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=



Comments:

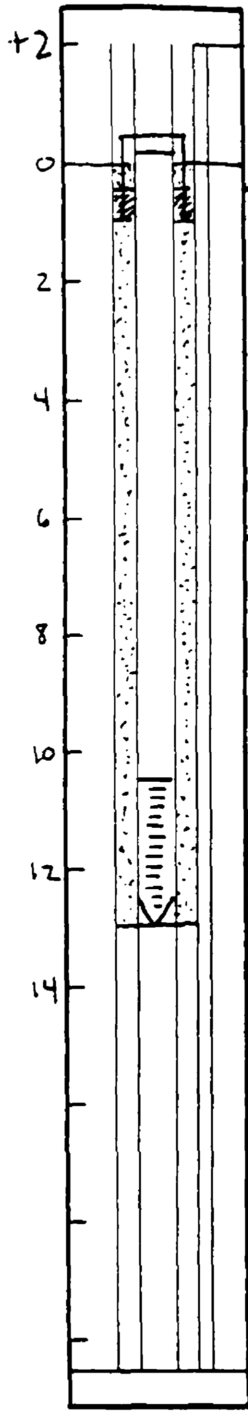
TD = 15.6' below TOC 2" PVC.

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lauerman/W. Woessner

DATE 7/13/95



Well No. T1

Boring No. X–Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: ______ Elevation Ground Level ______

Top of Casing ______

Drilling Summary:

Total Depth 12.55

Borehole Diameter 1.5"

Casing Stick-up Height 0.2"

Driller WCEC Missoula, MT

Rig Geoprobe

Bit(s)

Drilling Fluid none

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+.5 – 1	C1	–
+.2 – 10.55	C2	–
10.55 – 12.55	S1	–
–		–
–		–

Casing: C1 3" O.D. Black Steel w/ lockable lid

C2 Sch 80 PVC 1.25" O.D.

Screen: S1 Sch 80 PVC 1.25" O.D. Hand slotted w/ hacksaw

S2

Filter Pack: (none) natural pack

Grout Seal: none

Bentonite Seal: Hole Plug 0.5 – 1'

Well Development:

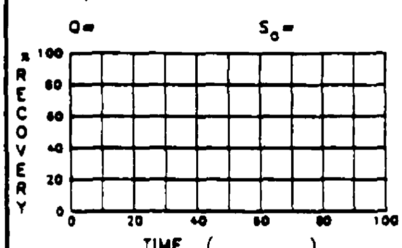
Pumped with 1/2" tubing w/ peristaltic pump until sand removal was clear

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



Comments:

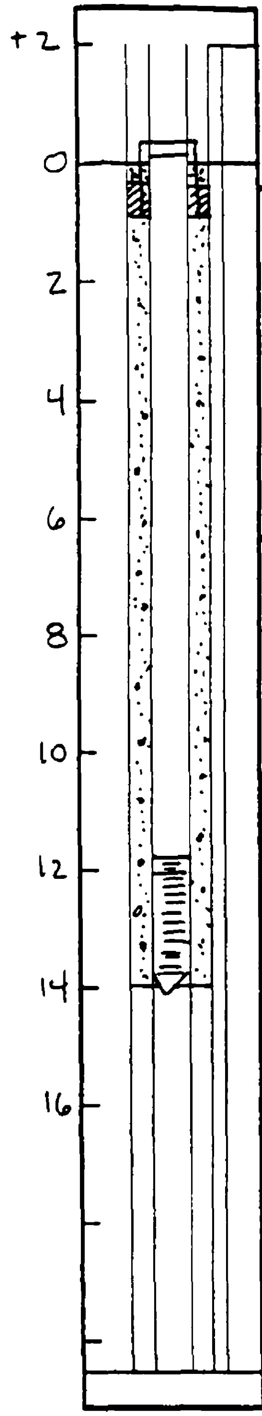
TD = ~~12.75~~ 12.55 below TOC 1.25" PVC

SITE NAME F45

LOCATION Frenchtown, MT

SUPERVISED BY B.C. Lauerman

DATE 7/31/95



Well No. T-2

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing

Drilling Summary:

Total Depth 13.85'

Borehole Diameter 1.5"

Casing Stick-up Height 0.2'

Driller WCEC Missoula, MT

Rig Geoprobe

Bit(s)

Drilling Fluid none

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+0.5 - 1	C1	-
+.2 - 11.85	C2	-
11.85 - 13.85	S1	-

Casing: C1 3" O.D. Black Steel w/ lockable lid

C2 Sch 80 PVC 1.25" O.D.

Screen: S1 SCH 80 PVC 1.25" O.D. hand slotted w/ hacksaw

S2

Filter Pack: (none) natural pack

Grout Seal: none

Bentonite Seal: hole plug

Well Development:

Pumped with 1/2" tubing and peristaltic pump until sand removed and clear

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=

% RECOVERY 0 20 40 60 80 100

TIME ( )

0 20 40 60 80 100

Comments: TD= 13.85' below TOC 1.25" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

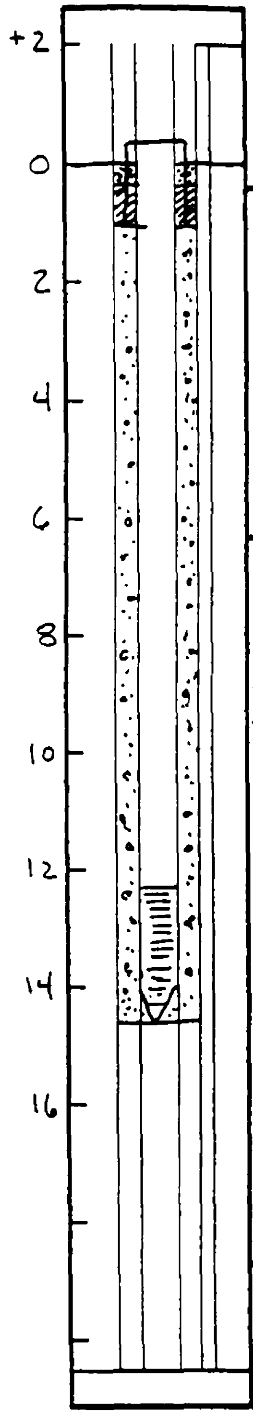
SUPERVISED BY B.C. Lauerman

DATE 7/31/95

Well No. T-3

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing

Drilling Summary:

Total Depth 14.5'

Borehole Diameter 1.5"

Casing Stick-up Height 0.2'

Driller WCEC Missoula, MT

Rig Geoprobe

Bit(s)

Drilling Fluid none

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+0.5 - 1	C1	-
+.2 - 12.5	C2	-
12.5 - 14.5	S1	-
-		-
-		-

Casing: C1 3" O.D. Black Steel w/ lockable l.d

C2 Sch 80 PVC 1.25" O.D.

Screen: S1 SCH 80 PVC 1.25" O.D. Hand slotted w/ hacksaw

S2

Filter Pack: (none) natural pack

Grout Seal: none

Bentonite Seal: tub Plug

Well Development:

Pumped with 1/2" tubing and peristaltic pump until sand removed and clear

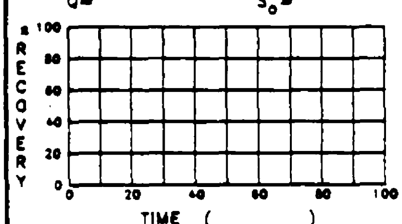
Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q=

S_o=



Comments:

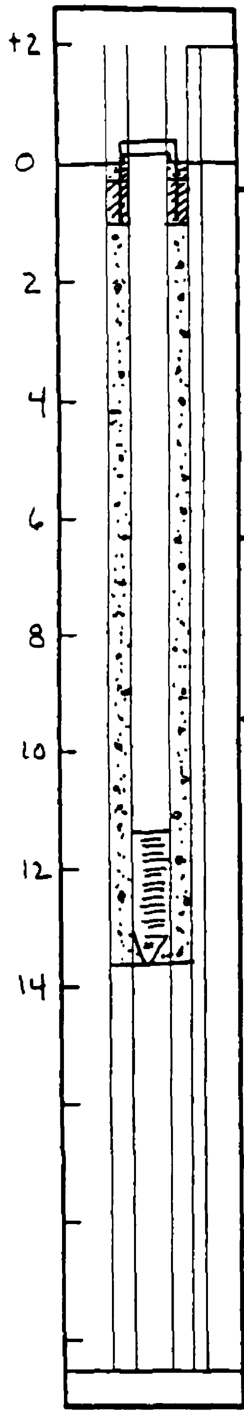
TD: 14.50' below TOC 1.25" PVC.

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B.C. Lauerman

DATE 7/31/95



Well No. T-4

Boring No. X-Ref: ______

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: ______ Elevation Ground Level ______

Top of Casing ______

Drilling Summary:

Total Depth 13.45'

Borehole Diameter 1.5"

Casing Stick-up Height 0.2'

Driller WCFC Missoula, MT

Rig Geoprobe

Bit(s) ______

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+0.5 - 1	C1	-
+0.2 - 11.45	C2	-
11.45 - 13.45	S1	-
-		-
-		-

Casing: C1 3" O.D. Black Steel w/ lockable l.d.

C2 Sch 80 PVC 1.25" O.D.

Screen: S1 Sch 80 PVC 1.25" O.D. (hand slotted w/ hacksaw)

S2 ______

Filter Pack: (None) natural pack

Grout Seal: None

Bentonite Seal: Hole Plug

Well Development:

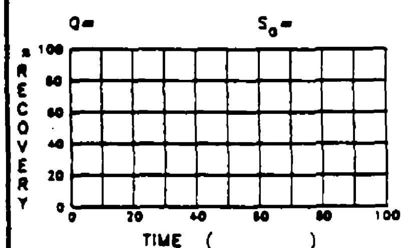
Pumped with 1/2" tubing w/ peristaltic pump until sand removed and clear

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



Comments: TD = 13.45' below TOC 1.25" PVC

SITE NAME FHS

LOCATION Frenchtown, MT

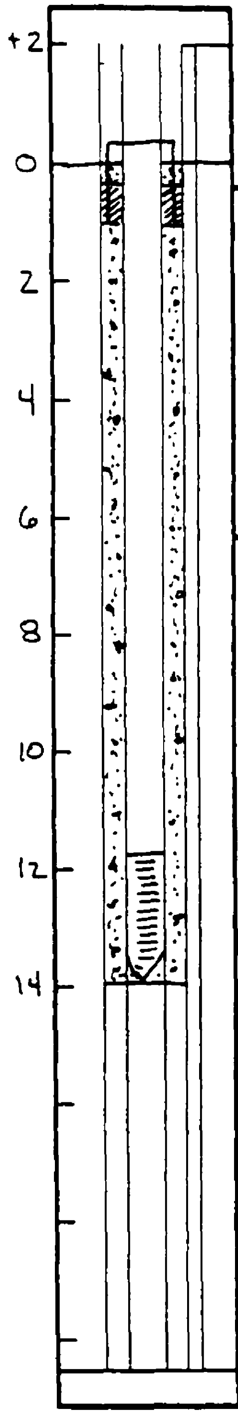
SUPERVISED BY B.C. Lauerman

DATE 7/31/95

Well No. T-5

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing

Drilling Summary:

Total Depth 13.7'

Borehole Diameter 1.5"

Casing Stick-up Height 0.2'

Driller WCEC Missoula, MT

Rig Geoprobe

Bit(s)

Drilling Fluid none

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging				
Casing				
Filter Placement				
Cementing				
Development				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+0.5 - 1	C1	-
+0.2 - 11.7	C2	-
11.7 - 13.7	S1	-
-		-
-		-

Casing: C1 3" O.D. Black Steel w/ lockcap 1.0

C2 Sch 80 PVC 1.25" O.D.

Screen: S1 Sch 80 PVC 1.25" O.D. hand slotted w/ hacksaw

S2

Filter Pack: (none) natural pack

Grout Seal: none

Bentonite Seal: Itch Plug

Well Development:

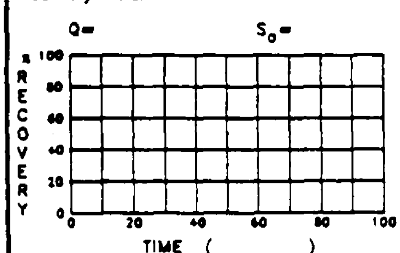
Pumped with 1/2" tubing and peristaltic pump until sand removed and clear

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



Comments:

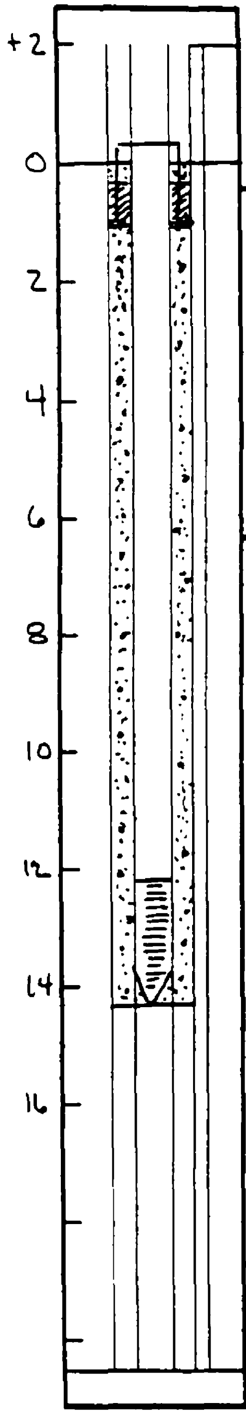
TD = 13.9' below TOC 1.25" PVC

SITE NAME F45

LOCATION Frenchtown, MT

SUPERVISED BY B.C. Lauerman

DATE 7/31/95



Well No. T-6

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: ______

Elevation Ground Level ______

Top of Casing ______

Drilling Summary:

Total Depth 14.35'
Borehole Diameter 1.5"
Casing Stick-up Height 0.2'
Driller WCFC Missoula, MT

Rig Geoprobe
Bit(s)

Drilling Fluid none

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+0.5 – 1	C1	–
+0.2 – 12.35	C2	–
12.35 – 14.35	S1	–
–		–
–		–

Casing: C1 3" O.D. Black Steel w/ lockable I.D.
C2 Sch 80 PVC 1.25" O.D.

Screen: S1 Sch 80 PVC 1.25" O.D. (hand slotted w/ hacksaw)
S2

Filter Pack: (none) natural pack

Grout Seal: none

Bentonite Seal: thin plug

Well Development:

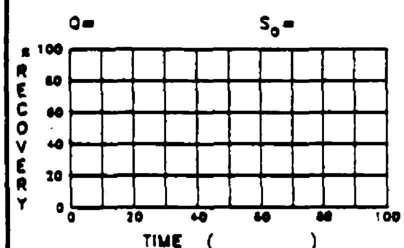
Pumped with 1/2" tubing w/ peristaltic pump until sand removed and clear

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=



Comments:

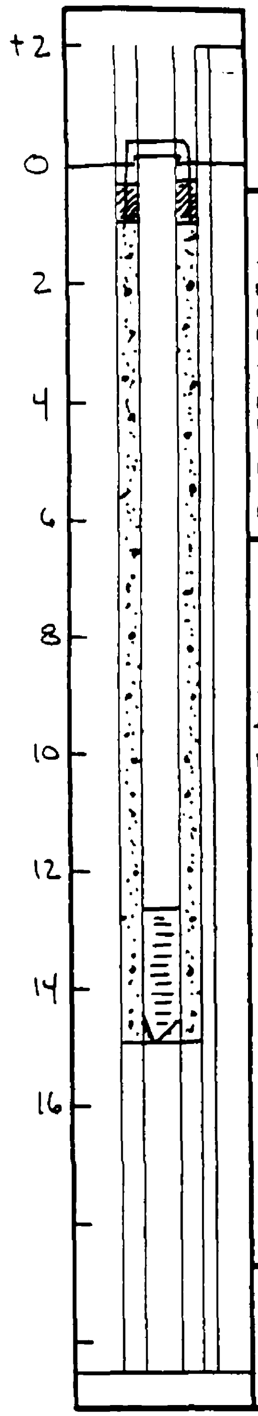
TD: ~~14.55~~ 14.35' below TOC 1.25" PVC.

SITE NAME F45

LOCATION Frenchtown, MT

SUPERVISED BY B.C. Lanerman

DATE 7/31/95



Well No. T-7

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing

Drilling Summary:

Total Depth 14.75'

Borehole Diameter 1.5"

Casing Stick-up Height 0.2'

Driller WCFC Missoula, MT

Rig Geoprobe

Bit(s)

Drilling Fluid none

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+0.5 – 1	C1	–
+0.2 – 12.75	C2	–
12.75 – 14.75	S1	–
–		–
–		–

Casing: C1 3" O.D. Black Steel w/ lockable l.d.

C2 Sch 80 PVC 1.25" O.D.

Screen: S1 Sch 80 PVC 1.25" O.D. (hand slotted w/ hacksaw)

S2

Filter Pack: (none) natural pack

Grout Seal: none

Bentonite Seal: Hole Plug

Well Development:

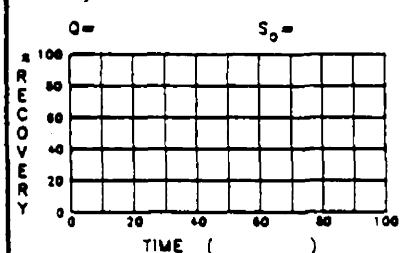
Pumped with 1/2" tubing w/ peristaltic pump until sand removed and clear

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=



Comments:

TD: 14.95' below TOC 1.25" PVC.

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B.C. Laverman

DATE 7/31/95

Well No. T-8

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

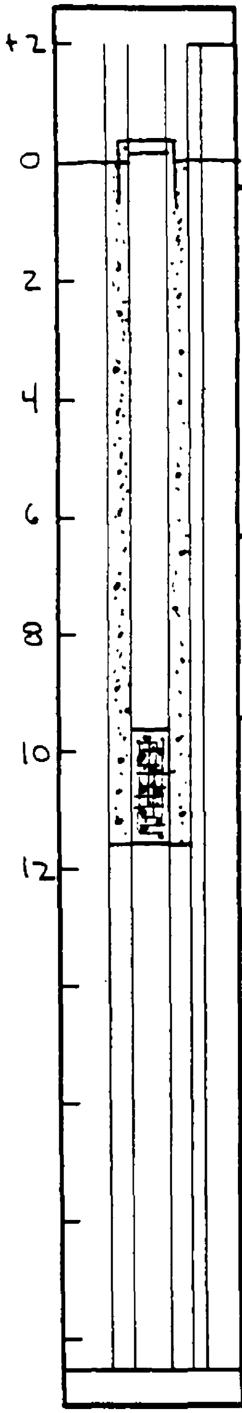
Top of Casing

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B. Lauerman / D. DeBorde

DATE 9/21/95



Drilling Summary:

Total Depth 11.4

Borehole Diameter 3/4"

Casing Stick-up Height 0.2

Driller None

Rig jackhammer

Bit(s)

Drilling Fluid none

Protective Casing 2" PVC

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+0.5 - 1	C1	-
+0.2 - 9.4	C2	-
9.4 - 11.4	S1	-
-		-
-		-

Casing: C1 2" SCH 40 PVC

C2 1/2" PVC tube

Screen: S1 1/2" PVC tube, drilled and wrapped w/ mesh.

S2

Filter Pack: none natural pack

Grout Seal: none

Bentonite Seal: none

Well Development:

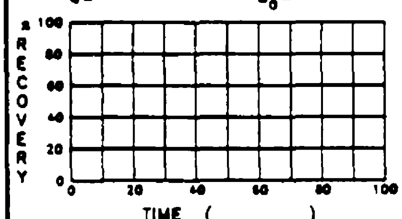
None

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

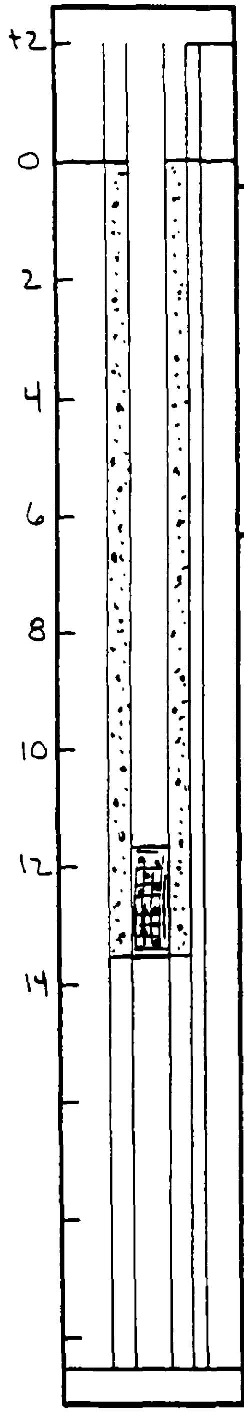
Recovery Data:

Q= S_0=



Comments:

TD = 11.4' below top of 1/2" tube.



Well No. T-9

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level

Top of Casing

Drilling Summary:

Total Depth 13.4'

Borehole Diameter 3/4''

Casing Stick-up Height 0.2

Driller none

Rig jackhammer

Bit(s)

Drilling Fluid None

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
–	C1	–
0.2 – 11.4	C2	–
11.4 – 13.4	S1	–
–		–
–		–

Casing: C1 Sch 40 PVC

C2 1/2" PVC tube

Screen: S1 1/2" PVC tube, drilled and wrapped with mesh.

S2

Filter Pack: none natural pack

Grout Seal: none

Bentonite Seal: None

Well Development:

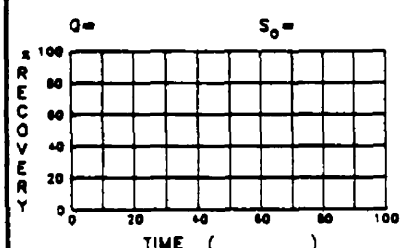
None

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_0=



Comments:

TD = 13.4' below top of 1/2" tube.

SITE NAME F118

LOCATION Frenchtown, MT

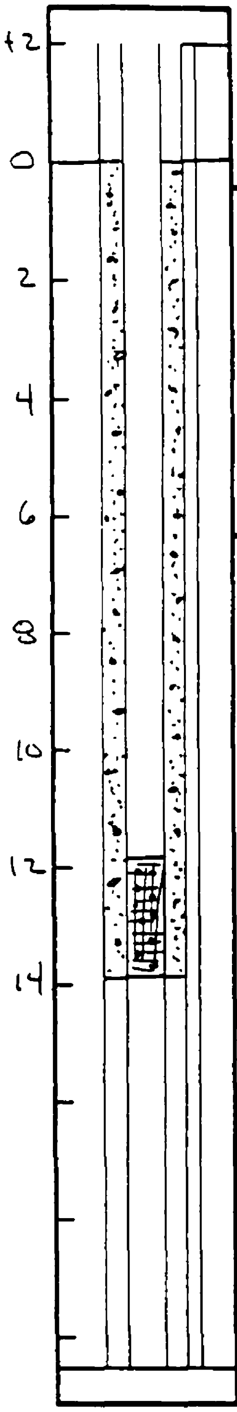
SUPERVISED BY B. Lowerman / D. DeBorde

DATE 9/21/95

Well No. T-10

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY



Survey Coords:

Elevation Ground Level

Top of Casing

Drilling Summary:

Total Depth 13.8'

Borehole Diameter 3/4"

Casing Stick-up Height 0.2

Driller none

Rig jackhammer

Bit(s)

Drilling Fluid none

Protective Casing C1

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications:

Basis: Geologic Log ____ Geophysical Log ____
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
-	C1	-
- 11.8	C2	-
11.8 - 13.8	S1	-
-		-
-		-

Casing: C1 2" Sch 40 PVC

C2 1/2" PVC tubing

Screen: S1 1/2" PVC tubing, drilled and wrapped w/ mesh.

S2

Filter Pack: None
natural pack

Grout Seal: None

Bentonite Seal: none

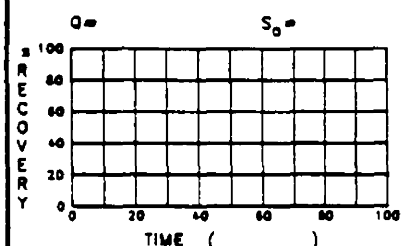
Well Development:

None

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:



Comments:
TD = 13.8' below top of 1/2" tube

SITE NAME FHS

LOCATION Frenchtown, MT

SUPERVISED BY B Lawrence / D. DeBorde

DATE 9/21/95

APPENDIX E

Potentiometric Data

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P1 (piezometer)	1994				MP ELEVATION = 100.00
	6-Sep	9:13	8.22	91.78	
	13-Sep	10:13	8.25	91.75	
	15-Sep	10:24	8.29	91.71	
	26-Sep	10:14	8.3	91.7	
	29-Sep	8:13	8.31	91.69	
	30-Sep	10:47	8.52	91.48	
	3-Oct	10:17	8.45	91.55	
	4-Oct	11:16	8.47	91.53	
	5-Oct	10:09	8.5	91.5	
	6-Oct	10:58	8.57	91.43	
	14-Oct	11:01	8.6	91.4	
	17-Oct	10:15	8.76	91.24	
	18-Oct	11:12	8.87	91.13	
	19-Oct	10:16	8.9	91.1	
	24-Oct	10:26	9.31	90.69	
	27-Oct	8:37	9.88	90.12	
	28-Oct	11:00	10.3	89.7	
	31-Oct	10:18	10.16	89.84	
	1-Nov	10:28	10.25	89.75	
	2-Nov	10:15	10.34	89.66	
	3-Nov	10:26	10.45	89.55	
	4-Nov	10:17	10.46	89.54	
	7-Nov	10:25	10.65	89.35	
	8-Nov	10:17	10.74	89.26	
	9-Nov	10:48	10.78	89.22	
	10-Nov	10:26	10.95	89.05	
	14-Nov	11:25	11.1	88.9	
	16-Nov	10:31	11.17	88.83	
	17-Nov	10:12	11.2	88.8	
	18-Nov	10:37	11.25	88.75	
	21-Nov	10:17	11.39	88.61	
	23-Nov	10:01	11.47	88.53	
	28-Nov	10:46	11.7	88.3	
	29-Nov	10:11	11.75	88.25	
	30-Nov	10:36	11.8	88.2	
	1-Dec	10:51	11.85	88.15	
	6-Dec	10:31	12.01	87.99	
	8-Dec	10:44	12.1	87.9	
	12-Dec	11:11	12.25	87.75	
	20-Dec	10:36	12.5	87.5	
	10-Jan	11:16	13.01	86.99	
	12-Jan	10:33	13.06	86.94	
	16-Jan	10:42	13.1	86.9	
	20-Jan	11:09	13.11	86.89	
	24-Jan	13:36	13.15	86.85	
	26-Jan	13:00	13.2	86.8	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P1 cont'd	1995				
	15-Feb	12:56	13.15	86.85	slight recovery in first part of Feb
	17-Feb	13:00	13.21	86.79	
	1-Mar	9:02	13.29	86.71	
	15-Mar	13:47	13.61	86.39	
	22-Mar	11:06	13.66	86.34	
	5-Apr	9:53	13.9	86.1	
	12-Apr	12:22	13.94	86.06	
	11-May	12:51	13.36	86.64	water table rising
	19-May	16:32	12.34	87.66	
	23-May	10:25	12.02	87.98	
	31-May	13:01	11.51	88.49	
	6-Jun	13:53	11.11	88.89	
	26-Jun	10:29	10.04	89.96	
	17-Jul		9.58	90.42	
	21-Aug	20:49	7.86	92.14	
	30-Sep	11:01	9.07	90.93	water table declining
	17-Oct	15:06	10	90	
	14-Nov	14:58	11.32	88.68	
	6-Dec	13:47	11.84	88.16	
	1996				
	22-Jan	11:45	11.9	88.1	
	20-Feb	13:09	11.95	88.05	
	23-Mar	13:56	11.9	88.1	
	3-Apr	14:25	12.19	87.81	
	30-May	14:40	11.48	88.52	water table rising
	20-Jun	10:40	9.67	90.33	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P2 (piezometer)	1994				MP ELEVATION = 99.80
	23-Sep	10:21	8	91.8	
	26-Sep	11:03	8.2	91.6	
	27-Sep	10:38	8	91.8	
	28-Sep	10:18	8.2	91.6	
	29-Sep	8:14	8.28	91.52	
	30-Sep	10:48	8.39	91.41	
	3-Oct	10:19	8.45	91.35	
	4-Oct	11:17	8.45	91.35	
	6-Oct	11:01	8.55	91.25	
	7-Oct	10:18	8.6	91.2	
	10-Oct	10:27	8.75	91.05	
	11-Oct	10:18	8.83	90.97	
	12-Oct	10:17	8.9	90.9	
	13-Oct	10:16	8.97	90.83	
	14-Oct	11:03	9.02	90.78	
	17-Oct	10:19	9.26	90.54	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P2 cont'd	1994				
	18-Oct	11:14	9.36	90.44	
	19-Oct	10:19	9.41	90.39	
	24-Oct	10:29	9.75	90.05	
	26-Oct	11:09	9.86	89.94	
	27-Oct	8:35	9.89	89.91	
	31-Oct	10:19	10.19	89.61	
	1-Nov	10:31	10.26	89.54	
	2-Nov	10:16	10.31	89.49	
	3-Nov	10:28	10.38	89.42	
	4-Nov	10:19	10.41	89.39	
	7-Nov	10:26	10.61	89.19	
	8-Nov	10:18	10.65	89.15	
	9-Nov	10:49	10.7	89.1	
	10-Nov	10:27	10.85	88.95	
	14-Nov	11:27	11.01	88.79	
	15-Nov	10:14	11.05	88.75	
	16-Nov	10:32	11.1	88.7	
	17-Nov	10:13	11.15	88.65	
	18-Nov	10:38	11.2	88.6	
	21-Nov	10:18	11.34	88.46	
	22-Nov	10:45	11.36	88.44	
	23-Nov	10:02	11.5	88.3	
	28-Nov	10:47	11.65	88.15	
	29-Nov	10:12	11.67	88.13	
	30-Nov	10:37	11.75	88.05	
	1-Dec	10:52	11.76	88.04	
	6-Dec	10:32	11.91	87.89	
	8-Dec	10:45	12	87.8	
	12-Dec	11:12	12.13	87.67	
	20-Dec	10:37	12.4	87.4	
	1995				
	10-Jan	11:17	12.95	86.85	
	12-Jan	10:34	13	86.8	
	16-Jan	10:43	13.05	86.75	
	24-Jan	13:37	13.02	86.78	
	26-Jan	13:01	13.16	86.64	
	8-Feb	11:32	12.85	86.95	slight recovery in first part of Feb
	9-Feb	13:07	12.83	86.97	
	15-Feb	12:58	13.05	86.75	
	17-Feb	13:01	13.17	86.63	
	1-Mar	9:00	13.24	86.56	
	15-Mar	13:49	13.47	86.33	
	22-Mar	11:01	13.55	86.25	
	5-Apr	9:52	13.75	86.05	
	12-Apr	12:19	13.81	85.99	
	11-May	12:50	13.29	86.51	water table rising

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P2 cont'd	1994				
	19-May	18:31	12.26	87.54	
	23-May	10:24	11.96	87.84	
	31-May	15:00	11.42	88.38	
	6-Jun	13:52	11.01	88.79	
	28-Jun	10:28	9.97	89.83	
	17-Jul		9.53	90.27	
	21-Aug	20:40	7.9	91.9	
	30-Sep	11:00	9.06	90.74	water table declining
	17-Oct	15:09	9.94	89.86	
	14-Nov				DECOMMISSIONED

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P3 (piezometer)	1994				MP ELEVATION = 99.71
	28-Sep	10:21	8.23	91.48	
	29-Sep	9:43	8.23	91.48	
	3-Oct	10:21	8.45	91.26	
	5-Oct	10:14	8.47	91.24	
	6-Oct	11:03	8.55	91.16	
	7-Oct	10:20	8.6	91.11	
	10-Oct	10:29	8.75	90.96	
	11-Oct	10:19	8.83	90.88	
	12-Oct	10:18	8.9	90.81	
	13-Oct	10:17	8.97	90.74	
	14-Oct	11:04	9.02	90.69	
	17-Oct	10:19	9.26	90.45	
	18-Oct	11:14	9.36	90.35	
	19-Oct	10:19	9.41	90.3	
	24-Oct	10:29	9.75	89.96	
	26-Oct	11:10	9.85	89.86	
	28-Oct	11:03	9.95	89.76	
	31-Oct	10:20	10.02	89.69	
	1-Nov	10:32	10.29	89.42	
	2-Nov	10:18	10.26	89.45	
	3-Nov	10:30	10.34	89.37	
	4-Nov	10:20	10.39	89.32	
	7-Nov	10:28	10.59	89.12	
	8-Nov	10:19	10.62	89.09	
	9-Nov	10:50	10.68	89.03	
	10-Nov	10:29	10.75	88.96	
	15-Nov	10:15	11.04	88.67	
	16-Nov	10:33	11.09	88.62	
	17-Nov	10:14	11.12	88.59	
	18-Nov	10:39	11.18	88.53	
	21-Nov	10:19	11.3	88.41	
	22-Nov	10:46	11.34	88.37	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P3 cont'd	1994				
	23-Nov	10:03	11.4	88.31	
	28-Nov	10:48	11.59	88.12	
	29-Nov	10:13	11.69	88.02	
	30-Nov	10:39	11.7	88.01	
	1-Dec	10:53	11.79	87.92	
	6-Dec	10:34	11.89	87.82	
	8-Dec	10:48	11.95	87.76	
	12-Dec	11:13	12.1	87.61	
	20-Dec	10:38	12.36	87.35	
	1995				
	10-Jan	11:18	12.87	86.84	
	12-Jan	10:35	12.8	86.91	
	18-Jan	10:44	12.97	86.74	
	24-Jan	13:38	12.98	86.73	
	28-Jan	13:02	13.14	86.57	
	8-Feb	11:35	12.76	86.95	slight recovery in first part of Feb
	9-Feb	13:08	12.8	86.91	
	15-Feb	12:59	13.02	86.69	
	17-Feb	13:03	13.16	86.55	
	1-Mar	8:58	13.14	86.57	
	15-Mar	13:51	13.36	86.35	
	22-Mar	11:02	13.44	86.27	
	5-Apr	9:51	13.71	86	
	12-Apr	12:28	13.77	85.94	
	11-May	12:45	13.25	86.46	water table rising
	19-May	18:28	12.21	87.5	
	23-May	10:19	11.9	87.81	
	31-May	14:53	11.38	88.33	
	6-Jun	13:45	11.04	88.67	
	28-Jun	10:22	10	89.71	
	17-Jul		9.51	90.2	
	21-Aug	20:32	7.88	91.83	
	30-Sep	10:55	9.01	90.7	water table declining
	17-Oct	15:08	9.95	89.76	
	14-Nov				DECOMMISSIONED

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P4 (piezometer)	1994				MP ELEVATION = 99.99
	21-Sep	10:11	8	91.99	
	22-Sep	10:20	8.21	91.78	
	26-Sep	11:07	8.22	91.77	
	27-Sep	10:43	8.3	91.69	
	29-Sep	9:45	8.31	91.68	
	3-Oct	10:23	8.4	91.59	
	4-Oct	11:19	8.47	91.52	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P4 cont'd	1994				
	5-Oct	10:15	8.47	91.52	
	6-Oct	11:05	8.56	91.43	
	7-Oct	13:21	8.62	91.37	
	10-Oct	10:30	8.75	91.24	
	11-Oct	10:20	8.81	91.18	
	12-Oct	10:20	8.95	91.04	
	13-Oct	10:18	8.99	91	
	14-Oct	11:05	9.1	90.89	
	17-Oct	10:21	9.34	90.65	
	18-Oct	9:39	9.39	90.6	
	19-Oct	10:21	9.46	90.53	
	24-Oct	10:31	9.8	90.19	
	26-Oct	11:11	9.91	90.08	
	27-Oct	8:30	9.9	90.09	
	28-Oct	11:04	9.91	90.08	
	31-Oct	10:21	10.05	89.94	
	1-Nov	10:33	10.27	89.72	
	2-Nov	10:19	10.32	89.67	
	3-Nov	10:32	10.4	89.59	
	4-Nov	10:21	10.45	89.54	
	8-Nov	10:20	10.73	89.26	
	9-Nov	10:51	10.79	89.2	
	10-Nov	10:30	11.01	88.98	
	14-Nov	11:30	11.07	88.92	
	16-Nov	10:34	11.19	88.8	
	17-Nov	10:15	11.21	88.78	
	18-Nov	10:40	11.25	88.74	
	21-Nov	10:20	11.4	88.59	
	22-Nov	10:47	11.49	88.5	
	23-Nov	10:04	11.5	88.49	
	28-Nov	10:49	11.69	88.3	
	29-Nov	10:14	11.75	88.24	
	30-Nov	10:40	11.86	88.13	
	1-Dec	10:54	11.86	88.13	
	6-Dec	10:35	12.02	87.97	
	8-Dec	10:47	12.11	87.88	
	12-Dec	11:14	12.15	87.84	
	20-Dec	10:39	12.5	87.49	
	1995				
	10-Jan	11:19	13.02	86.97	
	12-Jan	10:36	13.01	86.98	
	16-Jan	10:45	13.12	86.87	
	20-Jan	11:12	13.12	86.87	
	24-Jan	13:39	13.15	86.84	
	26-Jan	13:03	13.15	86.84	
	8-Feb	11:38	12.92	87.07	slight recovery in first part of Feb

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
P4 cont'd	1994				
	9-Feb	13:09	12.96	87.03	
	15-Feb	13:01	13.11	86.88	
	17-Feb	13:04	13.25	86.74	
	1-Mar	8:56	13.32	86.67	
	15-Mar	13:53	13.57	86.42	
	22-Mar	11:04	13.63	86.36	
	5-Apr	9:50	13.89	86.1	
	12-Apr	12:25	13.97	86.02	
	11-May	12:47	13.43	86.56	water table rising
	19-May	16:27	12.37	87.62	
	23-May	10:22	12.07	87.92	
	31-May	14:56	11.57	88.42	
	6-Jun	13:46	11.19	88.8	
	28-Jun	10:23	10.11	89.88	
	17-Jul		9.6	90.39	
	21-Aug	20:35	7.9	92.09	
	30-Sep	11:17	9.07	90.92	water table declining
	17-Oct	15:05	10.02	89.97	
	14-Nov				DECOMMISSIONED

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
MH	1994				MP ELEVATION = 99.30
	6-Sep	9:15	7.79	91.51	water table declining
	8-Sep	9:41	7.81	91.49	
	9-Sep	10:30	7.85	91.45	
	12-Sep	10:10	7.9	91.4	
	13-Sep	10:10	7.6	91.7	water table rising
	15-Sep	10:21	7.45	91.85	
	16-Sep	10:17	7.5	91.8	
	19-Sep	10:53	7.3	92	
	23-Sep	10:17	7.4	91.9	water table declining
	26-Sep	11:00	7.85	91.45	
	27-Sep	10:33	7.7	91.6	
	28-Sep	10:12	7.7	91.6	
	29-Sep	8:16	8.04	91.26	
	3-Oct	10:13	8.1	91.2	
	6-Oct	10:55	8.13	91.17	
	7-Oct	10:15	8.17	91.13	
	10-Oct	10:24	8.31	90.99	
	11-Oct	10:15	8.4	90.9	
	12-Oct	10:14	8.45	90.85	
	13-Oct	10:14	8.55	90.75	
	14-Oct	11:01	8.6	90.7	
	17-Oct	10:15	8.76	90.54	
	18-Oct	11:12	8.87	90.43	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]					
	19-Oct	10:16	8.9	90.4	
	24-Oct	10:26	9.31	89.99	
	26-Oct	11:07	9.45	89.85	
	27-Oct	8:33	9.46	89.84	
	1-Nov	10:26	9.79	89.51	
	2-Nov	10:13	9.86	89.44	
	3-Nov	10:24	9.82	89.48	
	7-Nov	10:23	10.11	89.19	
	8-Nov	10:15	10.2	89.1	
	9-Nov	10:47	10.22	89.08	
	10-Nov	10:24	10.35	88.95	
	14-Nov	11:23			dry
	[illegible]				
	31-May	14:47			dry
	28-Jun	10:16	9.59	89.71	water table rising
	17-Jul		9.06	90.24	
	21-Aug	20:26	7.55	91.75	
	30-Sep	10:27	8.51	90.79	water table declining
	17-Oct	15:01	9.33	89.97	
	14-Nov				DECOMMISSIONED

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]	[illegible]				MP ELEVATION = 1[illegible].22
	31-May	15:11			dry
	28-Jun	10:30	10.36	89.86	water table rising
	17-Jul		9.85	90.37	
	21-Aug	20:42	8.23	91.99	
	30-Sep	11:06	9.4	90.82	water table declining
	17-Oct	14:58	10.3	89.92	
	14-Nov				DECOMMISSIONED

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]	[illegible]				MP ELEVATION = 1[illegible].12
	31-May	15:10			dry
	28-Jun	10:31	10.33	89.79	water table rising
	17-Jul		9.85	90.27	
	21-Aug	20:43	8.24	91.88	
	30-Sep	11:08	9.41	90.71	water table declining
	17-Oct	14:57	10.28	89.84	
	14-Nov				DECOMMISSIONED

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M4	[illegible]				MP ELEVATION = 100.06
	31-May	14:58			dry
	28-Jun	10:32	10 27	89 79	water table rising
	17-Jul		9 76	90 3	
	21-Aug	20:44	8 17	91 89	
	30-Sep	11:12	9 34	90 72	water table declining
	17-Oct	14:58	10 21	89 85	
	14-Nov				DECOMMISSIONED
WELL I.D.	**DATE**	**TIME**	**DTW**	**WATER TABLE ELEVATION**	**COMMENTS**
M5	[illegible]				MP ELEVATION = 100.21
	31-May	14:57			dry
	28-Jun	10:33	10.32	89 89	water table rising
	17-Jul		9 81	90 4	
	21-Aug	20:36	7 9	92 31	
	30-Sep	11:15	9 08	91 13	water table declining
	17-Oct	14:55	9 93	90 28	
	14-Nov				DECOMMISSIONED
WELL I.D.	**DATE**	**TIME**	**DTW**	**WATER TABLE ELEVATION**	**COMMENTS**
M6	[illegible]				MP ELEVATION = 99.80
	31-May	15:12			dry
	28-Jun	10:27	10 01	89 79	water table rising
	17-Jul		9 5	90 3	
	21-Aug	20:39	7.94	91 86	
	30-Sep	10:57	9 09	90 71	water table declining
	17-Oct	15:10	10	89 8	
	14-Nov				DECOMMISSIONED
WELL I.D.	**DATE**	**TIME**	**DTW**	**WATER TABLE ELEVATION**	**COMMENTS**
M7	[illegible]				MP ELEVATION = 99.96
	28-Jun	10:34	10.13	89 83	
	17-Jul		9 66	90 3	water table rising
	21-Aug	20:33	7 97	91 99	
	30-Sep	11:21	9 1	90 86	
	17-Oct	14:54	10 02	89 94	water table declining
	14-Nov				DECOMMISSIONED

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]	[illegible]				MP ELEVATION = 100.08
	28-Jun	10:35	10.35	89.73	
	17-Jul		9.86	90.22	water table rising
	21-Aug	20:31	8.29	91.79	
	30-Sep	10:36	9.41	90.67	
	17-Oct	15:02	10.31	89.77	water table declining
	14-Nov				DECOMMISSIONED
WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]	[illegible]				MP ELEVATION = 99.40
	31-May	14:43	11.17	88.23	
	28-Jun	10:14	9.76	89.64	water table rising
	17-Jul		9.28	90.12	
	21-Aug	20:24	7.74	91.66	
	30-Sep	10:31	8.85	90.55	water table declining
	17-Oct	15:11	9.72	89.68	
	14-Nov				DECOMMISSIONED
WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M10	[illegible]				MP ELEVATION = 99.58
	31-May	14:44			dry
	28-Jun	10.12	9.98	89.6	water table rising
	17-Jul		9.46	90.12	
	21-Aug	20:21	7.91	91.67	
	30-Sep	10:37	9.03	90.55	water table declining
	17-Oct	15:13	9.91	89.67	
	14-Nov				DECOMMISSIONED
WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M11	[illegible]				MP ELEVATION = 99.98
	1-Mar	8:47	13.41	86.57	
	15-Mar	13:45	13.63	86.35	water table declining
	22-Mar	10:59	13.71	86.27	
	5-Apr	9:46	13.89	86.09	
	12-Apr	12:20	13.96	86.02	
	19-May	16:33	12.47	87.51	water table rising
	23-May	16:13	12.14	87.84	
	31-May	13:00	11.64	88.34	
	28-Jun	10:36	10.14	89.84	
	17-Jul		9.68	90.3	
	21-Aug	20:41	8.08	91.9	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M11 cont'd	1995				
	30-Sep	11:04	9.25	90.73	
	17-Oct	14:51	10.11	89.87	water table declining
					NEW MP ELEVATION = 99.76
	14-Nov	14:57	11.27	88.49	
	8-Dec	13:46	11.77	87.99	
	1996				
	20-Feb	13:07	11.87	87.89	
	23-Mar	12:44	11.81	87.95	
	3-Apr	12:24	12.12	87.64	
	30-May	14:41	11.35	88.41	water table rising
	20-Jun	10:39	9.48	90.28	
	18-Jul		7.86	91.9	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M12					MP ELEVATION = 100.03
	1-Mar	8:46	13.52	86.51	
	15-Mar	13:43	13.74	86.29	water table declining
	22-Mar	10:58	13.82	86.21	
	5-Apr	10:49	14	86.03	
	12-Apr	12:22	14.07	85.96	
	11-May	12:49	13.6	86.43	water table rising
	19-May	18:30	12.59	87.44	
	23-May	10:23	12.27	87.76	
	31-May	14:59	11.75	88.28	
	6-Jun	13:50	11.31	88.72	
	28-Jun	10:26	10.27	89.76	
	17-Jul		9.78	90.25	
	21-Aug	20:38	8.23	91.8	
	30-Sep	11:10	9.37	90.66	water table declining
	17-Oct	14:48	10.23	89.8	
					NEW MP ELEVATION = 99.83
	14-Nov	14:56	11.38	88.45	
	8-Dec	13:44	11.88	87.95	
	1996				
	20-Feb	13:05	11.97	87.86	
	23-Mar	12:46	11.91	87.92	
	3-Apr	14:23	12.22	87.61	
	30-May	14:42	11.46	88.37	water table rising
	20-Jun	10:38	9.57	90.26	
	18-Jul		7.91	91.92	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
MW13	1995				MP ELEVATION = 100.13
	1-Mar	8:44	13.6	86.53	
	15-Mar	13:41	13.82	86.31	water table declining
	22-Mar	10:57	13.91	86.22	
	5-Apr	9:48	14.09	86.04	
	12-Apr	12:23	14.16	85.97	
	11-May	12:48	13.69	86.44	water table rising
	19-May	16:29	12.67	87.46	
	23-May	10:20	12.36	87.77	
	31-May	14:54	11.84	88.29	
	6-Jun	13:48	11.4	88.73	
	28-Jun	10:25	10.36	89.77	
	17-Jul		9.89	90.24	
	21-Aug	20:37	8.31	91.82	
	30-Sep	11:14	9.45	90.68	water table declining
	17-Oct	14:50	10.31	89.82	
					NEW MP ELEVATION = 99.89
	14-Nov	14:55	11.42	88.47	
	8-Dec	13:43	11.93	87.96	
	1996				
	20-Feb	13:04	12.01	87.88	
	23-Mar	12:48	11.96	87.93	
	3-Apr	14:22	12.26	87.63	
	30-May	14:43	11.51	88.38	water table rising
	20-Jun	10:37	9.6	90.29	
	18-Jul		8.02	91.87	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
MW14	1995				MP ELEVATION = 99.88
	1-Mar	8:07	13.29	86.59	
	15-Mar	13:39	13.52	86.36	water table declining
	22-Mar	10:55	13.6	86.28	
	5-Apr	9:49	13.78	86.1	
	12-Apr	12:24	13.85	86.03	
	11-May	12:48	13.39	86.49	water table rising
	19-May	16:28	12.34	87.54	
	23-May	10:21	12.05	87.83	
	31-May	14:55	11.55	88.33	
	6-Jun	13:47	11.11	88.77	
	28-Jun	10:24	10.02	89.86	
	17-Jul		9.54	90.34	
	21-Aug	20:34	7.91	91.97	
	30-Sep	11:18	9.07	90.81	water table declining
	17-Oct	14:53	9.94	89.94	
					NEW MP ELEVATION = 99.87
	14-Nov	14:53	11.31	88.56	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible] cont'd	1995				
	8-Dec	13:40	11 84	88 03	
	1996				
	20-Feb	13:03	11 93	87 94	
	23-Mar	12:49	11 88	87 99	
	3-Apr	14:20	12 17	87 7	
	30-May	14:44	11 42	88 45	water table rising
	20-Jun	10:36	9 48	90 39	
	18-Jul		7 89	91 98	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]	1995				MP ELEVATION = [illegible]
	1-Mar	8:36	13 32	86 54	
	15-Mar	8:35	13 55	86.31	water table declining
	22-Mar	10:48	13 63	86 23	
	5-Apr	9:37	13 81	86 05	
	12-Apr	12:18	13 88	85 98	
	11-May	12:41	13 4	86 46	water table rising
	19-May	16:22	12 4	87 46	
	23-May	10:15	12 09	87 77	
	31-May	14:48	11 54	88 32	
	6-Jun	13:41	11 09	88 77	
	28-Jun	10:18	10 06	89 8	
	17-Jul		9 6	90 26	
	21-Aug	20:27	8.02	91 84	
	30-Sep	10:50	9 16	90 7	water table declining
	17-Oct	14:48	10 03	89 83	
					NEW MP ELEVATION = 99.52
	14-Nov	14:49	11 07	88 45	
	8-Dec	13:29	11 53	87 99	
	1996				
	20-Feb	9:15	11 6	87 92	
	23-Mar	12:40	11.56	87 96	
	3-Apr	14:27	11 86	87 66	
	30-May	14:25	11 1	88 42	water table rising
	20-Jun	10:30	9 23	90 29	
	18-Jul		7 59	91 93	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]	1995				MP ELEVATION = [illegible]
	1-Mar	8:37	12 98	86 5	
	15-Mar	13:37	13 2	86 28	water table declining
	22-Mar	10:48	13 27	86.21	
	5-Apr	10:53	13 46	86 02	
	12-Apr	12:17	13 52	85 96	

APPENDIX E

POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M16 cont'd	1995				
	11-May	12 42	13 05	86 43	water table rising
	19-May	16 23	12 05	87 43	
	23-May	10 16	11 74	87 74	
	31-May	14 49	11 2	88 28	
	6-Jun	13 42	10 9	88 58	
	28-Jun	10 19	9 74	89 74	
	17-Jul		9 23	90 25	
	21-Aug	20 28	7 72	91 76	
	30-Sep	10 47	8 86	90 62	water table declining
	17-Oct	14 44	9 71	89 77	
					NEW MP ELEVATION = 99.49
	14-Nov	14 50	11 06	88 43	
	8-Dec	13 31	11 55	87 94	
	1996				
	20-Feb	13 00	11 63	87 86	
	23-Mar	13 01	11 58	87 91	
	3-Apr	14 31	11 88	87 61	
	30-May	14 27	11 12	88 37	water table rising
	20-Jun	10 32	9 24	90 25	
	18-Jul		7 64	91 85	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M17	1995				MP ELEVATION = 99.88
	1-Mar	8 39	13 4	86 48	
	15-Mar	13 35	13 63	86 25	water table declining
	22-Mar	10 52	13 69	86 19	
	5-Apr	9 45	13 87	86 01	
	12-Apr	12 16	13 95	85 93	
	11-May	12 43	13 49	86 39	water table rising
	19-May	16 24	12 47	87 41	
	23-May	10 17	12 16	87 72	
	31-May	14 50	11 63	88 25	
	6-Jun	13 43	11 21	88 67	
	28-Jun	10 20	10 19	89 69	
	17-Jul		9 7	90 18	
	21-Aug	20 29	8 16	91 72	
	30-Sep	10 45	9 3	90 58	water table declining
	17-Oct	14 43	10 15	89 73	
					NEW MP ELEVATION = 99.57
	14-Nov	14 51	11 18	88 39	
	8-Dec	13 33	11 67	87 9	
	1996				
	20-Feb	13 01	11 75	87 82	
	23-Mar	12 54	11 71	87 86	
	23-May	10 17	12 16	87 72	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
MH7 cont'd	1996				
	3-Apr	14:33	12	87.57	
	30-May	14:28	11.25	88.32	water table rising
	20-Jun	10:33	9.36	90.21	
	18-Jul		7.8	91.77	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
MH8	1995				MP ELEVATION = 99.72
	1-Mar	8:41	13.27	86.45	
	15-Mar	13:33	13.49	86.23	water table declining
	22-Mar	10:54	13.56	86.16	
	5-Apr	9:44	13.74	85.98	
	12-Apr	12:15	13.81	85.91	
	11-May	12:44	13.36	86.36	water table rising
	19-May	16:25	12.34	87.38	
	23-May	10:18	12.03	87.69	
	31-May	14:51	11.51	88.21	
	6-Jun	13:44	11.07	88.65	
	28-Jun	10:21	10.06	89.66	
	17-Jul		9.56	90.16	
	21-Aug	20:30	8.05	91.67	
	30-Sep	10:42	9.16	90.56	water table declining
	17-Oct	14:41	10.02	89.7	
					NEW MP ELEVATION = 99.51
	14-Nov	14:53	11.15	88.36	
	8-Dec	13:38	11.62	87.89	
	1996				
	20-Feb	13:02	11.7	87.81	
	23-Mar	12:52	11.68	87.83	
	3-Apr	14:34	11.97	87.54	
	30-May	14:29	11.21	88.3	water table rising
	20-Jun	10:36	9.32	90.19	
	18-Jul		7.85	91.66	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
MH9	1995				MP ELEVATION = 99.29
	1-Mar	8:49	12.8	86.49	
	15-Mar	13:23	13.02	86.27	water table declining
	22-Mar	10:45	13.08	86.21	
	5-Apr	9:38	13.26	86.03	
	12-Apr	12:06	13.33	85.96	
	11-May	12:40	12.87	86.42	water table rising
	19-May	16:21	11.86	87.43	
	23-May	10:14	11.55	87.74	
	31-May	10:35	11.02	88.27	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M15 cont'd	1995				
	6-Jun	13:40	10.54	88.75	
	28-Jun	10:17	9.53	89.76	
	17-Jul		9.03	90.26	
	19-Aug		7.54	91.75	
	21-Aug	20:48	7.51	91.78	
	30-Sep		8.68	90.61	water table declining
	17-Oct	14:35	9.91	89.38	
					NEW MP ELEVATION = 99.27
	14-Nov	14:47	10.86	88.41	
	8-Dec	13:14	11.35	87.92	
	1996				
	20-Feb	12:42	11.43	87.84	
	23-Mar	13:04	11.4	87.87	
	3-Apr	14:40	11.7	87.57	
	30-May	14:33	10.93	88.34	water table rising
	20-Jun	10:27	9.06	90.21	
	18-Jul		7.5	91.77	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M-20	1995				MP ELEVATION = 99.20
	1-Mar	8:51	12.73	86.47	
	15-Mar	13:25	12.95	86.25	water table declining
	22-Mar	10:43	13.04	86.16	
	5-Apr	9:39	13.21	85.99	
	12-Apr	12:07	13.28	85.92	
	11-May	12:39	12.83	86.37	water table rising
	19-May	16:20	11.81	87.39	
	23-May	10:13	11.51	87.69	
	31-May	14:45	10.97	88.23	
	6-Jun	13:34	10.54	88.66	
	28-Jun	10:15	9.54	89.66	
	17-Jul		9.08	90.12	
	21-Aug	20:25	7.52	91.68	
	30-Sep	10:29	8.64	90.56	water table declining
	17-Oct	14:36	9.5	89.7	
					NEW MP ELEVATION = 99.20
	14-Nov	14:39	10.84	88.36	
	8-Dec	13:10	11.32	87.88	
	1996				
	20-Feb	12:59	11.4	87.8	
	23-Mar	13:50	11.33	87.87	
	3-Apr	14:38	11.67	87.53	
	30-May	14:32	10.91	88.29	water table rising
	20-Jun	10:31	9.04	90.16	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
MW1	1995				MP ELEVATION = 99.20
	1-Mar	8 53	12 77	86 43	
	15-Mar	13 26	12 99	86 21	water table declining
	22-Mar	10 41	13 06	86 14	
	5-Apr	9 40	13 24	85 96	
	12-Apr	12 08	13 31	85 89	
	11-May	12 38	12 85	86 35	water table rising
	19-May	16 19	11 84	87 36	
	23-May	10 12	11.54	87 66	
	31-May	14 42	11 01	88 19	
	6-Jun	13 33	10 58	88 62	
	28-Jun	10 13	9 58	89 62	
	17-Jul		9 08	90 12	
	21-Aug	20 23	7 58	91 62	
	30-Sep	10 33	8 68	90 52	water table declining
	17-Oct	14 37	9 55	89 65	
					NEW MP ELEVATION = 99.20
	14-Nov	14 36	10 88	88 32	
	6-Dec	13 07	11 35	87 85	
	1996				
	20-Feb	12 56	11 43	87 77	
	23-Mar	13 11	11 41	87 79	
	3-Apr	14 37	11 69	87 51	
	30-May	14 31	10 95	88 25	water table rising
	20-Jun	10 34	9.05	90 15	
	18-Jul		7.74	91 46	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
MW2	1995				MP ELEVATION = 99.88
	1-Mar	8 54	13 4	86 48	
	15-Mar	13 28	13 62	86 26	water table declining
	22-Mar	10 40	13 69	86 19	
	5-Apr	9 41	13 87	86 01	
	12-Apr	12 09	13 93	85 95	
	11-May	12 37	13 48	86 4	water table rising
	19-May	16 16	12 47	87 41	
	23-May	10 11	12 17	87 71	
	31-May	14 41	11 63	88 25	
	6-Jun	13 32	11 21	88 67	
	28-Jun	10 13	10 21	89 67	
	17-Jul		9 73	90 15	
	21-Aug	20 22	8 19	91 69	
	30-Sep	10 35	9 31	90 57	water table declining
	17-Oct	14 36	11 01	88 87	
					NEW MP ELEVATION = 99.35
	14-Nov	14 38	11 01	88 34	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M22 cont'd	1995				
	8-Dec	13:04	11.5	87.85	
	1996				
	20-Feb	12:57	11.58	87.77	
	23-Mar	13:08	11.55	87.8	
	3-Apr	14:36	11.93	87.42	
	30-May	14:30	11.09	88.26	water table rising
	20-Jun	10:35	9.2	90.15	
	18-Jul		7.83	91.52	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M23	1996				MP ELEVATION = 102.01
	1-Mar	8:42	15.57	86.44	
	16-Mar	13:30	15.79	86.22	water table declining
	22-Mar	10:39	15.86	86.15	
	5-Apr	9:43	16.03	85.98	
	12-Apr	12:09	16.1	85.91	
	11-May	12:36	15.65	86.36	water table rising
	19-May	16:17	14.64	87.37	
	23-May	10:10	14.39	87.62	
	31-May	14:40	13.81	88.2	
	6-Jun	13:30	13.38	88.63	
	28-Jun	10:11	12.38	89.63	
	17-Jul		11.9	90.11	
	21-Aug	20:20	10.35	91.66	
	30-Sep	10:39	11.47	90.54	water table declining
	17-Oct	14:40	12.33	89.68	
	14-Nov				DECOMMISSIONED

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M24	1996				MP ELEVATION = [illegible].78
	21-Feb	13:46	13.2	86.58	
	22-Feb	10:33	13.2	86.58	water table declining
	27-Feb	12:31	13.27	86.51	
	1-Mar	8:34	13.28	86.5	
	7-Mar	12:52	13.4	86.38	
	9-Mar	13:13	13.46	86.32	
	15-Mar	11:06	13.53	86.25	
	22-Mar	10:31	13.6	86.18	
	5-Apr	9:36	13.77	86.01	
	12-Apr	12:05	13.84	85.94	
	11-May	12:31	13.34	86.44	water table rising
	19-May	16:12	12.37	87.41	
	23-May	10:05	12.06	87.72	
	31-May	14:34	11.51	88.27	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible] cont'd	1995				
	6-Jun	13:08	11.06	88.72	
	28-Jun	10:06	10.07	89.71	
	17-Jul		9.6	90.18	
	21-Aug	20:13	8.04	91.74	
	30-Sep	10:02	9.2	90.58	water table declining
	17-Oct	14:33	10.05	89.73	
					NEW MP ELEVATION = 99.34
	14-Nov	14:28	10.98	88.36	
	8-Dec	12:40	11.46	87.88	
	1996				
	20-Feb	12:50	11.57	87.77	
	23-Mar	13:08	11.5	87.84	
	3-Apr	14:47	11.79	87.55	
	30-May	14:24	11.03	88.31	water table rising
	20-Jun	10:21	9.18	90.18	
	18-Jul		7.81	91.53	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]	1995				MP ELEVATION = 99.61
	1-Mar	8:32	13.14	86.47	
	15-Mar	8:36	13.37	86.24	water table declining
	22-Mar	10:33	13.44	86.17	
	5-Apr	9:35	13.62	85.99	
	12-Apr	12:04	13.68	85.93	
	11-May	12:32	13.21	86.4	water table rising
	19-May	16:13	12.21	87.4	
	23-May	10:06	11.91	87.7	
	31-May	14:31	11.68	87.93	
	6-Jun	13:09	10.91	88.7	
	28-Jun	10:07	9.93	89.68	
	17-Jul		9.48	90.13	
	21-Aug	20:11	7.93	91.68	
	30-Sep	10:00	9.07	90.54	water table declining
	17-Oct	14:31	9.92	89.69	
					NEW MP ELEVATION = 99.38
	14-Nov	15:00	11.02	88.38	
	8-Dec	12:42	11.51	87.87	
	1996				
	20-Feb	12:51	11.57	87.81	
	23-Mar	13:05	11.54	87.84	
	3-Apr	14:46	11.82	87.56	
	30-May	14:22	11.07	88.31	water table rising
	20-Jun	10:20	9.23	90.15	
	18-Jul		7.81	91.57	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M26	1995				MP ELEVATION = 99.33
	1-Mar	8 30	12 93	86 4	
	15-Mar	11 05	13 15	86 18	water table declining
	22-Mar	10 34	13.22	86 11	
	5-Apr	9 34	13 4	85 93	
	12-Apr	12 03	13 47	85 86	
	11-May	12 33	13 01	86 32	water table rising
	19-May	16 14	12 01	87 32	
	23-May	10 07	11 7	87 63	
	31-May	14 37	11 15	88 18	
	6-Jun	13 10	10 73	88 6	
	28-Jun	10 08	9 75	89 58	
	17-Jul		9 3	90 03	
	19-Aug		7 72	91 61	
	21-Aug	20 12	7 77	91 56	
	30-Sep	9 57	8 89	90 44	water table declining
	17-Oct	14 45	9 75	89 58	
					NEW MP ELEVATION = 99.13
	14-Nov	14 30	10 88	88 25	
	8-Dec	12 48	11 32	87 81	
	1996				
	20-Feb	12 53	11 39	87 74	
	23-Mar	13 18	11 37	87 76	
	3-Apr	14 45	11 65	87 48	
	30-May	9 24	10 92	88 21	water table rising
	20-Jun	10 19	9 03	90 1	
	18-Jul		7 65	91 73	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M27	1995				MP ELEVATION = 99.56
	1-Mar	8 28	13 21	86 35	
	15-Mar	11 03	13 44	86 12	water table declining
	22-Mar	10 36	13 5	86 06	
	5-Apr	9 26	13 67	85 89	
	12-Apr	12 02	13 74	85 82	
	11-May	12 34	13 3	86 26	water table rising
	19-May	16 15	12 29	87 27	
	23-May	10 08	11 99	87 57	
	31-May	14 38	11 44	88 12	
	6-Jun	13 11	11 05	88 51	
	28-Jun	10 09	10 07	89 49	
	17-Jul		9 62	89 94	
	21-Aug	20 08	8 11	91 45	
	30-Sep	9 55	9 2	90 36	water table declining
					NEW MP ELEVATION = 99.16

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]	[illegible]				
	17-Oct	14:29	10 08	89 5	
	14-Nov	14:32	10 98	88 2	
	6-Dec	12:49	11 44	87 74	
	1996				
	20-Feb	12:54	11 5	87 68	
	23-Mar	13:22	11 5	87 68	
	3-Apr	14:58	11 78	87 4	
	30-May	9:23	11.05	88 13	water table rising
	20-Jun	10:16	9 15	90 03	
	18-Jul		7 8	91 38	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
[illegible]	[illegible]				MP ELEVATION = [illegible]
	21-Feb	13:47	15 47	86 41	
	22-Feb	10:35	15 5	86 38	water table declining
	27-Feb	12 27	15 55	86 33	
	1-Mar	8:27	15 55	86 33	
	7-Mar	12:49	15 65	86 23	
	9-Mar	13:13	15 67	86 21	
	15-Mar	11:02	15 77	86 11	
	22-Mar	10:37	15 84	86 04	
	5-Apr	9:25	16 01	85 87	
	12-Apr	12:01	16 07	85 81	
	11-May	12:35	15 63	86 25	water table rising
	19-May	16:16	14 63	87 25	
	23-May	10:09	14 33	87 56	
	31-May	14:39	13 78	88 1	
	6-Jun	13:12	13 37	88 51	
	28-Jun	10:10	12 43	89 45	
	17-Jul		12 02	89 86	
	21-Aug	20:06	10 48	91 4	
	30-Sep	9:53	11 56	90 32	water table declining
	17-Oct	14:28	12 42	89 46	
					NEW MP ELEVATION = 101.46
	14-Nov	14:33	13 3	88 16	
	6-Dec	12:53	13 75	87 71	
	1996				
	20-Feb	12:55	13 82	87 64	
	23-Mar	13:28	13 81	87 65	
	3-Apr	14:58	14 09	87 37	
	30-May	9:22	13 37	88 09	water table rising
	20-Jun	10:17	11 47	89 99	
	18-Jul		10 08	91 38	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M-29	**1995**				**MP ELEVATION = 99.88**
	1-Mar	8:20	13.46	86.42	
	15-Mar	10:55	13.68	86.2	water table declining
	22-Mar	10:28	13.75	86.13	
	5-Apr	9:21	13.92	85.96	
	12-Apr	11:57	13.99	85.89	
	11-May	12:30	13.53	86.35	water table rising
	19-May	16:11	12.54	87.34	
	23-May	10:04	12.23	87.65	
	31-May	14:33	11.68	88.2	
	6-Jun	13:07	11.26	88.62	
	28-Jun	10:05	10.29	89.59	
	17-Jul		9.78	90.1	
	21-Aug	20:02	8.3	91.58	
	30-Sep	9:42	9.41	90.47	water table declining
	17-Oct	14:20	10.28	89.6	
					NEW MP ELEVATION = 99.78
	14-Nov	14:26	11.49	88.29	
	8-Dec	12:37	11.97	87.81	
	1996				
	20-Feb	12:49	12.03	87.75	
	23-Mar	13:30	12.03	87.75	
	3-Apr	14:48	12.32	87.46	
	30-May	9:16	11.58	88.2	water table rising
	20-Jun	10:11	9.71	90.07	
	18-Jul		8.22	91.56	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M30	**1995**				**MP ELEVATION = 100.42**
	1-Mar	8:21	14.08	86.34	
	15-Mar	10:57	14.3	86.12	water table declining
	22-Mar	10:26	14.36	86.06	
	5-Apr	9:22	14.53	85.89	
	12-Apr	11:58	14.6	85.82	
	11-May	12:29	14.16	86.26	water table rising
	19-May	16:10	13.16	87.26	
	23-May	10:03	12.85	87.57	
	31-May	14:32	12.31	88.11	
	6-Jun	13:06	11.9	88.52	
	28-Jun	10:04	10.95	89.47	
	17-Jul		10.44	89.98	
	21-Aug	20:03	8.98	91.44	
	30-Sep	9:45	10.07	90.35	water table declining
	17-Oct	14:23	10.94	89.48	
					NEW MP ELEVATION = 99.86

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M30	**1995**				
	14-Nov	14:25	11.68	88.17	
	8-Dec	12:35	12.12	87.73	
	1996				
	20-Feb	13:48	12.17	87.68	
	23-Mar	13:29	12.2	87.65	
	3-Apr	14:48	12.48	87.37	
	30-May	9:19	11.75	88.1	water table rising
	20-Jun	10:12	9.86	89.99	
	18-Jul		8.44	91.41	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M-31	**1995**				**MP ELEVATION = 99.76**
	1-Mar	8:23	13.45	86.31	
	15-Mar	10:58	13.66	86.1	water table declining
	22-Mar	10:25	13.73	86.03	
	5-Apr	9:23	13.91	85.85	
	12-Apr	11:59	13.97	85.79	
	11-May	12:28	13.53	86.23	water table rising
	19-May	16:09	12.54	87.22	
	23-May	10:02	12.22	87.54	
	31-May	14:31	11.68	88.08	
	6-Jun	13:05	11.27	88.49	
	28-Jun	10:03	10.32	89.44	
	17-Jul		9.84	89.92	
	19-Aug		8.35	91.41	
	21-Aug	20:04	8.4	91.36	
	30-Sep	9:47	9.47	90.29	water table declining
	17-Oct	14:24	10.33	89.43	
					NEW MP ELEVATION = 99.76
	14-Nov	14:17	11.62	88.14	
	8-Dec	12:32	12.06	87.7	
	1996				
	20-Feb	12:44	12.12	87.64	
	23-Mar	13:33	12.11	87.65	
	3-Apr	14:49	12.38	87.38	
	30-May	9:20	11.65	88.11	water table rising
	20-Jun	10:13	9.77	89.99	
	18-Jul		8.39	91.37	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M32	**1995**				**MP ELEVATION = 101.55**
	1-Mar	8:25	15.26	86.29	
	15-Mar	11:00	15.47	86.08	wate table declining
	22-Mar	10:23	15.54	86.01	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M32 cont'd	1995				
	5-Apr	9:24	15.71	85.84	
	12-Apr	12:00	15.78	85.77	
	11-May	12:27	15.34	86.21	water table rising
	19-May	16:08	14.35	87.2	
	23-May	10:01	14.04	87.51	
	31-May	14:29	13.5	88.05	
	6-Jun	13:04	13.08	88.47	
	28-Jun	10:02	12.17	89.38	
	17-Jul		11.73	89.82	
	21-Aug	20:05	10.23	91.32	
	30-Sep	9:50	11.31	90.24	water table declining
	17-Oct	14:28	12.14	89.41	
					NEW MP ELEVATION = 101.34
	14-Nov	14:18	13.23	88.11	
	8-Dec	12:30	13.67	87.67	
	1996				
	20-Feb	10:43	13.77	87.57	
	23-Mar	13:35	13.72	87.62	
	3-Apr	14:50	13.99	87.35	
	30-May	9:21	13.26	88.08	water table rising
	20-Jun	10:14	11.38	89.96	
	18-Jul		10.01	91.33	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M33	1995				MP ELEVATION = 100.96
	1-Mar	8:18	14.68	86.28	
	15-Mar	10:53	14.9	86.06	water table declining
	22-Mar	10:21	14.96	86	
	5-Apr	9:30	15.12	85.84	
	12-Apr	11:58	15.19	85.77	
	11-May	12:28	14.76	86.2	water table rising
	19-May	16:07	13.77	87.19	
	23-May	10:00	13.46	87.5	
	31-May	14:28	12.91	88.05	
	6-Jun	13:03	12.51	88.45	
	28-Jun	9:59	11.59	89.37	
	17-Jul		11.11	89.85	
	21-Aug	19:55	9.68	91.28	
	30-Sep	9:31	10.75	90.21	water table declining
	17-Oct	14:19	11.61	89.35	
					NEW MP ELEVATION = 100.96
	14-Nov	14:15	12.87	88.08	
	8-Dec	12:27	13.31	87.64	
	1996				
	20-Feb	10:42	13.39	87.58	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M33 cont'd	**1996**				
	23-Mar	13:38	13.36	87.59	
	3-Apr	14:54	13.63	87.32	
	30-May	9:17	12.91	88.04	water table rising
	20-Jun	10:09	11.05	89.9	
	18-Jul		9.67	91.28	
WELL I.D.	**DATE**	**TIME**	**DTW**	**WATER TABLE ELEVATION**	**COMMENTS**
M34	**1995**				**MP ELEVATION = 102.04**
	1-Mar	8:16	15.75	86.29	
	15-Mar	10:52	15.96	86.08	water table declining
	22-Mar	10:19	16.03	86.01	
	5-Apr	9:31	16.2	85.84	
	12-Apr	11:54	16.26	85.78	
	11-May	12:25	15.83	86.21	water table rising
	19-May	16:05	14.84	87.2	
	23-May	9:59	14.52	87.52	
	31-May	14:27	13.98	88.06	
	6-Jun	13:01	13.58	88.46	
	28-Jun	9:58	12.66	89.38	
	17-Jul		12.2	89.84	
	21-Aug	19:54	10.74	91.3	
	30-Sep	9:28	11.8	90.24	water table declining
	17-Oct	14:18	12.68	89.36	
					NEW MP ELEVATION = 101.67
	14-Nov	14:13	13.58	88.09	
	8-Dec	12:24	14.02	87.65	
	1996				
	20-Feb	10:40	14.1	87.57	
	23-Mar	13:39	14.08	87.59	
	3-Apr	14:53	14.35	87.32	
	30-May	9:16	13.64	88.03	water table rising
	20-Jun	10:08	11.75	89.92	
	18-Jul		10.4	91.27	
WELL I.D.	**DATE**	**TIME**	**DTW**	**WATER TABLE ELEVATION**	**COMMENTS**
M35	**1995**				**MP ELEVATION = 101.97**
	1-Mar	8:14	15.68	86.29	
	15-Mar	10:50	15.9	86.07	water table declining
	22-Mar	10:17	15.97	86	
	5-Apr	9:19	16.14	85.83	
	12-Apr	11:53	16.2	85.77	
	11-May	12:24	15.77	86.2	water table rising
	19-May	16:03	14.78	87.19	
	23-May	9:58	14.46	87.51	

APPENDIX E

POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M35 cont'd	**1995**				
	31-May	14:23	13.92	88.05	
	6-Jun	13:00	13.52	88.45	
	28-Jun	9:57	12.6	89.37	
	17-Jul		12.16	89.81	
	21-Aug	19:53	10.67	91.3	
	30-Sep	9:23	11.74	90.23	water table declining
	17-Oct	14:17	12.61	89.36	
					NEW MP ELEVATION = 101.57
	14-Nov	14:24	13.48	88.09	
	8-Dec	12:22	13.92	87.65	
	1996				
	20-Feb	10:39	13.99	87.58	
	23-Mar	13:43	13.99	87.58	
	3-Apr	14:51	14.25	87.32	
	30-May	9:15	13.53	88.04	water table rising
	20-Jun	10:07	11.65	89.92	
	18-Jul		10.29	91.28	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M36	**1995**				**MP ELEVATION = 103.58**
	21-Feb	13:48	17.24	86.34	
	22-Feb	10:39	17.25	86.33	water table declining
	27-Feb	12:29	17.3	86.28	
	1-Mar	8:12	17.31	86.27	
	7-Mar	12:50	17.41	86.17	
	9-Mar	13:14	17.5	86.08	
	15-Mar	10:48	17.53	86.05	
	22-Mar	10:15	17.59	85.99	
	5-Apr	9:17	17.76	85.82	
	12-Apr	11:51	17.82	85.76	
	11-May	12:23	17.39	86.19	water table rising
	19-May	16:01	16.4	87.18	
	23-May	9:57	16.07	87.51	
	31-May	14:25	15.54	88.04	
	6-Jun	12:58	15.14	88.44	
					NEW MP ELEVATION = 102.75
	14-Nov	14:06	14.71	88.04	water table declining
	8-Dec	12:18	15.14	87.61	
	1996				
	20-Feb				snowed under
	23-Mar	13:41	15.19	87.56	
	3-Apr	14:52	15.46	87.29	
	30-May	9:13	14.74	88.01	water table rising
	20-Jun	10:06	12.88	89.87	
	18-Jul		11.54	91.21	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M37	1995				MP ELEVATION = 102.33
	1-Mar	8:02	15.99	86.34	
	15-Mar	17:01	16.2	86.13	water table declining
	22-Mar	10:12	16.27	86.06	
	5-Apr	9:15	16.45	85.88	
	12-Apr	12:13	16.51	85.82	
	11-May	12:21	16.04	86.29	water table rising
	19-May	15:59	15.03	87.3	
	23-May	9:51	14.72	87.61	
	31-May	14:16	14.19	88.14	
	6-Jun	12:56	13.79	88.54	
	28-Jun	9:55	12.84	89.49	
	17-Jul		12.4	89.93	
	21-Aug	19:46	10.85	91.48	
	30-Sep	12:16	11.93	90.4	water table declining
	17-Oct	14:15	12.8	89.53	
					NEW MP ELEVATION = 102.26
	14-Nov	15:02	14.07	88.19	
	8-Dec	12:59	14.54	87.72	
	1996				
	20-Feb	10:34	14.6	87.66	
	23-Mar	13:47	14.6	87.66	
	13-Apr	15:00	14.81	87.45	
	30-May	14:45	14.12	88.14	water table rising
	20-Jun	10:04	12.24	90.02	
	18-Jul		10.78	91.48	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M38	1995				MP ELEVATION = 99.18
	8-Dec	13:17	11.25	87.93	
	1996				
	20-Feb	13:12	11.33	87.85	water table declining
	23-Mar	13:03	11.3	87.88	
	13-Apr	14:41	11.61	87.57	
	30-May	14:34	10.83	88.35	water table rising
	20-Jun	10:26	8.99	90.19	
	18-Jul		7.4	91.78	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M39	1995				MP ELEVATION = 99.16
	8-Dec	13:22	11.23	87.93	
	1996				
	20-Feb	13:13	11.3	87.86	water table declining
	23-Mar	13:51	11.29	87.87	
	13-Apr	14:42	11.58	87.58	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
M39 cont'd	1996				
	30-May	14:35	10.82	88.34	water table rising
	20-Jun	10:25	8.97	90.19	
	18-Jul		7.37	91.79	
WELL I.D.	**DATE**	**TIME**	**DTW**	**WATER TABLE ELEVATION**	**COMMENTS**
M40	1995				MP ELEVATION = 99.08
	14-Nov	14:46	10.7	88.38	
	8-Dec	13:24	11.19	87.89	water table declining
	1996				
	20-Feb	11:08	11.28	87.8	
	23-Mar	13:52	11.27	87.81	
	13-Apr	14:43	11.55	87.53	
	30-May	14:36	10.8	88.28	water table rising
	20-Jun	10:24	8.95	90.13	
	18-Jul		7.52	91.56	
WELL I.D.	**DATE**	**TIME**	**DTW**	**WATER TABLE ELEVATION**	**COMMENTS**
M41	1995				MP ELEVATION = 99.05
	14-Nov	14:45	10.73	88.32	
	8-Dec	13:26	11.21	87.84	water table declining
	1996				
	20-Feb	13:17	11.31	87.74	
	23-Mar	13:53	11.3	87.75	
	13-Apr	14:44	11.58	87.47	
	30-May	14:37	10.81	88.24	water table rising
	20-Jun	10:23	8.95	90.1	
	18-Jul		7.53	91.52	
WELL I.D.	**DATE**	**TIME**	**DTW**	**WATER TABLE ELEVATION**	**COMMENTS**
T1	1996				MP ELEVATION = 101.00
	20-Feb	13:15	11.18	89.82	
WELL I.D.	**DATE**	**TIME**	**DTW**	**WATER TABLE ELEVATION**	**COMMENTS**
T2	1996				MP ELEVATION = 99.07
	20-Feb	13:16	11.24	87.83	

APPENDIX E
POTENTIOMETRIC DATA

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
T3	1996				MP ELEVATION = 98.85
	20-Feb	13:18	11.22	87.63	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
T4	1996				MP ELEVATION = 99.32
	20-Feb				snowed under

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
T5					MP ELEVATION = 99.07
	1996				
	20-Feb	13:23	11.32	87.75	

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
T6	1996				MP ELEVATION = 99.00
	20-Feb				snowed under

WELL I.D.	DATE	TIME	DTW	WATER TABLE ELEVATION	COMMENTS
T7	1996				MP ELEVATION = 99.01
	20-Feb	13:22	11.29	87.72	

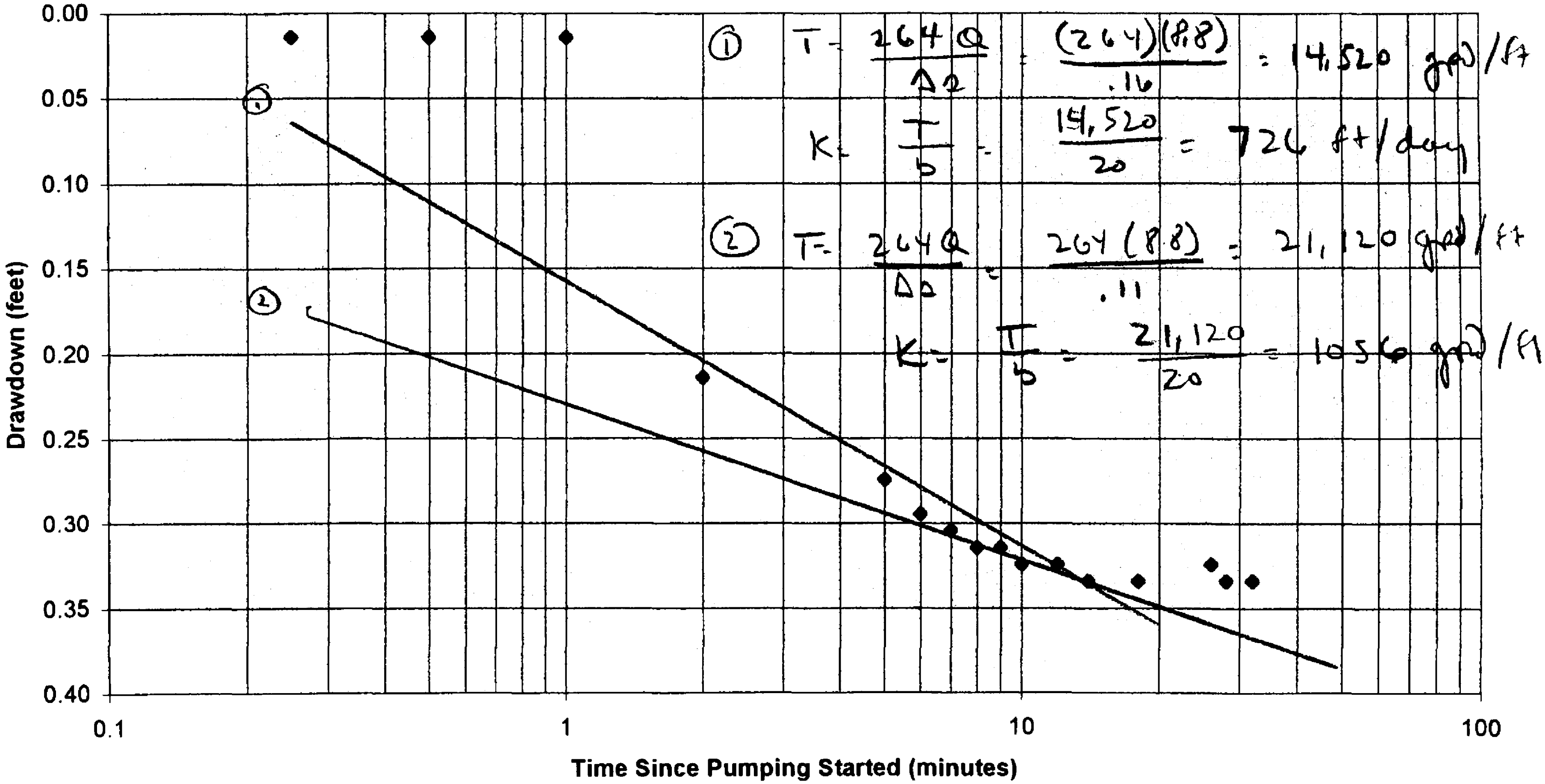
APPENDIX F

Aquifer Test Data
and Analyses

Well M19 Constant Discharge Test

t	Well M38		Well M39		t'	Well M38		Well M39	
(min)	Depth to Water (feet)	Drawdown (feet)	Depth to Water (feet)	Drawdown (feet)	(min)	Depth to Water (feet)	Residual (feet)	Depth to Water (feet)	Residual (feet)
0	13.01	0.00	15.00	0.00	0	13.31	0.3	15.04	0.04
0.25	13.02	0.014	15.00	0.00	0.25	13.13	0.12	15.03	0.03
0.5	13.02	0.014	15.00	0.00	0.5	13.08	0.07	15.02	0.02
1	13.02	0.014	15.00	0.00	0.75	13.05	0.04	15.01	0.01
2	13.22	0.214	15.02	0.02	1	13.04	0.03	15.01	0.01
5	13.28	0.274	15.03	0.03	2	13.02	0.01	15.01	0.01
6	13.30	0.294	15.03	0.03	3	13.01	0	15.00	0.00
7	13.31	0.304	15.04	0.04	4	13.01	0	15.00	0.00
8	13.32	0.314	15.04	0.04	5	13.01	0	15.00	0.00
9	13.32	0.314	15.04	0.04	6	13.01	0	15.00	0.00
10	13.33	0.324	15.04	0.04	10	13.01	0	15.00	0.00
12	13.33	0.324	15.04	0.04	12	13.01	0	15.00	0.00
14	13.34	0.334	15.04	0.04	14	13.01	0	15.00	0.00
18	13.34	0.334	15.04	0.04	16	13.00	-0.01	15.00	0.00
26	13.33	0.324	15.04	0.04	18	13.00	-0.01	15.00	0.00
28	13.34	0.334	15.04	0.04					
32	13.34	0.334	15.04	0.04					

Observation Well M38



APPENDIX G

Bromide Tracer Test Data

APPENDIX G
BROMIDE TRACER TEST DATA

TRENCHTOWN HIGH SCHOOL
BROMIDE TRACER TEST
BROMIDE CONCENTRATIONS (ppm)

ELAPSED TIME (hours)

WELL#	0	9	16	22	29	36	44	55	68	79	94	104	117	127	144	151
19	4130	690	280	240	280	121	52	30	12	8	6	3	3			
38	5250	1950		400		262	160	125	107	82	50	24	10	0		
39							6		2	0.14						
T1							0	24	108	160	132	158	125	93	56	47
40					0	8	124	320	210	142	64	38	19	10.4	5.8	4.4
T2							0	0	0	11	158	240	122	66.4	21.6	15.9
T3							0		0	0	0.7	1.7	4	5.3	7.5	9.6
41							0		0	0	0.5	2.3	10.11	13.4	15	11.6
T4							0		2?	5?	6.8	15.7	25.2	31.6	29.3	26.6
T5							0		0							
T6							0		0							
26							0		0							
T7							0		0							0.5

WELL#	166	175	187	211	224	236	248	260	272	284	296	308	320	333	344	357	368	381	392	404	428
19																					
38																					
39																					
T1	28.3	18	13.9	7.7																	
40	2.6	1.9	2.1	0.9																	
T2	8	4.9	2.5	1.3																	
T3	8.4	8.5	6.4	3.6																	
41	10.11	7.5	10.3	5.7																	
T4	22.3	17.4	14.7	10.1																	
T5								0	0	0	0				0					0	
T6								2.2	1.5	0	0.5	1	1	0.99	1.1	1.4	1.2	1.7?	1.5?	1.7?	?
26				0.25			0		0	0	?				0					?	
T7	1	2	2.5	3.6				9.3	10.6	10.5	10.3	?	8	7.6	10.6	9.3	6.7	7.1	4.9	5.5	3.6

APPENDIX G
BROMIDE TRACER TEST FIELD DATA

FRENCHTOWN HIGH SCHOOL
BROMIDE TRACER TEST
ELECTRICAL CONDUCTANCE FIELD MEASUREMENTS (MICROMHOS)

TIME ELAPSED SINCE BROMIDE INJECTION (hours)

WELL	9	16	22	29	36	44	55	68	79	94	104	117	127	144	152
M19	950	640	575	550	495	442	371	347	342	350	338	334	333	344	323
M38	1410	630	590	575	610	580	510	473	435	398	359	335	323	341	304
M39	375	352	367	365	328	332	322	315	318	322	311	304	305	318	297
TI	332	298	318	338	311	328	375	459	520	485	500	470	404	397	361
M40	305	293	303	319	305	441	500	520	467	370	259	333	314	322	307
T2	318	293	304	311	298	308	317	304	321	468	540	443	377	344	322
T3		343	364	378	350	356	360	350	366	353	349	345	340	352	340
M41			334	363	320	336	331	329	334	345	339	348	343	353	331
T4			383	375	347	362	362	355	370	369	369	389	394	398	382
T5			318	336	305	304	321	311	319	328	330	304	321	329	325
M26			344	361	332	333	349	334	348	341	336	342	341	349	341
T6			450	480	449	452	459	440	474	461	440	433	424	437	423
T7			378	413	388	371	403	368	441	362	380	375	375	381	372
T8															

WELL	162	166	175	187	200	211	224	236	248	260	272	284	296	308	320	333	344	357	368	381	392	404	428	452	477
M19	332	305	339	309	329	321		338	350	328	341	341	331	340		346		360		355		354	342	339	344
M38	310																								
M39																									
TI		347	321	331		310		303					302					318							
M40	289		312	287	311		311	311	302	299	309	308	310	304		318		330		330		328			372
T2		307	301	281		299		290					300					314							
T3		313	332	311		310		313					311					321							
M41	318		330	315	326	311	321	328	320	313	325	315	313	310		304		330		321		319			332
T4		357	370	335		339		327					319					328							
T5		304	302	285		270	369	284	295	279	311	293	288	298	280	260		289	314	295	303	296	287		
M26		319	332	309		322	339	310	312	315	339	319	317	302	319	311		311	337	311	329	309	299		
T6		414	409	390		379	399	391	380	358	380	370	371	359	361	375		342	361	341	360	339	320	329	
T7	345		359	349	370	341	372	363	380	370	370	382	380	362	370	364		379	379	361	359	348	332	332	332
T8																									325

FRENCHTOWN HIGH SCHOOL
BROMIDE TRACER TEST
pH FIELD MEASUREMENTS

TIME ELAPSED SINCE BROMIDE INJECTION (hours)

WELL	9	16	22	29	36	44	55	68	79	94	104	117	127	144	152
M19	6.37		6.1	6.3	6.4	6.5	6.8	6.7	6.7	6.7	6.7	6.5	6.5	6.5	6.9
M38	6.16		6.2	6.4	6.1	6.2	6.3	6.4	6.8	6.2	6.3	6.1	6.3	6.1	6.4
M39	6.01		6.2	6.3	6.2	6.4	6.3	6.4	6.5	6.3	6.4	6.2	6.3	6.2	6.7
TI	6.22		6.3	6.4	6.2	6.3	6.5	6.4	6.7	6.4	6.4	6.4	6.5	6.4	6.7
M40	6.25		6.4	6.6	6.4	6.4	6.6	6.6	6.9	6.7	6.7	6.5	6.6	6.5	6.9
T2	6.41		6.5	6.6	6.5	6.5	6.7	6.8	7.1	6.6	6.5	6.4	6.6	6.6	6.7
T3			6.2	6.4	6.2	6.2	6.4	6.4	6.6	6.6	6.3	6.3	6.4	6.3	6.8
M41			6.4	6.6	6.5	6.5	6.6	6.7	6.7	6.8	6.4	6.4	6.6	6.5	6.5
T4			6.1	6.4	6.2	6.2	6.4	6.4	6.4	7.1	6.4	6.2	6.4	6.4	6.4
T5			6.2	6.4	6.2	6.3	6.5	6.4	6.6	6.8	6	6.2	6.4	6.2	6.8
M26			6.2	6.5	6.2	6.3	6.4	6.6	6.5	6.8	6.4	6.4	6.4	6.3	6.7
T6			6.1	6.3	6.1	6.2	6.3	6.3	6.4	6.5	6.2	6.2	6.3	6.2	6.7
T7			6.2	6.2	6.1	6	6	6.3	6.3	6.3	6.2	6.2	6.2	6.1	6.7
T8															

WELL	162	166	175	167	200	211	224	236	248	260	272	284	296	308	320	333	344	357	368	381	392	404	428	452	477
M19	6.4		6.5	6.6	6.4	6.5		6.9	6.8	7	7	6.8	7	7.3		6.5		6.6		6.3		6.4	6.7	6.6	6.8
M38	6.1																								
M39																									
TI		6.3	6.3	6.4		6.4		6.4					6.8	6.6											
M40	6.6		6.3	6.5	6.4		6.7	6.9	6.7	7.1	7.1	7	7	7		6.3		6.4		6.3		6.4			6.7
T2		6.4	6.6	6.6		6.5		6.5					6.7					6.6							
T3		6.1	6.2	6.4		6.1		6.2					6.8					6.3							
M41	6.3		6.5	6.4	6.3	6.4	6.6	6.9	6.2	6.9	6.9	7	6.8	6.9		6.3		6.4		6.2		6.4			6.8
T4		6.1	6.3	6.3		6.5		6.3					6.9					6.3							
T5		6.1	6.1	6.2		6.2	6.3	6.2	6.2	6.4	6.7	6.4	6.5	6.6	6.2	6.2	6.1	6.3	6.4	6.2	6.3	6.4	6.1		
M26		6.2	6.3	6.3		6.2	6.3	6.2	6.5	6.6	6.7	6.3	6.4	6.9	6.2	6.3	6.3	6.5	6.4	6.3	6.3	6.3	6.4		
T6		6.1	6.3	6.1		6.6	6.3	6.2	6.3	6.5	6.6	6.3	6.6	6.6	6.4	6.1	6.2	6.4	6.4	6.2	6.3	6.2	6.3		6.5
T7	6		6.1	6.3	6	6	6.1	6.2	6.4	6.6	6.7	6.3	6.7	6.6	6.1	6	6.1	6	6.2	6	6.2	6.1	6.3	6.4	6.3
T8																									7

APPENDIX G
BROMIDE TRACER TEST DATA

Hours	Bromide (mg/l) W19	W40	W41	T7
0	4130			
9	690			
12				
16	280			
22	240			
24				
29	280			
36	121	8		
44	52	124		
48				
55	30	320		
60				
68	12	210		
72				
79	8	142		
84				
94	6	64	0 5	
96				
104	3	38	2 3	
108				
117	3	19	10 11	
120				
127		10 4	13 4	
132				
144		5 8	15	
151		4 4	11 6	0 5
156				
166		2 6	10 11	1
168				
175		1 9	7 5	2
180				
187		2 1	10 3	2 6
192				
204				
211		0 9	5 7	3 6
216				
228				
240				
252				
264				
272				10 63
276				
284				10 52
288				
296				
300				
308				
312				
320				8 44
324				
333				7 62
336				
344				10 6
348				
357				9 37
360				
368				6 72
372				
381				7 1
384				
392				4 92
396				
404				5 48
408				
420				
428				3 61
432				

Hours	Temperature (°C) W19	W40	W41	T7	T8
0	14 1	12 8	13 2		
9					
12	15 8	15 5			
16					
22					
24	12 7	12 7			
29					
36	15 1	15 2	15 2	15 6	
44					
48	14 7	13 2	13 4	12 8	
55					
60		14 4	14 9	15 1	
68					
72	14 7	14	13 4	13 6	
79					
84	13 8	13 3	13 8	15 1	
94					
96	14 2	11 9	13 1	13 2	
104					
108	14 6	13 8	14 3	14 6	
117					
120	16 2	14 3	14 3	14 5	
127					
132					
144					
151					
156					
166					
168	15 6	15 1	15	14 5	
175					
180				16 3	
187					
192	16 2	15 4	15 8	16 2	
204				16 3	
211					
216	16 7	15 3	15 5	15 3	
228				16 3	
240	15 6	14 6	14 9	15 3	
252					
264	15			14	
272					
276					
284					
288	15 4			14 6	
296					
300					
308					
312					
320					
324					
333					
336					
344					
348					
357					
360					
368					
372					
381					
384					
392					
396					
404					
408					
420					
428					
432					
444					
456					
468					
480	13 8	13 4	13 5	13 3	13 8

Hours	pH W19	W40	W41	T7	T8
0	6 15	6 55	6 31	6 02	
9					
12	6 48	6 34			
16					
22					
24	6 6	6 52			
29					
36	6 39	6 37	6 34	6 03	
44					
48	6 47	6 46	6 36	5 98	
55					
60		6 72	6 58	6 14	
68					
72	6 85	6 92	6 88	6 17	
79					
84	6 81	6 74	6 2	6 36	
94					
96	6 96	7 09	6 87	6 56	
104					
108	7 03	7 09	6 94	6 65	
117					
120	6 76	6 96	6 95	6 33	
127					
132	6 95	6 99	6 84	6 69	
144	7 3	7 02	6 9	6 59	
151					
156				6 09	
166					
168	6 5	6 31	6 25	6 02	
175					
180				6 11	
187					
192	6 57	6 35	6 37	6 04	
204				6 17	
211					
216	6 3	6 26	6 24	5 99	
228				6 15	
240	6 41	6 4	6 42	6 11	
252					
264	6 72			6 26	
272					
276					
284					
288	6 61			6 37	
296					
300					
308					
312	6 83	6 73	6 82	6 3	7 02
320					
324					
333					
336					
344					
348					
357					
360					
368					
372					
381					
384					
392					
396					
404					
408					
420					
428					
432					
444					
456					
468					
480	6 67	6 57	6 55	6 36	6 64

Hours	D O (mg/L) W19	W40	W41	T7	T8
0	1 5	0 8	1	1	
9					
12	3 1	1 9			
16					
22					
24	2 1	0 7			
29					
36	0 8	0 9	1 3	3 5	
44					
48	1 2	0 8	1 3	3 4	
55					
60		1 6	0 7	3 5	
68					
72	1 4	0 9	1 6	3 5	
79					
84	1	1 1	1 1	2 6	
94					
96	0 9		0 8	2 7	
104					
108	1 8	0 9	0 7	2 4	
117					
120	0 9	0 8	0 8	3 1	
127					
132					
144					
151					
156					
166					
168	0 8	1 8	0 7	2 5	
175					
180				2 4	
187					
192	0 9	0 8	1	3	
204				2 5	
211					
216	1 6	1	0 8	3 4	
228				3 3	
240	0 9	0 8	1	2 2	
252					
264	0 9			2 4	
272					
276					
284					
288	1			2 2	
296					
300					
308					
312					
320					
324					
333					
336					
344					
348					
357					
360					
368					
372					
381					
384					
392					
396					
404					
408					
420					
428					
432					
444					
456					
468					
480					

APPENDIX H

Inorganic Water Quality Analytical Data

APPENDIX H
ANALYTICAL RESULTS
CATIONS

Sample	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Ti	Zn
6M11 2/8	2/13/95	N.D.	N.D.	N.D.	65.3	N.D.	N.D.	N.D.	N.D.	5.452	21.3	2.127	0.0115	12.6	N.D.	0.23	N.D.	10.1	0.1239	N.D.	0.017
6M12 2/8	2/13/95	N.D.	N.D.	0.051	51.7	N.D.	N.D.	N.D.	N.D.	7.994	16.7	5.075	0.0333	55.1	N.D.	0.43	N.D.	10.7	0.1512	N.D.	0.0141
6M13 2/8	2/13/95	N.D.	N.D.	0.098	79.8	N.D.	N.D.	N.D.	1.12	10.76	26.2	3.994	0.0127	40.4	N.D.	0.24	N.D.	13.7	0.1808	N.D.	0.0164
6M14 2/8	2/13/95	N.D.	N.D.	N.D.	63.7	N.D.	N.D.	N.D.	N.D.	6.506	22.6	6.018	0.0325	14.7	N.D.	N.D.	N.D.	8.03	0.1331	N.D.	0.0122
6M15 2/8	2/13/95	0.101	N.D.	0.078	29.8	N.D.	N.D.	N.D.	0.076	9.597	10.4	1.006	N.D.	32.1	N.D.	0.53	N.D.	8.36	0.0701	N.D.	0.0216
6M16 2/8	2/13/95	N.D.	N.D.	0.086	62.9	N.D.	N.D.	N.D.	0.033	10.86	20.9	5.826	N.D.	30.3	N.D.	0.65	N.D.	12	0.1393	N.D.	0.0106
6M17 2/8	2/13/95	N.D.	N.D.	0.052	66.7	N.D.	N.D.	N.D.	0.032	5.842	20.6	2.107	N.D.	20	N.D.	0.38	N.D.	12.9	0.1297	N.D.	0.0106
6M18 2/8	2/13/95	0.316	N.D.	N.D.	57.8	N.D.	N.D.	N.D.	N.D.	5.409	19.1	1.678	N.D.	13.6	N.D.	0.46	N.D.	13.2	0.117	N.D.	0.011
6M19 2/8	2/13/95	N.D.	N.D.	0.092	62.5	N.D.	N.D.	N.D.	0.248	17.52	22.4	2.072	N.D.	33.4	N.D.	1.3	N.D.	10.4	0.143	N.D.	0.0146
6M21 2/8	2/13/95	N.D.	N.D.	N.D.	73.9	N.D.	N.D.	N.D.	N.D.	4.968	17.3	1.37	N.D.	16.9	N.D.	0.48	N.D.	13.8	0.1365	N.D.	0.013
6M22 2/8	2/13/95	0.393	N.D.	0.057	53	N.D.	N.D.	N.D.	0.22	4.347	19.2	0.7476	N.D.	30.6	N.D.	0.47	N.D.	16	0.1274	N.D.	0.0131
6M23 2/8	2/13/95	1.11	N.D.	N.D.	54.4	N.D.	N.D.	N.D.	0.853	4.715	19	0.188	N.D.	7.9	N.D.	0.27	N.D.	15.2	0.1044	N.D.	0.0359
6M24 2/8	2/13/95	N.D.	N.D.	0.042	62.9	N.D.	N.D.	N.D.	0.121	5.004	19.6	0.1598	N.D.	14.6	N.D.	0.42	N.D.	12.3	0.1085	N.D.	0.0133
6M25 2/8	2/13/95	N.D.	N.D.	0.086	46.7	N.D.	N.D.	N.D.	N.D.	14.38	15.6	4.42	N.D.	30.2	N.D.	0.97	N.D.	13.1	0.0931	N.D.	0.0118
6M26 2/8	2/13/95	N.D.	N.D.	0.067	56.2	N.D.	N.D.	N.D.	N.D.	10.86	18.3	1.587	N.D.	20.9	N.D.	0.86	N.D.	11.7	0.1074	N.D.	0.0118
6M27 2/8	2/13/95	0.074	N.D.	N.D.	60.2	N.D.	N.D.	N.D.	0.055	5.741	19.8	0.3101	N.D.	12.7	N.D.	0.46	N.D.	13.2	0.1176	N.D.	0.0138
6M28 2/6	2/13/95	N.D.	N.D.	N.D.	56.8	N.D.	N.D.	N.D.	0.034	4.838	21.3	0.0347	N.D.	9.33	N.D.	0.41	N.D.	12.2	0.1091	N.D.	0.0518
6M29 2/6	2/13/95	N.D.	N.D.	N.D.	62.3	N.D.	N.D.	N.D.	N.D.	6.044	18.7	0.1533	N.D.	8.62	N.D.	0.5	N.D.	11	0.1001	N.D.	0.038
6M30 2/6	2/13/95	N.D.	N.D.	N.D.	71.5	N.D.	N.D.	N.D.	0.049	7.142	21.8	0.5312	N.D.	13.9	N.D.	0.51	N.D.	11.8	0.118	N.D.	0.0405
6M31 2/6	2/13/95	N.D.	N.D.	N.D.	68	N.D.	N.D.	N.D.	0.03	9.07	21.4	0.5539	N.D.	14.6	N.D.	0.72	N.D.	11.5	0.1172	N.D.	0.0335
6M32 2/6	2/13/95	N.D.	N.D.	N.D.	59.2	N.D.	N.D.	N.D.	N.D.	6.145	18.9	0.1932	N.D.	10.7	N.D.	0.59	N.D.	11.8	0.1022	N.D.	0.0365
6M33 2/6	2/13/95	N.D.	N.D.	N.D.	63.5	N.D.	N.D.	N.D.	N.D.	8.398	20	1.442	N.D.	13.4	N.D.	0.48	N.D.	8.91	0.1064	N.D.	0.0441
6M34 2/6	2/13/95	N.D.	N.D.	N.D.	60.1	N.D.	N.D.	N.D.	N.D.	7.958	18.4	0.1164	N.D.	10.5	N.D.	0.73	N.D.	11.8	0.0986	N.D.	0.0412
6M35 2/6	2/13/95	N.D.	N.D.	N.D.	67.4	N.D.	N.D.	N.D.	N.D.	5.741	22.5	0.1399	N.D.	10.6	N.D.	0.4	N.D.	11.9	0.1185	N.D.	0.0704
6M36 2/6	2/13/95	0.079	N.D.	N.D.	62.5	N.D.	N.D.	N.D.	0.087	6.752	19.8	0.3742	N.D.	11.4	N.D.	0.47	N.D.	11.7	0.1074	N.D.	0.076
6M37 2/6	2/13/95	N.D.	N.D.	N.D.	56.9	N.D.	N.D.	N.D.	0.036	5.618	19.7	0.0138	N.D.	8.39	N.D.	0.49	N.D.	12	0.0998	N.D.	0.0264
6P1 3/1	3/8/95	N.D.	N.D.	N.D.	55.3	N.D.	N.D.	N.D.	N.D.	2.412	18.3	0.0155	N.D.	8.33	N.D.	N.D.	N.D.	11	0.1017	N.D.	0.9366
6P4 3/1	3/8/95	N.D.	N.D.	N.D.	53.2	N.D.	N.D.	N.D.	N.D.	2.371	18.4	0.0898	N.D.	8.08	N.D.	N.D.	N.D.	11.1	0.1034	N.D.	2.116
6M11 3/1	3/8/95	N.D.	N.D.	N.D.	62.8	N.D.	N.D.	N.D.	N.D.	3.689	20	1.35	N.D.	9.26	N.D.	N.D.	N.D.	10.8	0.1157	N.D.	0.0348
6M12 3/1	3/8/95	0.149	N.D.	N.D.	60.8	N.D.	N.D.	N.D.	0.133	3.553	19.7	2.022	N.D.	13	N.D.	0.22	N.D.	11.7	0.1318	N.D.	0.0306
6M13 3/1	3/8/95	N.D.	N.D.	0.067	84.5	N.D.	N.D.	N.D.	0.717	7.107	28.3	4.5	N.D.	33.6	N.D.	N.D.	N.D.	16	0.187	N.D.	0.0478
6M14 3/1	3/8/95	0.479	N.D.	N.D.	55.2	N.D.	N.D.	N.D.	0.365	3.112	19.6	1.392	N.D.	8.9	N.D.	N.D.	N.D.	12.6	0.1098	N.D.	0.0872
6M15 3/1	3/8/95	N.D.	N.D.	0.114	45.1	N.D.	N.D.	N.D.	N.D.	9.701	15.8	0.9642	N.D.	47.9	N.D.	0.29	N.D.	9.31	0.103	N.D.	0.2984
6M16 3/1	3/8/95	N.D.	N.D.	0.045	59.1	N.D.	N.D.	N.D.	0.038	5.036	19.1	0.9094	N.D.	23	N.D.	1.1	N.D.	11.8	0.1156	N.D.	0.0058
6M17 3/1	3/8/95	N.D.	N.D.	N.D.	60.2	N.D.	N.D.	N.D.	N.D.	3.112	19.5	0.8022	N.D.	14.6	N.D.	0.3	N.D.	11.8	0.1149	N.D.	0.0571
6M18 3/1	3/8/95	0.896	N.D.	N.D.	58	N.D.	N.D.	N.D.	0.702	2.512	20.1	0.1664	N.D.	12.7	N.D.	0.5	N.D.	15.1	0.1141	N.D.	0.0416
6M19 3/1	3/8/95	N.D.	N.D.	0.077	47.2	N.D.	N.D.	0.0102	0.046	12.12	17.5	1.122	N.D.	32.2	N.D.	2.1	N.D.	9.32	0.1065	N.D.	0.0286
6M21 3/1	3/8/95	N.D.	N.D.	N.D.	71.3	N.D.	N.D.	N.D.	N.D.	2.241	18.6	0.2392	N.D.	17.8	N.D.	0.33	N.D.	13.1	0.1366	N.D.	0.0397
6M22 3/1	3/8/95	0.106	N.D.	0.045	51.3	N.D.	N.D.	N.D.	0.064	2.077	20.4	0.2383	N.D.	21.6	N.D.	0.36	N.D.	14.1	0.1218	N.D.	0.0459
6M23 3/1	3/8/95	0.103	N.D.	N.D.	51.7	N.D.	N.D.	N.D.	0.058	2.106	18.5	0.0237	N.D.	8.04	N.D.	N.D.	N.D.	10.9	0.101	N.D.	0.0321
6M24 3/1	3/8/95	N.D.	N.D.	N.D.	57	N.D.	N.D.	N.D.	N.D.	2.453	18.2	0.0207	N.D.	10.9	N.D.	0.2	N.D.	10.8	0.1003	N.D.	0.022
6M25 3/1	3/8/95	0.462	N.D.	0.048	49	N.D.	N.D.	0.0124	0.666	6.142	16.4	2.705	N.D.	22.3	N.D.	0.49	N.D.	12.6	0.0943	N.D.	0.0482
6M26 3/1	3/8/95	N.D.	N.D.	0.056	52.3	N.D.	N.D.	N.D.	N.D.	6.285	17.2	0.7614	N.D.	24.5	N.D.	1.2	N.D.	10.8	0.0988	N.D.	0.0101
6M27 3/1	3/8/95	0.211	N.D.	N.D.	58.7	N.D.	N.D.	N.D.	0.178	2.936	19.3	0.2066	N.D.	11.9	N.D.	0.41	N.D.	12.2	0.1142	N.D.	0.0218
6M28 3/1	3/8/95	N.D.	N.D.	N.D.	56.5	N.D.	N.D.	N.D.	N.D.	1.888	22.1	0.0174	N.D.	9.83	N.D.	N.D.	N.D.	11.6	0.1126	N.D.	0.0185
6M29 3/1	3/8/95	0.289	N.D.	N.D.	56.8	N.D.	N.D.	N.D.	0.305	2.412	18.4	0.0318	N.D.	9.66	N.D.	N.D.	N.D.	11.3	0.1002	N.D.	0.0212
6M30 3/1	3/8/95	1.24	N.D.	0.045	64	N.D.	N.D.	N.D.	1.14	4.248	21.2	0.16	N.D.	16.7	N.D.	0.28	N.D.	15.1	0.1155	N.D.	0.087
6M31 3/1	3/8/95	0.07	N.D.	0.047	67	N.D.	N.D.	N.D.	0.099	6.56	22.4	0.2924	N.D.	18.8	N.D.	0.85	N.D.	11.1	0.1248	N.D.	0.024
6M32 3/1	3/8/95	N.D.	N.D.	N.D.	63.5	N.D.	N.D.	N.D.	N.D.	3.271	21.2	0.168	N.D.	11.6	N.D.	0.29	N.D.	11.6	0.1172	N.D.	0.0277
6M33 3/1	3/8/95	N.D.	N.D.	N.D.	56.6	N.D.	N.D.	N.D.	N.D.	3.9	18.3	1.142	N.D.	11.1	N.D.	N.D.	N.D.	9.25	0.1013	N.D.	0.0155

APPENDIX H
ANALYTICAL RESULTS
CATIONS

Sample	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Ti	Zn
6M34 3/1	3/8/95	N.D.	N.D.	N.D.	55.9	N.D.	N.D.	N.D.	N.D.	3.547	18.7	0.0836	N.D.	11.1	N.D.	0.35	N.D.	11	0.102	N.D.	0.0178
6M35 3/1	3/8/95	N.D.	N.D.	N.D.	58.7	N.D.	N.D.	N.D.	N.D.	2.647	20.8	0.023	N.D.	9.84	N.D.	N.D.	N.D.	11.4	0.1087	N.D.	0.0248
6M36 3/1	3/8/95	N.D.	N.D.	N.D.	60.9	N.D.	N.D.	N.D.	N.D.	3.283	20.5	0.0647	N.D.	11.1	N.D.	0.22	N.D.	11.4	0.1091	N.D.	0.0554
6M37 3/1	3/8/95	N.D.	N.D.	N.D.	53.8	N.D.	N.D.	N.D.	N.D.	2.371	19.5	0.0061	N.D.	7.95	N.D.	N.D.	N.D.	11.1	0.1014	N.D.	0.2219
6TANK 3/1	3/8/95	N.D.	N.D.	0.189	47.1	N.D.	N.D.	0.0154	N.D.	21.02	15.8	0.0174	N.D.	55.1	N.D.	7	N.D.	11	0.1091	N.D.	0.024
6M15 3/15	5/26/95	N.D.	N.D.	N.D.	55.7	N.D.	N.D.	N.D.	0.036	N.A.	18.3	1.367	N.D.	23	N.D.	0.34	N.D.	9.2	0.1205	N.D.	0.0064
6M25 3/15	5/26/95	N.D.	N.D.	0.044	48.2	N.D.	N.D.	N.D.	N.D.	N.A.	15.7	1.33	N.D.	21.6	N.D.	1.1	N.D.	9.52	0.0975	N.D.	0.012
6TANK 3/15	5/26/95	N.D.	N.D.	0.25	44.9	N.D.	N.D.	N.D.	0.036	N.A.	15	0.0084	N.D.	55.9	N.D.	9.9	N.D.	9.47	0.1143	N.D.	0.0308
6P1 3/22	5/26/95	N.D.	N.D.	N.D.	53.4	N.D.	N.D.	N.D.	N.D.	N.A.	17.1	N.D.	N.D.	8.26	N.D.	0.22	N.D.	9.48	0.106	N.D.	0.5443
6P2 3/22	5/26/95	0.104	N.D.	N.D.	59.2	N.D.	N.D.	N.D.	0.067	N.A.	19.2	0.0144	N.D.	8.08	N.D.	0.26	N.D.	9.33	0.1024	N.D.	0.744
6P3 3/22	5/26/95	N.D.	N.D.	N.D.	53.1	N.D.	N.D.	N.D.	N.D.	N.A.	17.7	0.0088	N.D.	7.9	N.D.	0.22	N.D.	9.28	0.1076	N.D.	3.214
6P4 3/22	5/26/95	N.D.	N.D.	N.D.	51.2	N.D.	N.D.	N.D.	N.D.	N.A.	17.3	0.0101	N.D.	7.99	N.D.	0.23	N.D.	9.35	0.107	N.D.	1.54
6M11 3/22	5/26/95	0.137	N.D.	N.D.	53.7	N.D.	N.D.	N.D.	0.08	N.A.	17.4	0.1066	N.D.	8.1	N.D.	0.23	N.D.	9.61	0.1081	N.D.	0.032
6M12 3/22	5/26/95	0.114	N.D.	N.D.	56.3	N.D.	N.D.	N.D.	0.084	N.A.	18.4	0.1202	N.D.	8.51	N.D.	0.27	N.D.	9.77	0.116	N.D.	0.0174
6M13 3/22	5/26/95	0.212	N.D.	N.D.	55.1	N.D.	N.D.	N.D.	0.145	N.A.	18.6	0.2542	N.D.	8.76	N.D.	0.23	N.D.	10.1	0.1145	N.D.	0.0218
6M14 3/22	5/26/95	0.076	N.D.	N.D.	52.4	N.D.	N.D.	N.D.	0.045	N.A.	18.3	0.3353	N.D.	8.01	N.D.	0.22	N.D.	9.48	0.1112	N.D.	0.0194
6M15 3/22	5/26/95	0.201	N.D.	0.128	49.4	N.D.	N.D.	N.D.	0.251	N.A.	17.4	1.25	N.D.	51.7	N.D.	0.36	N.D.	9.57	0.1234	N.D.	0.1058
6M16 3/22	5/26/95	N.D.	N.D.	0.042	60.1	N.D.	N.D.	N.D.	N.D.	N.A.	20.1	4.613	N.D.	22.6	N.D.	0.43	N.D.	9.83	0.1459	N.D.	0.053
6M17 3/22	5/26/95	N.D.	N.D.	N.D.	59.8	N.D.	N.D.	N.D.	N.D.	N.A.	19	0.7242	N.D.	15.8	N.D.	0.47	N.D.	10	0.1227	N.D.	0.038
6M18 3/22	5/26/95	0.078	N.D.	N.D.	57.9	N.D.	N.D.	N.D.	0.032	N.A.	19.6	0.0101	N.D.	13.2	N.D.	0.57	N.D.	10	0.1234	N.D.	0.0285
6M19 3/22	5/26/95	N.D.	N.D.	0.078	51.8	N.D.	N.D.	N.D.	N.D.	N.A.	18.9	1.017	N.D.	34.1	N.D.	2.3	N.D.	7.17	0.125	N.D.	0.061
6M20 3/22	5/26/95	0.432	N.D.	N.D.	60.2	N.D.	N.D.	N.D.	0.284	N.A.	19.2	0.2311	N.D.	16.5	N.D.	0.41	N.D.	11.2	0.1188	N.D.	0.0446
6M21 3/22	5/26/95	N.D.	N.D.	N.D.	64.5	N.D.	N.D.	N.D.	N.D.	N.A.	16.8	0.3332	N.D.	14.8	N.D.	0.33	N.D.	10.3	0.1357	N.D.	0.0427
6M22 3/22	5/26/95	0.34	N.D.	N.D.	50.9	N.D.	N.D.	N.D.	0.221	N.A.	19.4	0.1351	N.D.	18.3	N.D.	0.36	N.D.	11.9	0.1297	N.D.	0.057
6M23 3/22	5/26/95	N.D.	N.D.	N.D.	49.8	N.D.	N.D.	N.D.	N.D.	N.A.	17.5	0.0078	N.D.	7.52	N.D.	0.27	N.D.	8.99	0.1051	N.D.	0.0492
6M24 3/22	5/26/95	N.D.	N.D.	N.D.	55.2	N.D.	N.D.	N.D.	N.D.	N.A.	17.3	0.236	N.D.	11	N.D.	0.34	N.D.	9.1	0.1063	N.D.	0.0793
6M25 3/22	5/26/95	N.D.	N.D.	N.D.	54.8	N.D.	N.D.	N.D.	N.D.	N.A.	17.2	0.3044	N.D.	14.7	N.D.	0.41	N.D.	9.27	0.1074	N.D.	0.0396
6M26 3/22	5/26/95	N.D.	N.D.	0.048	53.6	N.D.	N.D.	N.D.	N.D.	N.A.	17.4	0.8862	N.D.	24.1	N.D.	1.3	N.D.	9.24	0.1096	N.D.	0.0542
6M27 3/22	5/26/95	N.D.	N.D.	N.D.	56.7	N.D.	N.D.	N.D.	N.D.	N.A.	18.5	0.0069	N.D.	11.6	N.D.	0.48	N.D.	9.89	0.1188	N.D.	0.0562
6M28 3/22	5/26/95	N.D.	N.D.	N.D.	56.3	N.D.	N.D.	N.D.	N.D.	N.A.	20.9	N.D.	N.D.	9.28	N.D.	0.27	N.D.	9.68	0.1192	N.D.	0.1265
6M29 3/22	5/26/95	0.37	N.D.	N.D.	55.9	N.D.	N.D.	N.D.	0.411	N.A.	17.6	0.0404	N.D.	9.01	N.D.	0.28	N.D.	9.61	0.1066	N.D.	0.1505
6M30 3/22	5/26/95	N.D.	N.D.	0.042	57.7	N.D.	N.D.	N.D.	N.D.	N.A.	18.1	0.0212	N.D.	17.4	N.D.	0.37	N.D.	9.6	0.1111	N.D.	0.1005
6M31 3/22	5/26/95	N.D.	N.D.	0.045	60.8	N.D.	N.D.	N.D.	N.D.	N.A.	20.1	0.2097	N.D.	21.4	N.D.	1.2	N.D.	9.43	0.1253	N.D.	0.0932
6M32 3/22	5/26/95	N.D.	N.D.	N.D.	62.2	N.D.	N.D.	N.D.	N.D.	N.A.	20.2	0.0477	N.D.	12.6	N.D.	0.52	N.D.	9.88	0.1242	N.D.	0.0899
6M33 3/22	5/26/95	N.D.	N.D.	N.D.	57.6	N.D.	N.D.	N.D.	N.D.	N.A.	17.9	0.1042	N.D.	11	N.D.	0.23	N.D.	8.28	0.1105	N.D.	0.1265
6M34 3/22	5/26/95	N.D.	N.D.	N.D.	58.1	N.D.	N.D.	N.D.	N.D.	N.A.	18.7	N.D.	N.D.	10.9	N.D.	0.58	N.D.	9.35	0.1132	N.D.	0.1295
6M35 3/22	5/26/95	0.128	N.D.	N.D.	58.5	N.D.	N.D.	N.D.	0.105	N.A.	20.2	0.0121	N.D.	9.57	N.D.	0.33	N.D.	9.95	0.1172	N.D.	0.1507
6M36 3/22	5/26/95	N.D.	N.D.	N.D.	60.8	N.D.	N.D.	N.D.	N.D.	N.A.	20.1	0.022	N.D.	10.4	N.D.	0.34	N.D.	9.6	0.1191	N.D.	0.1984
6M37 3/22	5/26/95	0.121	N.D.	N.D.	52.5	N.D.	N.D.	N.D.	0.049	N.A.	18.7	0.0056	N.D.	9.76	N.D.	2.2	N.D.	9.27	0.1094	N.D.	0.2214
6TANK 3/22	5/26/95	N.D.	N.D.	0.205	44.1	N.D.	N.D.	N.D.	0.068	N.A.	15	0.0144	N.D.	52.1	N.D.	7.9	N.D.	9.11	0.1182	N.D.	0.0197
6M12 4/5	9/27/95	N.D.	N.D.	N.D.	58.3	N.D.	N.D.	N.D.	N.D.	2.473	18.6	0.0263	N.D.	8.72	N.D.	N.D.	N.D.	11.8	0.1143	N.D.	N.D.
6M16 4/5	9/27/95	N.D.	N.D.	0.075	63.5	N.D.	N.D.	N.D.	N.D.	6.25	20.7	1.527	N.D.	29.1	N.D.	1	N.D.	13.4	0.1384	N.D.	0.0123
6TANK 4/5	9/27/95	N.D.	N.D.	0.149	45.9	N.D.	N.D.	N.D.	0.032	25.17	15.5	0.0152	N.D.	59.6	N.D.	7.8	N.D.	11.4	0.1157	N.D.	0.0166
6M24 5/2	9/27/95	N.D.	N.D.	N.D.	55.6	N.D.	N.D.	N.D.	N.D.	2.361	17.6	0.0009	N.D.	9.33	N.D.	0.2	N.D.	11.2	0.1054	N.D.	0.007
6M25 5/2	9/27/95	N.D.	N.D.	0.042	55.4	N.D.	N.D.	N.D.	N.D.	4.028	17.8	0.5485	N.D.	20.6	N.D.	0.56	N.D.	11.8	0.1086	N.D.	0.0116
6M26 5/2	9/27/95	N.D.	N.D.	0.056	54.3	N.D.	N.D.	N.D.	N.D.	6.009	17.7	0.8171	N.D.	23.7	N.D.	1.2	N.D.	11.6	0.1099	N.D.	0.0216
6M27 5/2	9/27/95	N.D.	N.D.	N.D.	59.6	N.D.	N.D.	N.D.	N.D.	2.473	19.4	N.D.	N.D.	12.9	N.D.	0.42	N.D.	12.4	0.121	N.D.	0.0058
6M28 5/2	9/27/95	N.D.	N.D.	N.D.	60.5	N.D.	N.D.	N.D.	N.D.	2.041	21.6	N.D.	N.D.	9.65	N.D.	N.D.	N.D.	11.9	0.1249	N.D.	0.0214
6M29 5/2	9/27/95	N.D.	N.D.	N.D.	55.2	N.D.	N.D.	N.D.	N.D.	2.203	17.3	N.D.	N.D.	8.69	N.D.	0.2	N.D.	10.8	0.1029	N.D.	0.015
6M30 5/2	9/27/95	N.D.	N.D.	N.D.	54.4	N.D.	N.D.	N.D.	N.D.	3.046	17.2	0.0117	N.D.	17.5	N.D.	0.27	N.D.	11.2	0.1038	N.D.	0.0075

APPENDIX H
ANALYTICAL RESULTS
CATIONS

Sample	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Tl	Zn
6M31 5/2	9/27/95	N.D.	N.D.	0.05	59.3	N.D.	N.D.	N.D.	N.D.	7.179	19.4	0.0845	N.D.	23.4	N.D.	1.1	N.D.	11.4	0.1217	N.D.	0.0156
6M32 5/2	9/27/95	N.D.	N.D.	0.042	65.9	N.D.	N.D.	N.D.	N.D.	3.106	21.1	0.0091	N.D.	17.3	N.D.	0.5	N.D.	12.6	0.1308	N.D.	0.0259
6TANK 5/2	9/27/95	N.D.	N.D.	0.26	46.6	N.D.	N.D.	N.D.	0.033	14.61	14.8	0.0087	N.D.	47.7	N.D.	4.4	N.D.	11	0.1153	N.D.	0.0184
6P1 5/23	9/27/95	N.D.	N.D.	N.D.	55.1	N.D.	N.D.	N.D.	0.119	1.989	17.3	0.015	N.D.	8.88	N.D.	0.19	N.D.	11.6	0.108	N.D.	0.7184
6P2 5/23	9/27/95	0.368	N.D.	N.D.	60.9	N.D.	N.D.	N.D.	0.275	2.15	19.4	0.0143	N.D.	8.58	N.D.	N.D.	N.D.	12.6	0.104	N.D.	1.167
6P3 5/23	9/27/95	N.D.	N.D.	N.D.	53.8	N.D.	N.D.	N.D.	N.D.	1.885	17.7	0.0052	N.D.	8.43	N.D.	N.D.	N.D.	11.7	0.1071	N.D.	2.892
6M11 5/23	9/27/95	N.D.	N.D.	N.D.	55.8	N.D.	N.D.	N.D.	N.D.	2.019	17.6	N.D.	N.D.	9.25	N.D.	0.2	N.D.	11.8	0.1103	N.D.	0.1271
6M12 5/23	9/27/95	N.D.	N.D.	N.D.	54.3	N.D.	N.D.	N.D.	N.D.	1.885	17.4	N.D.	N.D.	10.3	N.D.	0.32	N.D.	11.9	0.1089	N.D.	0.0148
6M13 5/23	9/27/95	N.D.	N.D.	N.D.	52.8	N.D.	N.D.	N.D.	N.D.	2.214	17.4	N.D.	N.D.	8.85	N.D.	0.23	N.D.	11.6	0.1077	N.D.	0.0626
6M14 5/23	9/27/95	N.D.	N.D.	N.D.	52.3	N.D.	N.D.	N.D.	N.D.	1.87	17.5	N.D.	N.D.	8.59	N.D.	0.2	N.D.	11.7	0.1081	N.D.	0.0053
6M15 5/23	9/27/95	N.D.	N.D.	0.169	53.5	N.D.	N.D.	N.D.	N.D.	15.42	18.1	1.039	N.D.	60.1	N.D.	0.39	N.D.	10.5	0.136	N.D.	0.049
6M16 5/23	9/27/95	N.D.	N.D.	0.056	55.3	N.D.	N.D.	N.D.	N.D.	6.169	17.3	1.746	N.D.	22.7	0.021	0.5	N.D.	12.4	0.1228	N.D.	0.0159
6M17 5/23	9/27/95	N.D.	N.D.	N.D.	54.2	N.D.	N.D.	N.D.	N.D.	3.942	16.7	0.0769	N.D.	18	N.D.	0.7	N.D.	12.2	0.1096	N.D.	0.0093
6M18 5/23	9/27/95	N.D.	N.D.	N.D.	55.8	N.D.	N.D.	N.D.	N.D.	1.906	18.3	N.D.	N.D.	15.2	N.D.	0.5	N.D.	12.7	0.1188	N.D.	0.0272
6M19 5/23	9/27/95	N.D.	N.D.	0.098	56.9	N.D.	N.D.	N.D.	N.D.	10.64	19.1	1.804	N.D.	38.2	N.D.	2.3	N.D.	11.4	0.1262	N.D.	0.0161
6M20 5/23	9/27/95	N.D.	N.D.	0.042	58.5	N.D.	N.D.	N.D.	N.D.	3.867	17.9	0.0188	N.D.	18.3	N.D.	0.59	N.D.	12.2	0.1164	N.D.	0.0066
6M21 5/23	9/27/95	0.341	N.D.	N.D.	80.1	N.D.	N.D.	N.D.	N.D.	1.778	16.7	0.0148	N.D.	13.5	N.D.	0.32	N.D.	14.6	0.1653	N.D.	0.0209
6M22 5/23	9/27/95	N.D.	N.D.	N.D.	56.9	N.D.	N.D.	N.D.	N.D.	1.367	21.3	0.0063	N.D.	19.4	N.D.	0.33	N.D.	13.8	0.1377	N.D.	0.0259
6M23 5/23	9/27/95	N.D.	N.D.	N.D.	50.4	N.D.	N.D.	N.D.	N.D.	1.666	17.1	N.D.	N.D.	7.77	N.D.	0.22	N.D.	11	0.1047	N.D.	0.0131
6M24 5/23	9/27/95	N.D.	N.D.	N.D.	55.1	N.D.	N.D.	N.D.	N.D.	1.923	16.6	N.D.	N.D.	9.14	N.D.	0.3	N.D.	10.9	0.1039	N.D.	N.D.
6M25 5/23	9/27/95	N.D.	N.D.	N.D.	34.4	N.D.	N.D.	N.D.	N.D.	6.439	11.5	0.0807	N.D.	15.1	N.D.	0.97	N.D.	11.3	0.0745	N.D.	0.0199
6M26 5/23	9/27/95	N.D.	N.D.	0.047	44.3	N.D.	N.D.	N.D.	N.D.	6.315	14.1	0.2466	N.D.	20.9	N.D.	1.5	N.D.	12.3	0.0942	N.D.	0.009
6M27 5/23	9/27/95	N.D.	N.D.	N.D.	55.4	N.D.	N.D.	N.D.	N.D.	2.047	23.7	N.D.	N.D.	12.1	N.D.	0.43	N.D.	12.5	0.1298	N.D.	0.0135
6M28 5/23	9/27/95	N.D.	N.D.	N.D.	56.1	N.D.	N.D.	N.D.	N.D.	1.718	18.8	N.D.	N.D.	9.55	N.D.	0.3	N.D.	11.6	0.1147	N.D.	0.0239
6M29 5/23	9/27/95	N.D.	N.D.	N.D.	54.3	N.D.	N.D.	N.D.	N.D.	1.649	16.4	N.D.	N.D.	8.67	N.D.	0.24	N.D.	10.6	0.1012	N.D.	N.D.
6M30 5/23	9/27/95	N.D.	N.D.	N.D.	52.5	N.D.	N.D.	N.D.	N.D.	2.751	16	N.D.	N.D.	19.6	N.D.	0.36	N.D.	11.7	0.1008	N.D.	0.0056
6M31 5/23	9/27/95	N.D.	N.D.	N.D.	63.2	N.D.	N.D.	N.D.	N.D.	1.912	19.6	N.D.	N.D.	14.2	N.D.	0.48	N.D.	12.3	0.1242	N.D.	0.009
6M32 5/23	9/27/95	N.D.	N.D.	0.045	62.7	N.D.	N.D.	N.D.	N.D.	2.528	19.7	0.0066	N.D.	18.1	N.D.	0.45	N.D.	12.5	0.1252	N.D.	0.0085
6M33 5/23	9/27/95	N.D.	N.D.	N.D.	73.3	N.D.	N.D.	N.D.	N.D.	3.815	22.4	N.D.	N.D.	24.3	N.D.	0.32	N.D.	9.72	0.1399	N.D.	0.0148
6M34 5/23	9/27/95	N.D.	N.D.	N.D.	64.5	N.D.	N.D.	N.D.	N.D.	3.14	19.8	N.D.	N.D.	14.4	N.D.	0.56	N.D.	11.9	0.1238	N.D.	0.0091
6M35 5/23	9/27/95	N.D.	N.D.	N.D.	59	N.D.	N.D.	N.D.	N.D.	1.957	19.1	N.D.	N.D.	13.1	N.D.	0.33	N.D.	12	0.1161	N.D.	0.0161
6M36 5/23	9/27/95	N.D.	N.D.	N.D.	62.9	N.D.	N.D.	N.D.	N.D.	2.214	19.9	N.D.	N.D.	10.2	N.D.	0.32	N.D.	11.7	0.1208	N.D.	0.0193
6M37 5/23	9/27/95	0.078	N.D.	N.D.	49.1	N.D.	N.D.	N.D.	N.D.	1.557	16.2	N.D.	N.D.	7.83	N.D.	0.29	N.D.	10.6	0.1009	N.D.	0.0093
6TANK 5/23	9/27/95	N.D.	N.D.	0.284	46.5	N.D.	N.D.	N.D.	0.102	18.88	14.3	0.0094	N.D.	49	N.D.	6.1	N.D.	11.1	0.1145	N.D.	0.0399
6M15 5/25	9/27/95	N.D.	N.D.	0.167	52.9	N.D.	N.D.	N.D.	N.D.	16.08	17.5	1.031	N.D.	59.4	N.D.	0.49	N.D.	9.8	0.1345	N.D.	0.0116
6M19 5/25	9/27/95	N.D.	N.D.	0.079	53.4	N.D.	N.D.	N.D.	N.D.	8.926	17.2	1.901	N.D.	31.1	N.D.	1.9	N.D.	10.9	0.113	N.D.	0.0037
6M26 5/25	9/27/95	N.D.	N.D.	0.042	41.4	N.D.	N.D.	N.D.	N.D.	6.663	12.9	0.1572	N.D.	19.7	N.D.	1.6	N.D.	12.3	0.0884	N.D.	N.D.
6M31 5/25	9/27/95	N.D.	N.D.	N.D.	62	N.D.	N.D.	N.D.	N.D.	1.861	19.1	N.D.	N.D.	14.1	N.D.	0.45	N.D.	12.1	0.1216	N.D.	N.D.
6M34 5/25	9/27/95	N.D.	N.D.	N.D.	63.3	N.D.	N.D.	N.D.	N.D.	3.062	19.4	N.D.	N.D.	14.3	N.D.	0.55	N.D.	11.7	0.1215	N.D.	N.D.
6TANK 5/25	9/27/95	N.D.	N.D.	N.D.	46.2	N.D.	N.D.	N.D.	0.038	17.4	14.5	0.008	N.D.	47.4	N.D.	6.4	N.D.	11.3	0.1155	N.D.	0.0131
6M21 6/1	11/30/95	0.09	N.D.	N.D.	72	N.D.	N.D.	N.D.	0.067	1.726	14.5	0.0057	N.D.	12	N.D.	0.24	N.D.	13.9	0.1524	N.D.	0.0052
6M22 6/1	11/30/95	N.D.	N.D.	N.D.	53.3	N.D.	N.D.	N.D.	N.D.	1.864	20.7	N.D.	N.D.	16.5	N.D.	0.28	N.D.	13.9	0.1297	N.D.	N.D.
6M23 6/1	11/30/95	0.668	N.D.	N.D.	50.2	N.D.	N.D.	N.D.	0.764	2.324	18.3	0.0649	N.D.	7.92	N.D.	0.25	N.D.	13.4	0.1077	N.D.	0.0539
6M24 6/1	11/30/95	N.D.	N.D.	N.D.	54.2	N.D.	N.D.	N.D.	N.D.	2.093	17.6	N.D.	N.D.	8.65	N.D.	0.2	N.D.	11.1	0.1061	N.D.	N.D.
6M25 6/1	11/30/95	N.D.	N.D.	N.D.	45.8	N.D.	N.D.	N.D.	N.D.	5.006	16.2	0.0274	N.D.	11.2	N.D.	0.73	N.D.	10.8	0.0958	N.D.	0.0056
6M26 6/1	11/30/95	N.D.	N.D.	N.D.	39.4	N.D.	N.D.	N.D.	N.D.	7.07	13.4	0.0707	N.D.	17.4	N.D.	1.6	N.D.	12.8	0.0889	N.D.	0.0089
6M27 6/1	11/30/95	N.D.	N.D.	N.D.	57.5	N.D.	N.D.	N.D.	N.D.	2.292	24.1	N.D.	N.D.	10.9	N.D.	0.3	N.D.	13.4	0.1421	N.D.	0.0119
6M28 6/1	11/30/95	N.D.	N.D.	N.D.	56.9	N.D.	N.D.	N.D.	N.D.	1.891	20.8	N.D.	N.D.	10.2	N.D.	N.D.	N.D.	12.4	0.1217	N.D.	0.0778
6M29 6/1	11/30/95	N.D.	N.D.	N.D.	56.8	N.D.	N.D.	N.D.	N.D.	2.009	18.5	N.D.	N.D.	9.39	N.D.	N.D.	N.D.	11.4	0.1114	N.D.	0.0282
6M30 6/1	11/30/95	N.D.	N.D.	N.D.	54.6	N.D.	N.D.	N.D.	N.D.	3.241	17.6	N.D.	N.D.	20	N.D.	0.34	N.D.	12.3	0.1075	N.D.	0.0115

APPENDIX H
ANALYTICAL RESULTS
CATIONS

Sample	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Ti	Zn
6M31 6/1	11/30/95	N.D.	N.D.	N.D.	66.2	N.D.	N.D.	N.D.	N.D.	2.733	21.6	N.D.	N.D.	16.9	N.D.	0.44	N.D.	13.1	0.1329	N.D.	0.041
6M32 6/1	11/30/95	N.D.	N.D.	N.D.	62.4	N.D.	N.D.	N.D.	N.D.	2.943	20.6	N.D.	N.D.	18.6	N.D.	0.47	N.D.	12.8	0.1264	N.D.	0.0212
6M33 6/1	11/30/95	0.341	N.D.	N.D.	65.1	N.D.	N.D.	N.D.	0.279	3.93	20.7	0.022	N.D.	17.9	N.D.	0.37	N.D.	11.6	0.1256	N.D.	0.0221
6M34 6/1	11/30/95	N.D.	N.D.	N.D.	65.5	N.D.	N.D.	N.D.	N.D.	3.383	21.3	N.D.	N.D.	14.6	N.D.	0.49	N.D.	12.4	0.129	N.D.	0.0054
6M35 6/1	11/30/95	N.D.	N.D.	N.D.	60.7	N.D.	N.D.	N.D.	N.D.	2.265	20.2	N.D.	N.D.	11.6	N.D.	0.33	N.D.	12.2	0.12	N.D.	N.D.
6M36 6/1	11/30/95	0.114	N.D.	N.D.	66.1	N.D.	N.D.	N.D.	0.111	2.605	21.9	0.0261	N.D.	10.2	N.D.	0.34	N.D.	12.3	0.1287	N.D.	0.0223
6M37 6/1	11/30/95	N.D.	N.D.	N.D.	47.6	N.D.	N.D.	N.D.	N.D.	1.817	16.6	N.D.	N.D.	7.43	N.D.	0.28	N.D.	10.4	0.1024	N.D.	0.0041
6TANK 6/1	11/30/95	N.D.	N.D.	N.D.	51.1	N.D.	N.D.	0.0218	0.044	11.83	18.3	0.0073	N.D.	36.5	N.D.	6.8	-0.02	12.3	0.1288	N.D.	0.0251
6P1 6/7	11/30/95	N.D.	N.D.	N.D.	55.6	N.D.	N.D.	N.D.	N.D.	2.384	17.2	N.D.	N.D.	8.54	N.D.	0.31	N.D.	11.1	0.1076	N.D.	1.103
6P3 6/7	11/30/95	N.D.	N.D.	N.D.	52.2	N.D.	N.D.	N.D.	N.D.	1.982	17.4	N.D.	N.D.	8	N.D.	0.29	N.D.	11.5	0.1049	N.D.	2.368
6P4 6/7	11/30/95	N.D.	N.D.	N.D.	56.1	N.D.	N.D.	N.D.	N.D.	2.416	17.3	N.D.	N.D.	8.3	N.D.	0.39	N.D.	11.2	0.1165	N.D.	1.32
6M11 6/7	11/30/95	N.D.	N.D.	N.D.	59.1	N.D.	N.D.	N.D.	N.D.	2.462	17.2	N.D.	N.D.	8.51	N.D.	0.38	N.D.	11.4	0.1139	N.D.	0.0334
6M12 6/7	11/30/95	N.D.	N.D.	N.D.	56.5	N.D.	N.D.	N.D.	N.D.	2.332	16.8	N.D.	N.D.	9.33	N.D.	0.44	N.D.	11.4	0.1106	N.D.	0.023
6M13 6/7	11/30/95	N.D.	N.D.	N.D.	57.2	N.D.	N.D.	N.D.	N.D.	2.393	17.4	N.D.	N.D.	8.1	N.D.	0.4	N.D.	11.5	0.1126	N.D.	0.0091
6M14 6/7	11/30/95	N.D.	N.D.	N.D.	54.7	N.D.	N.D.	N.D.	N.D.	2.342	16.8	N.D.	N.D.	7.73	N.D.	0.38	N.D.	11.4	0.1095	N.D.	0.0206
6M15 6/7	11/30/95	N.D.	N.D.	N.D.	55.5	N.D.	N.D.	0.0103	N.D.	18.19	17.6	1.437	N.D.	52.9	N.D.	1.8	N.D.	12.7	0.1376	N.D.	0.0104
6M16 6/7	11/30/95	N.D.	N.D.	N.D.	50.6	N.D.	N.D.	N.D.	N.D.	5.587	14.5	0.4941	N.D.	15.9	N.D.	1	N.D.	11.7	0.102	N.D.	0.0087
6M17 6/7	11/30/95	N.D.	0.08	N.D.	58.3	N.D.	N.D.	N.D.	N.D.	4.981	16.7	0.077	N.D.	19.3	N.D.	0.96	N.D.	12.5	0.1157	N.D.	N.D.
6M18 6/7	11/30/95	N.D.	0.088	N.D.	56.2	N.D.	N.D.	N.D.	N.D.	2.297	17.2	N.D.	N.D.	12.3	N.D.	0.72	N.D.	12.3	0.116	N.D.	N.D.
6M19 6/7	11/30/95	N.D.	0.098	0.085	58.5	N.D.	N.D.	N.D.	N.D.	9.889	17.5	1.502	N.D.	33.9	N.D.	2.8	N.D.	11.8	0.1197	N.D.	N.D.
6M20 6/7	11/30/95	N.D.	0.095	N.D.	60.6	N.D.	N.D.	N.D.	N.D.	4.341	17.4	0.0175	N.D.	18.1	N.D.	0.77	N.D.	11.9	0.1176	N.D.	0.0169
6M21 6/7	11/30/95	N.D.	0.084	N.D.	78.3	N.D.	N.D.	N.D.	N.D.	1.724	13.5	N.D.	N.D.	13.9	N.D.	0.51	N.D.	13.3	0.158	N.D.	0.0596
6M22 6/7	11/30/95	N.D.	0.085	N.D.	56.9	N.D.	N.D.	N.D.	N.D.	1.928	19.5	N.D.	N.D.	16.9	N.D.	0.54	N.D.	14.1	0.1334	N.D.	0.0169
6M23 6/7	11/30/95	N.D.	0.077	N.D.	53.6	N.D.	N.D.	N.D.	N.D.	2.098	17	N.D.	N.D.	7.81	N.D.	0.45	N.D.	11.3	0.1091	N.D.	0.0056
6M24 6/7	11/30/95	N.D.	N.D.	N.D.	55.2	N.D.	N.D.	N.D.	N.D.	2.285	15.3	N.D.	N.D.	7.9	N.D.	0.54	N.D.	10.9	0.1014	N.D.	0.0176
6M25 6/7	11/30/95	N.D.	0.086	N.D.	48.5	N.D.	N.D.	N.D.	N.D.	4.477	14.9	0.0261	N.D.	9.02	N.D.	1.1	N.D.	10.4	0.0943	N.D.	0.0072
6M26 6/7	11/30/95	N.D.	0.095	N.D.	39.5	N.D.	N.D.	N.D.	N.D.	6.725	11.7	0.0232	N.D.	14.2	N.D.	2	N.D.	11.1	0.0838	N.D.	0.0126
6M27 6/7	11/30/95	N.D.	0.107	N.D.	62.4	N.D.	N.D.	N.D.	N.D.	2.438	22.1	N.D.	N.D.	9.44	N.D.	0.61	N.D.	12.7	0.1462	N.D.	0.0193
6M28 6/7	11/30/95	N.D.	0.083	N.D.	57.5	N.D.	N.D.	N.D.	N.D.	2.28	18	N.D.	N.D.	9.55	N.D.	0.51	N.D.	11.7	0.1155	N.D.	0.0659
6M29 6/7	11/30/95	N.D.	0.081	N.D.	56.3	N.D.	N.D.	N.D.	N.D.	2.28	15.6	N.D.	N.D.	8.03	N.D.	0.51	N.D.	10.8	0.102	N.D.	0.028
6M30 6/7	11/30/95	N.D.	0.077	N.D.	56	N.D.	N.D.	N.D.	N.D.	3.396	15.7	N.D.	N.D.	16	N.D.	0.61	N.D.	11.6	0.1037	N.D.	0.0273
6M31 6/7	11/30/95	N.D.	0.083	N.D.	64.8	N.D.	N.D.	N.D.	0.041	2.728	18.9	0.0108	N.D.	15.8	N.D.	0.78	N.D.	12.4	0.1241	N.D.	0.0245
6M32 6/7	11/30/95	N.D.	0.07	N.D.	63.4	N.D.	N.D.	N.D.	N.D.	3.115	18.1	N.D.	N.D.	16.8	N.D.	0.87	N.D.	12	0.1194	N.D.	0.0284
6M33 6/7	11/30/95	N.D.	0.075	N.D.	62.5	N.D.	N.D.	N.D.	N.D.	3.684	17.5	N.D.	N.D.	15.7	N.D.	0.56	N.D.	9.87	0.1142	N.D.	0.0265
6M34 6/7	11/30/95	N.D.	0.087	N.D.	67.9	N.D.	N.D.	N.D.	N.D.	3.551	19.3	N.D.	N.D.	14	N.D.	0.84	N.D.	12	0.1251	N.D.	0.0111
6M35 6/7	11/30/95	N.D.	0.094	N.D.	66.2	N.D.	N.D.	N.D.	N.D.	2.679	19.5	N.D.	N.D.	11.5	N.D.	0.63	N.D.	12	0.1222	N.D.	0.0241
6M36 6/7	11/30/95	N.D.	0.104	N.D.	70.7	N.D.	N.D.	N.D.	N.D.	2.933	20.3	N.D.	N.D.	9.6	N.D.	0.66	N.D.	11.7	0.1276	N.D.	0.0251
6M37 6/7	11/30/95	N.D.	0.075	N.D.	51.6	N.D.	N.D.	N.D.	N.D.	2.189	15.6	N.D.	N.D.	6.95	N.D.	0.59	N.D.	10.2	0.102	N.D.	0.013
6TANK 6/7	11/30/95	N.D.	0.089	0.055	51.2	N.D.	N.D.	N.D.	0.05	6.353	14	0.0098	N.D.	28.9	N.D.	3.9	N.D.	11.6	0.1193	N.D.	0.0199
6P1 5/30	8/17/96	N.D.	N.D.	N.D.	45.38	N.D.	N.D.	N.D.	N.D.	1.459	14.17	N.D.	N.D.	7.371	N.D.	N.D.	N.D.	10.85	0.0891	N.D.	0.2687
6M11 5/30	8/17/96	N.D.	N.D.	N.D.	46.2	N.D.	N.D.	N.D.	N.D.	1.576	14.53	N.D.	N.D.	7.697	N.D.	N.D.	N.D.	10.93	0.1014	N.D.	N.D.
6M12 5/30	8/17/96	N.D.	N.D.	N.D.	46.47	N.D.	N.D.	N.D.	N.D.	1.792	14.8	N.D.	N.D.	8.362	N.D.	N.D.	N.D.	10.83	0.1008	N.D.	N.D.
6M13 5/30	8/17/96	0.437	N.D.	N.D.	47.02	N.D.	N.D.	N.D.	0.4186	1.796	15.52	0.0185	N.D.	7.547	N.D.	N.D.	N.D.	12.63	0.1042	N.D.	N.D.
6M14 5/30	8/17/96	N.D.	N.D.	N.D.	44.2	N.D.	N.D.	N.D.	N.D.	1.576	14.8	N.D.	N.D.	7.359	N.D.	N.D.	N.D.	10.65	0.1004	N.D.	N.D.
6M15 5/30	8/17/96	N.D.	N.D.	0.1526	46.89	N.D.	N.D.	N.D.	9.69	18.37	14.51	1.147	N.D.	51.29	N.D.	13.3	N.D.	12.21	0.1204	N.D.	N.D.
6M16 5/30	8/17/96	N.D.	N.D.	N.D.	48.64	N.D.	N.D.	N.D.	N.D.	3.279	15.07	0.0872	N.D.	15.17	N.D.	0.4177	N.D.	11.86	0.1118	N.D.	N.D.
6M17 5/30	8/17/96	N.D.	N.D.	N.D.	52.48	N.D.	N.D.	N.D.	N.D.	2.327	16.3	N.D.	N.D.	13.64	N.D.	0.298	N.D.	12.02	0.1144	N.D.	N.D.
6M18 5/30	8/17/96	N.D.	N.D.	N.D.	47.43	N.D.	N.D.	N.D.	N.D.	1.744	15.23	N.D.	N.D.	12.45	N.D.	0.3817	N.D.	11.54	0.1107	N.D.	N.D.
6M19 5/30	8/17/96	N.D.	N.D.	0.0726	47.29	N.D.	N.D.	0.0171	N.D.	8.499	15.32	1.222	N.D.	34.32	N.D.	2.979	N.D.	11.21	0.1114	N.D.	N.D.
6M20 5/30	8/17/96	N.D.	N.D.	N.D.	48.08	N.D.	N.D.	N.D.	N.D.	2.335	14.79	N.D.	N.D.	12.62	N.D.	0.4156	N.D.	11.14	0.104	N.D.	N.D.

APPENDIX H
ANALYTICAL RESULTS
CATIONS

Sample	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sr	Ti	Zn
6M21 5/30	8/17/96	N.D.	N.D.	N.D.	70.52	N.D.	N.D.	N.D.	N.D.	1.062	14.48	N.D.	N.D.	11.38	N.D.	0.2196	N.D.	11.88	0.1598	N.D.	N.D.
6M22 5/30	8/17/96	N.D.	N.D.	N.D.	49.72	N.D.	N.D.	N.D.	N.D.	0.9428	17.97	N.D.	N.D.	15.3	N.D.	0.2991	N.D.	12.89	0.1266	N.D.	N.D.
6M24 5/30	8/17/96	N.D.	N.D.	N.D.	49.13	N.D.	N.D.	N.D.	N.D.	3.583	14.75	0.0385	N.D.	13.78	N.D.	0.561	N.D.	11.33	0.1076	N.D.	N.D.
6M25 5/30	8/17/96	N.D.	N.D.	0.0527	51.38	N.D.	N.D.	N.D.	N.D.	6.058	16.08	1.278	N.D.	27.38	N.D.	1.183	N.D.	11.57	0.1183	N.D.	N.D.
6M26 5/30	8/17/96	N.D.	N.D.	0.0601	50.01	N.D.	N.D.	N.D.	N.D.	8.035	16.08	0.3572	N.D.	29.73	N.D.	1.6	N.D.	11.47	0.1188	N.D.	N.D.
6M27 5/30	8/17/96	N.D.	N.D.	N.D.	51.45	N.D.	N.D.	N.D.	0.0355	1.406	17.03	N.D.	N.D.	10.34	N.D.	0.296	N.D.	12.12	0.1214	N.D.	N.D.
6M28 5/30	8/17/96	N.D.	N.D.	N.D.	49.4	N.D.	N.D.	N.D.	N.D.	1.42	18.39	N.D.	N.D.	8.587	N.D.	N.D.	N.D.	11.37	0.114	N.D.	N.D.
6M29 5/30	8/17/96	N.D.	N.D.	N.D.	49.54	N.D.	N.D.	N.D.	0.0338	1.677	14.86	0.0017	N.D.	8.92	N.D.	N.D.	N.D.	10.89	0.1049	N.D.	N.D.
6M30 5/30	8/17/96	N.D.	N.D.	N.D.	51.45	N.D.	N.D.	N.D.	N.D.	2.13	16.11	N.D.	N.D.	15.01	N.D.	0.2104	N.D.	11.34	0.1083	N.D.	N.D.
6M31 5/30	8/17/96	N.D.	N.D.	N.D.	52.74	N.D.	N.D.	N.D.	0.0597	1.751	16.86	0.0166	N.D.	11.25	N.D.	0.298	N.D.	11.63	0.1169	N.D.	N.D.
6M32 5/30	8/17/96	N.D.	N.D.	N.D.	53.56	N.D.	N.D.	N.D.	0.0465	2.291	17.46	0.0076	N.D.	11.95	N.D.	0.2991	N.D.	11.86	0.1194	N.D.	N.D.
6M33 5/30	8/17/96	N.D.	N.D.	N.D.	54.59	N.D.	N.D.	N.D.	0.0212	2.342	17.13	N.D.	N.D.	24.38	N.D.	0.2135	N.D.	10.72	0.1124	N.D.	N.D.
6M34 5/30	8/17/96	N.D.	N.D.	N.D.	50.74	N.D.	N.D.	N.D.	0.0347	3.087	16.3	N.D.	N.D.	14.36	N.D.	0.4424	N.D.	11.72	0.1111	N.D.	N.D.
6M35 5/30	8/17/96	N.D.	N.D.	N.D.	49.8	N.D.	N.D.	N.D.	0.0345	1.624	17.48	0.0022	N.D.	8.583	N.D.	N.D.	N.D.	11.19	0.1112	N.D.	N.D.
6M36 5/30	8/17/96	N.D.	N.D.	N.D.	53.9	N.D.	N.D.	N.D.	0.0342	1.958	17.45	N.D.	N.D.	8.503	N.D.	N.D.	N.D.	10.99	0.114	N.D.	N.D.
6M37 5/30	8/17/96	N.D.	N.D.	N.D.	46.22	N.D.	N.D.	N.D.	N.D.	1.405	15.79	N.D.	N.D.	7.427	N.D.	N.D.	N.D.	10.53	0.1045	N.D.	0.0052
6M40 5/30	8/17/96	N.D.	N.D.	0.0838	48.85	N.D.	N.D.	0.0131	N.D.	8.51	16.33	0.5813	N.D.	36.87	N.D.	2.765	N.D.	11.8	0.1186	N.D.	N.D.
6M41 5/30	8/17/96	N.D.	N.D.	0.0643	50.58	N.D.	N.D.	0.0108	0.0545	6.576	16.61	0.2651	N.D.	30.67	N.D.	1.739	N.D.	11.79	0.118	N.D.	0.0066
6TANK 5/30	8/17/96	N.D.	N.D.	0.0733	48.79	N.D.	N.D.	0.0135	0.1211	13.83	15.42	0.011	N.D.	53.47	N.D.	7.316	N.D.	11.32	0.1305	N.D.	0.0406

APPENDIX H CATION QA\QC

Sample Name	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	S	Ti	Zn
6P1 5/30	8/17/96	N.D.	N.D.	N.D.	45.38	N.D.	N.D.	N.D.	N.D.	1.459	14.17	N.D.	N.D.	7.371	N.D.	N.D.	N.D.	10.85	0.0991	N.D.	0.2687
6P1FD 5/30	8/17/96	N.D.	N.D.	N.D.	45	N.D.	N.D.	N.D.	N.D.	1.711	13.91	N.D.	N.D.	7.409	N.D.	N.D.	N.D.	10.6	0.0957	N.D.	0.2699
RPD					0.84					15.90	1.85			0.51				2.33	3.49		0.45
6P2 3/22	5/26/95	0.104	N.D.	N.D.	59.2	N.D.	N.D.	N.D.	0.087	N.A.	19.2	0.0144	N.D.	8.08	N.D.	0.26	N.D.	9.33	0.1024	N.D.	0.744
6P2FD 3/22	5/26/95	0.124	N.D.	N.D.	58.4	N.D.	N.D.	N.D.	0.893	N.A.	19.4	0.0548	N.D.	8.1	N.D.	0.24	N.D.	12.2	0.1026	N.D.	6.283
RPD		17.54			1.36				172.09		1.04	116.78		0.25		8.00		26.66	0.20		157.85
6M11 2/8	2/13/95	N.D.	N.D.	N.D.	65.3	N.D.	N.D.	N.D.	N.D.	5.452	21.3	2.127	0.0115	12.6	N.D.	0.23	N.D.	10.1	0.1239	N.D.	0.017
6M11LD 2/8	2/13/95	N.D.	N.D.	N.D.	69	N.D.	N.D.	N.D.	N.D.	7.799	21.5	2.169	0.0111	12	N.D.	0.51	N.D.	10.3	0.1195	N.D.	0.0176
RPD					5.51					35.42	0.93	1.96	3.54	4.88		75.68		1.96	3.62		3.47
6M12 5/23	9/27/95	N.D.	N.D.	N.D.	54.3	N.D.	N.D.	N.D.	N.D.	1.885	17.4	N.D.	N.D.	10.3	N.D.	0.32	N.D.	11.9	0.1089	N.D.	0.0148
6M12LD 5/23	9/27/95	N.D.	N.D.	N.D.	51.9	N.D.	N.D.	N.D.	N.D.	1.773	16	N.D.	N.D.	9.88	N.D.	0.39	N.D.	11.3	0.1027	N.D.	0.015
RPD					4.52					6.12	8.38			4.16		19.72		5.17	5.86		1.34
6M13 3/22	5/26/95	0.212	N.D.	N.D.	55.1	N.D.	N.D.	N.D.	0.145	N.A.	18.6	0.2542	N.D.	8.76	N.D.	0.23	N.D.	10.1	0.1145	N.D.	0.0218
6M13FD 3/22	5/26/95	0.204	N.D.	N.D.	55.1	N.D.	N.D.	N.D.	0.141	N.A.	18.6	0.257	N.D.	8.77	N.D.	0.24	N.D.	10	0.1145	N.D.	0.0206
RPD		3.85			0.00				2.80		0.00	1.10		0.11		4.26		1.00	0.00		5.86
6M14 3/1	3/8/95	0.479	0.007	0.005	55.2	0.0003	0.0025	0.0049	0.365	3.112	19.6	1.392	0.002	8.9	0.004	0.18	N.D.	12.6	0.1098	0.0221	0.0872
6M14LD 3/1	3/8/95	0.491	N.D.	N.D.	57.3	N.D.	N.D.	N.D.	0.387	3.383	19.9	1.431	N.D.	9	N.D.	0.23	N.D.	13	0.1112	N.D.	0.0893
RPD		2.47			3.73				5.85	8.34	1.52	2.76		1.12		24.39		3.13	1.27		2.38
6M15 3/15	5/26/95	N.D.	N.D.	N.D.	55.7	N.D.	N.D.	N.D.	0.036	N.A.	18.3	1.367	N.D.	23	N.D.	0.34	N.D.	9.2	0.1205	N.D.	0.0064
6M15FD 3/15	5/26/95	N.D.	N.D.	0.04	55.4	N.D.	N.D.	N.D.	0.04	N.A.	18.3	1.376	N.D.	23.6	N.D.	0.32	N.D.	9.2	0.1213	N.D.	0.0074
RPD					0.54				10.53		0.00	0.66		2.58		6.06		0.00	0.66		14.49
6M15 5/23	9/27/95	N.D.	N.D.	0.169	53.5	N.D.	N.D.	N.D.	N.D.	15.42	18.1	1.039	N.D.	60.1	N.D.	0.39	N.D.	10.5	0.136	N.D.	0.049
6M15FD 5/23	9/27/95	N.D.	N.D.	0.17	53.4	N.D.	N.D.	N.D.	N.D.	15.54	18.2	1.036	N.D.	60.5	N.D.	0.36	N.D.	10.5	0.1364	N.D.	0.0339
RPD				0.59	0.19					0.78	0.55	0.29		0.66		8.00		0.00	0.29		36.43
6M15 5/25	9/27/95	N.D.	N.D.	0.167	52.9	N.D.	N.D.	N.D.	N.D.	16.08	17.5	1.031	N.D.	59.4	N.D.	0.49	N.D.	9.8	0.1345	N.D.	0.0116
6M15LD 5/25	9/27/95	N.D.	N.D.	0.166	53.1	N.D.	N.D.	N.D.	N.D.	16.04	17.4	1.033	N.D.	58.8	N.D.	0.52	N.D.	9.81	0.1337	N.D.	0.0118
RPD				0.60	0.38					0.25	0.57	0.19		1.02		5.94		0.10	0.60		1.71
6M15 6/7	11/30/95	N.D.	N.D.	N.D.	56.5	N.D.	N.D.	0.0103	N.D.	16.19	17.6	1.437	N.D.	52.9	N.D.	1.6	N.D.	12.7	0.1376	N.D.	0.0104
6M15LD 6/7	12/1/95	N.D.	N.D.	0.17	54.5	N.D.	N.D.	N.D.	0.033	16.06	19	1.416	N.D.	56.6	0.001	1.4	N.D.	13	0.1375	N.D.	0.0143
RPD					1.82					0.77	7.65	1.47		6.76		25.00		2.33	0.07		31.58
6M15FD 6/7	11/30/95	N.D.	N.D.	0.155	56.6	N.D.	N.D.	0.0165	N.D.	16.17	17.6	1.453	N.D.	52.5	N.D.	1.6	N.D.	12.7	0.138	N.D.	0.0238
RPD					1.96			46.27		0.11	0.00	1.11		0.76		0.00		0.00	0.29		78.36
6M16 2/8	2/13/95	N.D.	N.D.	0.086	62.9	N.D.	N.D.	N.D.	0.033	10.86	20.9	5.826	N.D.	30.3	N.D.	0.65	N.D.	12	0.1393	N.D.	0.0106
6M16FD 2/8	2/13/95	N.D.	N.D.	0.084	60.7	N.D.	N.D.	N.D.	0.03	10.41	20.4	5.675	N.D.	30.2	N.D.	0.56	N.D.	11.7	0.1376	N.D.	0.0112
RPD				2.35	3.56					4.23	2.42	2.63		0.33		14.88		2.53	1.23		5.50
6M16 3/1	3/8/95	N.D.	N.D.	0.045	59.1	N.D.	N.D.	N.D.	0.038	5.036	19.1	0.9094	N.D.	23	N.D.	1.1	N.D.	11.8	0.1156	N.D.	0.0056
6M16FD 3/1	3/8/95	N.D.	N.D.	0.044	58.9	N.D.	N.D.	N.D.	N.D.	4.959	19	0.8493	N.D.	22.9	N.D.	1.2	N.D.	11.8	0.1141	N.D.	N.D.
RPD				2.25	0.34					1.54	0.52	6.83		0.44		8.70		0.00	1.31		
6M16 4/5	9/27/95	N.D.	N.D.	0.075	63.5	N.D.	N.D.	N.D.	N.D.	6.25	20.7	1.527	N.D.	29.1	N.D.	1	N.D.	13.4	0.1384	N.D.	0.0123
6M16FD 4/5	9/27/95	N.D.	N.D.	0.067	59.9	N.D.	N.D.	N.D.	N.D.	5.964	19.4	1.413	N.D.	26.9	N.D.	0.97	N.D.	12.8	0.1305	N.D.	N.D.
RPD				11.27	5.83					4.68	6.48	7.76		7.86		3.05		4.58	5.88		
6M19 5/23	9/27/95	N.D.	N.D.	0.098	56.9	N.D.	N.D.	N.D.	N.D.	10.84	19.1	1.804	N.D.	38.2	N.D.	2.3	N.D.	11.4	0.1262	N.D.	0.0161
6M19FD 5/23	9/27/95	N.D.	N.D.	0.101	57.1	N.D.	N.D.	N.D.	N.D.	10.72	19	1.823	N.D.	38	N.D.	2.3	N.D.	11.4	0.1256	N.D.	0.0193
RPD				3.02	0.35					0.75	0.52	1.05		0.52		0.00		0.00	0.32		18.08

APPENDIX H CATION QA\QC

Sample Name	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	S	Ti	Zn
6M19 6/7	11/30/95	N.D.	0.098	0.085	58.5	N.D.	N.D.	N.D.	N.D.	9.889	17.5	1.502	N.D.	33.9	N.D.	2.8	N.D.	11.8	0.1197	N.D.	N.D.
6M19LD 6/7	12/1/95	N.D.	N.D.	0.102	54.5	N.D.	N.D.	N.D.	N.D.	9.505	18.6	1.48	N.D.	35.6	0.004	2.3	N.D.	11.9	0.1173	N.D.	N.D.
RPD				18.18	3.80					3.96	6.09	2.84		4.89		19.61		0.84	2.03		
6M20 5/23	9/27/95	N.D.	N.D.	0.042	58.5	N.D.	N.D.	N.D.	N.D.	3.867	17.9	0.0188	N.D.	18.3	N.D.	0.59	N.D.	12.2	0.1164	N.D.	0.0066
6M20LD 5/23	9/27/95	N.D.	N.D.	N.D.	57.1	N.D.	N.D.	N.D.	N.D.	4.026	17	0.0176	N.D.	17.9	N.D.	0.69	N.D.	11.8	0.112	N.D.	0.0066
RPD					2.42					4.08	5.16	6.59		2.21		15.63		3.33	3.85		0.00
6M21 3/22	5/26/95	N.D.	N.D.	N.D.	64.5	N.D.	N.D.	N.D.	N.D.	N.A.	16.8	0.3332	N.D.	14.8	N.D.	0.33	N.D.	10.3	0.1357	N.D.	0.0427
6M21FD 3/22	5/26/95	N.D.	N.D.	N.D.	65.2	N.D.	N.D.	N.D.	N.D.	N.A.	16.9	0.3334	N.D.	14.9	N.D.	0.33	N.D.	10.4	0.1372	N.D.	0.0463
RPD					1.08						0.59	0.06		0.67		0		0.97	1.10		8.09
6M22 5/30	8/17/96	N.D.	N.D.	N.D.	49.72	N.D.	N.D.	N.D.	N.D.	0.9428	17.97	N.D.	N.D.	15.3	N.D.	0.2991	N.D.	12.89	0.1266	N.D.	N.D.
6M22FD 5/30	8/17/96	N.D.	N.D.	N.D.	48.02	N.D.	N.D.	N.D.	0.0537	2.284	14.72	0.0059	N.D.	11.98	N.D.	0.3548	N.D.	11.18	0.1034	N.D.	N.D.
RPD					3.48					83.13	19.88			24.34		17.04		14.21	20.17		
6M24 2/8	2/13/95	N.D.	N.D.	0.042	62.9	N.D.	N.D.	N.D.	0.121	5.004	19.6	0.1598	N.D.	14.6	N.D.	0.42	N.D.	12.3	0.1085	N.D.	0.0133
6M24LD 2/8	2/13/95	N.D.	N.D.	0.04	63.8	N.D.	N.D.	N.D.	0.118	6.391	19.3	0.1591	N.D.	13.9	N.D.	0.62	N.D.	12.3	0.1043	N.D.	0.0137
RPD				4.88	1.42				2.51	24.34	1.54	0.44		4.91		38.46		0.00	3.95		2.96
6M26 3/1	3/8/95	N.D.	N.D.	0.056	52.3	N.D.	N.D.	N.D.	N.D.	6.265	17.2	0.7614	N.D.	24.5	N.D.	1.2	N.D.	10.8	0.0988	N.D.	0.0101
6M26LD 3/1	3/8/95	N.D.	N.D.	0.057	53.3	N.D.	N.D.	N.D.	N.D.	6.295	17.2	0.7768	N.D.	25.1	N.D.	1.2	N.D.	11	0.0992	N.D.	0.0101
RPD				1.77	1.89					0.48	0.00	2.28		2.42		0.00		1.83	0.40		0.00
6M26FD 3/1	3/8/95	N.D.	N.D.	0.06	52.1	N.D.	N.D.	N.D.	N.D.	6.23	17.3	0.7769	N.D.	24.9	N.D.	1.1	N.D.	10.9	0.0994	N.D.	0.0072
RPD				6.90	0.38					0.56	0.58	2.02		1.62		8.70		0.92	0.81		33.53
6M26 5/2	9/27/95	N.D.	N.D.	0.056	54.3	N.D.	N.D.	N.D.	N.D.	6.009	17.7	0.8171	N.D.	23.7	N.D.	1.2	N.D.	11.6	0.1099	N.D.	0.0216
6M26FD 5/2	9/27/95	N.D.	N.D.	0.057	54.5	N.D.	N.D.	N.D.	N.D.	5.951	17.6	0.81	N.D.	23.4	N.D.	1.2	N.D.	11.6	0.1093	N.D.	0.015
RPD				1.77	0.37					0.97	0.57	0.87		1.27		0.00		0.00	0.55		36.07
6M26 6/1	11/30/95	N.D.	N.D.	N.D.	39.4	N.D.	N.D.	N.D.	N.D.	7.07	13.4	0.0707	N.D.	17.4	N.D.	1.6	N.D.	12.8	0.0869	N.D.	0.0089
6M26LD 6/1	12/1/95	N.D.	N.D.	N.D.	40.3	N.D.	N.D.	N.D.	N.D.	6.734	13.4	0.073	N.D.	17.3	N.D.	1.6	N.D.	12.8	0.0879	N.D.	0.0125
RPD					2.26					4.87	0.00	3.20		0.58		0.00		0.00	1.13		33.64
6M26FD 6/1	11/30/96	N.D.	N.D.	N.D.	38.7	N.D.	N.D.	N.D.	N.D.	6.941	13.3	0.0688	N.D.	17.1	N.D.	1.6	N.D.	12.7	0.088	N.D.	N.D.
RPD					1.79					1.84	0.75	2.72		1.74		0.00		0.78	1.02		
6M26 6/7	11/30/95	N.D.	0.095	N.D.	39.5	N.D.	N.D.	N.D.	N.D.	8.725	11.7	0.0232	N.D.	14.2	N.D.	2	N.D.	11.1	0.0838	N.D.	0.0126
6M26LD 6/7	12/1/95	N.D.	N.D.	N.D.	39.2	N.D.	N.D.	N.D.	N.D.	6.559	12.9	0.0263	N.D.	15.1	-0.001	1.5	N.D.	11.5	0.0845	N.D.	0.0145
RPD					0.76					2.50	9.76	12.53		6.14		28.57		3.54	0.83		14.02
6M26FD 6/7	11/30/95	N.D.	0.087	N.D.	39.7	N.D.	N.D.	N.D.	N.D.	6.833	11.8	0.0223	N.D.	14.3	N.D.	2	N.D.	11.2	0.0842	N.D.	0.0204
RPD			8.79		0.51					1.59	0.85	3.96				0.00		0.90	0.48		47.27
6M28 2/6	2/13/95	N.D.	N.D.	N.D.	56.8	N.D.	N.D.	N.D.	0.034	4.836	21.3	0.0347	N.D.	9.33	N.D.	0.41	N.D.	12.2	0.1091	N.D.	0.0518
6M28FD 2/6	2/13/95	N.D.	N.D.	N.D.	57.7	N.D.	N.D.	N.D.	0.048	5.033	21.5	0.0359	N.D.	9.3	N.D.	0.45	N.D.	12.2	0.1066	N.D.	0.0466
RPD					1.57				30.00	3.95	0.93	3.40		0.32		9.30		0.00	2.32		10.57
6M28 5/2	9/27/95	N.D.	N.D.	N.D.	60.5	N.D.	N.D.	N.D.	N.D.	2.041	21.6	N.D.	N.D.	9.65	N.D.	N.D.	N.D.	11.9	0.1249	N.D.	0.0214
6M28LD 5/2	9/27/95	N.D.	N.D.	N.D.	59.7	N.D.	N.D.	N.D.	N.D.	1.532	20.2	N.D.	N.D.	9.72	N.D.	0.3	N.D.	11.5	0.1222	N.D.	0.0226
RPD					1.33					28.49	6.70			0.72				3.42	2.19		5.45
6M28 5/30	8/17/96	N.D.	N.D.	N.D.	49.4	N.D.	N.D.	N.D.	N.D.	1.42	18.39	N.D.	N.D.	8.587	N.D.	N.D.	N.D.	11.37	0.114	N.D.	N.D.
6M28FD 5/30	8/17/96	N.D.	N.D.	N.D.	49.07	N.D.	N.D.	N.D.	N.D.	1.539	18.71	N.D.	N.D.	8.886	N.D.	N.D.	N.D.	11.21	0.1138	N.D.	N.D.
RPD					0.67					8.04	1.73			3.42				1.42	0.18		
6M30 5/23	9/27/95	N.D.	N.D.	N.D.	52.5	N.D.	N.D.	N.D.	N.D.	2.751	16	N.D.	N.D.	19.6	N.D.	0.36	N.D.	11.7	0.1008	N.D.	0.0056
6M30LD 5/23	9/27/95	N.D.	N.D.	0.041	52.5	N.D.	N.D.	N.D.	N.D.	2.777	15.7	0.0052	N.D.	19.5	N.D.	0.42	N.D.	11.6	0.1	N.D.	0.0063
RPD					0.00					0.94	1.89			0.51		15.38		0.86	0.80		11.76

APPENDIX H CATION QA\QC

Sample Name	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	S	Ti	Zn
6M31 6/1	11/30/95	N.D.	N.D.	N.D.	66.2	N.D.	N.D.	N.D.	N.D.	2.733	21.6	N.D.	N.D.	16.9	N.D.	0.44	N.D.	13.1	0.1329	N.D.	0.041
6M31FD 6/1	11/30/95	N.D.	N.D.	N.D.	65.6	N.D.	N.D.	N.D.	N.D.	2.374	21.4	N.D.	N.D.	15.7	N.D.	0.45	N.D.	13.1	0.1317	N.D.	N.D.
RPD					0.91					14.06	0.93			7.36		2.25		0.00	0.91		
6M32 2/8	2/13/95	N.D.	N.D.	N.D.	59.2	N.D.	N.D.	N.D.	N.D.	6.145	18.9	0.1932	N.D.	10.7	N.D.	0.59	N.D.	11.8	0.1022	N.D.	0.0365
6M32LD 2/8	2/13/95	N.D.	N.D.	N.D.	62.8	N.D.	N.D.	N.D.	N.D.	7.582	19.4	0.1995	N.D.	10.6	N.D.	0.81	N.D.	12.1	0.103	N.D.	0.0389
RPD					5.90					20.94	2.61	3.21		0.94		31.43		2.51	0.78		6.37
6M34 6/1	11/30/95	N.D.	N.D.	N.D.	65.5	N.D.	N.D.	N.D.	N.D.	3.383	21.3	N.D.	N.D.	14.6	N.D.	0.49	N.D.	12.4	0.129	N.D.	0.0054
6M34FD 6/1	11/30/95	N.D.	N.D.	N.D.	65.9	N.D.	N.D.	N.D.	N.D.	3.59	21.4	N.D.	N.D.	16	N.D.	0.51	N.D.	12.5	0.1304	N.D.	0.0243
RPD					0.61					5.94	0.47			9.15		4.00		0.80	1.08		127.27
6M34 6/7	11/30/95	N.D.	0.087	N.D.	67.9	N.D.	N.D.	N.D.	N.D.	3.551	19.3	N.D.	N.D.	14	N.D.	0.84	N.D.	12	0.1251	N.D.	0.0111
6M34FD 6/7	11/30/95	N.D.	0.079	N.D.	67.1	N.D.	N.D.	N.D.	N.D.	3.556	18.9	N.D.	N.D.	13.8	N.D.	0.85	N.D.	11.8	0.1227	N.D.	0.0111
RPD			9.64		1.19					0.14	2.09			1.44		1.18		1.68	1.94		0.00
6M37 3/1	3/8/95	N.D.	N.D.	N.D.	53.8	N.D.	N.D.	N.D.	N.D.	2.371	19.5	0.0061	N.D.	7.95	N.D.	N.D.	N.D.	11.1	0.1014	N.D.	0.2219
6M37LD 3/1	3/8/95	N.D.	N.D.	N.D.	53.9	N.D.	N.D.	N.D.	N.D.	1.918	19.4	0.0073	N.D.	8.25	N.D.	0.2	N.D.	11.2	0.1027	N.D.	0.2255
RPD					0.19					21.12	0.51	17.91		3.70				0.90	1.27		1.61
6M37 5/23	9/27/95	0.078	N.D.	N.D.	49.1	N.D.	N.D.	N.D.	N.D.	1.557	16.2	N.D.	N.D.	7.83	N.D.	0.29	N.D.	10.6	0.1009	N.D.	0.0093
6M37FD 5/23	9/27/95	N.D.	N.D.	N.D.	47.6	N.D.	N.D.	N.D.	0.03	1.577	15.8	N.D.	N.D.	7.68	N.D.	0.29	N.D.	10.3	0.0982	N.D.	0.0071
RPD					3.10					1.28	2.50			1.93		0.00		2.87	2.71		26.83
6TANK 6/1	11/30/95	N.D.	N.D.	N.D.	51.1	N.D.	N.D.	0.0218	0.044	11.83	18.3	0.0073	N.D.	36.5	N.D.	6.8	N.D.	12.3	0.1288	N.D.	0.0251
6TANKLD 6/1	12/1/95	N.D.	N.D.	0.108	53.1	N.D.	N.D.	N.D.	0.05	11.98	17.2	0.0094	N.D.	37.6	0.008	6.8	N.D.	12.6	0.1316	N.D.	0.0286
RPD					3.84				12.77	1.28	5.37	25.15		2.97		0.00		2.41	2.15		13.04

Sample Name	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	S	Ti	Zn
BLANK	2/13/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	2/13/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	2.058	N.D.	N.D.	N.D.	0.151	N.D.	0.25	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	2/13/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	3.338	N.D.	N.D.	N.D.	0.251	N.D.	0.43	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	3/8/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	3/8/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	3/8/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	3/8/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	3/8/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	5/26/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.A.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	5/26/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.A.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	5/26/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.A.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	5/26/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.A.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	9/27/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	9/27/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	9/27/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	9/27/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	9/27/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.22	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	9/27/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.21	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	9/27/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.23	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	11/30/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.023	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	11/30/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	11/30/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	11/30/95	N.D.	0.078	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.31	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	11/30/95	N.D.	0.078	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.31	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	11/30/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.48	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	11/30/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.47	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	12/1/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	12/1/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	12/1/95	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	8/17/96	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
BLANK	8/17/96	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

APPENDIX H CATION QA\QC

Sample Name	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	S	Ti	Zn
LITHIUM 460 288	3/8/95	0.016	-0.002	-0.002	0.602	0.0002	0.0011	0.0536	0.003	61.3	0.033	0.0007	0.0038	1.88	0.005	0.15	-0.012	-0.005	0.0055	0.0018	0.0918
USGS T107	2/13/95	0.231	0.01	0.143	12.7	0.0153	0.0133	0.0302	0.048	2.051	2.3	0.0502	0.0135	22.8	0.037	0.12	0.038	4.08	0.0589	0.0054	0.0878
USGS T107	2/13/95	0.217	0.017	0.142	13.4	0.0158	0.0131	0.0284	0.052	3.82	2.29	0.0517	0.0174	21.7	0.037	0.32	0.031	4.11	0.0589	0.0153	0.0911
USGS T107	2/13/95	0.208	0.005	0.139	13.8	0.0177	0.0155	0.0284	0.05	4.975	2.29	0.0521	0.0165	21	0.033	0.5	0.041	4.11	0.0583	0.0234	0.0935
USGS T107	3/8/95	0.233	0.018	0.143	13.4	0.018	0.0154	0.0334	0.058	1.735	2.37	0.0539	0.0167	22.5	0.033	0.12	0.011	4.04	0.0806	0.0055	
USGS T107	3/8/95	0.248	0.022	0.143	13.8	0.0187	0.0149	0.0342	0.061	1.547	2.38	0.0553	0.0158	22.8	0.03	0.18	0.01	4.08	0.0817	0.0052	0.0972
USGS T107	3/8/95	0.253	0.005	0.143	13.4	0.0184	0.0143	0.035	0.057	1.077	2.37	0.0548	0.0169	23.4	0.029	0.1	N D	4.04	0.0818	0.0028	0.0975
USGS T107	3/8/95	0.259	0.01	0.144	14	0.0201	0.0174	0.0384	0.058	1.485	2.44	0.0575	0.0173	23.8	0.032	0.15	0.006	4.16	0.0832	0.0057	0.1018
USGS T107	3/8/95	0.241	0.011	0.137	12.9	0.0193	0.0144	0.0353	0.054	1.769	2.11	0.0546	0.0113	24.1	0.033	0.21	-0.01	3.91	0.08	0.0028	0.0968
USGS T107	5/26/95	0.27	0.019	0.134	13.1	0.0174	0.0132	0.0008	0.058		2.28	0.052	0.0168	22.9	0.031	0.2	0.01	3.43	0.0849	0.0055	0.0949
USGS T107	5/26/95	0.272	0.024	0.132	13.2	0.0174	0.0147	0.0012	0.057		2.25	0.0518	0.02	22.8	0.031	0.21	0.029	3.42	0.085	0.0052	0.0955
USGS T107	5/26/95	0.276	0.021	0.13	13	0.0168	0.014	-0.0009	0.057		2.23	0.0509	0.0178	22.8	0.031	0.21	0.016	3.38	0.0845	0.0055	0.0958
USGS T107	5/26/95	0.266	0.033	0.133	13	0.0184	0.0148	0.0009	0.057		2.24	0.052	0.0184	22.8	0.035	0.15	0.017	3.4	0.0844	0.0049	0.0929
USGS T107	9/27/95	0.23	0.003	0.143	12.8	0.018	0.0127	0.0245	0.052	1.345	2.25	0.0504	0.0154	22.9	0.034	0.03	0.04	4.2	0.0833	0.0018	0.0856
USGS T107	9/27/95	0.241	0.009	0.141	12.8	0.0162	0.0125	0.0245	0.055	1.091	2.24	0.0504	0.0139	23.1	0.035	0.05	0.032	4.2	0.0835	0.0018	0.0882
USGS T107	9/27/95	0.244	0.018	0.141	12.7	0.0166	0.0118	0.0234	0.05	1.14	2.17	0.0511	0.0154	22.7	0.035	0.12	0.056	4.15	0.0825	0.0025	0.0874
USGS T107	9/27/95	0.264	0.011	0.146	13.2	0.0175	0.0125	0.0249	0.052	0.9647	2.2	0.053	0.0133	23.7	0.035	0.14	0.032	4.24	0.0844	0.0026	0.0895
USGS T107	9/27/95	0.246	0.015	0.135	12.6	0.0166	0.0108	0.0231	0.048	0.7123	2.1	0.0509	0.012	23.1	0.036	0.18	0.014	4.09	0.082	0.0019	0.0857
USGS T107	9/27/95	0.253	0.013	0.14	12.7	0.0177	0.0111	0.0245	0.049	0.8471	2.06	0.0511	0.0127	23	0.034	0.22	0.043	4.07	0.0814	0.0032	0.0875
USGS T107	9/27/95	0.238	0.01	0.144	12.6	0.0166	0.0094	0.0234	0.049	0.8129	2.05	0.0504	0.0116	23.2	0.032	0.21	0.023	4.02	0.0814	0.0028	0.088
USGS T107	11/30/95	0.251	0.023	0.119	13.2	0.0196	0.0153	0.034	0.056	1.342	2.34	0.0518	0.0159	23.1	0.022	0.11	0.019	4.3	0.0853	0.0054	0.0895
USGS T107	11/30/95	0.274	0.024	0.123	13.4	0.0129	0.0158	0.0348	0.056	0.9234	2.37	0.0528	0.0183	23.9	0.028	0.14	0.02	4.38	0.0879	0.0033	0.0893

Sample Name	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	S	Ti	Zn
USGS T107	11/30/95	0.267	0.012	0.114	12.9	0.0138	0.0141	0.0325	0.052	1.019	2.21	0.0513	0.014	22.5	0.025	0.2	0	4.19	0.0841	0.0041	0.0874
USGS T107	11/30/95	0.255	0.092	0.118	13.7	0.0121	0.0158	0.0314	0.056	1.251	2.18	0.0538	0.0148	21.9	0.024	0.34	0.013	4.18	0.0865	0.0045	0.09
USGS T107	11/30/95	0.253	0.075	0.114	13.9	0.0133	0.0151	0.0314	0.057	1.362	2.13	0.0535	0.0143	21.5	0.025	0.42	0.007	4.16	0.0859	0.0062	0.093
USGS T107	11/30/95	0.243	0.08	0.105	13.4	0.0138	0.0119	0.0302	0.054	1.399	2.02	0.0519	0.017	20.6	0.025	0.48	0.02	4.02	0.0831	0.0074	0.0911
USGS T107	11/30/95	0.248	0.094	0.109	13.7	0.0129	0.0148	0.0302	0.053	1.497	2.03	0.0528	0.0159	20.5	0.03	0.55	0.014	4.04	0.0833	0.0087	0.0945
USGS T107	12/1/95	0.243	0.014	0.138	13.7	0.0195	0.0183	0.0183	0.063	1.037	2.39	0.0545	0.0184	23.5	0.026	0	0.02	4.35	0.0886	0.0021	0.093
USGS T107	12/1/95	0.265	0.038	0.143	13.8	0.0169	0.013	0.014	0.057	0.8366	2.33	0.0555	0.0191	23.5	0.033	0.11	-0.005	4.32	0.0868	0.0019	0.0966
USGS T107	12/1/95	0.28	0.024	0.139	13.6	0.0185	0.0153	0.0156	0.06	0.861	2.3	0.0559	0.0164	23.2	0.032	0.14	-0.009	4.29	0.0857	0.0025	0.0973
USGS T107	8/17/96	0.233	0.015	0.1282	13.54	0.0169	0.0139	0.03	0.064	0.9611	2.219	0.053	0.018	22.47	0.0248	-0.0166	0.031	3.894	0.0682	-0.0011	0.0818
USGS T107 VALUES		**0.22**	**0.0108**	**0.13**	**11.7**	**0.0143**	**0.011**	**0.03**	**0.052**	**0.84**	**2.1**	**0.045**	**0.015**	**20.7**	**0.0281**		**0.028**	**3.8**	**0.081**		**0.0758**
U M T107 VALUES		**0.2384**	**0.0123**	**0.1341**	**12.8878**	**0.0169**	**0.0138**	**0.0324**	**0.0533**	**2.1112**	**2.2495**	**0.0517**	**0.0147**	**22.7909**	**0.0323**	**0.1015**	**0.0278**	**3.9327**	**0.0593**	**0.0032**	**0.0905**

Sample Name	Date	Al	As	B	Ca	Cd	Co	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Si	S	Ti	Zn
USGS T117	2/13/95	0.07	0.007	0.157	23.1	0.0026	0.0054	0.0044	0.501	3.365	11.1	0.2415	0.0145	22.2	0.009	0.32	-0.002	6.34	0.2556	0.0057	0.2025
USGS T117	3/8/95	0.083	0.009	0.154	23.6	0.0022	0.0055	0.0069	0.495	2.93	11.1	0.245	0.0109	21.3	0.009	0.34	-0.01	6	0.2514	0.0048	0.2055
USGS T117	5/26/95	0.101	0.024	0.148	23.4	0.0018	0.0058	-0.0272	0.515		10.8	0.2414	0.0145	21.8	0.009	0.39	0.008	5.21	0.2755	0.0054	0.211
USGS T117	9/27/95	0.079	0.008	0.158	23.4	0.003	0.0051	-0.0018	0.51	2.828	11	0.2416	0.0108	22	0.012	0.27	0.014	6.38	0.2737	0.0039	0.207
USGS T117	11/30/95	0.098	0.024	0.134	23.9	0.0006	0.0075	0.0088	0.524	2.625	11.2	0.2461	0.0183	22	0.005	0.33	0.013	6.48	0.2807	0.0062	0.2059
USGS T117	12/1/95	0.085	0.014	0.151	24.9	0.0036	0.0051	-0.0058	0.543	2.4	11.6	0.2561	0.0141	22.6	0.008	0.28	-0.009	6.59	0.2893	0.0033	0.2173
USGS T117 VALUES		0.079	0.0069	0.151	20.9	0.0022	0.0043	0.006	0.474	2.11	10.05	0.22	0.012	20	0.01		0.005	5.54	0.285		0.176
U M T117 VALUES		0.0822	0.0089	0.148	23.4868	0.0026	0.0053	0.0059	0.5003	4.5583	11.1216	0.2459	0.0121	21.8263	0.0118	0.3008	0.0082	6.0618	0.255	0.0016	0.2031

APPENDIX H
ANALYTICAL RESULTS
ANIONS

2/6/96 I.D.	ALK mg/L	CHLOR mg/L	NITRATE mg/L	AMMON mg/L	TOTAL N mg/L	PHOS mg/L	SULF mg/L
M23	240	3.337	1.927	0.0297	1.9567	ND	18.901
M28	194	4.657	1.939	0.0213	1.9603	ND	20.586
M28FD	200	4.319	1.948	0.0138	1.9618	ND	20.13
M29	192	5.339	1.239	0.0146	1.2536	ND	19.723
M30	202	12.906	8.573	0.113	8.686	ND	18.994
M31	204	8.444	5.094	0.331	5.425	ND	21.413
M32	190	5.127	2.88	0.0149	2.8749	ND	20.686
M33	234	7.257	3.661	0.163	3.824	ND	20.127
M34	194	4.718	2.536	0.023	2.559	ND	19.955
M35	232	3.785	3.426	0.0339	3.4599	ND	21.576
M36	218	3.761	2.647	0.0362	2.6832	ND	20.372
M37	192	3.671	0.919	0.0278	0.9468	ND	20.053
TANK	324	NA	NA	37.8	NA	NA	NA

3/1/96 I.D.	ALK mg/L	CHLOR mg/L	NITRATE mg/L	AMMON mg/L	TOTAL N mg/L	PHOS mg/L	SULF mg/L
P1	211	2.549	0.627	NA	0.627	ND	19.962
P4	200	2.339	0.664	NA	0.664	ND	20.281
M11	205	3.34	0.577	ND	0.577	ND	20.604
M12	212	4.25	1.289	0.261	1.55	ND	21.627
M13	342	22.51	0.096	1.38	1.476	ND	7.366
M14	200	2.83	0.634	ND	0.634	ND	19.72
M15	186	30.91	7.764	1.09	8.854	ND	13.77
M16	188	12.945	7.063	0.555	7.618	ND	15.509
M16FD	194	13.144	7.088	0.552	7.64	ND	15.522
M17	210	7.756	3.809	NA	3.809	ND	18.946
M18	182	8.077	5.533	NA	5.533	ND	20.335
M19	166	27.592	9.108	2.56	11.668	0.374	12.193
M20	NA	NA	NA	NA	NA	NA	NA
M21	208	5.684	2.991	0.112	3.103	ND	19.478
M22	182	5.091	2.391	NA	2.391	ND	20.354
M23	179	2.962	1.483	NA	1.483	ND	18.607
M24	185	3.755	1.585	NA	1.585	ND	20.314
M25	174	12.729	7.33	1.9	9.23	ND	15.917
M26	184	14.94	4.749	1.31	6.059	ND	13.746
M26FD	210	15.019	4.755	1.22	5.975	ND	13.936
M27	198	5.295	2.389	NA	2.389	ND	14.235
M28	212	3.36	1.722	NA	1.722	ND	19.821
M29	230	3.063	0.913	NA	0.913	ND	20.255
M30	205	13.536	6.97	NA	6.97	ND	17.641
M31	221	13.945	6.727	NA	6.727	ND	17.157
M32	201	8.767	4.781	NA	4.781	ND	18.755
M33	195	6.792	2.868	NA	2.868	ND	19.111
M34	194	5.807	3.265	ND	3.265	ND	19.638
M35	206	3.375	2.532	ND	2.532	ND	20.116
M36	205	3.021	2.333	ND	2.333	ND	20.038
M37	191	3.859	1.03	ND	1.03	ND	19.874
TANK	398	290.18	ND	74.8	74.8	4.132	1.422

2/8/96 I.D.	ALK mg/L	CHLOR mg/L	NITRATE mg/L	AMMON mg/L	TOTAL N mg/L	PHOS mg/L	SULF mg/L
M11	284	7.822	1.007	0.0233	1.0303	ND	22.265
M12	316	13.991	0.554	2.97	3.524	ND	19.118
M13	334	25.586	ND	2.73	2.73	ND	5.09
M14	232	5.542	ND	0.0136	0.0136	ND	20.93
M15	68	23.742	15.524	0.511	16.035	ND	12.624
M16	212	20.464	7.047	1.02	8.067	ND	12.596
M16FD	216	20.382	7.04	1.04	8.08	ND	12.357
M17	232	16.061	7.417	1.62	9.037	ND	16.706
M18	190	7.939	5.195	0.351	5.546	ND	20.29
M19	202	28.924	8.305	2.4	10.705	ND	15.445
M20	NA	NA	NA	NA	NA	NA	NA
M21	222	6.047	3.103	0.006	3.109	ND	19.252
M22	202	5.3	2.844	0.0079	2.8519	ND	20.135
M24	192	10.174	5.972	0.534	6.506	ND	18.63
M25	76	25.512	28.35	2.68	31.03	ND	15.223
M26	174	17.048	11.028	0.758	11.786	ND	14.382
M27	200	5.062	3.561	0.0476	3.6086	ND	20.553

3/16/96 I.D.	ALK mg/L	CHLOR mg/L	NITRATE mg/L	PHOS mg/L	SULF mg/L
M15	144	13.821	2.494	ND	16.18
M15FD	217	13.48	2.469	ND	16.519
M25	252	13.989	7.015	ND	14.785
TANK	365	35.814	ND	7.628	3.588

APPENDIX H
ANALYTICAL RESULTS
ANIONS

3/22/96 I.D.	ALK mg/L	CHLOR mg/L	NITRATE mg/L	PHOS mg/L	SULF mg/L
P1	184	2.643	0.542	ND	19.201
P2	220	2.634	0.811	ND	20.249
P2FD	225	3.03	0.82	ND	20.093
P3	154	2.812	0.697	ND	19.827
P4	201	2.407	0.56	ND	19.335
M11	206	2.784	0.59	ND	19.715
M12	194	3.393	0.788	ND	20.96
M13	192	3.022	1.15	ND	20.426
M13FD	196	2.894	1.09	ND	19.484
M14	202	2.36	0.784	ND	19.22
M15	196	38.096	16.112	ND	9.762
M16	238	13.814	3.046	ND	17.667
M17	174	9.064	5.583	ND	17.843
M18	180	10.836	8.253	ND	19.848
M19	170	33.378	13.966	1.775	11.491
M20	201	11.042	6.065	ND	16.176
M21	188	6.114	3.568	ND	19.271
M21FD	212	6.228	3.647	ND	19.233
M22	208	4.584	2.397	ND	20.409
M23	175	2.611	1.02	ND	18.529
M24	176	4.635	2.593	ND	20.782
M25	190	8.724	2.519	ND	17.948
M26	194	16.755	5.022	0.641	13.9
M27	196	5.698	2.878	ND	17.735
M28	201	3.321	1.817	ND	20.518
M29	198	3.143	0.858	ND	20.777
M30	190	11.782	5.382	ND	16.563
M31	221	14.446	4.425	0.586	15.968
M32	202	10.073	4.856	ND	17.884
M33	186	8.957	4.259	ND	18.805
M34	187	7.903	3.946	ND	18.771
M35	201	4.483	2.458	ND	20.49
M36	208	3.903	2.348	ND	20.529
M37	194	3.258	0.806	2.137	19.364
TANK	360	40.384	0.078	6.831	2.568

4/5/96 I.D.	CHLOR mg/L	NITRATE mg/L	PHOS mg/L	SULF mg/L
M12	3.754	1.693	ND	13.917
M16	17.856	11.096	1.034	20.081
M16FD	18	11.18	0.399	13.874
TANK	49.496	ND	6.923	0.757

5/2/96 I.D.	CHLOR mg/L	NITRATE mg/L	PHOS mg/L	SULF mg/L
M24	3.474	1.153	ND	20.164
M25	16.529	10.303	0.137	17.42
M26	19.491	7.42	0.605	16.371
M26FD	19.727	7.44	0.565	15.977
M27	8.994	4.674	0.245	18.134
M28	4.122	2.401	ND	20.49
M29	3.094	0.74	ND	20.346
M30	12.668	8.874	ND	18.848
M31	19.261	5.8	0.672	16.429
M32	17.364	4.804	0.3	15.722
TANK	43.649	ND	3.076	9.96

APPENDIX H
ANALYTICAL RESULTS
ANIONS

5/23/96 I.D.	ALK mg/L	CHLOR mg/L	NITRATE mg/L	PHOS mg/L	SULF mg/L
P1	198	3.036	0.555	ND	19.536
P2	208	3.596	1.174	ND	19.407
P3	209	3.603	0.812	ND	19.038
P4	158	3.515	ND	ND	29.101
M11	196	4.238	1.081	ND	19.458
M12	188	3.922	1.39	ND	19.565
M13	178	2.881	0.84	ND	18.917
M14	179	2.237	0.716	ND	18.645
M15	225	42.432	8.139	ND	14.026
M15FD	220	41.346	7.948	ND	14.039
M16	201	13.527	6.566	0.339	18.454
M17	191	8.291	5.759	0.484	17.761
M18	176	9.965	6.576	0.317	18.59
M19	169	23.001	21.174	1.798	16.309
M19FD	185	23.468	21.446	1.846	16.152
M20	204	9.668	4.772	0.129	16.928
M21	221	9.373	6.362	ND	18.905
M22	217	6.178	3.769	ND	19.598
M23	179	2.837	1.552	ND	17.764
M24	175	3.387	1.209	ND	20.326
M25	127	6.957	7.412	0.705	20.087
M26	121	11.964	13.486	1.21	18.563
M27	184	7.197	4.118	ND	16.687
M28	193	4.01	2.201	ND	19.102
M29	191	3.111	0.685	ND	19.382
M30	165	9.381	9.831	ND	18.94
M31	211	11.148	6.158	ND	18.048
M32	208	13.307	5.236	ND	15.961
M33	263	6.429	2.14	ND	24.487
M34	207	12.513	4.23	0.31	16.293
M35	188	8.175	3.534	ND	18.287
M36	203	7.325	3.294	ND	19.077
M37	180	2.906	0.969	ND	16.875
M37FD	170	2.708	0.983	ND	16.778
TANK	338	41.058	ND	4.821	2.104

5/28/96 I.D.	ALK mg/L	CNLOR mg/L	NITRATE mg/L	PHOS mg/L	SULF mg/L
M15	250	42.694	7.084	ND	13.26
M19	195	18.432	13.22	1.037	17.217
M26	112	10.128	13.098	0.911	19.72
M31	196	11.053	6.404	ND	18.302
M34	212	12.602	4.292	ND	16.575
TANK	334	39.944	ND	5.013	1.257

6/1/96 I.D.	ALK mg/L	CHLOR mg/L	NITRATE mg/L	PHOS mg/L	SULF mg/L
P1	160	2.594	0.482	ND	19.337
P2	207	2.792	0.904	ND	18.929
P3	193	2.697	0.318	ND	19.016
P4	190	2.541	0.547	ND	18.685
M11	194	3.218	1.041	ND	19.126
M12	186	3.417	1.498	ND	18.87
M13	180	3.311	0.852	ND	18.631
M14	157	2.837	0.608	ND	18.37
M15	286	39.8	1.858	ND	9.093
M16	238	11.173	320	1	48.497
M17	224	12.922	5.265	0.71	15.302
M18	190	6.018	3.811	0.51	18.893
M19	152	14.6	31.7	2.209	16.405
M20	197	13.16	2.596	0.625	14.047
M21	191	6.904	5.32	ND	19.087
M22	192	7.864	4.183	ND	18.674
M23	180	2.441	1.16	ND	17.943
M24	184	2.625	0.631	ND	20.341
M25	158	4.787	1.431	0.615	19.902
M26	120	5.533	7.255	1.365	19.808
M26FD	129	7.716	7.413	1.456	19.839
M27	195	6.591	3.584	ND	13.633
M28	221	3.472	1.964	ND	18.609
M29	185	2.913	0.665	ND	18.641
M30	161	9.242	10.329	ND	18.456
M31	202	11.641	6.445	ND	16.917
M31FD	204	11.62	6.422	ND	16.868
M32	182	12.844	5.932	ND	16.057
M33	227	4.395	1.997	ND	20.324
M34	210	12.13	4.105	ND	15.897
M34FD	209	12.061	4.106	ND	15.887
M35	200	8.229	3.905	ND	17.747
M36	182	9.176	3.615	ND	17.42
M37	175	2.34	0.897	ND	16.029
TANK	304	26.554	ND	5.957	1.276

APPENDIX H
ANALYTICAL RESULTS
ANIONS

6/6/95 SAMPLE	ALK mg/L	CHLOR mg/L	NITRATE mg/L	PHOS mg/L	SULF mg/L
P1	163	2.758	0.581	ND	20.216
P2	202	2.95	0.861	ND	19.727
P3	196	3.805	0.885	ND	19.503
P4	208	2.696	0.56	ND	19.319
M11	193	4.428	0.969	ND	19.856
M12	200	4.738	1.201	ND	19.92
M13	180	3.924	0.798	ND	19.496
M14	156	3.639	0.606	ND	19.247
M15	292	42.905	4.834	0.888	8.401
M15FD	280	39.51	4.711	0.942	8.128
M16	187	7.308	2.082	0.398	18.372
M17	208	11.215	3.256	0.343	17.357
M18	152	5.472	3.242	0.143	19.371
M19	163	20.828	NA	1.605	17.888
M20	235	7.95	1.196	0.286	17.584
M21	191	8.887	4.595	ND	18.482
M22	179	8.068	4.706	ND	19.458
M23	176	3.594	0.82	ND	18.941
M24	185	2.757	0.559	ND	20.59
M25	135	4.196	1.129	0.288	20.892
M26	124	4.908	3.645	1.073	20.32
M26FD	130	4.21	3.755	1.092	20.435
M27	204	7.988	3.7	ND	14.888
M28	193	3.857	2.05	ND	19.243
M29	176	3.056	0.656	ND	19.058
M30	186	7.841	8.495	ND	19.559
M31	203	12.221	6.084	ND	16.956
M32	195	11.611	4.938	ND	16.884
M33	230	4.151	1.631	ND	20.858
M34	213	11.601	4.016	ND	16.692
M34FD	212	11.996	4.123	ND	17.105
M35	210	10.115	4.2	ND	17.799
M36	221	10.532	3.805	ND	17.234
M37	171	2.844	1.048	ND	16.81
TANK	226	13.765	ND	1.754	0.91

10/17/95 SAMPLE	AMMON (mg/L)	10/17/96 SAMPLE	AMMON (mg/L)
M15	23.1	M23	0.02
M16	0.024	M26	0.42
M17	0.025	M26FD	0.49
M18	0.028	M31	0.019
M19	2.46	M34	0.016
M20	0.048	M36	0.021
M21	0.025	M37	0.016
M22	0.023	M41	0.72

5/30/96 SAMPLE	FLUO mg/L	CHLOR mg/L	NITRATE mg/L	AMMON mg/L	TOTAL N mg/L	PHOS mg/L	SULF mg/L
M11	0.05	2.39	0.76	ND	0.76	0.00	15.35
M12	0.06	2.94	1.31	0.15	1.46	0.00	17.01
M13	0.06	2.57	1.52	ND	1.52	0.00	15.27
M14	0.09	4.80	0.76	ND	0.76	0.00	21.40
M15	0.46	25.59	0.22	13.80	14.02	3.74	0.00
M16	0.03	8.67	5.85	ND	5.85	0.17	14.03
M17	0.04	7.77	5.64	ND	5.64	0.11	14.39
M18	0.05	5.81	3.63	ND	3.63	0.14	16.05
M19	0.05	19.04	8.75	1.80	10.55	1.31	9.71
M20	0.04	6.27	4.48	ND	4.48	0.16	14.87
M21	0.01	9.31	6.38	ND	6.38	0.00	18.98
M22	0.03	7.16	3.39	ND	3.39	0.11	14.43
M22FD	0.03	6.58	4.75	ND	4.75	0.17	14.97
M24	0.05	5.32	1.47	1.40	2.87	0.22	15.20
M25	0.01	17.38	11.74	1.20	12.94	0.51	11.03
M26	0.03	19.08	16.12	0.40	16.52	0.68	11.09
M27	0.02	6.41	4.33	ND	4.33	0.10	15.48
M28	0.05	3.34	2.35	ND	2.35	0.00	17.16
M28FD	0.05	3.32	2.39	ND	2.39	0.00	16.75
M29	0.03	2.54	0.98	ND	0.98	0.00	17.65
M30	0.02	5.74	2.61	ND	2.61	0.00	16.26
M31	0.03	5.98	3.90	ND	3.90	0.11	17.32
M32	0.04	5.92	3.82	ND	3.82	0.11	17.39
M33	0.13	3.73	1.11	ND	1.11	0.00	18.82
M34	0.03	7.55	5.24	ND	5.24	0.18	16.60
M35	0.06	2.76	1.45	ND	1.45	0.00	17.93
M36	0.04	3.39	1.90	ND	1.90	0.00	20.21
M37	0.07	1.98	0.96	ND	0.96	0.00	14.74
M40	0.00	21.26	19.59	0.50	20.09	1.18	10.02
M41	0.03	18.46	14.55	0.30	14.85	0.70	12.08
P1	0.05	1.62	0.61	ND	0.61	0.00	15.66
P1FD	0.05	1.64	0.61	ND	0.61	0.00	16.83
TANK	4.08	25.75	0.17	11.80	11.97	2.91	1.47

NA = Not Analyzed
ND = Not Detected At or Above the Laboratory Detection Limit

APPENDIX H FIELD PARAMETERS

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
P1	3/1/96	6.8	278	NA	9.5	NA
P4		6.77	250	NA	8.7	NA
M11		6.75	281	NA	8.4	NA
M12		6.69	292	NA	9.2	NA
M13		6.74	411	NA	8	NA
M14		7.22	238	NA	8.6	NA
M15		6.1	349	NA	8.6	NA
M16		6.29	301	190	NA	NA
M17		6.5	338	NA	8.2	NA
M18		6.48	290	NA	8.5	NA
M19		6.02	321	NA	5.8	NA
M20		NA	NA	NA	NA	NA
M21		6.73	303	NA	7.1	NA
M22		6.36	279	NA	8.1	NA
M23		6.51	248	NA	8.7	NA
M24		6.54	255	NA	7.2	NA
M25		6.23	274	NA	6.3	NA
M26		6.07	302	195	NA	NA
M27		6.25	247	NA	5.9	NA
M28		6.55	274	NA	8.5	NA
M29		6.71	240	NA	5.7	NA
M30		6.46	311	NA	6.8	NA
M31		6.09	339	NA	7.7	NA
M32		6.58	296	NA	7.7	NA
M33		6.7	263	NA	7.5	NA
M34		6.5	262	NA	8	NA
M35		6.55	279	NA	8.2	NA
M36		6.51	282	NA	7.9	NA
M37		6.62	243	NA	8.4	NA
TANK		7.26	700	NA	13.3	NA

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
P1	3/22/96	7	280	180	11.1	3.5
P2		7	295	190	NA	4.9
P3		7	278	180	10.2	4
P4		7	274	170	11.1	4.9
M11		7	264	NA	10.5	4.1
M12		6	273	NA	9.1	4.6
M13		7	269	NA	9.4	4.5
M14		7	267	NA	9.6	4.2
M15		6	405	NA	8.5	2.1
M16		7	352	NA	8.6	5
M17		7	309	NA	9	3
M18		7	302	NA	9.3	3.6
M19		6	372	NA	7.7	1.7
M20		7	321	NA	9.4	3.2
M21		7	311	NA	9.1	3.6
M22		7	285	NA	9.3	4.5
M23		7	253	NA	9.4	5.5
M24		7	275	NA	9.2	5.6
M25		7	280	NA	8.6	2.7
M26		7	312	NA	8.3	1.8
M27		7	279	NA	9	5.1
M28		7	292	NA	9.8	4
M29		7	272	NA	8.8	4.6
M30		7	301	NA	8.8	2.8
M31		7	328	NA	9.6	2.1
M32		7	319	NA	9.3	3.8
M33		7	299	NA	10.6	4.5
M34		7	310	NA	10.9	4.8
M35		7	311	NA	11.4	4
M36		7	285	NA	11.4	4
M37		7	272	NA	10.5	6.4
TANK		7	720	355	16	0.9

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
M15	3/15/96	6.38	323	210	8.5	NA
M25		6.34	297	198	8.5	NA
TANK		7.15	700	362	14.9	NA

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
M12	4/2/96	6.8	NA	195	11.6	4.2
M16		6.7	NA	235	11.3	1.4
TANK		7.4	NA	420	18.6	1

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
M15	5/25/96	6.03	495	NA	11.3	3
M19		6.16	425	NA	10.3	4.1
M26		6.01	281	NA	10.3	8.8
M31		6.49	352	NA	10.5	8.2
M34		6.57	393	NA	10.8	8.1
TANK		7.17	770	NA	21	3.1

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
M24	5/2/96	7	313	180	10.7	5.4
M25		7	364	208	11	4.3
M26		7	387	224	11.2	7.2
M27		7	332	192	10.2	6.9
M28		7	347	191	11	5.9
M29		8	322	202	10.9	7
M30		7	331	205	9.5	3.3
M31		7	372	240	9.7	2.6
M32		7	NA	360	10	2.7
TANK		8	660	319	17.9	0.9

APPENDIX H FIELD PARAMETERS

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
P1	5/23/96	6.72	197	NA	12.7	2.9
P2		7.12	324	NA	12.4	3
P3		6.79	297	NA	12.7	3.8
P4		7.13	298	NA	12.7	3
M11		6.9	303	NA	12.4	3.7
M12		6.67	311	NA	12.5	4
M13		6.71	292	NA	12.5	4.2
M14		6.73	291	NA	12.5	4.8
M15		6	515	NA	12.2	1.3
M16		6.48	367	NA	11.9	2.1
M17		6.44	344	NA	11.7	1.6
M18		6.44	337	NA	11.3	3.9
M19		6.27	492	NA	11.3	2
M20		6.5	360	NA	10.8	1.7
M21		6.49	389	NA	11.2	4.7
M22		6.51	353	NA	11.8	4.7
M23		6.5	288	NA	12.4	5.2
M24		6.65	303	NA	11.5	4.1
M25		5.95	250	NA	10.3	4.2
M26		6.11	312	NA	10.9	3.9
M27		6.48	335	NA	9.7	6.1
M28		6.6	318	NA	11.1	4.8
M29		6.82	302	NA	11.9	5.2
M30		6.45	342	NA	10.5	2
M31		6.55	352	NA	9.8	4.9
M32		6.5	373	NA	10.7	3.9
M33		7.01	425	NA	10.1	7
M34		6.59	364	NA	10.6	4.2
M35		6.59	329	NA	10.7	2.9
M36		6.77	368	NA	12.7	3.5
M37		6.84	263	NA	10.6	5.7
TANK		7.11	695	NA	21.8	1.3

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
TANK	5/30/96	7	790	NA	19.4	0.2
P1		7	320		10.8	3.7
M11		7	380		11	4.8
M12		7	330		11.5	5.2
M13		7	335		11.2	2.8
M14		7	320		11.2	3.5
M15		6	790		11.9	0
M16		7	380		10.2	0.5
M17		7	398		10	2.6
M18		7	340		10.3	4.4
M19		7	490		9.8	0.1
M20		7	360		9.9	2.5
M21		7	399		9.7	6.1
M22		7	350		10	5.6
M24		7	410		10.9	0.8
M25		7	480		9.9	0.3
M26		7	510		9.1	0.8
M27		7	300		8.5	7.6
M28		7	360		10	4.8
M29		7	350		9.2	3.4
M30		7	390		8.8	2.7
M31		7	400		8.4	5.7
M32		7	308		9.4	5.4
M33		7	440		8.3	5.9
M34		7	390		9.2	2.4
M35		7	350		9.4	4.8
M36		7	390		10	4.4
M37		7	330		9.6	5.6
M40		6	560		9.8	0.4
M41		6	480		9	1.8
T1		6	620		9.4	1.4
T2		6	420		9.6	0.7
T4		7	540		9.4	2.4
T7		6	430		8.3	2.2

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
P1	6/1/96	6.88	309	NA	11.8	3.3
P2		7.16	315	NA	11.9	2.7
P3		7.04	310	NA	11.6	3.2
P4		6.88	298	NA	12.1	3.8
M11		6.82	297	NA	11.5	3.5
M12		6.88	303	NA	11.9	4.2
M13		6.88	289	NA	11.8	3.7
M14		6.82	286	NA	12	4.2
M15		6.27	530	NA	11.5	0.9
M16		6.53	330	NA	10.2	1.9
M17		6.43	352	NA	9.9	1.1
M18		6.43	287	NA	9.5	3.7
M19		6.2	492	NA	10.2	1.7
M20		6.49	352	NA	9.4	1.3
M21		6.15	327	NA	9.2	4.5
M22		6.34	296	NA	8.4	3.7
M23		6.6	250	NA	10	4.7
M24		6.78	272	NA	10	4.6
M25		6.31	246	NA	9.5	3
M26		6.21	241	NA	9.1	5.1
M27		6.41	298	NA	8.5	6.3
M28		6.58	282	NA	9.5	4.5
M29		6.81	277	NA	9.8	5.3
M30		6.31	314	NA	9.4	1.2
M31		6.43	347	NA	9.7	3.7
M32		6.36	352	NA	10.3	2.1
M33		6.91	342	NA	10.5	7.1
M34		6.6	353	NA	11.2	2.7
M35		6.74	334	NA	11.4	2.4
M36		6.8	351	NA	12.2	2.2
M37		7.15	270	NA	11.7	4.6
TANK		7.07	660	NA	21.3	0.5

SAMPLE	Date	pH	EC micromohs/cm	TDS mg/L	TEMP Celsius	DO ppm
P1	6/6/96	7	277	180	10	4.6
P2		7	296	191	10.4	2.4
P3		7	262	191	9.1	4.2
P4		7	268	170	9.9	3.5
M11		7	283	180	10.5	3.4
M12		7	269	175	9.9	4.8
M13		7	266	175	9.7	4
M14		7	261	170	9.5	4.9
M15		6	500	292	9.6	2.3
M16		7	289	190	8.8	0.8
M17		6	305	206	7.4	2.1
M18		6	268	179	8.1	4.6
M19		6	364	227	8.3	1.7
M20		7	295	191	8	1.9
M21		7	304	195	8.2	4.9
M22		6	290	190	8.6	4.7
M23		7	247	165	8.4	5.4
M24		7	241	161	8	5.4
M25		6	238	157	7.9	2.8
M26		6	219	145	7.3	3.9
M27		6	286	190	7	5.9
M28		7	271	179	8.1	4.1
M29		7	248	170	7.8	5.6
M30		6	291	190	7.6	2.1
M31		6	318	204	7.6	2.7
M32		6	315	205	7.6	2.1
M33		7	311	202	7.6	6
M34		7	327	203	8.1	2.9
M35		7	311	198	8.1	2.7
M36		7	327	200	8.5	2
M37		7	293	161	7.9	3.5
TANK		7	479	230	20	1.9

APPENDIX I

Coliform Analytical Data

APPENDIX I
COLIFORM ANALYTICAL RESULTS

DATE	SAMPLE	TOTAL COLIFORM (CFU)	FECAL COLIFORM (CFU)	COMMENTS
9/23/94	P1	0	0	
	P2	0	0	
	P3	0	0	
	P4	0	0	
	P4FD	0	0	Field duplicate
	TANK	1.44E+08	8.00E+04	
2/6/96	M23	N.A.	0	
	M28	N.A.	0	
	M29	N.A.	0	
	M30	N.A.	0	
	M31	N.A.	0	
	M32	N.A.	0	
	M33	N.A.	0	
	M34	N.A.	0	
	M35	N.A.	0	
	M36	N.A.	0	
	M37	N.A.	0	
	TANK	N.A.	4.70E+05	
2/8/96	M11	N.A.	6	All samples collected on this
	M12	N.A.	3900	date were likely
	M13	N.A.	440	contaminated during well
	M14	N.A.	13	installation.
	M15	N.A.	104	
	M16	N.A.	300	
	M16FD	N.A.	198	Field duplicate
	M17	N.A.	3020	
	M18	N.A.	91	
	M19	N.A.	3080	
	M21	N.A.	3	
	M22	N.A.	3	
	M24	N.A.	11	
	M25	N.A.	0	
	M26	N.A.	8	
	M27	N.A.	8	
3/1/96	P1	0	N.A.	
	P4	0	N.A.	
	M11	45	N.A.	
	M12	4000	N.A.	
	M13	0	N.A.	
	M14	40	N.A.	
	M15	300	N.A.	
	M16	25	N.A.	
	M16FD	0	N.A.	Field duplicate
	M17	0	N.A.	
	M18	120	N.A.	
	M19	10000	N.A.	
	M21	40	N.A.	
	M22	25	N.A.	
	M23	0	N.A.	
	M24	38	N.A.	
	M25	0	N.A.	
	M26	0	N.A.	
	M26FD	0	N.A.	Field duplicate
	M27	0	N.A.	
	M28	0	N.A.	
	M29	0	N.A.	
	M30	0	N.A.	
	M31	0	N.A.	
	M32	0		
	M33	0	N.A.	
	M34	0	N.A.	

APPENDIX I
COLIFORM ANALYTICAL RESULTS

DATE	SAMPLE	TOTAL COLIFORM (CFU)	FECAL COLIFORM (CFU)	COMMENTS
3/1/96 cont'd				
	M35	0	N.A.	
	M36	0	N.A.	
	M37	0	N.A.	
	TANK	0	N.A.	
3/16/96	M15	4	N.A.	
	M15FD	4	N.A.	Field duplicate
	M25	0	N.A.	
	TANK	2.00E+05	N.A.	
3/22/96	P1	0	0	
	P2	0	0	
	P2FD	0	0	Field duplicate
	P3	0	0	
	P4	0	0	
	M11	0	0	
	M12	0	0	
	M13	0	0	
	M13FD	0	0	Field duplicate
	M14	0	0	
	M15	0	4	
	M16	0	0	
	M17	1920	0	
	M18	0	0	
	M19	0	0	
	M20	0	0	
	M21	0	0	
	M21FD	0	0	Field duplicate
	M22	0	0	
	M23	0	0	
	M24	0	0	
	M25	0	0	
	M26	0	0	
	M27	0	0	
	M28	0	0	
	M29	0	0	
	M30	0	0	
	M31	0	0	
	M32	0	0	
	M33	0	0	
	M34	0	0	
	M35	0	0	
	M36	0	0	
	M37	0	0	
	TANK	0	0	
6/1/96	M15	0	0	
	M16	0	0	
	M17	14	1	
	M18	0	0	
	M19	3	0	
	M21	0	0	
	M22	12	0	
	M26	0	0	
	M31	0	0	
	M34	0	0	
	M36	0	0	
	TANK	1.10E+05	4.80E+04	

APPENDIX I
COLIFORM ANALYTICAL RESULTS

DATE	SAMPLE	TOTAL COLIFORM (CFU)	FECAL COLIFORM (CFU)		COMMENTS	
8/26/96	M19	7	12			
	M40	0	0			
	M41	0	0			
	T7	8	5			
	TANK	2.10E+04	1.50E+04			
8/28/96	M19	0	0			
	M40	11	0		Questionable	
	M41	1	0			
	T7	0	0			
	TANK	2000	0			

APPENDIX I
COLIFORM ANALYTICAL RESULTS

DATE	SAMPLE	TOTAL COLIFORM (CFU) (24 hour)	TOTAL COLIFORM (CFU) (48 hour)	FECAL COLIFORM (CFU) (24 hour)	FECAL COLIFORM (CFU) (48 hour)
8/30/96	M19	6	31	1	0
	M40	0	1	0	0
	M41	1	1	0	0
	T7	0	0	0	0
	TANK	3000	6 80E+04	3 90E+04	4 60E+04
9/1/96	M19	0	0	0	0
	M40	0	0	0	0
	M41	0	2	0	0
	T7	0	79	67	63
	TANK	3000	6 80E+04	3 90E+04	4 60E+04
9/3/96	M19	0	16	0	9
	M40	0	0	0	0
	M41	0	1	0	0
	T7	0	0	0	0
	TANK	0	2 90E+04	0	1 10E+04
9/5/96	M19	0	0	0	0
	M40	0	0	0	0
	M41	0	0	0	0
	T7	0	0	0	0
	TANK	0	7000	0	0

DATE	SAMPLE	TOTAL COLIFORM (CFU) (24 hour)	TOTAL COLIFORM (CFU) (48 hour)	FECAL COLIFORM (CFU) (24 hour)	FECAL COLIFORM (CFU) (48 hour)
9/7/96	M19	6		0	
	T7	5		0	
	TANK	TNTC		1 40E+05	

DATE	SAMPLE	TOTAL COLIFORM (CFU)@48HRS (media A)	(media B)	FECAL COLIFORM (CFU)@48HRS (media B)	(media C)
9/16/96	M19	18	N.A.	N.A.	N.A.
	M40	TNTC/17	N.A.	N.A.	N.A.
	M41	TNTC/0	N.A.	N.A.	N.A.
	T7	0	N.A.	N.A.	N.A.
	TANK	2.00E+05	5 20E+04	1 80E+04	3 80E+04

DATE	SAMPLE	TOTAL COLIFORM (CFU)	FECAL COLIFORM (CFU)
9/22/96	M19	15	N.A.
	M40	14	N.A.
	M41	4	N.A.
	T7	0	N.A.
	T8	0	N.A.
	T9	15	N.A.
	M31	3	N.A.
	TANK	1 40E+05	N.A.

APPENDIX J

Coliphage Seeding Experiment
Field and Analytical Data

APPENDIX J
COLIPHAGE SEEDING EXPERIMENT
FIELD AND ANALYTICAL DATA

Hours	Lab Stock	After Seed	Enclosed	[illegible]82-15597 Dialysis	Well 19	Well 40	Well 41	Well T7	Well T8	Well T9	Well T10	Well 31
0	6 35E+11	1 06E+09	1 06E+09	1 06E+09	1 06E+09	9 53E-03	3 02E-02	4 05E-02				
9												
12	7 63E+11	1 24E+09	9 95E+08	1 02E+09	1 81E+08	2 47E-02						
16												
22												
24	4 73E+11	5 80E+08		9 78E+08	3 84E+07	4 68E-02						
29												
36			1 15E+09	1 11E+09	1 04E+07	3 65E+03		9 53E-04				
44												
48	1 23E+12	9 96E+08	1 18E+09	1 06E+09	5 56E+06	2 86E+05	1 81E-01					
55												
60			1 53E+09	1 01E+09	4 45E+06	8 64E+04	4 00E-01					
68												
72	1 37E+12	1 20E+09	1 54E+09	1 06E+09	2 28E+06	4 35E+04	1 80E+00	8 90E-04				
79												
84			1 08E+09	3 64E+08	2 89E+06	3 20E+04	3 46E+01					
94												
96	1 10E+12	1 22E+09	6 88E+08	7 36E+08	2 01E+06	1 00E+04	2 92E+03					
104												
108							3 63E+04					
117												
120	1 49E+12	9 50E+08	1 06E+09	5 44E+08	4 25E+05	6 44E+03	1 81E+05	1 81E-01				
127												
132						7 87E+03	2 36E+06					
144	1 65E+12	1 49E+09	1 05E+09	3 04E+08	4 74E+05	3 02E+03	1 87E+05					
151												
156												
166												
168	1 03E+12	9 08E+08	6 66E+08	2 39E+08	6 46E+05	2 27E+03	7 95E+04	3 00E-01				
175												
180												
187												
192					5 20E+05	2 14E+03		3 50E+00				
204												
211												
216	1 10E+12	8 14E+08	4 00E+08	1 39E+08	5 64E+05	1 65E+03	1 70E+04	1 37E+01				
228								1 55E+01				
240					1 63E+05	1 96E+03	2 11E+04	2 89E+01				
252												
264	9 84E+11	1 07E+09	3 04E+08	5 90E+07	3 84E+05			1 44E+01				
272												
276												
284												
288					1 10E+05			2 04E+01				
296												
300												
308												
312	1 21E+12	1 21E+09	1 82E+08	3 85E+07	9 06E+04	1 41E+03	1 09E+04	2 71E+01	8 90E-04			
320												
324												
333												
336												
344												
348												
357												
360												
368								1 36E+01				
372												
381												
384	1 08E+12	9 30E+08			5 78E+04			1 41E+01	8 90E-04			
392												
396												
404												
408												
420												
428												
432									4 29E-03			
444												
456												
468												
480	1 328E+12	1 186E+09	181875000	13800000	32700	1020	4700	11 3	0 0349603			
579									0 2			
603												
648	6 5E+11	522000000	29800000	7420000	7800	535	660	3 5	0 0247207	1 3	0 001917	0 00089
696									0 0074478	1 8	0 000953	0 004066
744									0 0009535	0 3	0 00089	0 00201
792		472000000	22800000	6140000	9880				0 0020101	1 1	0 020184	0 006519
864												
912												
4080			8500		1240							
4272						13 3						

APPENDIX J
COLIPHAGE SEEDING EXPERIMENT
FIELD AND ANALYTICAL DATA

Hours	Lab Stock	After Seed	Enclosed	PhiX174 Dialysis	Well 19	Well 40	Well 41	Well T7	Well T8	Well T9	Well T10	Well 31
0	8 80E+08	1 12E+06	1 12E+06	1 12E+06	1 12E+06	1 10E 02	9 13E 04	9 53E 04				
9												
12	1 23E+09	9 75E+05	2 00E+06	9 08E+05	8 14E+04	3 20E 03						
16												
22												
24	1 22E+09	7 85E+05	1 34E+06	1 35E+06	1 72E+04	9 13E 04						
29												
36			1 48E+06	1 21E+06	5 85E+04	4 00E 01		8 90E 04				
44												
48	1 10E+09	9 92E+05	2 14E+06	2 73E+06	2 53E+04	1 80E+00	9 53E 04					
55												
60			1 83E+06	1 03E+06	2 63E+04	5 09E 01						
68												
72	5 40E+08	6 62E+05	9 90E+05	1 13E+06	2 50E+04	2 00E 01	3 59E 02	8 90E 04				
79												
84			1 61E+06	7 50E+05	2 23E+04	2 23E 01	5 09E 01					
94												
96	5 48E+08	1 07E+06	1 53E+06	7 55E+05	1 40E+04	1 08E 01	1 30E+00					
104												
108							1 50E+00					
117												
120	3 96E+08	5 82E+05	8 30E+05	4 22E+05	3 00E+03	7 63E 02	1 30E+00	9 53E 04				
127												
132							8 00E 01					
144	9 84E+08	8 90E+05	8 90E+05	4 38E+05	2 94E+03	7 63E 02	6 00E 01	5 74E 03				
151												
156												
166												
168	8 46E+08	1 01E+06	9 54E+05	3 54E+05	2 53E+03		3 00E 01	3 45E 02				
175												
180												
187												
192					1 72E+03	9 36E 02	8 00E 01	7 63E 02				
204												
211												
216	6 46E+08	9 66E+05	7 98E+05	3 01E+05	1 16E+03			5 45E 02				
228												
240					1 33E+03	6 40E 02	1 00E 01	1 21E 01				
252												
264	9 66E+08	1 65E+06	9 54E+05	2 75E+05	1 40E+03			7 63E 02				
272												
276												
284												
288					1 27E+03			4 68E 02				
296												
300												
308												
312	7 62E+08	9 44E+05	6 88E+05	2 43E+05	6 30E+02		2 50E 01	1 21E 01	8 90E 04			
320												
324												
333												
336												
344												
348												
357												
360												
368												
372												
381												
384	8 20E+08	9 13E+05			5 35E+02			7 63E 02	8 90E 04			
392												
396												
404												
408												
420												
428												
432									8 90E 04			
444												
456												
468												
480	458000000	1418000	396000	44800	327	0 076277	0 121356	0 0639602	9 53E 04			
579									9 53E 04	9 53E 04		
603												
648	807000000	1860000	450000	21400	162	0 0218739	0 0468487	0 0074478	0 00089	0 002889	0 00089	0 00089
696									0 00089	0 003198	0 00089	0 00089
744									0 00089	0 000953	0 00089	0 00089
792		1150000	171000	16100	268 5				0 00089	0 00201	0 00089	0 00089
864												
912												
4080			12800		140							
4272						0 05						