GW - 49

WORK PLANS

HYDROCARBON RECOVERY
at El Paso Natural Gas Company's
Blanco Plant

WORK PLAN

OCTOBER, 1991

EXECUTIVE SUMMARY

Hydrocarbon recovery is proposed at two locations at EPNG's Blanco plant. In the north area a new 6-inch diameter well is proposed near the existing monitoring well MW-19 (referred to here as RW-19A). This well will be screened so as to intercept the hydrocarbon layer at the top of the unconfined alluvial aquifer. In the south area the existing 4-inch diameter monitoring well, MW-6 which is screened across the top of the aquifer, is proposed as a recovery well while investigations proceed at this facility.

It is proposed that a dual pump system be installed in well RW-19A. This system will consist of a small diameter hydrocarbon-selective pump and a watertable depression pump. The liquids removed from the aquifer will be pumped separately as hydrocarbons and water, and will be disposed of separately.

It is proposed that a single pump be installed in MW-6 to pump both water and floating hydrocarbons. The hydrocarbon phase will be separated from the water phase on site and both fluids disposed of separately.

Pump sizes and pumping rates for both wells will be determined after completion of aquifer tests and analysis of the physical properties of the fluids to be pumped.

CONTENTS

HYDROCARBON RECOVERY
at El Paso Natural Gas Company's
Blanco Plant

I. BACKGROUND

Floating hydrocarbons have been identified in two monitoring wells at the Blanco Plant site. The New Mexico Oil Conservation Division has requested that El Paso Natural Gas (EPNG) prepare a work plan for removal of the hydrocarbons. This plan shall consist of recovery well installation, and pumping and disposal of the hydrocarbons. Further studies will be conducted to assess site hydrogeology and the source and extent of hydrocarbons.

The actions recommended are based on hydrogeologic information obtained during the studies by McBride-Ratcliff and Associates, Inc., (1988), Bechtel (1988) and K. W. Brown (1990), on preliminary results of the soil gas and groundwater survey performed by John Mathes and Associates (April 15-17, 1991), and on groundwater quality information obtained by EPNG personnel in June, 1991. The information pertinent to this work plan is summarized in Tables 1 and 2.

II. NORTH AREA

Based on data from soil borings for monitor wells and geotechnical programs, Well 19 is located in a paleochannel (buried canyon) in the bedrock (Figure 1), which is now filled with alluvial sediment. The canyon appears to be relatively steep-walled, and probably is reflected in the location of the present arroyo. The canyon walls appear to act as a control on the local groundwater movement.

This well was installed on January 11, 1990. At that time, PID vapor readings were at 2,000 ppm from inside the PVC casing and a hydrocarbon odor and oily sheen were reported on the water level probe. Water samples collected indicated 29 mg/l of total petroleum hydrocarbons, 4200 ug/l benzene, <50 ug/l toluene, 340 ug/l ethylbenzene, and 3740 ug/l total xylenes. None of these analytes were detected in water samples collected at that time from Well 2, approximately 500 feet downgradient.

Water samples were collected on June 18, 1991. At that time approximately 4 inches of free hydrocarbons were observed in the well. No odor or visible contamination was reported in Well 2 during that sampling event. Toluene was detected at .7 ug/l and total xylenes at .9 ug/l were detected in the samples from Well 2. The analyses did not detect total petroleum hydrocarbons at a detection limit of 1 mg/l.

The soil gas survey performed by John Mathes and Associates (JMA) at the north flare pit (samples designated AFP), which is no longer in use, indicates that this pit is possibly the source of the hydrocarbons found in Well 19 (Figure 2). Four borings were located at this pit, one upgradient and three downgradient. All four borings indicated the presence of hydrocarbons in soil gas samples collected. The evaporation pond which is presently lined, was previously unlined (samples designated EP), and may also be a source for hydrocarbons in Well 19. JMA collected three soil gas samples at this area. The upgradient sample (EP-1-20-SG) from location B-1 indicated the presence of hydrocarbons.

Groundwater was not encountered in probe holes at these locations and therefore no water samples were collected by JMA at either the flare pit or the pond.

A single recovery well is recommended just downgradient of Well 19. This location would recover hydrocarbons from both possible sources (the abandoned flare pit and the old unlined pond) and be near the leading edge of the plume of floating hydrocarbons. This proposed well is referred to as RW-19A in this work plan.

III. SOUTH AREA

The steep paleochannel identified in the north area appears to become more broad and shallow to the south end of the site (Figure 1), and filled with less alluvial material. The flare pit and Well 6 appear to be near the eastern edge of this channel. Groundwater flow is to the southwest near the flare pit. It appears that although Well 6 is slightly cross-gradient to the flare pit, no other potential sources exist in the area. In addition, the soil gas survey conducted by JMA (see below) indicates that hydrocarbon contamination attenuates rapidly away from this pit in the downgradient direction.

Well 6 was installed on September 21, 1988. Stained soil with hydrocarbon odor was detected between 12 and 23 feet below the surface. Soils analyzed from these intervals did not contain detectable levels of organic compounds. The well was screened between 19 and 29 feet below the surface. Water samples collected at that time were analyzed for benzene, toluene, ethylbenzene and total xylenes, and none of these compounds were detected. No samples were collected from this well in the January 1990 sampling round.

Water samples were collected on June 18, 1991. At this time 2 inches of free hydrocarbons were observed in this well.

Five soil gas samples were collected by JMA around the south flare pit (Figure 3). Sample FP-5-30-SG from the upgradient location (B-5) and samples FP-1-30-SG and FP-2-30-SG from downgradient locations (B-1 and B-2) indicated that hydrocarbons are present in the unsaturated zone. Only a trace of hydrocarbons (1 ug/l) were detected in upgradient location B-6 (sample FP-6-30-SG) and none in downgradient location B-4 (sample FP-4-30-SG). Water was encountered at the downgradient location B-3. No TPH or BTEX were detected in sample FP-3-30-WH collected at that location.

A single recovery well is indicated near the flare pit at this time. Existing Well 6 is located in such a position as to collect hydrocarbons, and is large enough to accommodate a pump. From the sampling history detailed above, it appears that hydrocarbons are migrating at a slow rate in this area. The best alternative therefore would be to pump this well with known contamination, while further studies are underway as to the configuration of the plume.

IV. SPECIFICATIONS

Specifications will be prepared for a contract driller and for in-house support from the conceptual outline which follows.

Well Drilling: The preferred drilling method is hollow stem auger, but air rotary equipment may be considered. Split spoon samples should be collected every 5 feet if hollow stem auger equipment is used. These samples will be for chemical analysis and lithologic logging purposes.

Well Construction: The well RW-19A will be constructed of six inch PVC. The screen will be either mild or stainless steel, placed near the with at least two feet of screen above the water level and at least 10 feet of screen below the water surface to produce sufficient volume of pumping and to accommodate seasonal water level fluctuations. At least a 15 foot, .010 screen will be used as it is anticipated that only the product layer will be pumped. A gravel pack consisting of silica sand, size #30, a bentonite seal, cement - bentonite grout to surface, and galvanized surface casing will also be installed.

Well Development: The well will be developed by surging and pumping with air or water to remove fine material introduced during drilling prior to sampling.

Aquifer Tests: Slug tests (either bail down or plug) will be conducted on both hydrocarbons and groundwater in the new recovery well RW-19A and in Well 6 prior to initiation of pumping.

Sampling and Analysis: Physical tests (grain size analysis, porosity, bulk density) will be performed on soils from screened intervals. Physical tests (viscosity, specific gravity) will be performed on hydrocarbons and on water samples. Chemical analysis will be performed on soil samples from the new well, and on floating hydrocarbons and water from both wells. Analytes will include cations/anions, TDS and nitrogen (NO3, NO2 and TKN). BTEX and TPH analyses will not be performed because floating product is present.

Surveying: Location, surface level, top of casing will be surveyed.

Pumping: Pump sizes and pumping rates for both wells will be determined after completion of aquifer tests and analysis of the physical properties of the fluids to be pumped.

RW-19A: The dual pump system should be of a small diameter in order to fit inside the 6 inch diameter well. One pump should be equipped with a sensor which allows collection of floating hydrocarbons only. The other pump shall be placed lower in the well in such a way as to create sufficient drawdown to recover the floating product.

MW-6: The pump should be of a small diameter in order to fit inside the 4 inch diamter well. The pump will be explosion proof and capable of pumping both hydrocarbons and water.

Disposal:

RW-19A: Assuming that the pumps collect the hydrocarbon phase and water phases separately, the limited volume of hydrocarbon liquid could possibly be disposed of through a used oil vendor. The water phase will be disposed of appropriately.

MW-6: Since both water and hydrocarbons are removed together, the liquids will be separated at the surface and disposed of appropriately.

TABLE 1

Hydrogeologic Conditions And Presence Of Contaminants At Existing Monitor Wells

	MW-19	MW-6
Lithology of screened interval	gravel, sandstone	clay, fine to med. sand
Aquifer thickness	64'	35' (estimated)
Saturated thickness	10'	12' (estimated)
Seasonal fluctuations	June 91 1' > Jan 90	June 91 2' > Jan 90
Boundaries	Arroyo/paleo channel wall < 50' to SE	outcrop 600' to west
Amount of product	4" layer (6/18)	2" layer (6/19)
Sources	north flare pit/unlined evap. pond	south flare pit
Well diameter	2"	4"
Hydraulic conductivity	1 x 10^{-1} (estimate no bail test)	1.5 x 10^{-4} cm/sec from bail test
Gradient	.007	.006
Transmissivity	212 gpd/ft. (b = 10')	102 gpd (b = 32') 38 gpd/ft (b = 12')

Table 2. Blanco Plant Monitor Well Data

WELL NO.	GROUND ELEV.	TOP OF CASING	DEPTH TO BR	BED ROCK ELEV	DEPTH TO TD	TOTAL DEPTH ELEV.	SCREEN INTER-VAL	BASE SCREEN	DATE	DEPTH TO WATER	STATIC WATER LEVEL	DATE	DEPTH TO WATER	STATIC WATER LEVEL
1	5649	na	51	5598	52	5597	na							
2	5614	5615.97	57.5	5556.5	57.5	5556.5	10	5557.7	1/8/90	51.87	5564.1	6/18/91	53.75	5562.22
3	5590	na	6	5584	8	5582	na							
4	5582	na	7	5575	8	5574	na							
5	5565	5566.5	?	5565	20	5545	10	5546.5	1/8/90	14.05	5552.45	6/18/91	14.67	5551.83
6	5576	5577	?	5576	31	5545	10	5547	1/8/90	21.22	5555.78	6/18/91	23.25	5553.75
7	5568	5569	20.5	5547.5	21	5547	10	5549	1/8/90	17.65	5551.35	6/18/91	18	5551
8	5578	5580.3	32	5546	35	5543	10	5544.7	1/8/90	26.47	5553.83	6/18/91	28.83	5551.47
9	5567	na	10	5557	12.5	5554.5	na							0
10	5563	5564.2	14	5549	15	5548	5	5549.2	1/8/90	12.59	5551.61	6/18/91	13.5	5550.7
11	5598.1	na	5	5593.1	70	5528.1	na							0
12	5599.05	5601.44	5	5594.05	25	5574.05	5	5574.3	1/15/90	21.4	5580.04	6/18/91	18.58	5582.86
13	5597.38	5597.44	3	5594.38	23.8	5573.58	5	5573.83	1/15/90	17.7	5579.74	6/18/91	15.17	5582.27
14	5598.14	5598.07	4	5594.14	27.4	5570.74	5	5570.99	1/15/90	21.5	5576.57	6/18/91	22.58	5575.49
15	5596.5	5596.32	4	5592.5	26.9	5569.6	5	5569.85	1/15/90	20	5576.32	6/18/91	21	5575.32
16	5597.58	5597.43	4	5593.58	29	5568.58	5	5568.83	1/15/90	27.3	5570.13	6/18/91	19.33	5578.1
17	5599.16	5601.51	5	5594.16	12	5587.16	3	5587.41	1/15/90	dry	na	6/18/91	dry	na
18	5598.15	5598.21	4	5594.15	11	5587.15	3	5587.4	1/15/90	dry	na	6/18/91	10	5588.21
19	5619.7	5622.02	64	5555.7	66	5553.7	10	5554.5	1/15/90	55.7	5566.32	6/18/91	56.67	5565.35

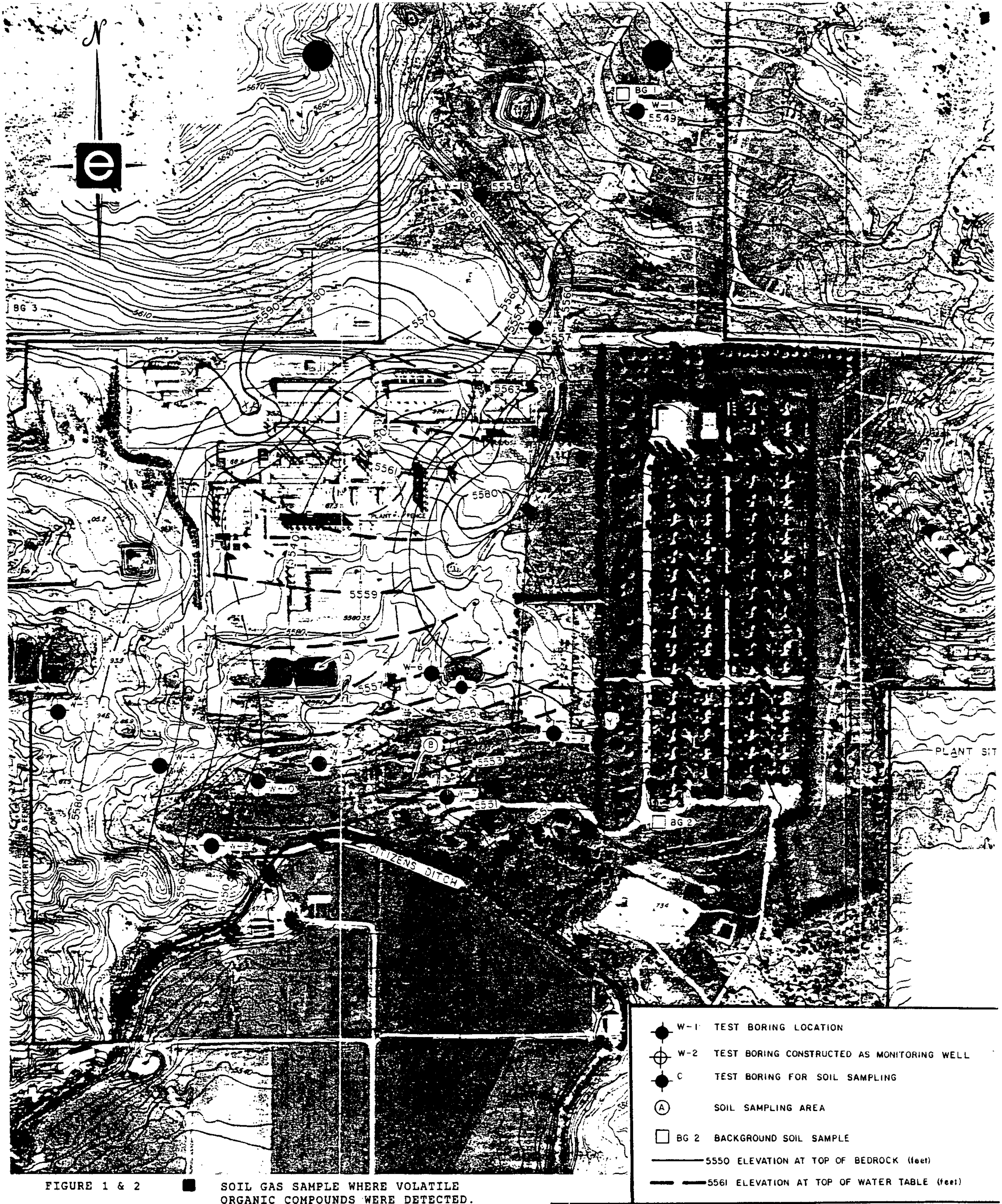


FIGURE 1 & 2	■	SOIL GAS SAMPLE WHERE VOLATILE ORGANIC COMPOUNDS WERE DETECTED.
	▲	"CLEAN SOIL" GAS SAMPLE
FIGURE 2	⊗	PROPOSED EXTRACTION WELL LOCATION

ENGINEERING RECORD	
DRAWN BY	Aero-Graphics
TRACED BY	
CHECKED BY	
APPROVED	
DATE	
PHOTO DATE	10-18-82
CONTOUR INTERVAL	2'

El Paso
Natural Gas Company

SITE INVESTIGATION LOCATION PLOT
BLANCO PLANT

SEC. 14, TWS 29-N, RANGE 11-W
SAN JUAN COUNTY, NEW MEXICO DATE: NOV. 198

FIGURE 1

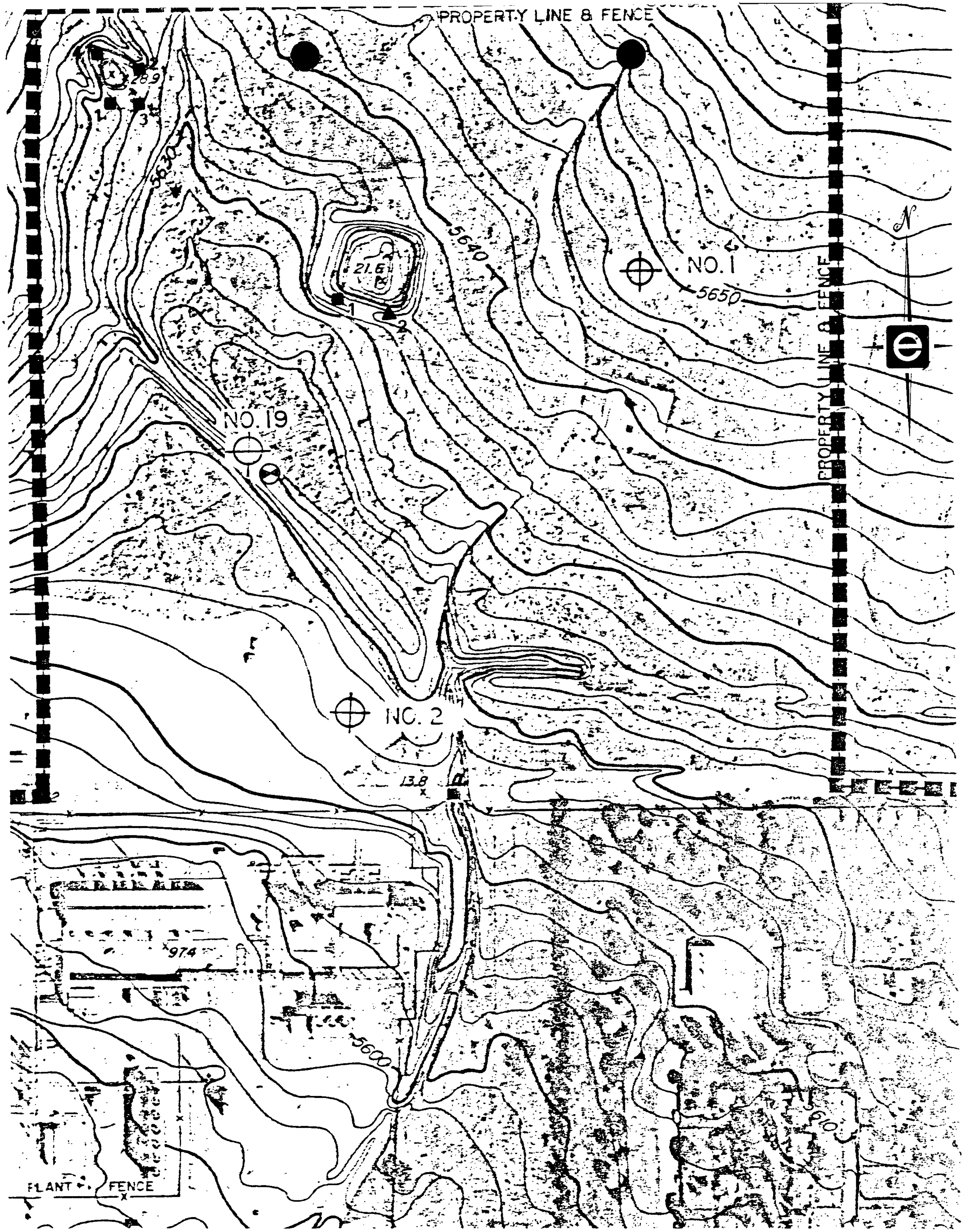

PROPERTY LINE & FENCE
28.9
1
2
3
5630
5640
21.6
1
2
NO. 1
5650
PROPERTY LINE & FENCE
N
NO. 19
1
NO. 2
13.8
974
5600
610
PLANT FENCE

FIGURE 2

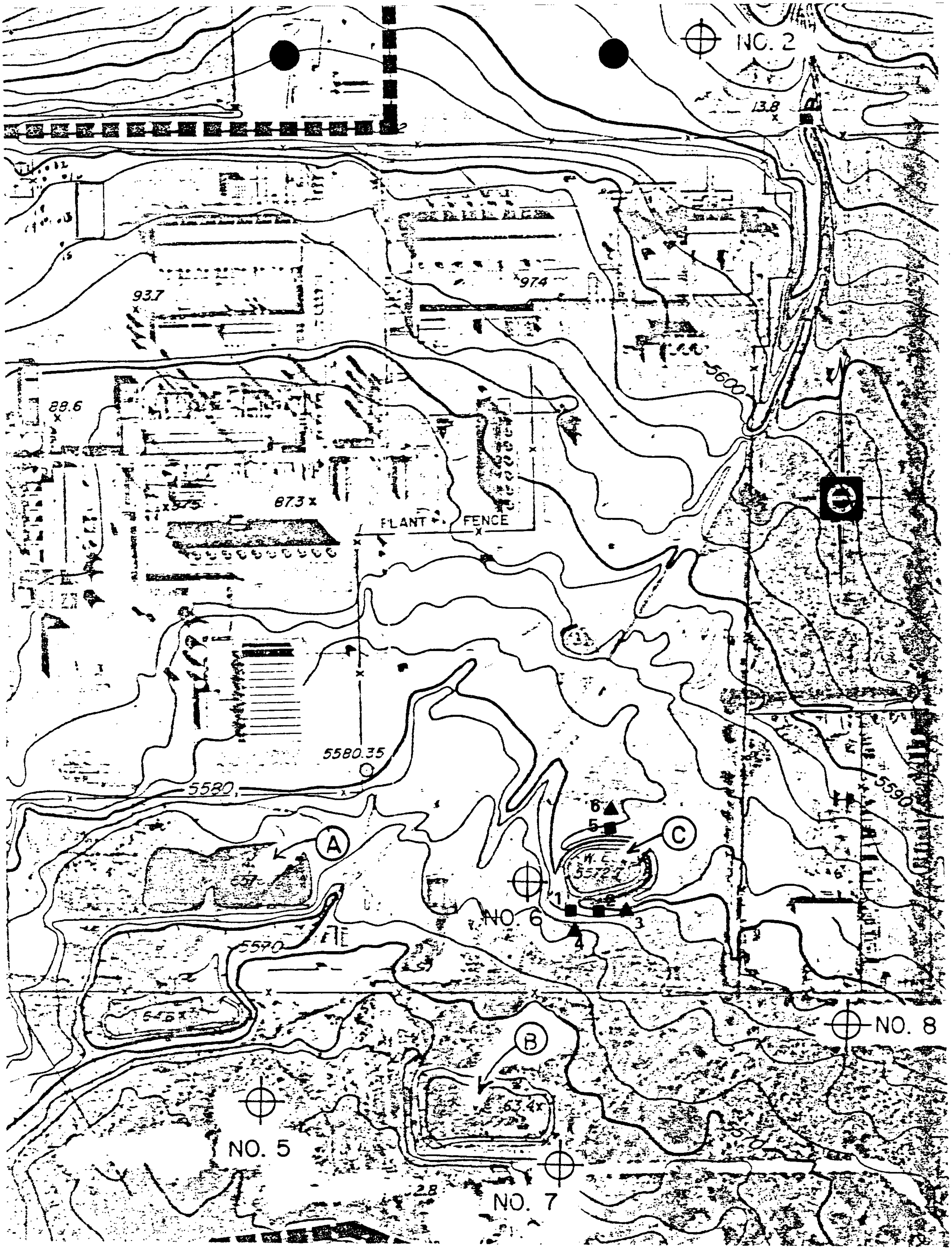

NO. 2
13.8
97.4
93.7
5600
88.6
87.5
87.3
PLANT FENCE
5580.35
5580
5590
6
5
C
A
W.E.
5572
1
2
3
4
NO. 6
5570
B
63.4
NO. 8
NO. 5
NO. 7
2.8

FIGURE 3

File Copy

RECEIVED
OCT - 6 1988
OIL CONSERVATION DIVISION
SANTA FE

Final

WORK PLAN

GROUNDWATER QUALITY INVESTIGATION OF THE BLANCO PLANT EL PASO NATURAL GAS CO.

Bloomfield, N.M.

September 1988

TABLE OF CONTENTS

WORK PLAN

Final

WORK PLAN

Groundwater Quality Investigation
of the
Blanco Plant

El Paso Natural Gas Company

September 1988

WORK PLAN

Groundwater Quality Investigation
of the
Blanco Plant

El Paso Natural Gas

1.0 Background

The New Mexico Environmental Improvement Division (NMEID) "Superfund" staff conducted a site investigation at the Blanco Plant on August 7, 1987. This inspection was requested by NMEID as a preliminary part of the process necessary to obtain specific information required to ascertain whether the Blanco Plant qualifies for the Superfund National Priorities List. Based on this site investigation, NMEID has requested that further investigation be undertaken at the Blanco Plant to assess the groundwater quality under the plant property. NMEID's rationale for requesting this investigation is as follows:

- wastewaters were deposited in wastewater ponds during the gasoline plant operation until approximately 1964 when EPNG contracted the disposal to the City of Bloomfield wastewater treatment plant.
- wastewaters contained chromium (VI) and petroleum wastes.
- the groundwater is very shallow in the area and soils are very permeable.
- the disposal areas are up-gradient and in very close proximity to an irrigation water canal called Citizens Ditch.

The unanswered questions regarding this plant, based on NMEID's review of their information is:

- whether there is significant groundwater contamination by chromium and/or organics.
- whether there is significant contamination on ditch or other near surface sediments resulting from wastewater or organics disposal.

NMEID requested that in conjunction with the preparation of the discharge plan application properly located shallow monitoring wells be installed at the Blanco Plant to ascertain whether contamination of groundwater exists as a result of past wastewater disposal practices.

The results of NMEID site inspection and analysis of some soil and groundwater samples indicate variable concentrations in the soil and very low concentrations of chromium in the groundwater samples.

Samples collected by NMEID include:

1) Sediment from southeast corner of unused evaporation pond
2) Citizens ditch bank
3) Groundwater from Cletus Heron and George Goebel wells

The New Mexico state laboratory performed a metals analysis for all the samples, the results of which can be seen in Table 1-1. Results of metals analysis shown in Table 1-1 are by ICP scan and are in ug/g for soil samples and mg/l for well samples. EPNG obtained split samples from the above samples taken by NMEID. An independent laboratory ran the same analysis with the results listed in Table 1-2.

2.0 Objectives

The objectives of the groundwater investigation are to provide the regulatory agencies with sufficient information about the site to demonstrate that the Blanco plant is or will be in compliance with NMWQC regulations and to provide information to the NMEID to indicate whether there is significant groundwater contamination by chromium and/or organics as a result of past wastewater disposal practices.

3.0 Approach

The focus of the proposed investigation will be to determine the presence or absence of chromium and/or organics in the groundwater and, if they are present above background concentration levels, to determine whether the Blanco Plant operation "was the source" of chromium contamination. The investigation will also provide geologic and hydrogeologic information necessary for the discharge plan application.

The groundwater investigation will focus on the areas downgradient of potential contamination source points, namely inactive waste ponds, the abandoned evaporation pond and flare

TABLE 1-1
ANALYTICAL RESULTS FOR NMEID SAMPLE

Sediment Samples	%sol.	Date	Al	Ba	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Zn
Background 3"down	97.95	8-12-87	7200.	76.	<4.	2000.	4.	3.6	10.	8000.	<4.	2000.	200.	20.
Background 2' down	95.8	8-12-87	5500.	88.	<4.	7700.	4.	4.	<.	6600.	<4.	1500.	160.	10.
SE. corner of unused pond 3" down	97.8	8-12-87	9100.	110.	<5.	3700.	280.	3.	56.	8600.	<5.	2000.	96.	130.
SE corner of unused pond 2 feet down	84.5	8-12-87	12000.	170.	<5.	3600.	40.	7.1	20.	13000.	<5.	3100.	92.	40.
S. of SE corner of unused pond 3" down	96.5	8-12-87	14000.	160.	<5.	8000.	10.	7.	20.	14000.	<5.	3800.	330.	40.
S. outside of SG corner of unused pond. 2 ft down	96.0	8-12-87	6500.	80.	<4.	8300.	<4.	3.6	7.	7200.	<4.	1600.	210.	2.
DITCH BANK SAMPLES														
Background #5	80.2	12-9-87	5200.	130.	<5.	3600.	5.	3.8	9.	6700.	9.	1900.	120.	20.
#1	95.7	12-9-87	4900.	30.	<5.	21700.	<5.	2.2	6.5	4900.	<5.	2000.	170.	10.
#2	74.1	12-9-87	5600.	130.	<5.	3300.	5.	5.	270.	8300.	9.	2300.	120.	40.
#3	71.4	12-9-87	5800.	150.	<5.	3500.	5.	5.	40.	8200.	5.	2100.	140.	30.
#4	75.4	12-9-87	9500.	190.	<5.	4800.	5.	7.1	20.	11900.	10.	3200.	670.	40.
WELL SAMPLES		12-9-87												
Cletus Heron well		12-9-87	<.1	<.1	<.1	390	0.009	<.05	<0.05	7.2	<.1	44.	1.4	<.1
George Goebel well		12-9-87	<.1	<.1	<.1	240.	0.009	<.05	0.2	8.9	<.1	48.	0.8	0.8
Blank		12-9-87	<.1	<.1	<.001	7.	<.005	<.05	<.1	<.1	<.01	2.	<.05	<.1

TABLE 1-2

EL PASO NATURAL GAS COMPANY
BLANCO PLANT ANALYTICAL DATABASE

P A R A M E T E R	CITZ.DIT. #5 J87-104 (FILTERED) ICP SCAN mg/liter	CITZ.DIT. #5 J87-104 (FILTERED) ATM. ADS. mg/liter	CITZ.DIT. #5 J87-104 (UNFILTERED) ICP SCAN mg/liter	CITZ.DIT. #5 J87-104 (UNFILTERED) ATM. ADS. mg/liter	BGRND CITZ. J87-105 (FILTERED) ICP SCAN mg/liter	BGRND CITZ. J87-105 (FILTERED) ATM. ADS. mg/liter	BGRND CITZ. J87-105 (UNFILTERED) ICP SCAN mg/liter	BGRND CITZ. J87-105 (UNFILTERED) ATM. ADS. mg/liter	BLANCO PLT #9 J87-106 ICP SCAN mg/liter	BLANCO PLT #9 J87-106 ATM. ADS. mg/liter	J87-098 ICP SCAN ug/gram	J87-099 ICP SCAN ug/gram	J87-100 ICP SCAN ug/gram	J87-101 ICP SCAN ug/gram	J87-102 ICP SCAN ug/gram	J87-103 ICP SCAN ug/gram
MATRIX	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
COD	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
NITRATE - N	NT	<0.1	NT	NT	NT	0.2	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
OIL AND GREASE	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
TOC	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
O - PHOSPHATE	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
CYANIDE (TOTAL)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
PHENOLICS	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
ALUMINUM	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	500 TO 5,000	500 [illegible] 000	500 5,000	500 TO 5,000	500 TO 5,000	500 TO 5,000
ARSENIC	NT	<0.01	NT	<0.01	NT	<0.01	NT	<0.01	NT	<0.01	ND	[illegible]	ND	ND	ND	ND
BARIUM	0.1 TO 1.0	NT	0.1 TO 1.0	NT	0.1 TO 1.0	NT	0.1 TO 1.0	NT	0.1 TO 1.0	NT	50 TO 500	[illegible] 500	50 TO 500	50 TO 500	50 TO 500	50 TO 500
BERYLLIUM	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	< 5.0	< [illegible].0	< 5.0	< 5.0	< 5.0	< 5.0
CADMIUM	10 TO 100	0.001	10 TO 100	0.002	10 TO 100	0.003	10 TO 100	0.002	10 PPM	0.001	500 TO 5,000	500 T[illegible] 5,000	500 TO 5,000	500 TO 5,000	500 TO 5,000	500 TO 5,000
CALCIUM	NT	31.4	NT	NT	NT	32.2	NT	NT	NT	8.6	NT	[illegible]	NT	NT	NT	NT
CHROMIUM (TOTAL)	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	0.01	50 TO 500	5[illegible] 500	5 TO 50	5 TO 50	ND	5 TO 50
COPPER	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	50 TO 500	5 [illegible] 50	5 TO 50	5 TO 50	5 TO 50	5 TO 50
HARDNESS (AS CACO3)		8				0		NT								
IRON	0.1 TO 1.0	NT	0.1 TO 1.0	NT	0.1 TO 1.0	NT	0.1 TO 1.0	NT	0.1 TO 1.0	NT	5,000 TO 50,000	5,000 [illegible] 50,000	5,000 TO 50,000	5,000 TO 50,000	5,000 TO 50,000	5,000 TO 50,000
LEAD	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	ND	[illegible]	ND	ND	ND	ND
MAGNESIUM	4.5	4.2	7.7	NT	4.4	4.2	7.9	NT	<1.0	0.7	1180	1[illegible]0	2430	1840	1480	1480
MANGANESE	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	50 TO 500	50 [illegible] 500	50 TO 500	50 TO 500	50 TO 500	50 TO 500
MERCURY		0.0043		<0.0004		<0.0004		<0.0004		<0.0004	ND	ND	ND	ND	ND	ND
MOLYBDENUM	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	ND	ND	ND	ND	ND	ND
NICKEL	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	ND	ND	ND	ND	ND	ND
POTASSIUM	1.5	1.5	1.7	NT	1.7	1.7	1.8	NT	1.2	1.2	1420	1395	1990	745	1675	825
PHOSPHORUS	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	50 TO 500	50 TO 500	50 TO 500	50 TO 500	50 TO 500	50 TO 500
SELENIUM		<0.01		<0.01		<0.01		<0.01		<0.01	ND	ND	ND	ND	ND	ND
SILICA	1.0 TO 10.0	NT	1.0 TO 10.0	NT	1.0 TO 10.0	NT	1.0 TO 10.0	NT	1.0 TO 10.0	NT	50 TO 500	[illegible]00	500	500	50 TO 500	500
SILVER	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	ND	ND	ND	ND	ND	ND
SODIUM	13.6	13.9	13.9	NT	14.3	14.3	13.5	NT	53.0	53.0	1025	1[illegible]0	4560	3575	385	1105
ZINC	ND	NT	ND	NT	ND	NT	ND	NT	ND	NT	50 TO 500	50 [illegible] 500	50 TO 500	50 TO 500	50 TO 500	50 TO 500
T. ALKALINITY (AS CACO3)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
BICARBONATE ALKTY. (AS CACO3)	NT	61	NT	NT	NT	74	NT	NT	NT	107	NT	[illegible]	NT	NT	NT	NT
CHLORIDE	NT	2	NT	NT	NT	2	NT	NT	NT	4	NT	[illegible]	NT	NT	NT	NT
FLUORIDE	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
TDS	NT	210	NT	NT	NT	200	NT	NT	NT	160	NT	[illegible]	NT	NT	NT	NT
TOTAL RESIDUE	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
SULFATE	NT	52	NT	NT	NT	53	NT	NT	NT	18	NT	[illegible]	NT	NT	NT	NT
PCB'S	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
PH	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	[illegible]	NT	NT	NT	NT
ETHYLENE DIBROMIDE	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
NAPHTHALENE	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
MONOMETHYLNAPHTHALENE	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
ANION/CATION BALANCE (in meq)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
VOLATILE ORGANICS	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

NOTE:
- These results are from split samples from the samples taken by Dr. Ron Conrad of the NMEID Superfund Section on 8/10/87.
- K.E. Beasley and H. Van of EPNG collected the split samples.
- ND means Not Detected
- NT means Not Tested

J87-104 Citizens Ditch South of Plant
J87-105 Background Water from Citizens Ditch
J87-106 Citizens Ditch East of Plant
J87-098 Soil from Dry Pit @ 3"
J87-099 Soil from Dry Pit @ 24"
J87-100 Soil from Area South of Dry Pit @ 3"
J87-101 Soil from Area South of Dry Pit @24"
J87-102 Background Soil from East of Plant @ 3"
J87-103 Background Soil from East of Plant @ 24"

pit area. The presence of chromium in soil alone is not proof that the soil is contaminated by wastewater containing chromium. Some soils contain naturally occurring chromium (trivalent chromium), in relatively high concentrations. The sampling and analytical program is designed to confirm whether the past plant operations could have been source of the contamination, if indeed the contamination exists.

The exact locations of the monitoring wells were selected based on a review of the available information, a site visit, and recommendations provided to EPNG by the staff of NMEID during a meeting on April 27, 1988. In addition to the concern for possible groundwater contamination, groundwater flow direction and hydraulic conductivity was also considered in locating these wells. During the site investigation, an attempt will be made to visit existing local wells and obtain permission for including these wells into the monitoring network, especially for water level measurements.

It has been suggested that Citizen Ditch sediment and drill cuttings should be analyzed for chromium and/or organics. It should be recognized that even if chromium is found in the sediment, the presence of trivalent chromium in the sediment will not reveal whether it was caused by the plant operations. Furthermore, if cooling tower blowdown containing hexavalent chromium (Cr^{6+}) was discharged to Citizen Ditch 20 years ago, it is not likely to be still present in the sediment. In addition, organic compounds usually found in natural gas are biodegradable to some degree and should not be present in surface sediments after 20 years exposure to naturally occurring soil microorganisms. Normally, an ideal location for a monitoring well is some distance downgradient of a potential contamination source. Drill cuttings obtained from installation of monitoring wells downgradient of a potential source, especially cuttings from the unsaturated zone, should not be contaminated. Because of these considerations, the need for soil and sediment samples and analyses were reevaluated based on the site visit and review of the collected information and addressed in the proposed sampling plan.

4.0 Facility Description

The Blanco plant is a natural gas compressor facility processing approximately 650 MMSCFD of gas. The plant receives natural gas from three fields: the Picture Cliff Formation, the Dakota Formation and the Mesa Verde Formation. The extent of gas processing includes dehydration and removal of hydrocarbon by-products (C_3 to C_5 + liquids). In addition, the plant occasionally operates a fractionator which recovers lean oil from waste oils brought to the plant from various sources. The lean oil fraction is reused by the Blanco facility.

Wastewaters from the current facility consist of boiler blowdown, cooling tower blowdown, water treatment and domestic waste, plus a small quantity of contact wastewater from the dehydration and fractionation units. These wastewaters are comingled and sent to the Bloomfield municipal treatment facility.

Prior to 1964, the Blanco plant also operated a natural gas liquids ("gasoline") facility. The "gasoline" plant recovered propane, butane, pentanes and other heavier hydrocarbons and sold them as gasoline. The wastewaters from the plant were discharged to several evaporation ponds for complete retention/evaporation. When the gasoline plant ceased operations, the employee camp was also closed and the surface impoundments were reclaimed except for one evaporation pond. This pond currently serves as a boiler blowdown cooling pond. All waste streams now go to a surge basin with an oil skimmer then to the city of Bloomfield treatment plant.

5.0 Site Geology and Groundwater

The plant is located within the west-central part of the San Juan Basin (Figure 1), a large, asymetric structural depression that contains up to 15,000 feet of Paleozoic and Mesozoic sediments (Fassett and Hinds, 1971). Maximum topographic relief within 1 mile of the site is about 200 feet with elevations ranging from 5,500 to 5,700 feet above sea level. The area is characterized by bedrock hillsides and mesas and Plio-Pleistocene gravel terraces of the San Juan and Animas Rivers. All these features are cut by steep-walled arroyos. Drainage is to the south into the westerly-flowing San Juan River. Average annual precipitation in the area is 8.5 inches per year. Vegetation is typically desert brush that covers approximately 40% of the surface.

5.1 Regional Geology

The stratigraphy of the San Juan Basin comprises sedimentary materials ranging in age from Cambrian to Holocene. Figure 2 shows the upper portion of the stratigraphic column in the site area. The greatest recorded stratigraphic thickness in the basin is 14,423 feet in an oil well located near the structural center of the basin (Fassett and Hinds, 1971). During Late Cretaceous, three basin-wide cycles of transgression and regression resulted in an intertonguing lithology (sandstone, shale, siltstone, and coal) found throughout the Cretaceous rocks in the Basin.

A sequence of Late Cretaceous to Holocene rocks which crops out in the northwest section of central basin hosts numerous sandstone equifers, which are the source of many domestic and non-domestic water supplies in northwest New Mexico.

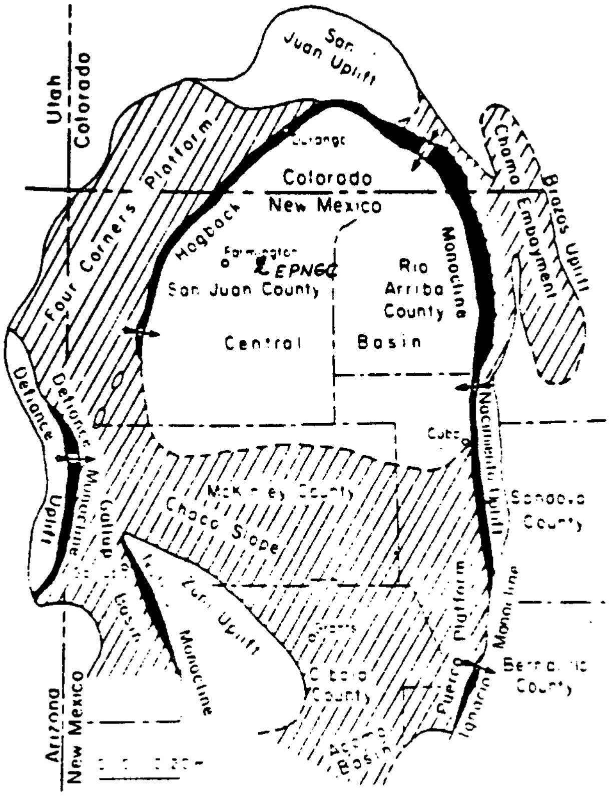
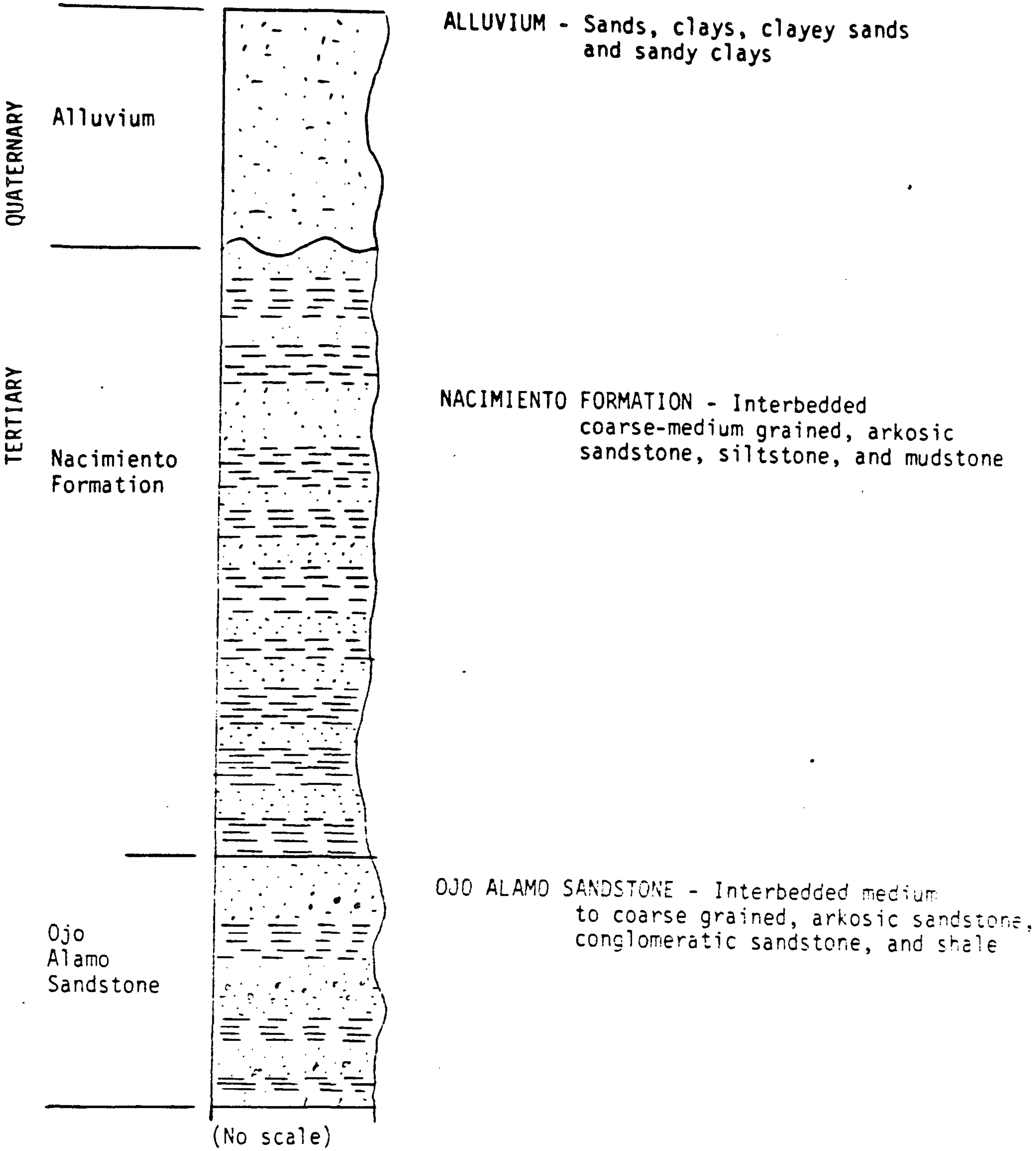


Diagram of the San Juan Basin Showing Structural Components and Location of Blanco Plant (Stone and Others, 1983).

FIGURE 1



Stratigraphic Column

Near the Blanco Plant Site

FIGURE 2

Most of the central basin is covered by Tertiary sediments of fluvial and alluvial origin. However, erosion has removed most of the Tertiary section from the El Paso Natural Gas Blanco Plant Site.

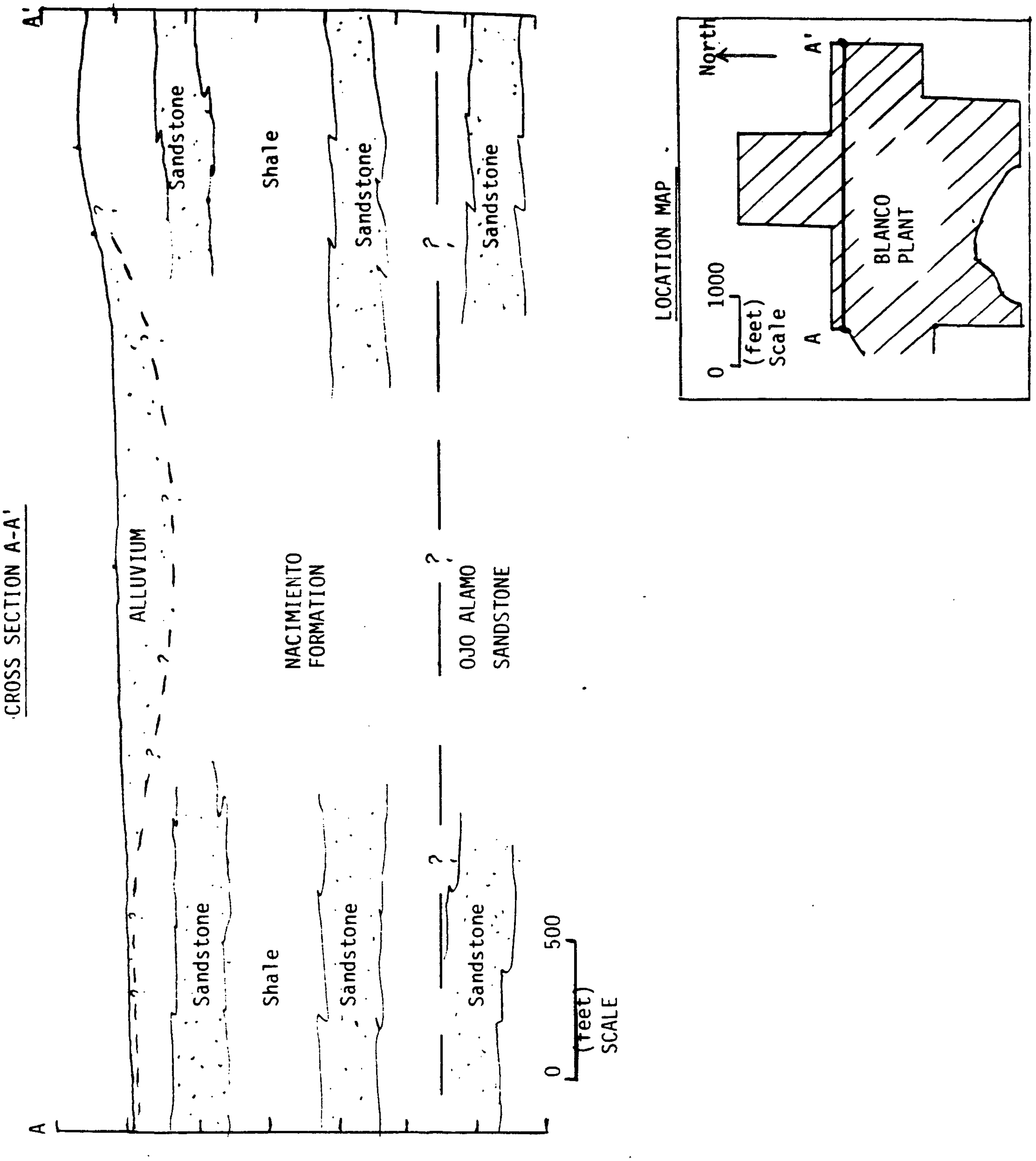
Thick Quaternary deposits are restricted to the San Juan, Animas and La Plata Valleys. These include extensive terrace deposits along the valleys of the San Juan River and its major tributaries.

5.2 Site Geology

The plant site is located on alluvium, which fills a canyon cut into the Nacimiento Formation. The alluvium consists of fine to coarse sands, clays, and varying combinations of the two. These were deposited by stream and wind action. The soils tend to be weak, compressible, and moderately permeable. At the plant site, thickness of the alluvium ranges from less than 3 feet to 75 feet. The alluvium is deposited on the Nacimiento Formation. A generalized geologic cross section of the plant site is shown on Figure 3.

The Nacimiento Formation (Paleocene) consists of interbedded mudstones and sandstones that were deposited as channel fill and stream flood plain deposits under humid conditions, as evidenced by the presence of lignite and carbonaceous plant debris. No attempt has been made in the literature to subdivide Nacimiento but the lower portion is generally characterized by interbedded black, carbonaceous mudstones and white, coarse-grained, arkosic sandstones. The upper portion of the formation is generally characterized by lighter colored mudstones and arkosic sandstones. Outcrops of Nacimiento near the plant site consist of interbedded tan, carbonaceous claystone, siltstone and coarse to medium grained, arkosic sandstone. Reported thickness of the Nacimiento within the Central Basin ranges from 418 feet to 2,232 feet (Stone and others, 1983). Thickness at the plant site is estimated to be approximately 450 feet. The Nacimiento conformably overlies the Oja Alamo Sandstone, and in some locations the two formations are shown to intertongue.

The Ojo Alamo Sandstone (Paleocene) consists of sandstone, conglomeratic sandstone and shale deposited in alluvial or fluvial environments. The nearest outcrop is found approximately 10 miles west of the plant site. The sandstone is a medium to very coarse grained, often pebbly, immature, lithic arkose. The pebbly sections, occurring in beds up to 10 feet thick, give the sandstone its locally conglomeratic character. In the Central Basin the thickness of the Ojo Alamo ranges from 72 feet to 313 feet (Stone and others, 1983). Under the plant site, thickness is estimated to be 170 feet (Stone and others, 1983).



Generalized Geologic Cross Section at Blanco Plant Site

FIGURE 3

5.3 Regional Groundwater Hydrology

Three groundwater systems are present in the Tertiary and younger sedimentary deposits in this area of the San Juan Basin.

- o Confined aquifers in Tertiary sandstone units
- o Unconfined (water-table) aquifer in Tertiary sandstone units near the outcrop areas
- o Unconfined (water-table) aquifers in Quaternary alluvium in river valleys and tributaries

5.4 Tertiary Sandstone Aquifers

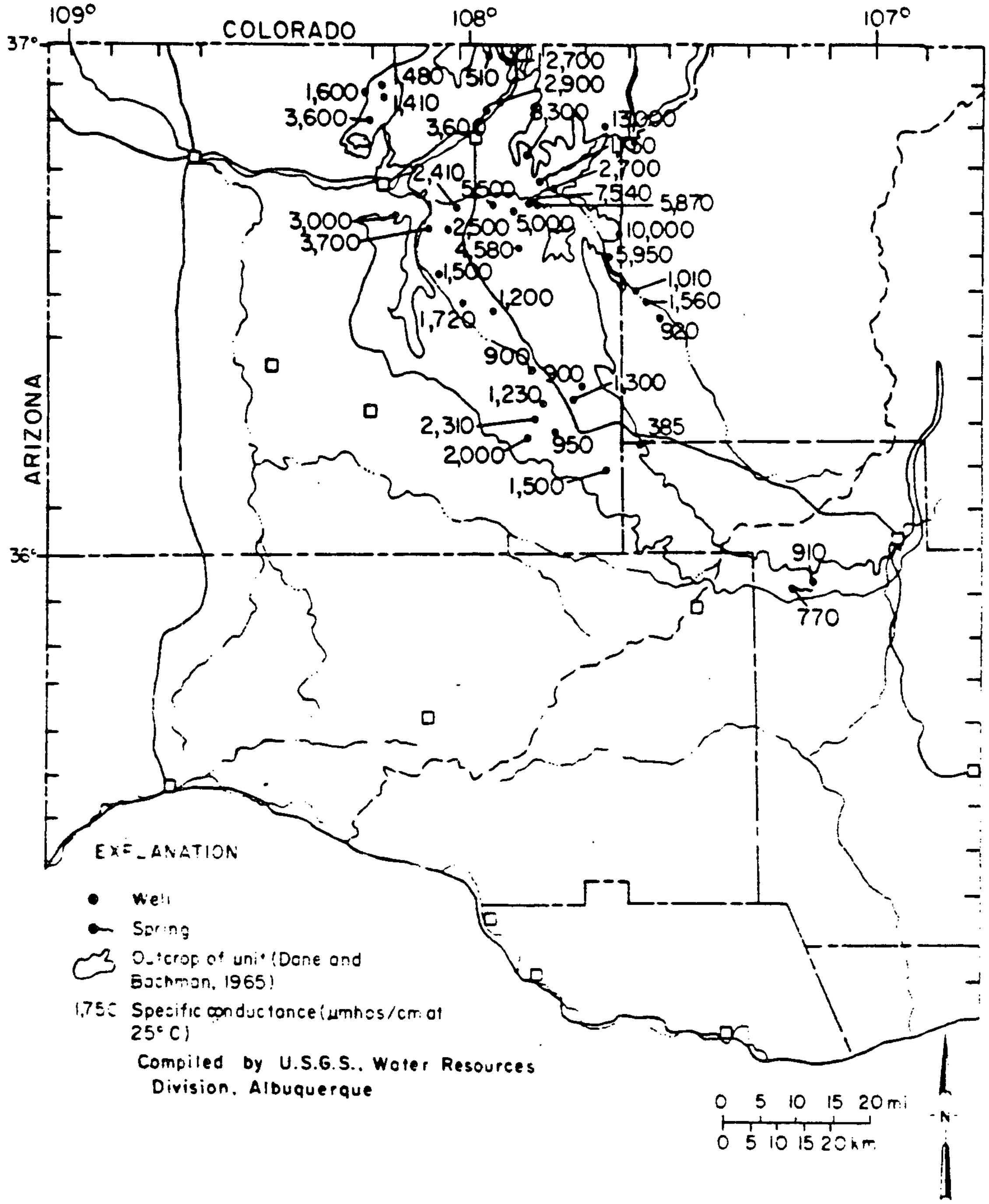
The Tertiary sandstone aquifers of the basin were deposited in fluvial or alluvial environments. Recharge to ground water is by infiltration of precipitation through formation exposures along the flanks of the Nacimiento Uplift and on the broad plateaus that occur in the central part of the basin. Groundwater in these aquifers flows from upland recharge areas to discharge areas along canyon floors. Springs and seeps result due to regional topographic and geomorphic controls. The hydraulic gradient is controlled by topography but the structural attitude of the formations can alter the flow direction or gradient Erosion has removed these units from much of the basin flanks.

Tertiary-sandstone aquifers commonly provide major sources of water for domestic and agricultural usage. The complex intertonguing of sandstone and shale units is the primary influence on specific conductance which can be as high as 10,500 umhos.

The two Tertiary aquifers occurring beneath the site are the Nacimiento Formation and the Oja Alamo sandstone. Neither are used as a direct source of water near the plant site. Seepage from the Nacimiento is probably a small source of recharge for the overlying alluvium aquifer.

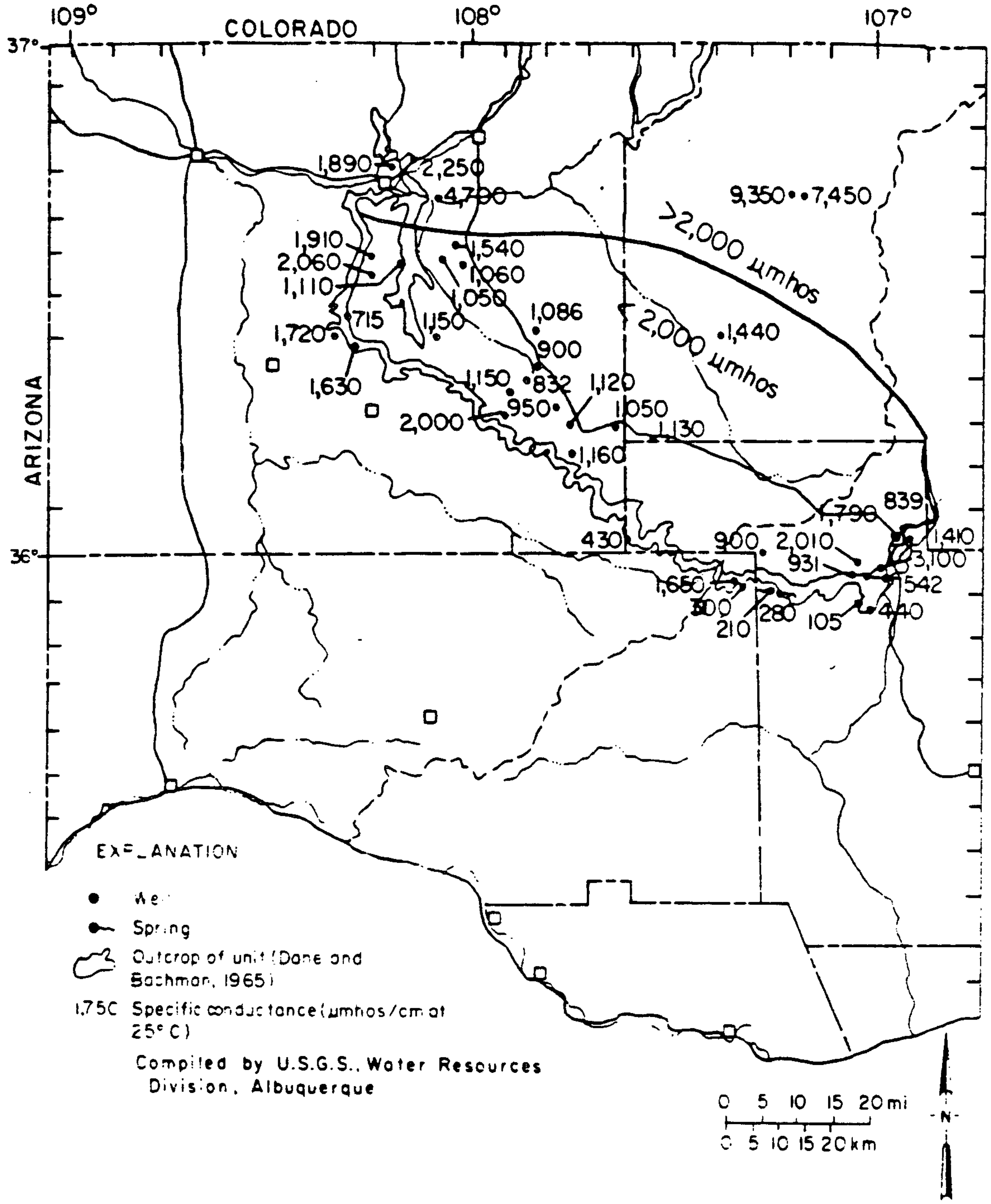
Transmissivities for the Nacimiento Formation are estimated to be as high as 100 ft^2/day for the coarser and more continuous sandstones. Transmissivities for the Ojo Alamo sandstone range from 0.5 ft^2/day to 250 ft^2/day (Stone and others, 1983).

Water quality as indicated by specific conductance is shown on Figure 4 for the Nacimiento Formation and on Figure 5 for the Ojo Alamo Sandstone. Measurements of specific conductance in micromhos (umhos) is used as an indicator of salinity. A general classification can be used as follows: $<$700 umhos = fresh; 700-2000 umhos = slightly saline; 2000-7000 umhos = saline; 7000-24,000 umhos = very saline; $>$24,000 umhos = brine. Specific conductance for the sandstones of the Nacimiento Formation ranges from less than 1,500 umhos to greater than 2,000 umhos in the finer grained portions of



Specific Conductance from Selected Wells
and Springs in Nacimiento/Animas Formations
(Stone & Others, 1983)

FIGURE 4



Specific Conductance From Selected Wells and Springs in Ojo Alamo Sandstone (Stone & Others, 1983)

FIGURE 5

the unit (Stone and others, 1983). Water in the Nacimiento along the San Juan River often exceeds 4000 umhos (Stone and others, 1983). Specific conductance for the Ojo Alamo Sandstone ranges from less than 1000 umhos to greater than 9000 umhos (Stone and others, 1983).

5.5 Quaternary Aquifers

Quaternary-sediment aquifers occur primarily as valley fill in the major river valleys and consist of gravel, sand, silt and clay. Groundwater recharge results from drainage from irrigated lands, infiltration of surface runoff and leakage from bedrock aquifers. Flow directions are concurrent with topographic slope and river-flow directions, and hydraulic conductivity can be extremely high. Transmissivities range from less than 1000 ft^2/day to more than 40,000 ft^2/day (Stone and others, 1983).

As Figure 6 shows, the quality of groundwater (in terms of specific conductance) in Quaternary River Valley alluvium is highly variable and specific conductance may range from less than 1500 to 6000 umhos (Stone and others, 1983). Water from this source is used for stock, irrigation and domestic purposes. In arroyos and tributaries of the major rivers the groundwater quality is also highly variable and specific conductance can be significantly higher than 6,000 umhos.

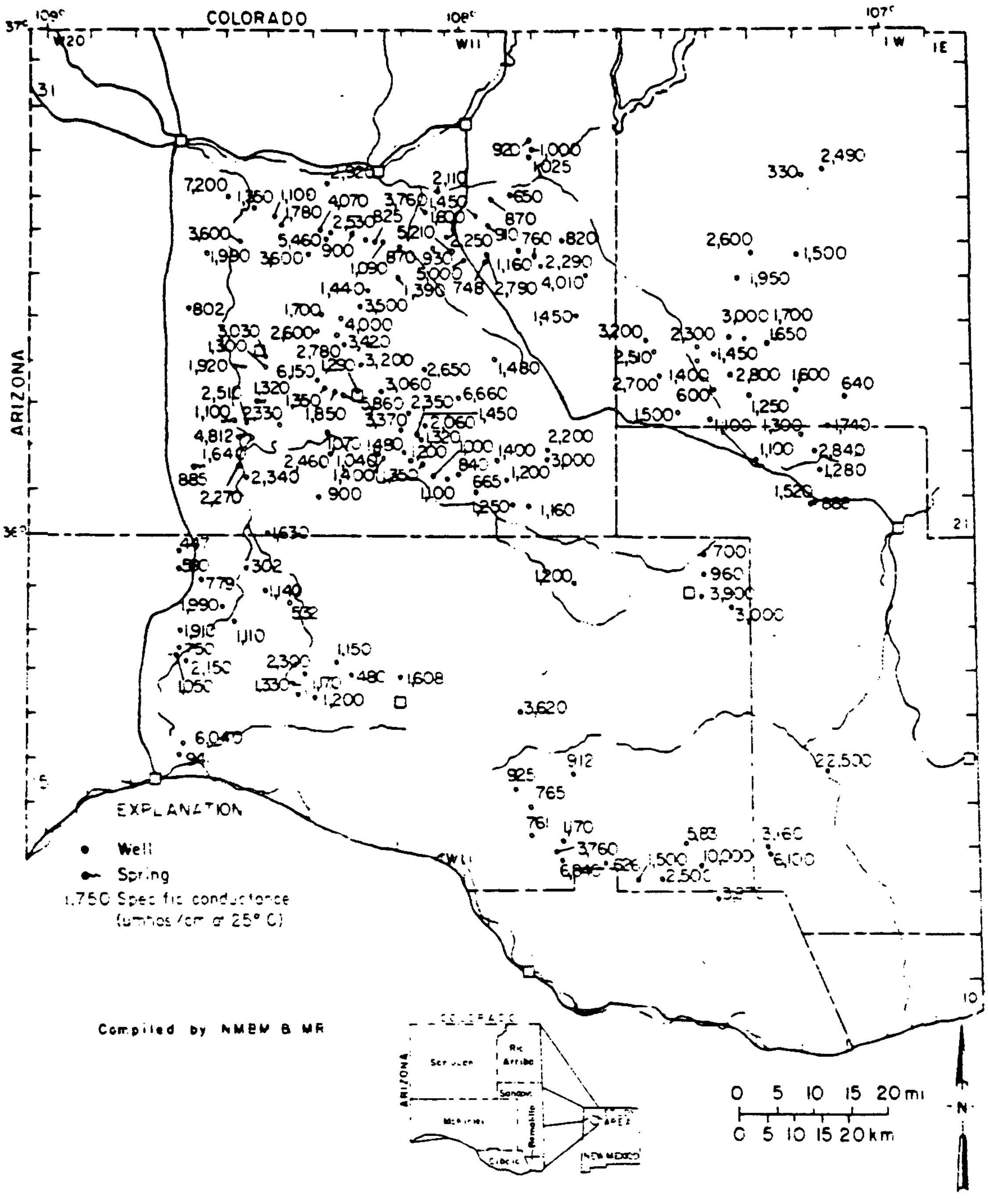
5.6 Local Groundwater Hydrology

Two groundwater regimes exist at the Blanco Plant site:

1. Unconfined sandstone aquifer in the Nacimiento Formation.
2. Unconfined aquifer in the canyon-filling alluvium beneath the plant site.

No wells are completed in the Nacimiento Formation near the plant site. Discussion for this aquifer is limited to that presented in the section on Regional Groundwater Hydrology, Tertiary Sandstone Aquifers.

The Blanco plant is constructed on the alluvium filling the canyon beneath the plant site. This alluvium is an unconfirmed aquifer limited laterally by edges of the canyon it fills. Based on available information, groundwater should flow from north-northeast to south-southwest beneath the plant side following the general trend of the canyon. The main source of recharge is by rainfall. The recharge area is limited north of the plant site by topography and the edges of the buried canyon. A small amount of recharge may occur from water seeping from the sandstone beds of the Nacimiento Formation. South of the plant site recharge is supplemented by irrigation. Depth to water near the south boarder of the plant



Specific Conductance from Selected Wells and Springs in Valley Fill Deposits (Stone and Others, 1983)

FIGURE 6

site is between 10 and 15 feet below the ground surface. Under the plant facilities, water depths have been reported over the last 25 years to range between 14.4 feet and 39 feet. Average transmissivity for the alluvium is estimated to be less than 1000 ft^2/day. Several wells have been completed in this aquifer south of the plant site.

6.0 Sampling Well Locations & Soil Sampling

To best intercept any path of potentially contaminated groundwater it is proposed to construct seven sampling wells as shown on Drawing No. 1.

The Blanco plant facilities are located on the western side of a north-northeast south-southwest trending buried canyon. The plant is constructed upon the moderately permeable sediments filling the canyon. As stated before, groundwater should flow from north-northeast to south-southwest beneath the plant following the general trend of the buried canyon.

Well Number 1 was chosen to be upgradient of any potential source of contamination. These sources, which include major plant facilities, could also include several sources north of the main plant facilities. North of the plant are an abandoned flare pit, settlement pond and an active gas well. It is possible that no water may be encountered at Well Location Number 1 during dry periods of the year, thus Well Location Number 2 was chosen to provide an alternative well still upgradient of the main plant facilities.

Five downgradient wells, Numbers 3 through 7, were located across the southern part of the plant property at such locations to assure interception of any possible path of potentially contaminated groundwater.

Noting the importance of sampling the soils beneath potential contaminating sources, it is proposed to obtain soil samples for analytical testing using a backhoe. Three areas are proposed for sampling, two abandoned settlement ponds and the active flare pit, designated respectively as A, B, and C on Drawing Number 1. Two soil samples are proposed to be obtained for each of several locations in each area. Samples are proposed to be taken at a depth of 1 and 4 feet at each location. Also several samples will be obtained from the saturated zone in downgradient wells.

ENGINEERING RECORD	
DRAWN BY	Aero-Graphics
TRACED BY	
CHECKED BY	
APPROVED	
DATE	
PHOTO DATE	10-18-82
CONTOUR INTERVAL	

GROUND WATER
SAMPLING WELLS
&
SOIL SAMPLE
LOCATIONS

El Paso
Natural Gas Company

BLANCO PLANT
SEC 14, TWS 29-N, RANGE 11-W
SAN JUAN COUNTY, NEW MEXICO

NO. 1 SAMPLING WELL LOCATION

(A) SOIL SAMPLING AREA

SCALE IN FEET

PLATE 5-1 DWG. NO. 1

APPENDIX A
Technical Specification for Drilling and Installation of Monitoring Wells

APPENDIX A

TECHNICAL SPECIFICATIONS

FOR

DRILLING AND INSTALLATION
OF MONITORING WELLS

for

El Paso Natural Gas Company

Blanco Plant

San Juan County, New Mexico

Prepared for

El Paso Natural Gas Company

by

Bechtel Environmental, Inc.

September 1988

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

TECHNICAL SPECIFICATIONS
FOR
DRILLING AND INSTALLATION OF
MONITORING WELLS
AT
BLANCO PLANT
SAN JUAN COUNTY, NEW MEXICO

1.0 SCOPE OF WORK

The work to be performed consists of furnishing all supervision, labor, equipment, tools, supplies and materials, and the performance of all operations in connection with the work items listed in Section 1.2, in accordance with the provisions of this specification.

Quantities shown in the Schedule of Prices are estimated. The final number, locations, and depths of the monitoring wells will be determined in the field by the Engineer.

1.1 Definitions and Standards

"Bechtel" as used in this specification refers to Bechtel Environmental, Inc.

"Owner" as used in this specification refers to El Paso Natural Gas Company (EPNG) or any of its authorized representatives.

"Engineer" as used in this specification refers to Bechtel and any of its authorized engineers, geologists or hydrogeologists assigned to this contract.

"Contractor" refers to the party to whom the Contract for the work herein described has been awarded, and any of its authorized representatives.

Unless otherwise specified or shown on the design drawings, materials and field operations shall conform to the latest issue of the following ASTM codes and standards and shall apply to the extent indicated herein.

ASTM D 653	Terms and Symbols Relating to Soils and Rock Mechanics
ASTM C 150	Portland Cement
ASTM F 480	Thermoplastic Water Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR)

1.2 Work Included

The work includes, but is not limited to:

1) Obtaining all necessary state and/or local permits for performing the work excluding permission for access and right of way.

2) Furnishing all supervision, labor, equipment, tools, supplies and materials to drill, sample, install and develop 7 ground-water monitoring wells at the approximate locations shown on Figure 1. The preferred method of drilling above the water table is hollow stem auger drilling to facilitate monitoring the holes with a h-mu meter. Below the water table, rotary method may be used as necessary. Maximum anticipated depth shall be 70 feet. Maximum anticipated screen length is 15 feet in each well.

3) Pumping and/or hauling water from sources approved by the Engineer to the work areas as required.

4) Properly cleaning and decontaminating all equipment which enters the drill hole or well, prior to each use and upon completion of the work.

5) Collecting all water from well drilling and development and storing in containers.

6) Cleaning and restoring the work areas to their original condition.

7) Supplying a pump that will fit in the monitoring wells with a variable discharge rate of 1 to 10 gallons per minute and pumping each monitoring well prior to Bechtel obtaining water samples.

1.3 Work Not Included

1) Obtaining permission for access and right-of-way.
2) Locating and surveying monitoring well sites.
3) Chemical analysis of water samples.

1.4 Location of Work

The field work will be performed on the Blanco Plant located near Bloomfield, New Mexico.

1.5 Access to Work

The Contractor shall provide his own means of moving equipment to the location of each drill hole or work site. No access roads, other than existing roads, will be provided. The Contractor may use available existing public or private roads and shall be responsible for the maintenance and repairs of such roads to the conditions as existed immediately prior to start of use by the Contractor. Fences that have to be lowered for access shall be restored by the Contractor to the conditions that existed immediately prior to start of work.

1.6 Health and Safety Requirements

The Contractor shall submit a Health and Safety Plan with the bid. The Contractor shall certify in writing to Owner that all Contractor personnel who will perform work at the site have completed the necessary OSHA training and have had the proper medical surveillance for work at hazardous waste sites in accordance with the Code of Federal Regulations, Title 29, Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response". Contractors are required to submit Attachment A, Health and Safety Certification, with the bid.

The Contractor shall provide all necessary health and safety equipment for each Contractor employee working at the site. The Contractor shall ensure that all health and safety equipment is in proper working order prior to the start of any work. The Contractor shall identify one individual as the health and safety contact for the Bechtel site health and safety officer. The Contractor shall be responsible for ensuring that all Contractor's employees working on the site comply with the directives of the Bechtel site health and safety officer. At a minimum, the Contractor shall provide the following health and safety gear for each employee working on the site:

- Hard hat
- Chemical resistant, steel toe boots or safety work shoes with protective overshoes
- Protective suits, Saranek-coated TYVEK
- Chemical resistant gloves, neoprene or nitrile

Contractor employees will be required to wear the above equipment if and when the site health and safety officer directs. Hard hats, safety boots and coveralls will be required during routine soil and well drilling.

2.0 SUBMITTALS

The driller shall keep an accurate log of each exploratory hole drilled, recording the top and bottom of each stratum penetrated, and the depths at which circulation was lost. A detailed log of each monitoring well completion shall also be submitted, showing the depths of screened intervals, seals, filter packed intervals, and types of materials used. The Contractor shall deliver one copy of the log of each completed exploratory hole or well to Bechtel, within 2 days of its completion. Driller shall submit a report to Bechtel at the end of each day's work describing the nature of the material encountered, the work done that day, enumerating the items of work accomplished, such as depth drilled, casing set, the water level in the hole at the beginning and end of each shift, and such other pertinent data as the Contractor is requested by the Engineer to record.

3.0 DRILLING

3.1 General

Seven monitoring wells will be drilled to a maximum anticipated depth of 70 feet. Five wells are anticipated to be 30 feet in depth. Drill holes may be added, deleted, or relocated as directed by the Engineer.

3.2 Water Supply

The Contractor shall provide all water necessary to perform the work. The equipment required may include pumps, water trucks or trailers, hoses, storage tanks and all other items necessary to provide an adequate water supply. The source of the water shall be subject to the approval of the Engineer. All discharge water from drilling, well development or sampling shall be stored in containers provided by the Contractor to prevent contamination, pollution, excessive erosion or any other damages.

3.3 Materials

3.3.1 Cement: All cement shall conform to ASTM C150 Type II Portland Cement.

3.3.2 Bentonite: The bentonite shall be a high-swelling, sodium-based Wyoming-type bentonite and shall be supplied in both powdered and pellet form. Powdered bentonite shall be free-flowing. Pellets shall be free of moisture and powder.

3.3.3 Cement/Bentonite Grout: Grout shall consist of materials specified herein and shall be mixed in the following proportions: 6.5 gallons of water and 3 pounds of powdered bentonite per sack of Type II cement. Bentonite shall be thoroughly mixed with the water prior to adding the cement.

3.3.4 Ground Cover: Ground cover for temporary storage of sampling equipment shall be plastic sheeting or other material approved by Bechtel.

3.4 Drilling Method and Equipment

Drill holes shall be advanced using equipment of the rotary type. The equipment shall be in good working condition and capable of drilling holes of the required diameter and securing satisfactory samples at the maximum drilling depth. The preferred drilling method for the soil above the water table is by hollow-stem auger with hydraulic feed. If it is not possible to reach the desired depth using the hollow-stem auger method, other drilling methods will be permitted at the discretion of the Engineer. Supplies for drilling shall include all casings, drill rigs, auger flights, bits, samplers, pipe, pumps, water, and tools.

3.5 Temporary Casing and Drilling Fluid Additives

When gravel, boulders, or any other type of obstruction are encountered in drill holes, or if unstable material is encountered, suitable methods shall be employed to drill through such obstructions or unstable material. Where necessary to keep the holes open and enable the holes to be advanced, temporary casing may be used. Casing shall not be abandoned in any hole unless specifically approved or directed by the Engineer.

All drilling fluid additives must be approved in advance by the Engineer. A manufacturer's chemical analysis of drilling additives must be made available, upon request of the Engineer.

3.6 Ground-Water Observations

Observations shall be made of the levels of any ground water encountered in all drill holes prior to drilling on each day. Any and all water conditions, and the presence of gas or artesian flows, shall be recorded by the Contractor at the depth encountered. Whenever required by the Engineer, holes shall be bailed or air-lifted for observation of ground-water conditions.

3.7 Abandoned Boreholes

The Contractor will not be reimbursed for the cost of drill holes abandoned before reaching the specified final depth and rejected by the Engineer because of mechanical failure of drilling equipment, negligence on the part of the Contractor or other such preventable causes. Any holes rejected shall be supplemented by another hole adjacent to the first, drilled at the contractors own cost.

In the event the supplementary hole is lost, it in turn shall be supplemented by another, and the acceptable portions of the respective holes shall be paid for in the manner specified for the original hole. Regardless of the reason for abandoning a hole, no payment will be made for moves and setup in order to drill a new hole at an adjacent location.

3.8 Backfilling Boreholes

If a hole is requested to be abandoned by the engineer, it shall be backfilled with a cement/bentonite grout to the top of the hold. The grout shall be approximately in the following proportions: 6.5 gallons of water and 3 pounds of bentonite per sack of Type II cement. The grout shall be placed by placing rods or pipe to the bottom of the hole and pumping the grout into the hole at the bottom until the grout reaches the top. Should loss or shrinkage of grout occur, holes shall be refilled until they remain full. No hole shall be left ungrouted overnight.

3.9 Soil Sampling

A few soil samples shall be taken in selected borings as directed by the Engineer. Samples shall be taken with a 3-inch O.D. modified California sampler fitted with new 6-inch brass liners. Drill holes shall first be cleaned to the bottom of the hole prior to sampling. Samples may be taken by driving with a standard 140 pound hammer. The sampler shall be driven 18 inches or to refusal. Drive shoes shall be replaced or repaired when they become dented or distorted. The contractor shall provide new, 6-inch brass liners and plastic caps. All samplers and liners shall be steam cleaned prior to each use.

4.0 MONITORING WELL INSTALLATION

4.1 General

Seven monitoring wells shall be drilled for the purpose of collecting ground-water samples and measuring water-level elevations. The wells shall be drilled according to the provisions of Section 3 of this specification. The monitoring wells will be installed individually with typical well design as shown in Figure 2. The maximum depth of any monitoring well will be 70 feet. The diameter of the drill holes shall be at least 9 inches, and shall be sufficient to allow the 4-inch diameter well casing, screen, filter pack, and seal to be installed.

4.2 Materials

4.2.1 Riser Casing: Monitoring wells shall be installed using a PVC riser casing between ground surface and the top of the well screen. PVC riser casing used for monitoring wells shall be flush-jointed, 4-inch Type 1, grade 1, 1120 PVC pipe and shall meet ASTM F480-81 specifications.

The wall thickness shall be Schedule 40. End fittings shall be double entry Stub ACME screw threads. The casing shall be clean, straight, and free of obstruction. No glue or solvent shall be used in the manufacture or installation of the PVC riser pipe.

4.2.2 Well Screen: Well screens shall be mill-slotted, 4-inch, Schedule 40 PVC, equal in percent open area to those manufactured by Timco Mfg., Inc. They shall be supplied in 5-ft and 10-ft lengths with flush joint threaded ends. The slots shall be 0.20-inch in length and shall be transverse to the pipe axis with a minimum of six rows. The screen shall have a 1-foot length of blank schedule 40 PVC casing located on the bottom for a sump. The bottom of the sump shall be capped. No glue or solvent shall be used in the manufacture or installation of the PVC screens and sumps.

4.2.3 Filter Pack: Filter pack material shall be clean, well-graded sand, with 100% by weight passing a No. 12 U.S. standard sieve and no more than 5% by weight passing a No. 30 U.S. standard sieve. Samples of filter pack material and sieve analyses shall be submitted to the Engineer for approval prior to beginning field operations.

4.2.4 Seal and Backfill: The seal above the filter pack shall consist of at least one foot of bentonite pellets tamped in place. Above the seal, the annular space around the riser casing shall be backfilled with cement/bentonite grout consisting of 6.5 gallons of clean potable water and 3 pounds of powdered bentonite per sack of Type II Portland cement. Cement and bentonite used shall conform to the requirements set forth in Section 3.3.

4.2.5 Surface Casing: Surface casing shall be new steel pipe of minimum 8-inch diameter. Surface casing shall extend from approximately 3 feet below the ground surface to 2 feet above unless otherwise directed by the Engineer and shall be vented and fitted with a steel protective cap that can be locked. Pipe extending above the ground surface shall be painted with reflective paint. Each monitoring well shall be clearly marked for identification with a numbering system determined by the Engineer.

Some monitoring wells may require below-grade completion, as directed by the Engineer. Wells completed below grade shall be protected by a traffic-rated, waterproof steel valve cover box. The proposed box shall be approved by the Engineer prior to installation. The box shall be provided with a secure or lockable cover.

4.3 Well Construction

4.3.1 Installing Screen and Riser Casing: The final depth of the hole shall be measured. The bottom of the sump section below the screen shall be capped. The length of screened section, the riser casing and the sump shall be measured and recorded to the nearest 0.01 foot before lowering into the hole through the drill casing. Any portion of riser casing extending above ground surface that is cut off, shall be measured and reported to the Engineer. Approved centering devices shall be used above and below the screen.

4.3.2 Installing Filter Pack: As soon as the casing and screen are in place, clean water shall be pumped into the riser casing so that return flow will rise to the surface through the annular space between the well casing and the hole wall, to clean the hole of cuttings and any drilling fluid additives. The pumping rate shall be such that any drilling fluid is displaced from the casing and hole. The sand for the filter pack shall be poured into the annular space between the riser casing and surface casing as soon as the viscosity of the return flow is low enough to allow the sand to sink. The cleaning of the hole shall continue until all the filter pack is in place. The filter pack shall extend at least two feet but not more than four feet above the top of the screen unless specifically directed by the Engineer. The Contractor shall measure and record the depth of the filter pack after allowing adequate time for all the sand to settle.

4.3.3 Installing Seal and Backfill: After the filter pack is placed, bentonite pellets shall be inserted in the hole. After sufficient time has elapsed for the pellets to reach the filter pack, they shall be tamped in place using a rod, pipe or heavy weight attached to a rope. The minimum thickness of this bentonite seal, after tamping, shall be one foot. Following emplacement of the seal, the remainder of the annular space between the riser casing and sides of the hole shall be filled with a cement/bentonite grout to the top of the hole. The grout shall be installed through a tremie pipe set in the annular space to within 5 feet of the bentonite seal.

4.3.4 Installing Protective Surface Casing: Before the grout backfill has set, the steel surface casing shall be set in place. Surface casing shall extend two feet above the surface and a minimum of three feet below the surface. Additional grout shall be added after drying until the grout seal reaches to within 4-inches of the top of PVC riser pipe. A grout apron will be placed around the surface casing and a drain hole will be drilled in the surface casing.

4.3.5 Developing Well: After the grout has been allowed to set for at least 12 hours, each monitoring well shall be developed by surging and pumping with air or water. Under no circumstances shall air be injected through the screened area of the well.

If air is to be used in the development process, an eductor line fitted with a check valve at the water intake point shall be used to avoid injection of air into the screen. Development shall continue for a minimum of two hours, or as directed by the Engineer, during which time the well shall be frequently surged in order that turbulence is created in the filter pack around the screen. Every effort will be made to provide as sediment free well as possible. Water removed during well cleaning and development will be collected by the Contractor in containers provided by the owner. Contractor will provide a means of measuring the total water volume removed from the well during development.

4.3.6 Pumping Well: After each well has been satisfactorily developed the contractor will install a pump and pump each well prior to water sampling by Bechtel. The volume of water to be pumped will be determined at the time of pumping by Bechtel. The equipment will be decontaminated before installation in each well.

5.0 DECONTAMINATION AND CLEANUP

5.1 Decontamination of Equipment and Tools

All equipment and tools used for drilling, sampling or well installation on the site shall be decontaminated by steam cleaning before work begins, between each exploratory hole or well site and at the completion of work. Monitoring well pipe for all wells shall be steam-cleaned prior to installation. Exterior surfaces of pumps used for well development or purging shall be steam cleaned between wells. Clear water shall be pumped through the pump to flush out any contaminants.

Care shall be taken to ensure sampling equipment is protected from contamination by ground contact. A plastic ground cover shall be used for this purpose for temporary storage in the work area.

5.2 Cleanup

The work areas shall be kept in neat and orderly condition at all times. On completion of the work, the Contractor shall remove his rig(s) and all surplus and unused material. Material removed from the holes shall be placed in a central location specified by the Owner. The Contractor shall leave the area in a clean condition, all to the satisfaction of the Engineer. Except for observation wells or as directed by the Engineer, the Contractor shall remove all casing, and all holes shall be completely backfilled as specified.

6.0 MEASUREMENT AND PAYMENT

Measurement and payment for all work performed within the scope of these specifications shall be on the basis listed below. The provisions of this section shall not be considered as a limitation or a modification of the work to be performed. Should the Contractor consider that any item which is required to complete the work as covered herein is not associated with one of the pay items, he must request clarification before signing this Contract.

At the end of each day the Contractor shall provide the Engineer with a signed invoice indicating quantities of successfully completed work for that day, as listed in the Schedule of Prices.

Quantities shown in the Schedule of Prices are estimated. Where actual quantities vary more than fifty percent (50%) above or below the estimated quantities stated in this contract, an equitable adjustment in the Contract price shall be made upon the demand of either party.

6.1 Mobilization and Demobilization

Mobilization and demobilization will be measured as a lump sum and shall include: furnishing and moving to the jobsite all personnel, drill rigs, and all other equipment, tools, materials, and supplies necessary for the work; moving in, cleaning and setting up the drill rig at the first hole; dismantling and removing the drill rig, equipment, materials, tools, and supplies from the jobsite; general cleanup of jobsite after completion of the work and all incidentals necessary to complete the work. If more than one rig is provided, this item includes payment for setup of all rigs at the first holes. Payment for mobilization and demobilization will be made at the lump sum price as stated in Item 1 of the Schedule of Prices. An amount equal to seventy- five percent (75%) of the lump sum will be included in the first monthly progress payment, and the balance will be included in the final payment.

6.2 Moving from Hole to Hole

Moving drill rig(s) from hole to hole will be measured as the number of setups made after the first hole for each drill rig. Setups made at adjacent locations to supplement abandoned holes will not be measured regardless of the reason for abandoning the hole. Payment for moving drill rig(s) from hole to hole will be made at the unit price per move as stated in Item 2 of the Schedule of Prices and shall constitute full compensation for furnishing all labor, equipment, supplies and materials to provide access and water supply to the next location, to steam-clean rigs and equipment between holes and complete the move.

6.3 Drilling and Installing Monitoring Wells

Drilling, reaming, and installing ground-water monitoring wells will be measured to the nearest linear foot as the number of linear feet from the bottom of the hole to the top of the surface casing. Measurement under this item includes: furnishing all bits, accessories, tremie pipe, temporary casing and/or drilling fluid (if needed); enlarging, cementing and redrilling and maintaining the hole by temporary casing or drilling fluid (if needed); furnishing all screens, sumps, riser casings, centralizers, surface casings, caps, couplings, filter material, cement, bentonite and other materials consumed; cleaning and decontaminating all monitoring well pipe; and installing and cleaning wells. Payment for drilling and installing monitoring wells will be made at the unit price per linear foot as stated in Item 3 of the Schedule of Prices and shall constitute full compensation for furnishing all labor, equipment, bits, temporary casing, drilling fluid, cement, supplies and materials for drilling and properly installing monitoring wells.

6.4 Developing Monitoring Wells

Developing monitoring wells will be measured to the nearest one-half hour of time spent by the Contractor in pumping or air lifting water from monitoring wells, as directed by the Engineer. The time measured for well development will commence when the equipment is started into the well and shall end when the equipment is removed from the well. No time will be measured for delays resulting from (1) arranging major apparatus such as pumps, compressors and generators; (2) equipment breakdown or repairs; or (3) equipment stuck in the hole. Measurement under this item includes furnishing compressed air, pumps, and any other equipment needed to develop the wells; installing or removing such equipment as directed by Bechtel; and operating equipment to properly develop wells. Payment will be made at the unit price per hour as stated in Item 4 of the Schedule of Prices and shall constitute full compensation for furnishing all labor, equipment, supplies and materials for properly developing monitoring wells.

6.5 Standby Time

Standby time will be measured to the nearest one-half hour of temporary periods of cessation of work of the drilling rig during the normal 8-hour work day when directed by the Engineer. Payment of standby time will be made at the unit price per hour as stated in Item 5 of the Schedule of Prices and shall constitute full compensation for standby time.

6.6 Sampling with Modified California Sampler

Samples collected with modified California (3-inch diameter) split barrel samplers will be measured as the number of such samples satisfactorily attempted. Payment for samples obtained with the California sampler will be made at the unit price per sample as stated in Item 6 of the Schedule of Prices and will constitute full compensation for furnishing all labor, equipment, supplies and materials (including liners and caps) for obtaining the sample, opening the sampler, steam-cleaning the sampler and liners and transporting samples to an approved storage area at the site.

6.7 Pumping Well Time

Pumping time will be measured to the nearest one-half hour of the time spent installing the pump, pumping, and removing the pump. Payment of pumping time will be made at the unit price per hour as stated in Item 7 of the Schedule of Prices and will constitute full compensation for furnishing all labor, equipment, supplies and materials for pumping and decontaminating equipment between usage in each well.

TABLE 1

SCHEDULE OF PRICES

Item No.	Description	Estimated Quantity	Unit	Unit Price	Total
1	Mobilization & Demobilization	Lump Sum	Lump Sum	____	____
2	Move from hole to hole	6	Each	____	____
3	Drilling and Installing Monitoring Wells	300	Linear Ft.	____	____
4	Developing Monitoring Wells	42	Hour	____	____
5	Standby Time	6	Hour	____	____
6	Sampling with Modified California Sampler	10	Each	____	____
7	Well Pumping Time	14	Hour	____	____
				TOTAL	____

The completion of all activities listed in this specification is expected to take ______ days.

ATTACHMENT A

HEALTH AND SAFETY CERTIFICATION

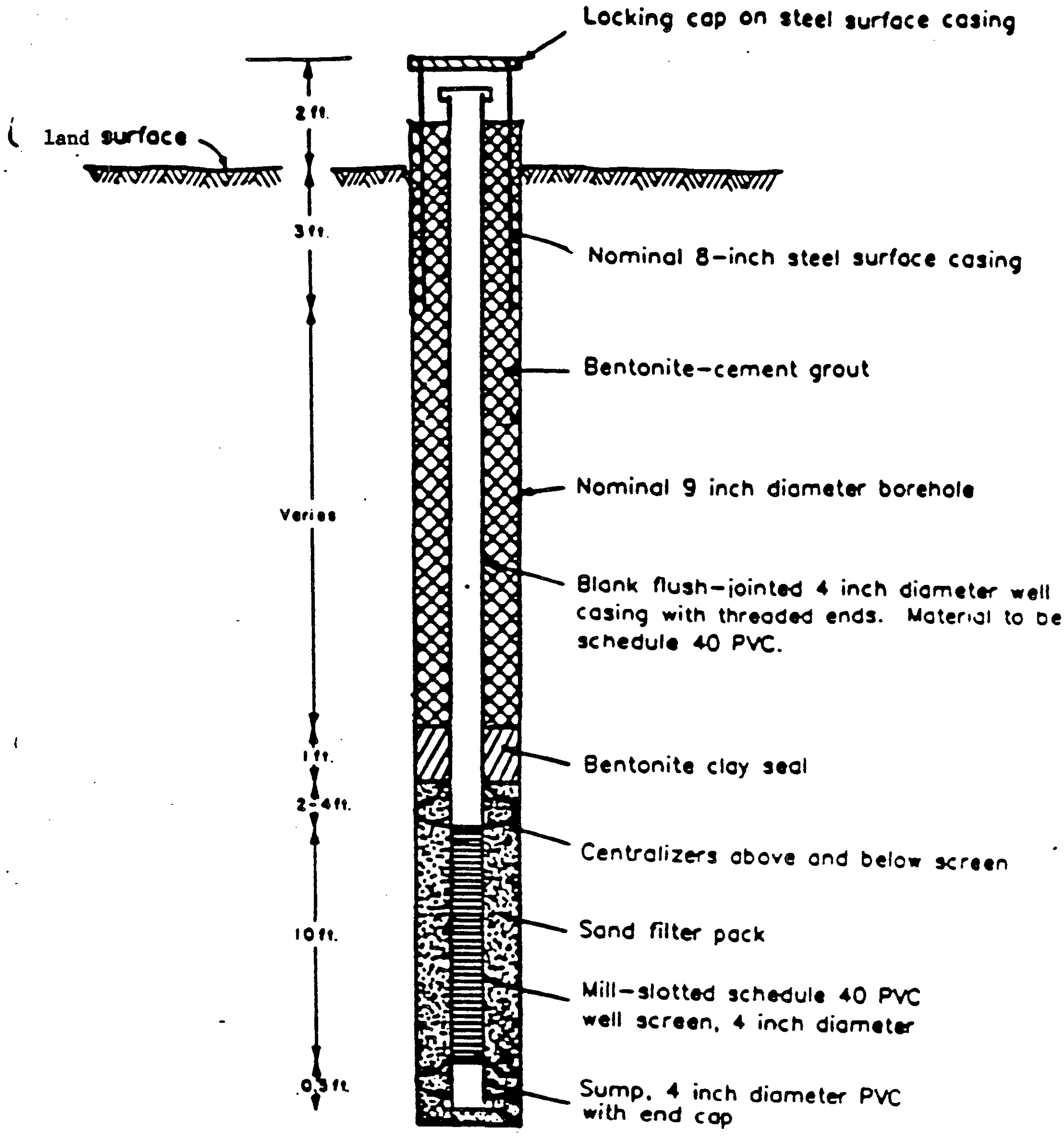
______________________________ certifies that all employees associated
Contractor

with this project will have received adequate health and safety training and medical surveillance to meet the requirements of OSHA 1910.120 "Hazardous Waste Operations and Emergency Response" prior to starting project activities.

____
Contractor Representative

____
Contractor Company

____
Date



NOT TO SCALE

Figure 2

Typical Monitoring Well Design

APPENDIX B
Sampling and Analytical Plan

APPENDIX B

SAMPLING AND ANALYTICAL PLAN
GROUNDWATER INVESTIGATION
FOR THE
BLANCO PLANT

EL PASO NATURAL GAS

SEPTEMBER 1988

SAMPLING AND ANALYTICAL PLAN

TABLE OF CONTENTS

LIST OF TABLES

SAMPLING AND ANALYTICAL PLAN

This section presents the sampling and analytical activities that will comprise the Blanco plant field investigation, and outlines procedures that will be implemented to assure quality control. Activities and procedures presented in this section describe sample location selection, chemical analyses, sample collection and transfer, equipment decontamination, quality assurance/quality control checks, field measurements, and disposal of waste fluids and soil cuttings. The Site Safety Plan is also included in this Work Plan as Appendix D.

1.0 SAMPLE LOCATIONS/RATIONALE

The objective of the proposed field investigation is to determine if chromium and/or organics are present in soils and ground water at levels above background concentrations due to facility operations. To accomplish this objective, the proposed ground water investigation will be conducted in areas downgradient of the abandoned evaporation ponds and the flare pit. A soils investigation will also be conducted in the abandoned evaporation ponds and flare pit areas and in the saturated soil from three downgradient soil borings. Background soil and ground water samples will be collected from upgradient boring/monitoring wells.

As shown on Drawing No. 1, five ground water wells will be located downgradient of the abandoned evaporation ponds and the flare pit. These wells have been located considering local ground water gradient and should intercept any potentially contaminated ground water that may be emanating from the evaporation ponds or the flare pit. Two additional wells (W1 and W2) will be located north (upgradient) of the Blanco plant to provide background soil and ground water quality data. Following installation and development, ground water samples will be obtained from all of the wells and will be analyzed as described in Section 2.0.

Soil samples will be obtained from the saturated zone of four of the well borings prior to installation of the wells. These samples will be obtained from three downgradient wells (W4, W5 and W6) and from the upgradient well (W1). Soil samples will also be obtained from shallow soil borings to be located in the abandoned evaporation ponds and the flare pit. One 5-foot boring will be located in each area. Soil samples from these borings will be collected at approximate depths of 1 and 4 feet. Soil samples will be collected as described in Section 3.0 and analyzed as described in Section 2.2.

2.0 CHEMICAL ANALYSES

Individual analytical parameters for the analyses of soil and ground water samples are listed on Table 2-1. Analytical methods and associated detection limits are presented on Table 2-2. Table 2-3 is the Soil and Ground Water Analytical Plan and includes such details as sample holding times, sample containers, and preservatives. The proposed soil and ground water analyses are discussed below.

2.1 Ground Water Analyses

In past years, the abandoned evaporation ponds at the Blanco facility received boiler and cooling tower blowdown that contained a chromium-based corrosion inhibitor and may have contained hydrocarbon residues or other volatile aromatic or halogenated compounds used in facility operations. The flare pit is used as an area for combustion of excess gases during overload situations and may contain some residual hydrocarbons or hydrocarbon combustion products. To determine if residual chromium and/or organics from past waste disposal practices may have migrated to ground water. Samples from the seven proposed ground-water monitoring wells will be analyzed for the following analytical parameters:

- Volatile organics by EPA Method 602
- Volatile halogenated organics by EPA Method 601
- Total petroleum hydrocarbons by EPA Method 8015
- Total chromium by EPA Method 7190
- Hexavalent chromium by EPA Method 7195 or 7197
- Total metals by ICP or AA
- Oxidation/reduction potential (field analysis only)
- Total dissolved solids
- pH
- Major anions/cations

Recent studies by the Electric Power Research Institute (EPRI) indicate that the oxidation or reduction potential and other properties of the soil/ground water system may directly effect chromium migration. Chromium migration may be impacted by iron and manganese present in the soil structure, by the water or soil leachate oxidation reduction potential or by the water or soil leachate pH. Measurement of these parameters or properties together with the hexavalent chromium analyses will aid in the analysis of potential chromium migration and its possible effect on local ground water.

At least one water sample will also be analyzed for Hazardous Substance List (HSL) volatile and semi-volatile organics by EPA gas chromatograph/mass spectrometer (GC/MS) method 624 and 625 to confirm the identity of contaminants found in samples analyzed by GC methods and to identify any unknown chromatographic peaks that cannot be identified by the proposed GC methods.

EPA methods 7195 or 7197 have been requested for the analyses of hexavalent chromium rather than EPA method 7196. EPA method 7196 is a colorimetric analysis typically used for the determination of hexavalent chromium, however, this analysis is subject to interference effects caused by other constituents present in the ground water or soil samples. The presence of molybdenum, mercury, vanadium and iron in a sample may produce interference problems during analysis, particularly if the hexavalent chromium concentration in the sample is low. These interferences could elevate detection limits resulting in unusable data. Regardless of the final analytical method chosen for hexavalent chromium analyses, all available means should be employed to keep detection limits at or below 0.010 mg/L.

Finally, temperature pH and specific conductivity will be measured in the field during well purging and sampling.

2.2 Soil Analyses

To determine if residual chromium and/or organic compounds are present in site soils, several soil samples will be collected from various site locations as described in Section 1.0.

These soil samples will be analyzed for the following:

- Total petroleum hydrocarbons by EPA method 8015
- Total chromium by EPA method 7190

- Hexavalent chromium by EPA methods 3060 (Alkaline digestion),and EPA 7195 or 7197
- Volatile aromatics by EPA method 8020
- Volatile halogenated organics by EPA method 8010
- Total metals by ICP scan
- Oxidation/reduction potential
- pH (field analysis only)

At least one soil sample will also be analyzed for HSL volatile and semi-volatile organics by EPA GC/MS methods to identify any unknown chromatographic peaks that cannot be identified by the proposed GC methods.

To prevent conversion of hexavalent to trivalent chromium, an alkaline digestion (EPA method 3060) will be used prior to analyses for hexavalent chromium by EPA methods 7195 or 7197. Individual analytical parameters and quantification limits for the analyses of soil samples are listed in Table 2-1. Table 2-3 references analytical methods to be used, sample containers and holding times for each analytical category.

3.0 SAMPLE COLLECTION TECHNIQUES

This section describes the procedures to be used in collecting soil and ground-water samples. The procedures are designed to ensure that samples are consistently collected, labeled, preserved and transported in a manner which maintains their integrity for their intended purposes. Samples to be collected may include:

- Subsurface soil samples collected during the installation of ground-water monitoring wells. These samples will be collected for geologic evaluation and for physical and/or chemical analysis. (The word "soil" in this context refers to those geologic materials underlying the site which can be sampled using drive samplers, thin-walled tubes or dry soil-coring methods.)
- Subsurface soil samples from shallow borings drilled in the abandoned waste evaporation ponds and the flare pit. These samples will be obtained for chemical analyses.
- Ground-water samples from five downgradient and two upgradient monitoring wells. These samples will be obtained for chemical analysis.

All samples will be handled in accordance with the chain-of-custody guidelines outlined in Section 8.0. All samples collected for chemical analysis will be collected in the sample containers described in and preserved as indicated in Table 2-3. Samples will be preserved in the field as appropriate for the analyses to be performed and will be analyzed within EPA holding times established for the analyses to be performed. (The holding times in Table 2.3 are taken from U.S. Environmental Protection Agency's November 1987 guideline document on the preparation of a U.S. EPA Region 9 Sample Plan.) Samples will be chilled at 4°C and will be shipped to the laboratory for analyses the day of sample collection.

3.1 Collection of Subsurface Soil Samples

Subsurface soil samples may be collected for lithologic description, chemical analysis or physical analysis. Soil will be collected every five feet during the installation of monitoring wells for geologic analysis and lithologic description. These samples will be collected using hollow-stem auger or rotary drilling methods. Samples will be logged in the field by a geologist. Details of the sample, such as color, lithology, texture, bedding, cementation, grain size distribution, structure, consistency, density and moisture, will be recorded on a geologic log form. (See Appendix for example form.) Samples will be sealed in plastic bags, labeled and stored for later reference.
Soil samples will be obtained from the saturated zone during installation of three of the monitoring wells. These samples which will be obtained for chemical analysis will be collected using the hollow-stem auger drilling method. Hollow stem augers will have a minimum inside diameter of three inches to permit use of a Modified California sampler through the augers. Drill rigs and all downhole equipment will be thoroughly steam-cleaned between each boring, and samplers will be cleaned before each use as described in Section 5.0.

Soil samples for chemical testing will also be collected from borings to be located in the abandoned waste evaporation ponds and the flare pit. One boring will be located in each pit. These borings will be drilled using a hand auger which will mimick the process used by a drill rig. The auger will be used to advance the hole to the desired depth for sampling. A drive sampler will be used to advance the hole to the desired depth for sampling. A drive sampler will be used to collect the sample. The sampler will be used with brass liners to minimize the loss of volatile compounds that may be present in the soil and to minimize the potential for cross-contamination between samples due to contact with the sampler.

Samples to be analyzed for chemical constituents will be collected with Modified California samplers. The Modified California sampler will be used with brass liner rings to minimize the potential for cross-contamination between samples, due to contact with the sampler, and to contain samples for laboratory analysis. Following removal from the hole, the following procedures will be implemented:

- Liners will be removed from sampler and marked to indicate top and bottom
- Geologist will examine and log the exposed soil at the end of each section
- One of the liners from each sampler will be sealed with teflon tape, capped with new plastic caps and labeled as described in Section 3.0
- Labeled liners will be sealed with strapping tape, placed in individual plastic bags and stored in coolers for shipment to the laboratory
- Chain-of-custody records will be filled out as described in Section 8.0
- Field notes will be recorded in waterproof ink in appropriate logbooks
- When coolers are ready for shipment to the laboratory, two copies of the chain-of-custody form will be placed inside a zip-lock bag and taped with strapping tape to the inside of the coolers
- Coolers will be sealed with duct tape
- Coolers will be labeled "Fragile" and "This-End-Up"

The laboratory will remove portions of the sample for testing by cutting away at least one-half inch of soil at the ends of each liner and coring subsamples from the sample centers.)

The pH of soil samples will be measured in the field. A measured quantity of soil will be mixed thoroughly with twice the volume of deionized water to form a leachate. The pH of the leachate will then be measured using a properly standardized pH meter.

Soil samples for physical analysis will be collected in split barrel or thin-walled samplers by the "dry core" method. In this method, the soil core sampler is located just ahead of the augers and is operated through the center of the auger string. No drilling fluids are used. Dry core samplers vary from one manufacturer to another (e.g., Mobile Drill equipment utilizes a standard Shelby tube for collection of samples while the CME equipment uses a split-tube core barrel). Regardless of the sampling technique used, the following procedures will be implemented by the sample handler:

- Shelby tube will be placed into clean plastic lined tray
- The geologist will remove any sloughed material from the sample, measure the sample and log lithologic details
- Sections will be selected for physical testing by the geologist and will be placed in sterile, wide-mouth jars
- The jars will be capped, labeled, and sealed with strapping tape.

For certain types of tests requiring undisturbed samples, Shelby tube samples will not be extruded in the field. In these instances, the tubes will be marked to indicate top and bottom, capped, taped, and labeled with date, borehole number, sample number and depth.

3.2 Collection of Ground-Water Samples

Ground-water samples will be collected from monitoring wells as described below. These samples will be sent to the laboratory to be analyzed for volatile aromatics, volatile halogenated organics, total metals, total chromium, hexavalent chromium, total petroleum hydrocarbon and other chemicals which may have been in boiler and cooling tower blowdown discharged to the site evaporation ponds. Field measurements of sample temperature, pH, oxidation/reduction potential and electrical conductivity will be made, as described in Section 10.0. Analytical methods to be used are discussed in Section 2.0. Details are discussed below.

All measuring and sampling equipment will be decontaminated before introduction into a well as described in Section 5.0. Water levels will be measured before sampling. The wells will then be purged using a submersible pump (Low yield/small diameter wells will be purged using a displacement type hand pump.) A minimum of three casing volumes will be removed from these wells. In the unlikely event that a well is pumped dry during purging, a minimum of two well volumes (water in casing) will be removed prior to sampling. During purging, indicator parameters (pH, conductivity and temperature) will be monitored to verify that the water to be sampled is representative of ground water from the formation. Purged water will be collected in barrels or tanks and stored temporarily on site for transport to a licensed disposal facility. Following purging, samples will be collected with a stainless steel bottom discharging, double check valve bailer, and transferred directly to appropriate sample containers.

Details of the sampling procedure followed at each well will be entered in a field notebook. The following information will be recorded at the time of sampling:

- Sampler's name
- Date and time of sample collection
- Well identification
- Depth to ground water prior to sampling (if measured)
- Weather conditions
- Purging method and equipment
- Purged volume and pumping rate; note if volume limited by low well yield
- Measurements of indicator parameters (e.g., temperature, specific conductance, pH)
- Water appearance and odor
- Sampling method and equipment
- Sample number
- Custody seal number
- Volume and type of sample containers used
- Field treatment or preservatives

Ground-water samples will be collected using the following procedures:

- Where appropriate, preservatives will be added to sample containers prior to sample collection
- Samples will be transferred from a stainless steel bailer or, in the case of supply wells, directly from the sample point to the appropriate sample containers. (The types of containers and volume of water to be collected for each analysis type are described in Table 2.3. When transferring samples from the bailer to the sample containers, care will be taken not to touch the bailer to the sample jar.)

- All water samples will be collected with no or minimal entrainment of air. To accomplish this, sample jars will be filled to overflowing and caps will be slid into place. Vials will be inverted and tapped gently. If air bubbles are detected in the vials, samples will be discarded and new samples will be taken.
- Containers will be labeled as described in Section 3.0.
- Samples containers will be sealed with strapping tape and chain of custody seals
- Containers will be placed in plastic bags, wrapped with padding material and stored in coolers for transport to laboratory for testing
- Field notes will be recorded in waterproof ink in appropriate log books
- Chain-of-custody records will be filled out as described in Section 5.0 of this plan
- Coolers will be labeled and sealed as described previously under Soil Sample Documentation and Handling

4.0 HANDLING AND DISPOSAL OF WASTE FLUIDS AND SOIL CUTTINGS

4.1 Drill Cuttings

Spoil materials from drilling operations including well abandonment activities on and immediately adjacent to the site will be placed in barrels and stored on site until the results of chemical analyses are available to assess their degree of contamination. Each barrel will be marked with the borehole number or numbers from which the cuttings came. Soils found to have contaminant levels below detection limits or below regulatory action levels, will be emptied from the barrels onto the abandoned evaporation pond or flare pit areas. Soils determined to be contaminated will be removed to an appropriate waste disposal facility. Drill cuttings from off-site wells will be collected and transported to the site, where they will be handled in the same manner as drill cuttings from onsite wells and borings.

4.2 Wastewater

Significant quantities of wastewater will be generated during the field investigation as a result of well development, ground-water sampling and pumping tests. This water will be collected in barrels and/or tanks which will be stored on site. Samples of this water will be analyzed to determine the presence of chromium and/or volatile compounds. If contaminants are above regulatory guidelines, the water will be commingled with plant effluent and sent to the Bloomfield wastewater treatment facility.

5.0 DECONTAMINATION PROCEDURES

All equipment that comes into contact with potentially contaminated soil, drilling fluid or water will be decontaminated prior to and after each use. Decontamination will consist of steam-cleaning or a non-phosphate detergent scrub, followed by fresh water and distilled water rinses. Equipment will be decontaminated on pallets or plastic sheeting, and clean equipment will be stored on clean plastic sheeting in uncontaminated areas. Materials to be stored more than a few hours will also be covered.

Drilling, sampling, testing (field) and well installation equipment will be decontaminated as follows:

- Drill rigs, augers, drill rods, mud tanks, sand separators, temporary casing and any other equipment placed in the hole during drilling will be steam-cleaned prior to use and between borings. Visible soil and grease will be removed with a stiff brush.

- Soil samplers used in on-site borings will be steam-cleaned prior to each use. Brass liners for the Modified California sampler and hand-driven samplers will be new and will be cleaned prior to use with a non-ionic detergent and hot water to remove any residual cutting oils. The liners will then be rinsed with certified organic free water.

- Casing, screen, couplings and caps used in monitoring well installation will be steam cleaned prior to installation. Visible foreign matter will be removed with a brush.

- The exterior surfaces and accessible interior portions of submersible, centrifugal and bladder pumps will be cleaned with non-ionic detergent and water prior to each use. Inaccessible interior portions of the pumps will be cleaned prior to each use by purging water through the pump and discharge lines. The exterior of pump discharge lines will be steam cleaned (steel exterior) or scrubbed with non-ionic detergent and water.

  - The stainless steel bailer used for collection of the ground-water samples will be cleaned at the start of the job and between wells as follows:

    - Non-phosphate detergent wash
    - Tap water rinse (several)
    - 0.1 N nitric acid rinse
    - Distilled water rinse (several)

  - Steel tapes, water probes, transducers, thermometer and water quality meters will be rinsed in distilled water or cleaned in a detergent solution and rinsed once in fresh water after each use.

6.0 SAMPLE CONTAINERS

The types of containers that will be used to collect and transport soil and water samples to the laboratory were presented in Table 2.3.

Precleaned sample containers will be supplied by the laboratory. Containers will be precleaned as follows:

Amber Glass Bottles and Wide Mouth Clear Glass Jars

1. Wash containers, closures and teflon liners in hot tap water with laboratory grade non-phosphate detergent.
2. Rinse three times with tap water.
3. Rinse one time with 1:1 nitric acid.
4. Rinse three times with ASTM Type 1 deionized water.
5. Rinse one time with pesticide grade methylene chloride.
6. Oven Dry.
7. Remove containers, closures, and teflon liners from oven.
8. Place teflon liners in closures and place closures on container. Attendant to wear gloves and containers not to be removed from preparation room until sealed.

40 ml Borosilicate Glass Vials, Wide Mouth Clear Glass Jars and Polyethylene Bottles

1. Wash containers, septa or liners, and closures in hot tap water with laboratory grade non-phosphate detergent.
2. Rinse three times with tap water.
3. Rinse three times with ASTM Type 1 deionized water.
4. Oven dry containers, septa or liners, and closures.

5. Remove containers, septa, and closures from oven.

6. Place liners in closures, teflon side down, and place closures on containers. Attendant to wear gloves and containers not to be removed from preparation room until sealed.

Polyethylene Bottles

1. Wash containers, closures, and teflon liners in hot tap water with laboratory grade non-phosphate detergent.

2. Rinse three times with tap water.

3. Rinse one time time with 1:1 nitric acid.

4. Rinse three times with ASTM Type 1 deionized water.

5. Air dry in containant-free-environment.

6. Place liners in closures and place closures on containers. Attendant to wear gloves and containers to not be removed from preparation room until sealed.

7.0 SAMPLE PRESERVATION

The water and soil sample preservation methods are shown in Table 2.3. It should be noted that the water samples for hexavalent chromium analysis will not be acidified to $pH<2$ with HNO_3 because the acid might oxidize any hexavalent chromium to trivalent chromium.

8.0 SAMPLE SHIPMENT AND DOCUMENTATION

Sample custody procedures will be followed through sample collection, transfer, analysis and disposal to ensure that the integrity of samples is maintained. All samples will be collected in accord with EPA chain-of-custody guidelines as prescribed in EPA <u>NEIC Policies and Procedures</u>, National Enforcement Investigations Center, Denver, Colorado, Revised 1984. Field sampling personnel will maintain field logbooks which contain at least the following information:

- Sample identification numbers
- Sample collection dates and approximate times
- Sample matrix
- Sample location and depth
- Sample appearance
- Sample field measurements (if applicable)
- Sample preservatives (if applicable)
- Type of sampling equipment used
- Type and number of sample containers
- Sampler's name
- Custody seal number

A sample label will be affixed to each individual sample collected. The following information will be recorded on each label:

- Project name and location
- Project number
- Date
- Sampler's initials
- Sample identification number

In addition to sample labels, custody seals will be strapped over the lids of all sample containers. Each of these seals will have a unique identification number that will be logged in the field notebook. These seals are designed to enable detection of sample tampering. A sample label and custody seal are included in Appendix E.

Chain-of-custody will be maintained using a multi-ply version of the chain-of-custody form included in Appendix E. Field personnel will log individual samples onto these forms when samples are collected, indicating sample identification numbers, matrices, time of collection and preservative added. The forms will accompany the samples from the field to the laboratory. Whenever a transfer of custody takes place, both parties will sign and date the accompanying chain-of-custody forms, and the individual relinquishing the samples will retain a copy of each form. The laboratory will attach copies of the completed chain-of-custody forms to the analytical reports prepared for the samples.

Analytical instructions will be submitted to the laboratory via letter or directly on the chain of custody forms. The instructions will reference sample identification numbers exactly as they appear on sample labels and chain-of-custody forms, and will indicate the samples to be analyzed, the analyses to be performed and the corresponding number and type (e.g., duplicate, spike) of quality control samples to be analyzed.

A designated sample custodian will take custody of all samples upon their arrival at the laboratory. The custodian will inspect all sample labels and custody forms to ensure that the information on each corresponds. The custodian will also inspect all samples for signs of damage or tampering. Any discrepancies in information or signs of damage or tampering will be documented by the custodian. The custodian will then assign a unique laboratory number to each sample and distribute the samples to the appropriate analysts or secured storage areas. All sample transfers in the laboratory will be recorded.

Laboratory personnel will be responsible for the care and custody of samples from the time of their receipt at the laboratory through their exhaustion or disposal. The laboratory will retain all written records of laboratory handling and analysis as part of a permanent laboratory file.

9.0 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Both field and laboratory quality control (QC) checks will be employed to evaluate the performance of laboratory analytical procedures. QC checks will take the form of samples introduced into the analytical stream to enable evaluation of analytical accuracy and precision.

9.1 Field Quality Control Checks

Field QC checks will consist of blind submission of blank, duplicate and background samples to the laboratory. The nature and frequency of these samples are described below.

Blanks

One travel blank will be submitted to the laboratory for analysis along with each shipping container containing soil or water samples to be analyzed for volatile constituents. The blank will consist of organic free water and will be analyzed for all of the volatile constituents for which the ground-water and/or soil samples will be analyzed.

Duplicates

During ground-water sampling, one duplicate ground-water sample will be collected and submitted to the laboratory for every 20 field samples. Given the heterogeneity of soils, and thus the questionable significance of a field soil duplicate, field soil duplicates will not be collected.

Background Samples

Background soil and ground-water samples will be collected from the proposed ground water well to be located upgradient of the plant site. The background soil sample will be collected from the locations at which the off-site ground-water monitoring well will be installed and developed. The background soil and ground water samples will be analyzed for the same constituents as the other soil and ground water samples.

9.2 Laboratory Quality Control Checks

Laboratory QC checks will include the following:

- Calibration of instruments as described in and at the frequency prescribed in the analytical methods used and in instrument manufacturers' instructions
- Analysis of standards for each analytical method to be performed at the start of each laboratory shift
- Analysis of one laboratory blank by each analytical method for every 20 samples analyzed, or one per batch, whichever is greater
- Analysis of one spike sample for every 20 samples analyzed, or one per batch, whichever is greater; spike samples will be spiked with representative compounds for each analytical method performed
- Analysis of one duplicate sample for every 20 samples analyzed, or one per batch, whichever is greater

Any spike or duplicate results which fall outside warning or control limits established on laboratory control charts will be reported in writing with all corresponding analytical data.

10.0 FIELD MEASUREMENTS

Field data will be collected during various sampling and monitoring activities of the field investigation. This section describes routine procedures to be followed by personnel performing field measurements. The methods presented below are intended to ensure that field measurements are consistent and reproducible when performed by various individuals. Forms to be used by field personnel for recording field measurements are shown in the Appendix. In addition to properly recording data on these forms, personnel will maintain field notebooks in which all data will be recorded.

The calibration and precision requirements for field measurements are summarized in Table 10.1.

The types of field measurements to be made at the site include:

- Water-level measurements in wells to establish vertical and horizontal hydraulic gradients
- Water-level measurements made as part of a permeability or aquifer test
- Conductivity, temperature, oxidation/reduction potential and pH measurements made on ground-water samples during pumping, well purging and sampling
- pH and oxidation/reduction potential on soil samples

Procedures for each of these measurements are presented below.

10.1 Water-Level Measurements

Water levels may be measured using a steel tape, electric probe and/or pressure transducer. If a pump or other equipment is in the well, measurement devices will be lowered slowly to avoid entanglements. Water level measurements in completed wells will be made from a permanently marked reference point on the well casing. The elevation of this point will be established by survey. Water levels measured in boreholes or wells during construction will be made relative to the ground surface. Measurements will be made and recorded to the nearest hundredth of a foot. In general, water level measurements to determine hydraulic gradients, and in some permeability or aquifer tests, will be made with an electric probe. Pressure transducers will be used for continuous water level recording in a single well and to record rapid changes in water level during permeability testing. A steel tape will be used for calibrating the electric probe and verifying the placement of the pressure transducer. A steel tape may also substitute for the electric probe. The following procedures will be followed during water level measurements.

Electric Water Probe

A battery-powered water probe will be used for most water level measurements. The probe will have firmly affixed or permanent marks on the cable at regular intervals of 5 feet or less. Prior to use, each probe will be calibrated with a steel tape which has no breaks or kinks. The tape will be used to check the spacing of markers on the probe cable (if the markers are not an integral part of the cable) and to determine any correction factor which must be applied to measurements made with the probe (resulting from cable stretch or change in length as a result of probe tip replacement). The correction factor will be determined by measuring the water level in a well at the site using both the probe and the steel tape. Calibration results will be recorded in a field notebook. In addition, if a correction factor is needed, a label will be affixed to the water level probe indicating the calibration date, the amount of the correction factor and the name of the person performing the calibration. The probe will be recalibrated annually, or whenever the sensor tip is replaced or the cable becomes severely twisted, kinked or stretched. Water levels measured with a probe will be repeated until consecutive measurements agree within 0.05 feet per 100-foot depth to water. That part of the cable that is submerged will be cleaned according to the procedure outlined in Section 4. Probes will be maintained in a clean and functional condition.

Steel Tape

A graduated steel tape will be used for a quality control check of other measurement methods and for water-level measurements when needed. A small steel weight will be affixed to the bottom end of the tape to keep it taut. The steel tape will be checked continuously for kinks. Identifying the fluid level will be accomplished by chalking the bottom 2 feet or more of the tape before each measurement. For calibration purposes, separate measurements must be taken until two are obtained which differ by less than 0.02 feet.

If oil products or films exist above the water phase, a separate measurement with water-finding paste and/or a clear acrylic bailer will be made to determine both depth to oil and depth to water. A steel tape will not be used in cascading wells.

After removal from each well, portions of the tape that have been submerged below the fluid level will be cleaned according to the procedures described in Section 4. Tapes will be maintained in a clean and functional condition.

Pressure Transducers

Electronic pressure transducers with an appropriate data logger unit may be used during single-well or multiple-well aquifer testing. They may also be used for continuous monitoring of water levels over a specified period of time.

The operation, calibration, maintenance and storage of the pressure transducers will be in accordance with the manufacturer's specifications. Each time a transducer is used, it will be calibrated by lowering and raising it through a measured depth range (typically 10 feet) and checking the transducer readout. If necessary, the transducer will be recalibrated.

The installation depth to the sensing tip of the transducer will be measured and recorded. The water level at time of placement will be measured with a steel tape or calibrated water probe. Transducers will not be positioned less than one foot from the well bottom. Electronic conditions which could affect transducer operation will be noted and recorded in the field log book. During aquifer or pumping tests where pressure transducers are being utilized, the water level will be checked before the test is begun using a steel tape or electric probe. Periodic checks shall be made during tests greater than four hours in duration.

When pressure transducers are used for continuous water-level monitoring over extended periods of time, the calibration of the transducer will be checked after the data logger is serviced for data retrieval or battery replacement. Measurements will be made using a steel tape or water probe at the time of transducer installation and immediately prior to transducer removal from the well.

10.2 Conductivity, Temperature Oxidation/Reduction Potential and pH Measurement

Specific conductance, water temperature and pH measurements will be made in the field during purging, and when a water sample is collected. The water sample will be placed in a bottle or jar used solely for field testing. A field pH meter with a combination electrode or equivalent will be used for pH measurements. A field conductivity meter will be used for specific conductance measurements. A field selective ion meter with temperature and oxidation/reduction potential (ORP) electrodes will be used for oxidation/reduction potential measurements of water samples. Prior to ORP measurement, water samples will be sparged with nitrogen to remove oxygen that may be in the sample and to prevent further aeration. Temperature measurements will be performed using standard thermometers or equivalent temperature meters. Combination instruments capable of measuring two or all three of the parameters may also be used.

All instruments will be calibrated as described on Table 10.1. If conductivity standards or pH buffers are used in field calibration, their values will be recorded in the field notebook. The sample-testing bottle and all probes will be thoroughly cleaned and rinsed with distilled water prior to any measurements, as described in Section 5.0.

TABLE 2-1
SOIL AND GROUND WATER
ANALYTICAL PARAMETERS

Volatile Aromatics - EPA Method 602/8020 (1,2)

Benzene
Chlorobenzene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Ethyl benzene
Toluene
Xylenes

Volatile Halogenated Organics - EPA Method 601/8010 (1,2)

1,1-Dichloroethylene
1,1-Dichloroethane
trans-1,2-Dichloroethylene
Chloroform
1,1,2-Trichloro-2,2,1-trifluoroethane
1,1,1-Trichloroethane
Carbon Tetrachloride
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloropropylene
Trichloroethylene
trans-1,3-Dichloropropylene
1,1,2-Trichloroethane
Dibromochloromethane
Bromoform
Tetrachloroethylene
1,1,2,2-Tetrachloroethane
Chlorobenzene

Metals (1,4)

Total Iron - ICP
Total Manganese - ICP
Total Chromium - AA
Total Arsenic - ICP
Hexavalent Chromium - EPA 7195 or 7197 (AA)
Total Cadmium - AA
Total Lead - AA
Total Mercury - ICP
Zinc AA or ICP
Copper - AA

Volatile Organics - EPA Method 624/8240 (1,2)

EPA Volatile Organic Priority Pollutants

Semi-Volatile Organics - EPA Method 625/8270 (1,2)

EPA Semi-Volatile Organic Priority Pollutants

Total Extractable Hydrocarbons - 8015 (1,2)

TABLE 2-1 (Cont'd)
SOIL AND GROUND WATER
ANALYTICAL PARAMETERS

Major Cations and Anions (4)

Calcium EPA 200.7
Magnesium EPA 200.7

Potassium EPA 200.7
Sodium EPA 200.7

Sulfate EPA 375.4
Alkalinity (Bicarbonate, Carbonate) EPA 310.1
Chloride EPA 325.3
Nitrate EPA 353.3

Basic Water Quality Parameters

ph - EPA 150.1 (3)
Total Dissolved Solids EPA 160.1 (4)

Other

Oxidation/Reduction Potential (Platinum silver-silver chloride combination electrode)

Notes

1) Test Methods for Evaluating Solid Waste, U. S. Environmental Protection Agency, SW-846, Third Edition, November 1986.

2) Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, PB83-201796, U. S. Environmental Protection Agency, July 1982.

3) EPA Test Methods for Chemical Analysis of Water and Wastes, March 1983.

4) Methods for Chemical Analysis of Water and Wastes, U. S. Environmental Protection agency, EPA 600/4-79-020.

5) Volatile halogenated organics and semi-volatiles refer to the hazardous substance list (HSL) compounds reported for EPA methods 624 and 625 (8240 and 8270) under EPA's Contract Laboratory Program (CLP).

TABLE 2-2
ANALYTICAL METHODS

Parameter	Method No.	Method	Method Detection Limits (ppb) (a)
Volatile Aromatics	EPA 602/8020	GC-PID	2-4/2-4 (b)
Volatile Halogenated Organics	EPA 601/8010	GC-HSD	0.2-5.2/0.2-5.2 (b)
Volatile Organics	EPA 624/8240	GC-MS	5-100/5-100 (b)
Semi-Volatile Organics	EPA 625/8270	GC-MS	10-50/660-3300 (b)
Total Extractable Hydrocarbons	EPA 8015	GC-FID	Not available (NA)
Metals			
Total Iron	EPA 6010	ICP	100 (c)
Total Manganese	EPA 6010	ICP	15 (c)
Total Chromium	EPA 218.1/7190 or 218.2/7191	AA	1.0-50/1.0-50
Hexavalent Chromium	EPA 218.4/7197 or 218.5/7195	AA	1.0-5/1.0-5
Total Arsenic	EPA 6010	ICP	10 (c)
Total Cadmium	EPA 7130 or 7131	AA	5 (c)
Total Mercury	EPA 6010	ICP	0.2 (c)
Total Zinc	EPA 6010	ICP	20 (c)
Total Lead	EPA 7420 or 7421	AA	5 (c)
Total Copper	EPA 7210	AA	25 (c)
Basic Water Quality Parameters			
Alkalinity (Bicarbonate/Carbonate)	EPA 310.1	Titrimetric	NA
Calcium	EPA 200.7	ICP	5 mg/L (c)
Chloride	EPA 300.0	Ion-Chromatography	NA
Magnesium	EPA 200.7	ICP	5 mg/L (c)
Nitrate	EPA 300.0	Ion-Chromatography	NA
Potassium	EPA 200.7	ICP	5 mg/L (c)
Sodium	EPA 200.7	ICP	5 mg/L (c)
Sulfate	EPA 300.0	Ion-Chromatography	NA
pH	EPA 150.1	Electrometric	Not applicable
Total Dissolved Solids	EPA 160.1	Gravimetric	NA
Oxidation/Reduction Potential	Platinum silver-silver combination electrode		NA

(a) Numbers left of slashes are method detection limits for water samples in ug/l; numbers to the right of slashes are limits for soil samples in ug/kg. Ranges indicate that detection limits may vary for different parameters detected by the same method. In some cases, detection limits may be elevated due to interferences or the presence of a parameter(s) at levels greater than five to ten times the method detection limits specified in this table. Actual detection limits achieved will be reported by the laboratory.

TABLE 2-2 CONTINUED

(b) These are Practical Quantitation Limits (PQLs) which are highly matrix dependent and may not always be achievable. PQLs for soil are based on wet weight. Normally data is reported on a dry weight basis; therefore, PQLs will be higher, based on the % moisture in each sample.

(c) Detection limits for soil/sediment samples are dependent on the percentage of solids in the sample (dry weight).

TABLE 2-3

SOIL AND GROUND WATER ANALYTICAL PLAN

ANALITYCAL PARAMETERS	VOLATILE ORGANICS	HALOGENATED VOLATILE ORGANICS	HEXAVALENT CHROME	TOTAL METALS/ TOTAL CHROMIUM	CATIONS (b)	ANIONS (c) pH, TDS	TOTAL PETROLEUM HYDROCARBONS	OXIDATION/ REDUCTION POTENTIAL	VOLATILE ORGANICS (GC/MS)	SEMIVOLATILE ORGANICS (GC/MS)
PRESERVATIVES/ SPECIAL HANDLING(a)	Chill to 4° C No head space Add HCL to ph <2	Chill to 4° C No head space Add HCL to ph <2	Chill to 4° C	Add HNO to pH<2 Chill to 4° C	Add HNO_3 to pH<2 Chill to 4° C	Chill to 4° C No head space	Add H_2SO_4 to pH<2 Chill to 4° C	Chill to 4° C	Chill to 4° C No head space Add HCL to pH<2	Chill to 4° C
ANALYTICAL HOLDING TIME	<14 days	<14 days	24 hours	<6 months	<6 months	28 days (nitrate - 48 hours)	14 days	24 hours	14 days	7 days
NO. OF BOTTLES PER ANALYSIS (a)	2 x 40 ml vials	2 X 40 ml vials	1 x 1 liter poly bottle	1 x 1 liter poly bottle	1 x 1 liter poly bottle	1 x 1 liter poly bottle	1 x 1 liter Amber glass	1 x 1 liter poly bottle	2 x 40 ml vials	1 x 1 liter Amber glass
GROUND WATER SAMPLES										
GW1	X	X	X	X	X	X	X	X(field)		
GW2	X	X	X	X	X	X	X	X "		
GW3	X	X	X	X	X	X	X	X "		
GW4	X	X	X	X	X	X	X	X "		
GW5	X	X	X	X	X	X	X	X "	X	X
GW6	X	X	X	X	X	X	X	X "		
GW7	X	X	X	X	X	X	X	X "		
GW8 (Dup of GW5)	X	X	X	X	X	X	X	X "		
SOIL SAMPLES										
A-1 (1')	X	X	X	X		X(field)	X	X		
A-2 (4')	X	X	X	X		X "	X	X		
B-1 (1')	X	X	X	X		X "	X	X		
B-2 (4')	X	X	X	X		X "	X	X	X	X
C-1 (1')	X	X	X	X		X "	X	X		
C-2 (4')	X	X	X	X		X "	X	X		
W3	X	X	X	X		X "	X	X		
W5	X	X	X	X		X "	X	X		
W6	X	X	X	X		X "	X	X		
W1 (upgradient well)	X	X	X	X		X "	X	X		

a) Subsurface soil samples will be collected in brass sectional liners (sleeves) and cooled to 4° C
b) Cations to be analyzed include calcium magnesium sodium and potassium
c) Anions to be analyzed include sulfate, carbonate, bicarbonate, chloride and nitrate.

SCHEDULE OF QUANTITIES AND PRICES

Analyses	Estimated Quantity of Analyses	Estimated Quantity of QA Analyses (Spikes and/or Duplicates)	Unit Price (Analyses)	Unit Price (QA Analyses)	Total Price
8010-Volatile Halogenated Organics	10	2			
8020-Volatile Aromatics	10	2			
8015-Total Extractable Hydrocarbons	10	2			
8240-HSL Volatile Organics	1	1			
8270-HSL Semi-volatile Organics	1	1			
Total Metals	10	2			
Hexavalent Chromium	10	2			
Oxidation/Reduction Potential	10	1			
pH	10	1			
Total					
601 -Volatile Halogenated Organics	8	2			
602 -Volatile Aromatics	8	2			
8015-Total Extractable Hydrocarbons	8	2			
624 -HSL Volatile Organics	1	1			
625 -HSL Semi-Volatile Organics	1	1			
Total Metals	8	2			
Hexavalent Chromium	8	2			
Anions/Cations	8	1			
pH	8	1			
Total					

APPENDIX C
Technical Specifications for Laboratory Analysis

APPENDIX C

TECHNICAL SPECIFICATIONS
FOR
LABORATORY ANALYSIS
OF
SOIL AND GROUND-WATER SAMPLES

for

El Paso Natural Gas Company
Blanco Plant
San Juan County, New Mexico

Prepared for

El Paso Natural Gas Company

by

BEI

September 1988

TABLE OF CONTENTS

LIST OF TABLES

1.0 GENERAL INFORMATION

This technical specification is part of a sampling and analysis program to investigate potential soil and groundwater contamination at El Paso Natural Gas Company's Blanco Plant facility in San Juan County, New Mexico. Analysis of ground-water and soil samples collected at the site will aid in assessment of site contamination, if any.

1.1 This specification identifies the requirements of the laboratory contractor in providing analytical services and related work.

1.2 The following abbreviations are used in this specification.

Bechtel:	Bechtel Environmental, Inc.
EPA:	United States Environmental Protection Agency
NEIC:	EPA/National Enforcement Investigations Center; Denver, CO.

2.0 SCOPE OF WORK

The laboratory contractor shall perform the tasks described below.

2.1 Provide supplies, equipment, and qualified personnel to perform work as described in this document.

2.2 Furnish pre-cleaned sample jugs, bottles, jars, preservatives, and ice chests.

2.3 Adhere to the NEIC chain-of-custody guidelines from sample receipt through sample disposal.

2.4 Meet holding times specified on Table 2.

2.5 Perform analyses according to EPA guidelines for laboratory quality control.

2.6 Analyze samples according to methods outlined in this specification.

2.7 Any modification to procedures described in this document must be discussed with the Bechtel Project Manager and must then be documented and reported.

2.8 Perform work in accordance with the Schedule of Quantities and Prices specified in Table 3. Quantities specified are estimates. The exact number of samples to be analyzed will be determined after field work has commenced.

2.9 Prepare a final report containing all analytical results and submit the report to Bechtel within 15 working days of sample receipt. (20 working days for GC/MS analyses). Preliminary results may be requested by Bechtel as they become available.

3.0 RELATED WORK NOT INCLUDED

The following tasks are not included in this work specification.

3.1 Sample collection.

3.2 Interpretation of analytical results.

4.0 MATERIALS AND SUPPLIES

4.1 The laboratory contractor shall supply pre-cleaned glassware and plasticware for sample collection. Sample containers shall be cleaned according to EPA protocols to eliminate any possible traces of organic and inorganic contamination.

4.2 The laboratory contractor shall supply ice chests in which to transport samples from the field to the laboratory.

5.0 SAMPLE HANDLING

5.1 Upon receipt of samples, the laboratory contractor shall follow chain-of-custody procedures as outlined in NEIC Policies and Procedures, EPA-330/9-78-001-R.

5.2 Once analysis is complete, the laboratory contractor shall store all remaining samples or sample portions until written permission to dispose of them is obtained from Bechtel.

5.3 The laboratory contractor may be asked by Bechtel to prepare and send split samples to other laboratories.

6.0 ANALYSIS

6.1 Samples designated for analysis shall be analyzed for the parameters listed in Table 1. Methods to be used are stated in Table 1. Equivalent or modified methods may be used if approved by Bechtel prior to use. All positive gas chromatograph determinations shall be confirmed with a second column.

6.2 Priority pollutants shall be analyzed by EPA Methods 8240 and 8270. In addition to priority pollutants, the 10 largest "non-priority pollutant" peaks shall also be identified, and an estimate of their concentrations be reported by the laboratory. An estimate of the total number of remaining peaks shall also be reported.

6.3 Detection limits reported for all analyses shall be on the order of those specified by the EPA methods in Table 1. When such limits are not achievable, explanations shall be included in the laboratory contractor's final analytical report.

6.4 EPA methods 7195 or 7197 are preferred to EPA method 7196 for the analyses of hexavalent chromium. EPA method 7196 is a colorimetric analysis which is subject to interferences caused by the presence of such compounds as molybdenum, mercury vanadium and iron in the ground water or soil sample. These interferences could elevate detection limits resulting in unusable data. Regardless of the analytical method chosen for hexavalent chromium analyses, all available means should be employed to keep detection limits at or below 0.010 mg/L. An alkaline digestion (EPA Method 3060) will be used prior to analyzing soil samples for hexavalent chromium.

6.5 Analysis shall be conducted in accord with EPA guidelines for quality control. Laboratory water, reagents, solvents, gases, and glassware shall be as specified in the Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA-600/4-79-019. Analytical instrumentation shall be calibrated and maintained as required by applicable EPA analytical methods or substituted equivalents.

6.6 Totals metals concentrations in soil samples will be reported on a "dry weight" basis.

7.0 QUALITY CONTROL

7.1 A minimum of one method or reagent blank shall be run with each batch of samples analyzed.

7.2 Each batch of samples analyzed shall include a minimum of one duplicate and one spiked sample in addition to standards and a reagent blank.

7.3 The contractor shall strictly adhere to holding times stated in the methods referenced in Table 2.

8.0 DOCUMENTATION AND REPORTING

8.1 Upon sample receipt, the laboratory contractor shall make note of the condition of sample containers, labels and seals, and shall record any unusual findings. Any such findings shall be reported to the Bechtel Project Manager immediately and shall be included in the laboratory contractor's report to Bechtel.

8.2 Any proposed deviations from this document including modifications of the specified analytical methods shall be discussed with Bechtel prior to execution and shall be included in the laboratory contractor's report to Bechtel.

8.3 Analytical results for each batch of samples analyzed shall be reported along with the corresponding quality control results for each batch. The detection limit for each analytical parameter in each sample shall also be reported.

8.4 Copies of all gas chromatograms, mass spectra and AA/ICP raw data, including those for blanks, standards and second column confirmations, shall be attached to the laboratory contractor's report to Bechtel.

8.5 Any analytical results which fall outside corresponding control chart warning or control limits for accuracy and precision shall be noted in the laboratory contractor's report to Bechtel. Analytical reports shall also indicate the maximum allowable concentrations for each regulated substance as required by the New Mexico Water Quality regulations.

8.6 Copies of all chain-of-custody forms shall be included in the laboratory contractor's report to Bechtel.

9.0 MEASUREMENT AND PAYMENT

9.1 Measurement and payment for all work performed within the scope of these specifications shall be as described in this section. The provisions of this section shall not be considered limitations or modifications of the work to be performed. Should the laboratory contractor determine that any item required to complete the work as described herein is not associated with one of the pay items, the contractor shall request clarification or modification of these specifications in writing prior to entering into a contract for the work.

9.2 Analytical work shall be measured as the number of samples on which individual analyses are performed. Analytical work for the purpose of generating quality control data (e.g., duplicates, spikes), excluding analysis of standards or method blanks, shall be measured as the number of samples on which quality control work is performed. Quantities listed in the Schedule of Quantities and Prices are estimates. The actual number of samples to be analyzed will be determined after field work has commenced.

9.3 Payment for analytical work shall be made at the unit prices quoted in the attached Schedule of Quantities and Prices and shall constitute full compensation for furnishing all labor, equipment, materials and supplies required to meet these specifications.

TABLE 1
SOIL AND GROUND WATER
ANALYTICAL PARAMETERS

Volatile Aromatics - EPA Method 602/8020 (1,2)

Benzene
Chlorobenzene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Ethyl benzene
Toluene
Xylenes

Volatile Halogenated Organics - EPA Method 601/8010 (1,2)

1,1-Dichloroethylene
1,1-Dichloroethane
trans-1,2-Dichloroethylene
Chloroform
1,1,2-Trichloro-2,2,1-trifluoroethane
1,1,1-Trichloroethane
Carbon Tetrachloride
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloropropylene
Trichloroethylene
trans-1,3-Dichloropropylene
1,1,2-Trichloroethane
Dibromochloromethane
Bromoform
Tetrachloroethylene
1,1,2,2-Tetrachloroethane
Chlorobenzene

Metals (1,4)

Total Iron - ICP
Total Manganese - ICP
Total Chromium - AA
Total Arsenic - ICP
Hexavalent Chromium - EPA 7195 or 7197 (AA)
Total Cadmium - AA
Total Lead - AA
Total Mercury - ICP
Zinc AA or ICP
Copper - AA

Volatile Organics - EPA Method 624/8240 (1,2)

EPA Volatile Organic Priority Pollutants

Semi-Volatile Organics - EPA Method 625/8270 (1,2)

EPA Semi-Volatile Organic Priority Pollutants

Total Extractable Hydrocarbons - 8015 (1,2)

TABLE 1 (Cont'd)

SOIL AND GROUND WATER

ANALYTICAL PARAMETERS

Major Cations and Anions (4)

Calcium EPA 200.7
Magnesium EPA 200.7

Potassium EPA 200.7
Sodium EPA 200.7

Sulfate EPA 375.4
Alkalinity (Bicarbonate, Carbonate) EPA 310.1
Chloride EPA 325.3
Nitrate EPA 353.3

Basic Water Quality Parameters

ph - EPA 150.1 (3)
Total Dissolved Solids EPA 160.1 (4)

Other

Oxidation/Reduction Potential (Platinum silver-silver chloride combination electrode)

Notes

1) *Test Methods for Evaluating Solid Waste*, U. S. Environmental Protection Agency, SW-846, Third Edition, November 1986.

2) *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, PB83-201796, U. S. Environmental Protection Agency, July 1982.

3) *EPA Test Methods for Chemical Analysis of Water and Wastes*, March 1983.

4) *Methods for Chemical Analysis of Water and Wastes*, U. S. Environmental Protection agency, EPA 600/4-79-020.

5) Volatile halogenated organics and semi-volatiles refer to the hazardous substance list (HSL) compounds reported for EPA methods 624 and 625 (8240 and 8270) under EPA's Contract Laboratory Program (CLP).

TABLE 2

SOIL AND GROUND WATER ANALYTICAL PLAN

ANALITYCAL PARAMETERS	VOLATILE ORGANICS	HALOGENATED VOLATILE ORGANICS	HEXAVALENT CHROME	TOTAL METALS/ TOTAL CHROMIUM	CATIONS (b)	ANIONS (c) pH, TDS	TOTAL PETROLEUM HYDROCARBONS	OXIDATION/ REDUCTION POTENTIAL	VOLATILE ORGANICS (GC/MS)	SEMIVOLATILE ORGANICS (GC/MS)
PRESERVATIVES/ SPECIAL HANDLING(a)	Chill to 4° C No head space Add HCL to ph <2	Chill to 4° C No head space Add HCL to ph <2	Chill to 4° C	Add HNO to pH<2 Chill to 4° C	Add HNO3 to pH<2 Chill to 4° C	Chill to 4° C No head space	Add H2 SO4 to pH<2 Chill to 4° C	Chill to 4° C	Chill to 4° C No head space Add HCL to pH<2	Chill to 4° C
ANALYTICAL HOLDING TIME	<14 days	<14 days	24 hours	<6 months	<6 months	28 days (nitrate - 48 hours)	14 days	24 hours	14 days	7 days
NO. OF BOTTLES PER ANALYSIS (a)	2 x 40 ml vials	2 X 40 ml vials	1 x 1 liter poly bottle	1 x 1 liter poly bottle	1 x 1 liter poly bottle	1 x 1 liter poly bottle	1 x 1 liter Amber glass	1 x 1 liter poly bottle	2 x 40 ml vials	1 x 1 liter Amber glass
GROUND WATER SAMPLES										
GW1	X	X	X	X	X	X	X	X(field)		
GW2	X	X	X	X	X	X	X	X "		
GW3	X	X	X	X	X	X	X	X "		
GW4	X	X	X	X	X	X	X	X "		
GW5	X	X	X	X	X	X	X	X "	X	X
GW6	X	X	X	X	X	X	X	X "		
GW7	X	X	X	X	X	X	X	X "		
GW8 (Dup of GW5)	X	X	X	X	X	X	X	X "		

A-1 (1')	X	X	X	X		X(field)	X	X		
A-2 (4')	X	X	X	X		X "	X	X		
B-1 (1')	X	X	X	X		X "	X	X		
B-2 (4')	X	X	X	X		X "	X	X	X	X
C-1 (1')	X	X	X	X		X "	X	X		
C-2 (4')	X	X	X	X		X "	X	X		
W3	X	X	X	X		X "	X	X		
W5	X	X	X	X		X "	X	X		
W6	X	X	X	X		X "	X	X		
W1 (upgradient well)	X	X	X	X		X "	X	X		

a) Subsurface soil samples will be collected in brass sectional liners (sleeves) and cooled to 4° C

b) Cations to be analyzed include calcium magnesium sodium and potassium

c) Anions to be analyzed include sulfate, carbonate, bicarbonate, chloride and nitrate.

TABLE 3

SCHEDULE OF QUANTITIES AND PRICES

Analyses	Estimated Quantity of Analyses	Estimated Quantity of QA Analyses (Spikes and/or Duplicates)	Unit Price (Analyses)	Unit Price (QA Analyses)	Total Price
8010-Volatile Halogenated Organics	10	2			
8020-Volatile Aromatics	10	2			
8015-Total Extractable Hydrocarbons	10	2			
8240-HSL Volatile Organics	1	1			
8270-HSL Semi-volatile Organics	1	1			
Total Metals	10	2			
Hexavalent Chromium	10	2			
Oxidation/Reduction Potential	10	1			
pH	10	1			
Total					
601 -Volatile Halogenated Organics	8	2			
602 -Volatile Aromatics	8	2			
8015-Total Extractable Hydrocarbons	8	2			
624 -HSL Volatile Organics	1	1			
625 -HSL Semi-Volatile Organics	1	1			
Total Metals	8	2			
Hexavalent Chromium	8	2			
Anions/Cations	8	1			
pH	8	1			
Total					

APPENDIX D
Site Safety Plan

APPENDIX D

SITE SAFETY PLAN

FOR THE

EL PASO NATURAL GAS COMPANY

BLANCO PLANT FACILITY

SAN JUAN COUNTY, NEW MEXICO

SEPTEMBER 1988

APPROVALS:

Henry Van
El Paso Natural Gas
Project Coordinator

Date

Monica Jorque
Bechtel Environmental, Inc.
Project Manager

Aug. 3/1988
Date

Karl A Lust CIH for
Ross Fisher CIH
Bechtel Environmental, Inc.
Site Health and Safety Supervisor

Aug 2, 1988
Date

Eric Berglund
Bechtel Environmental, Inc.
Site Health and Safety Officer

Aug 3, 1988
Date

TABLE OF CONTENTS

TABLE OF CONTENTS

Section

ILLUSTRATIONS

APPENDICES

Section 1.0

INTRODUCTION

This Health and Safety Plan has been prepared by Bechtel Environmental, Inc. (BEI) to help provide a safe and healthful work environment during site investigation work to be performed at El Paso Natural Gas Company, Blanco Plant Facility in Bloomfield, San Juan County, New Mexico. The purpose of the site investigation is to assess the nature and extent, if any, of contamination which may have been the result of previous cooling tower discharges to evaporation ponds at the facility.

The format and content of this plan have been established based on 29 CFR 1910.120 Hazardous Waste Safety Regulations (December 19, 1986) and on the Generic Site Safety Plan set forth in "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," NIOSH/OSHA/USCG/EPA/85-115, October 1985.

This plan has been prepared in accordance with the requirements set forth in the "Guidance on Remedial Investigations under CERCLA", EPA/540/G-85/002, June 1985, and "Guidance on Feasibility Studies Under CERCLA", EPA/540/G-85/003, June 1985. This plan also meets the requirements outlined in Federal OSHA regulations.

Although this plan is designed to be specific with regard to the planned work activities and potential encounters with contaminants, the nature of this type of field work requires a certain amount of flexibility to be incorporated. Unforeseen situations may arise or conditions may change during the course of the work that requires deviation from the plan. Thus, provisions have been made to allow changes by authorized field personnel when warranted and when approved by cognizant BEI supervisors.

Any changes will be attached in writing to the current site safety plan and appropriate entities notified by the site health and safety officer.

It is the policy of BEI to provide all employees and subcontractors with information and procedures for the safe and healthful conduct of projects. Bechtel employees working on this project must follow the procedures set forth in this plan, as well as all relevant Bechtel Health and Safety procedures. Subcontractors must develop their own health and safety procedures which may be modeled on Bechtel procedures and be at least as stringent. Subcontractor procedures must be reviewed by the BEI Health and Safety manager or his designee prior to the initiation of field work.

Each employee is encouraged to bring to the attention of his supervisor any unsafe or hazardous condition that he observes as he carries out his project responsibilities.

Section 2.0

EMERGENCY TELEPHONE NUMBERS

Site Location: East on US 64, 1 mile from junction of US 64 and NM 44, then 0.6 mile on dry road
Bloomfield, New Mexico

Local Emergency Services

Bloomfield Medical Clinic	(505) 632-8094
Farmington Hospital (San Juan Regional)	(505) 325-5011
Farmington Ambulance	(505) 325-6351
San Juan River Fire Dept.	(505) 632-8444
Police (City of Aztec)	(505) 632-8096
Environmental Health Information Desk	(505) 325-4446

Toxic Hazard Information

National Response Center	(800) 424-8802 (24 hour)
TOXLINE	(301) 496-1131
CHEMTREC (24 hour)	(800) 424-9300
RCRA Hotline	(800) 424-9346
TSCA Hotline	(202) 554-1404
EPA Pesticide Program	(206) 442-1090
EPA Environmental Emergencies	(206) 442-1263 (24 hour)

EPNG Contact

Henry Van	(915) 541-2832

Bechtel Contacts

Monica Jorque Project Manager	(713) 235-5452
Site Health and Safety Officer Eric Berglund	(713) 235-2407

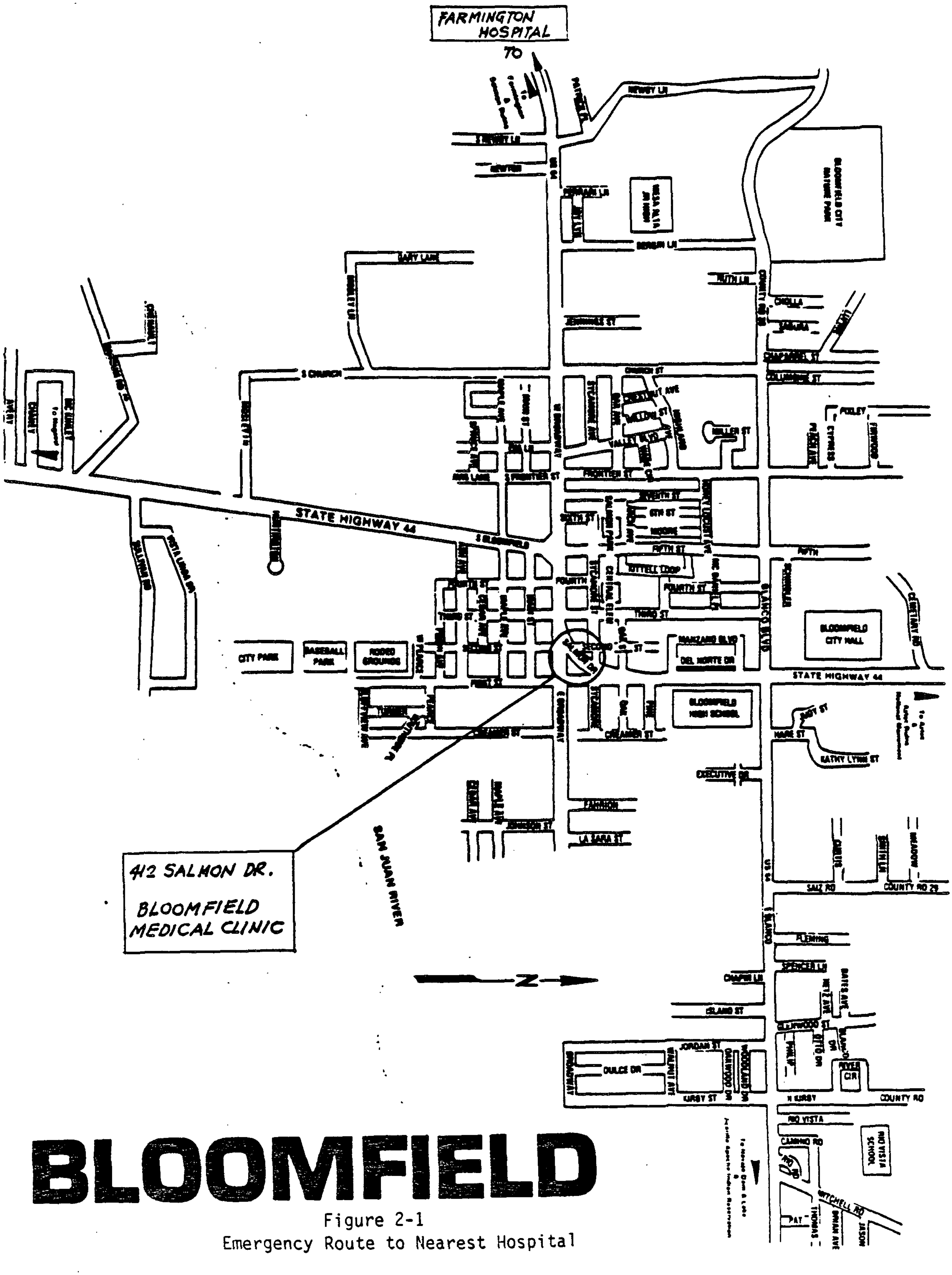


Figure 2-1
Emergency Route to Nearest Hospital

EMERGENCY TELEPHONE NUMBERS (cont'd)

Site Location: East on US 64, 1 mile from junction of US 64 and NM 44,
then 0.6 mile on dry road
Bloomfield, New Mexico

Bechtel Contacts (cont'd)

Ross Fisher CIH	W (415) 768-0444
BEI Health and Safety Supervisor	H (415) 685-6036

STANDARD PROCEDURES FOR REPORTING EMERGENCIES

When reporting an emergency situation, the following information shall be provided:

1. Name of person making call.
2. Telephone number and location of person making call.
3. Name of person(s) exposed or injured.
4. Nature of emergency.
5. Actions taken.
6. Name and location of site contact for emergency if other than caller.

Section 3.0

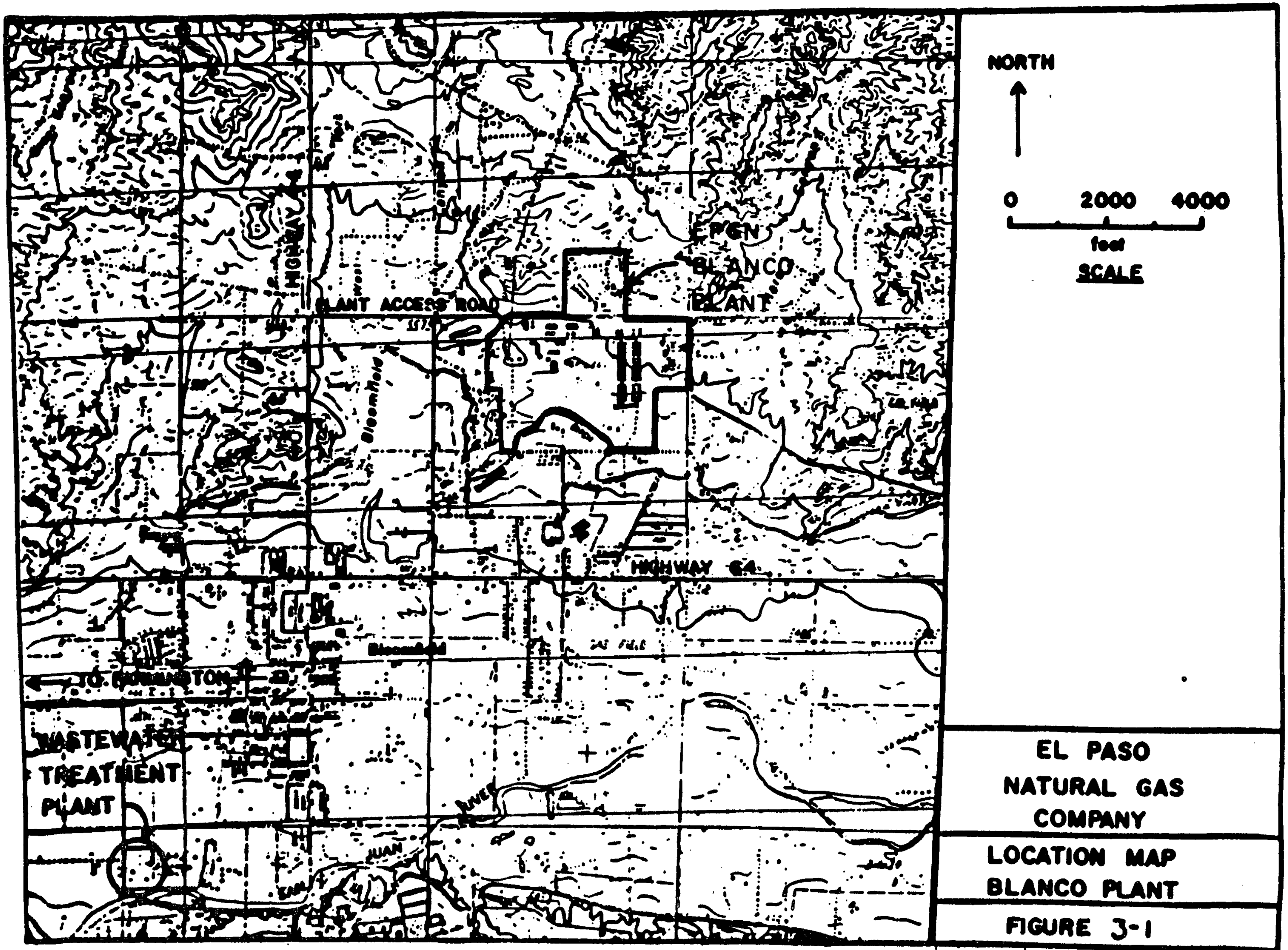
PROJECT DESCRIPTION

3.1 SITE CHARACTERISTICS

EPNG Blanco Plant Facility is located at Bloomfield, New Mexico. (Figure 3-1).

The facility is a natural gas compression facility with a capacity of 650 MMSCFD. In addition to the compressors, the facility also fractionates used oils on an occasional basis for reuse at the facility. For emergency depressurization, the plant operates a flare pit, located at the northeast side of the plant adjacent to the wastewater surge basin. Effluent from the surge basin goes to the city of Bloomfield treatment plant. The flare pit at the northside of the facility incinerates vent gases from the pigging operation.

FIGURE 3-1 SITE LOCATION



3.2 PLANNED OPERATIONS

The objectives of the site investigation are to:

- Define the nature and extent, if possible, of ground-water contamination.
- Assess the contamination at the facility, if any, due to previous discharges to site evaporation ponds.

The details of the proposed sampling and analysis program are in Appendix B and are summarized below.

- Seven monitoring wells will be installed to determine the presence or absence of chromium and/or organics in the ground water.
- Ground water and soil/sediment samples will be collected and analyzed for volatiles (EPA methods 601 and 602), heavy metals, total petroleum hydrocarbons, total chromium, hexavalent chromium and general ground water parameters, including TDS, pH, cations and anions.

Section 4.0

ON-SITE ORGANIZATION AND COORDINATION

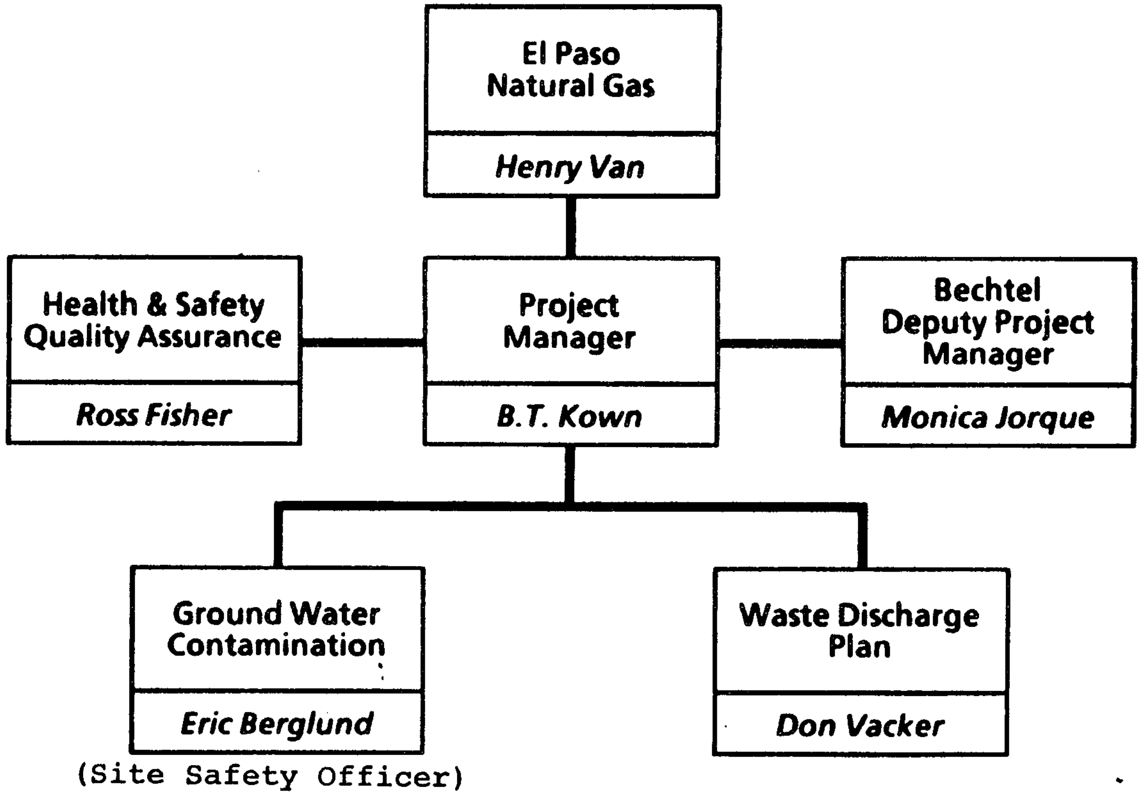
The project organization is as shown in Figure 4-1. Emergency contacts are given in Section 2.0. The organization has been designed so that the Site Health and Safety Officer (SHSO) is responsible to the Project Manager but also reports directly to the BEI Health and Safety Manager. This organizational structure ensures that the SHSO is able to interact with the BEI Health and Safety Manager independently of the Project Manager if health and safety problems arise.

The SHSO is specifically given the authority for the following actions:

- Require specific health and safety precautions prior to site entry by Bechtel or subcontractor personnel.
- Monitor subcontractor health and safety program/plan compliance.
- Require any Bechtel or subcontractor employee to obtain immediate medical attention in the case of a work-related injury or illness.
- Deny access to the site or any portion of the site.
- Order the immediate evacuation of Bechtel and/or subcontractor employees from any area of the site.
- Permit visitors on the site only at the direction of, and with the permission of, EPNG personnel.
- Coordinate on-site health and safety training.
- Ensure that environmental and personnel monitoring operations are on-going and in accordance with technical specifications, procedures and project instructions.
- Report all work-related illnesses and injuries, as well as all incidents which result in excessive exposures to personnel, to the Project Manager and BEI Health and Safety Manager.
- Halt work operations when any "imminent danger" is determined.

Figure 4-1

BLANCO PLANT DISCHARGE PLAN PROJECT ORGANIZATION



Section 5.0

HAZARD EVALUATION

5.1 CHEMICAL HAZARDS

Chromium and/or organics are suspected contaminants from previous plant operation discharges.

Potential routes of personal exposure are by inhalation or direct contact with soil/dust/and/or vapors during drilling and sampling activities. Generation of airborne dust particles will be prevented by routinely spraying water on dry soils being disturbed, if necessary. Workers will be required to wear respirators during drilling activities, unless the SHSO determines by monitoring that airborne concentrations are within acceptable limits.

The potential for dermal hazards from the direct contact of chemical substances that are damaging to the skin is not anticipated. Direct skin contact will be prevented by the use of protective clothing. Ingestion-type exposure is not likely to occur if proper personal hygiene measures are followed.

Toxicology and hazard information for chromium and certain organic compounds can be found in Appendix A. The permissable exposure limit (PEL), an allowable airborne employee exposure limit for chromium other than hexavalent is 0.5 mg/m^3 and for hexavalent chromium is 0.05 mg/m^3.

5.2 PHYSICAL HAZARDS

Safety hazards will be typical of those associated with construction activities and heavy equipment (drill rig, backhoe). The hazards include excessive noise and underground or overhead utilities (electrical and gas). As a standard practice all employees and visitors must wear a hard hat, in addition to suitable clothing and sturdy work shoes. Should noise from the equipment become too excessive, hearing protection will be provided. Contact with underground utilities at the excavation area is not anticipated. However, all above ground wiring will be located prior to raising any boom or initiating any drilling activities. Use of pressurized hoses or scaffolding are not anticipated during this investigation. Additionally, heat stress may be a hazard during hot weather because the workers will be in protective clothing. Workers will be required to take breaks as needed to prevent heat stress and to consume adequate quantities of liquid. EPNG requires an excavation permit prior to site work. Hearing protection shall be worn by personnel around drilling operations and when in the vicinity of other heavy equipment or machinery or as designated elsewhere by EPNG.

Section 6.0

ON-SITE CONTROL

The SHSO has been designated to coordinate access control and security on the site. Restricted work areas will be established by one or more of the following: signs, traffic cones, safety tape or equivalent. No unauthorized persons will be allowed within exclusion zone and contamination reduction zone.

All personnel and visitors will be required to check in and out with the SHSO upon entering and exiting the site. A site control log shall be maintained. All personnel entering an exclusion zone or contamination reduction area shall sign in and out upon entry to or egress from that area.

The area centering around the drilling or sampling operation, the exclusion zone (EZ), shall provide enough space for all equipment and personnel movements.

A surrounding contamination reduction zone (CRZ) shall also be physically defined, buffering the EZ from the clean or support area. A portion of the CRZ shall be constucted to meet the special decontamination needs of each aspect of the project and be the sole access point to the EZ. Decontamination provisions for drilling equipment, sampling equipment and personnel leaving the EZ will be available in the contamination reduction corridor (CRC).

Section 7

PERSONAL PROTECTIVE EQUIPMENT

Based on an evaluation of potential hazards, the following level of personal protective equipment have been designated for all work areas and tasks:

Level D

- coveralls
- safety boots
- hard hat
- gloves
- hearing protection (around drilling operations)

Location	Job Function	Level of Protection
All work areas	SHSO	D
	Drilling Crew	D
	Samplers	D
All work areas	Supervisors	D
	Visitors	D

If air sampling results suggest exposures which may approach or exceed any "allowable limits," Level C protection will be required. *

Level C

- Fullface or half-mask, Air-Purifying Cartridge type Respirator equipped with combination type Cartridge for protection against dusts, (HEPA filter) organic vapors, pesticides, dusts, fumes and mists.

- Tyvek/Saranex type suits
- Chemical-resistant gloves (inner and/or outer as appropriate)
- Hard hat
- Chemical-resistant safety boots

---

* SHSO may request Level C protection.

Section 8

COMMUNICATION PROCEDURES

A horn blast, car or other vehicle horn, will be the emergency signal to indicate that all personnel should leave the restricted area. The nearest telephone will be identified and pointed out to all field personnel in the event that emergency telephone calls must be made.

Section 9

DECONTAMINATION PROCEDURES

The SHSO will establish a decontamination station adjacent to the work area. The SHSO shall ensure that all workers use appropriate decontamination procedures and that decontamination equipment (detergent and rinse solutions, wash tubs, brushes and plastic bags) is available at the station. All personnel will be required to decontaminate or dispose of their protective equipment prior to leaving the site.

After protective equipment is cleaned and removed, individuals shall thoroughly wash their hands and all exposed skin surfaces before taking a break to eat, drink, chew or smoke.

Personnel will decontaminate in the following manner:

1) Remove hard hat, wash, rinse, stack to dry.
2) Remove and scrub boots.
3) Remove and discard Tyvek suit.
4) Remove respirator, wash, rinse, hang to dry (if worn).
5) Remove and discard (or clean for reuse) gloves.
6) Wash hands, face, and neck.
7) Proceed into clean area.

Disposable clothing will be disposed of as directed by the SHSO. Boots will be decontaminated each day and left on-site until conclusion of project field work.

Section 10

EMERGENCY PROCEDURES

Prior to site entrance, the SHSO shall plan escape routes and discuss them with all personnel who will be conducting work at the EPNG Blanco Plant facility. Initial planning includes establishing the best means for evacuation from the site in case of a catastrophe (e.g. explosion, fire, etc.). The nearest telephone will be identified for emergency situations. See Figure 2-1 for directions to the nearest hospital.

If an emergency involving actual or suspected personal injury occurs, the SHSO shall follow these steps:

- Remove the exposed or injured person(s) from immediate danger.
- Render First Aid if necessary. Decontaminate affected personnel after critical first aid is given.
- Obtain paramedic services or ambulance transport to local hospital. This procedure shall be followed even if there is no visible injury.
- Other personnel on site shall be evacuated to a safe distance until the SHSO determines that it is safe for work to resume. If there is any doubt regarding the condition of the area, work shall not commence until all safety issues are resolved.
- At the earliest time practicable, the SHSO shall contact the BEI Health and Safety Manager and the Project Manager, or their designees, giving details of the incident, and the steps taken to prevent its recurrence.
- A written report of the incident shall be forwarded to the BEI Health and Safety Manager and the Project Manager, or their designees, within twenty-four (24) hours following the incident.

The SHSO shall identify those individuals who have previously completed training programs in First Aid and CPR. These individuals should be appointed as alternates for the SHSO if he is incapacitated or needs assistance. Specific responsibilities for these individuals shall be delineated by the SHSO.

The SHSO shall have safety items immediately available on site. These items include:

- First Aid Kit - includes supplies for initial treatment of cuts and abrasions, severe lacerations, shock, heat stress, eye injuries, skin irritations, thermal and chemical burns, snake and insect bites and for immobilization of fractures, emetics.
- Portable emergency eyewashes
- Clean water supply
- Soap or waterless hand cleanser and towels

Section 11

AIR MONITORING

Personnel may be required to wear personal air monitoring equipment to identify possible contaminant exposure. Associated collection tubes and filters from personal monitoring will be sent to an AIHA accredited or NIOSH PAT (Proficiency in Analytical Testing) participant laboratory for analyses. Air monitoring will be done by or under the supervision of an industrial hygienist.

Section 12

TRAINING PROGRAM

Before beginning field operations, each BEI and subcontractor employee assigned to the program will be required to attend a site specific health and safety orientation presented by the SHSO. Visitors will be given abbreviated instructions by the SHSO on the health and safety precautions that are appropriate for the nature of their visit.

The purposes of this training program are to:

- Highlight key health and safety laws, regulations and guidelines;
- Enhance the ability of personnel to react responsibly, safely and quickly to emergency situations; and
- Increase the ability of employees to safely complete their work in an efficient and timely manner.

The SHSO will use the following topical outline to conduct the pre-work training session.

Project Scope of Work

- Work area orientation
- Work activities
- Key personnel and visitors
- Regulatory agencies

Health and Safety Program

- Bechtel policy
- Site Health and Safety Plan

Role of Site Health and Safety Officer

- Duties and authority
- Compliance with SHSO directives

Hazardous Substance Information

- Contaminants known or suspected (by area)
- Routes of exposure based on work activities
- Effects of exposure
    - Physiological warning signs
    - Acute vs. chronic-latent effects
    - Carcinogenic hazard
- Exposure variables
    - Exposure time
    - Distance from source
    - Wind dispersion

Hazard Control Program

- Medical surveillance
- Restricted access areas
- Personal protective equipment
- Personal monitoring
- Rules and procedures
- Personal hygiene

Type/Use of Protective Equipment

- Personal protective clothing
    - Gloves, coveralls, boots, etc.
    - Limitations of use
    - Areas of use
- Respiratory protective equipment
    - Fit testing
- \- Hearing Protection
- Decontamination of clothing and equipment
- Disposal of contaminated clothing and equipment

First Aid and Safety Equipment

- Identification of personnel trained in first aid/CPR
- First aid equipment
- Fire extinguishers
- Eye wash stations and emergency showers

Drilling-Related Safety

- Noise
- Hazards of rotating equipment and cables
- Equipment inspections
- Back and crush-type injuries
- Crushing type injuries
- Footing, slip/trip/fall, uneven terrain

Emergency Contacts and Response Procedures

- Telephone contacts for assistance
- Reporting responsibilities
- Evacuation procedures
- Accident/injury response
- Give directions to hospital

The training session will be documented by obtaining the signature of each participant on a roster (next page). No person will be allowed to work in the restricted area without completing the training program and signing the roster. Additional training will be provided as necessary or as unanticipated hazards are encountered. As stated earlier, visitors will receive abbreviated instructions.

Health & Safety Training/Toolbox Meeting

Roster

Section 13

MEDICAL MONITORING

BEI field employees participate in a medical surveillance program and receive a medical evaluation and clearance from the BEI consulting physician.

The associated baseline health assessment consists, at a minimum, of the following core elements:

- Review of personal and family medical history
- Review of work history and occupational medical history
- Screening physical examination
- Basic blood chemistry analysis, including complete blood count
  and standard blood panel (e.g. SMAC-20)
- Standard urinalysis
- Pulmonary function test
- Audiometry

Subcontractor employees shall also participate in a medical surveillance program.

APPENDIX A

TOXICOLOGICAL DATA

CHROMIUM

CAS: 7440-47-3

Cr

Metal and Inorganic Compounds, as Cr

TLV-TWA, 0.5 mg/m³ — Metal
0.5 mg/m³ — Cr II Compounds
0.5 mg/m³ — Cr III Compounds
0.05 mg/m³ — Water Soluble Cr VI Compounds
0.05 mg/m³, — Certain Water Insoluble Cr VI Compounds
Appendix A1a — Recognized Human Carcinogen
0.05 mg/m³ — Chromite Ore Processing (chromate), as Cr
Appendix A1a, — Recognized Human Carcinogen

Chromium is a metallic element, Atomic number 24, in Group VIB of the periodic table. It is a steel-gray, lustrous metal. Its physiochemical properties include:

Atomic weight: 51.996
Specific gravity: 7.20
Melting point: 1900°C
Boiling point: 2642°C

The metal reacts with dilute hydrochloric acid and sulfuric acid, but not with nitric acid

Chromium metal was first isolated in 1798. The chief uses of chromium and chromium compounds are in stainless and alloy steels, refractory products, tanning agents for leather, pigments, electroplating, catalyst, and in corrosion resistant products. Chromium is obtained from chromite ores ($FeO \bullet Cr_2O_3$). Relatively large deposits of chromite ore were found near Baltimore in the United States but no mining has taken place there since 1961.

Chromium can have a valence of 2, 3 or 6, and a wide range of chromium alloys and inorganic chromium compounds are encountered in the workplace. These chromium compounds vary greatly in their toxic and carcinogenic effects. For this reason it is necessary to divide chromium and its inorganic compounds into a number of groupings — each with its specific TLV based on available toxicological and epidemiological evidence. These groupings are:

1. Chromium metals and alloys: This grouping includes chromium metal, stainless steels and other chromium-containing alloys.
2. Divalent chromium compounds (Cr^{2+}) (Chromous compounds): This grouping includes chromous chloride ($CrCl_2$) and chromous sulfate ($CrSO_4$).
3. Trivalent chromium compounds (Cr^{3+}) (Chromic compounds): This grouping includes chromic oxide (Cr_2O_3), chromic sulfate ($Cr_2[SO_4]_3$), chromic chloride ($CrCl_3$), chromic potassium sulfate ($KCr[SO_4]_2$), and chromite ore ($FeO \bullet Cr_2O_3$).
4. Hexavalent chromium compounds (Cr^{6+}): This grouping includes chromium trioxide (CrO_3) — the anhydride of chromic acid chromates (e.g., Na_2CrO_4), dichromates (e.g., $Na_2Cr_2O_7$), and polychromates.

   Certain hexavalent chromium compounds have been demonstrated to be carcinogenic on the basis of epidemiological investigations on workers and experimental studies in animals. In general, these compounds tend to be of low solubility in water and thus may be subdivided into two subgroups.

   a. Water soluble hexavalent chromium compounds: These include chromic acid and its anhydride, and the monochromates and dichromates of sodium, potassium, ammonium, lithium, cesium and rubidium.
   b. Water insoluble hexavalent chromium compounds: These include zinc chromate, calcium chromate, lead chromate, barium chromate, strontium chromate, and sintered chromium trioxide.

Chromium Metal and Divalent and Trivalent compounds

Early studies indicated that trivalent chromium and divalent chromium compounds have a low order of toxicity.(1) Dermatitis has been reported in workers handling trivalent chromium compounds.(2,3)

Chest X-rays carried out in workers exposed to chromite dust have been reported to show "exaggerated pulmonary markings"(4) and Princi *et al*(5) have reported pulmonary disease in workers exposed to *ferrochrome* alloys with *chromium* levels *in air of 0.27 mg/m*³ reported. Other dusts and fumes were present, however, in this plant. Exposure to chromium metal does not give rise to pulmonary fibrosis or pneumoconiosis.

TLV-TWA Recommendations

Because of the low toxicity of the metal and its divalent and trivalent compounds, a TLV of 0.5 mg/m³ as Cr is recommended. This TLV should be adequate to prevent pulmonary disease or other toxic effect.

Hexavalent Chromium

The first cases of occupational health effects from hexavalent chromium were reported in 1827 by Cumin,(6) who observed cases of skin ulceration and dermatitis in dye workers handling potassium dichromate. Mackenzie(7) reported in 1884 that perforation of the nasal septum occurred in workers exposed to potassium bichromate. In 1916 DaCosta *et al*(8) described chrome ulcers in tanners and dryers. Parkhurst(9) in 1925 reported chrome dermatitis in blueprint workers *exposed to potassium dichromate.* Bloomfield and Blum(10) reported on their study of electroplaters exposed to acidic mist of hexavalent chromium compounds. They noted that 20 or 23 workers examined showed evidence of perforated or ulcerated nasal septa and skin ulcers (chrome holes). The Factory Inspectorate in Great Britain(11) reported in 1930 on the results of medical examinations of 223 persons engaged in chromium plating; 42.6% had dermatitis or skin ulcers and 52% had perforated or ulcerated nasal septa.

The occupational health literature affords abundant evidence that hexavalent chromium compounds may cause irritant and allergic contact dermatitis, skin ulcers, and nasal irritation varying from rhinitis to perforation of the nasal septum. Dermatitis from exposure to soluble hexavalent chromium has been reported in lithographers(12,13) diesel repair shop workers,(14) and leather workers.(15) Soluble chromates in cement have been stated to be the cause of cement dermatitis in some workers.(16)

*Attempts have been made to correlate the airborne levels of hex*avalent chromium with irritation of the nasal mucosa. In the study by Bloomfield and Blum,(10) electroplaters were exposed to estimated exposures ranging from 0.06 to 2.8 mg/m³ (as Cr^{6+}). Levels of Cr^{6+} in the form of chromium trioxide, were capable of giving rise to nasal irritation at concentrations as low as 0.06 mg/m³. It is difficult to rule out the importance of personal hygiene in the production of nasal symptoms from direct transfer of chromium (Cr^{6+}) to the nasal mucosa. Nasal irritation is produced from exposure to soluble chromate and bichromate salts as well as to chromic acid mist.(16,17) The study by the U.S. Public Health Service(18) noted that the mean concentration of water-soluble chromium in plants where nasal irritation was encountered was 0.068 mg/m³ as Cr^{6+}.

Epidemiological studies showing an increased incidence of lung cancer among workers involved in the manufacture of chrome pigments have been reported from Germany,(19) Norway(20) and United States.(21) Machle and Gregorius(17) first reported increased incidence of lung cancer in the United States chromate industry. Baetjer(22) carried out a case control study and confirmed the increased risk of lung cancer among the U.S. chromate workers. Mancuso and Hueper(23) attempted to estimate the airborne exposures to chromium in those who developed lung cancer. They found that these workers were exposed to 0.01 to 0.15 mg/m³ of water soluble chromium and 0.1 to 0.58 mg/m³ of water insoluble chromium. The insoluble fraction was denoted as Cr^{3+} and the soluble as Cr^{6+}, but it is impossible to assign Cr^{6+} or Cr^{3+} exclusively to either fraction.

The chromate workers in the preceding studies were exposed to various Cr^{3+} and Cr^{6+} compounds as well as to other substances. In general, the evidence does not suggest that chromite ore, a water insoluble Cr^{3+} substance, is a carcinogen. While the evidence is incomplete, it does appear that certain Cr^{6+} compounds, mainly water insoluble, were involved in increased risk of lung cancer. The experimental data from animals supports the view that water insoluble Cr^{6+} compounds, e.g., chromic and zinc chromates, are carcinogenic, whereas the soluble forms are not.(24) Royle,(25) however, has reported an increase in lung and other cancers in chrome platers in England.

Hexavalent chromium compounds have been said to also cause kidney damage in workers(26,27) where absorption through damaged skin has occurred.

TLV-TWA Recommendations

Water soluble hexavalent chromium compounds

A TLV of 0.05 mg/m³ as water soluble Cr^{6+} is considered adequate to protect against irritation of the respiratory tract and possible kidney and liver damage. NIOSH in the criteria document on chromic acid(28) recommended that occupational exposures be controlled to prevent exposures above 0.05 mg/m³ TWA. In a later criteria document on hexavalent chromium(29) NIOSH recommended a permissible exposure limit of 0.025 mg/m³.

Certain water insoluble hexavalent chromium compounds

A TLV of 0.05 mg/m³ as water insoluble Cr^{6+} and insertion in appendix A1a is recommended. There is, unfortunately, little previous environmental data from these exposures associated with increased respiratory cancer risk. With the data available, however, this TLV provides an adequate margin of safety. NIOSH recommended a permissible exposure limit of 0.001 mg/m³ for certain insoluble hexavalent chromium compounds.(29)

Mixed exposure to soluble and insoluble hexavalent chromium compounds

A TLV of 0.05 mg/m³, as Cr^{6+} is recommended.

Chromite Ore Processing and Chromate Pigment Manufacture

It may be advisable to list these process TLVs both as 0.05 mg/m³, as Cr, and include them in appendix A1a. This TLV will serve to draw attention to those processes where increased risk of cancer has been associated with chromium compounds.

Other recommendations

Chromic acid and chromates, as Cr, Sweden (1978) 0.02 mg/m³; Czechoslovakia (1969) 0.05 mg/m³; USSR (1976) 0.005 mg/m³. Lower valence chromium, Sweden 0.5 mg/m³ for metal and compounds, as Cr; USSR, chromic oxide 1 mg/m³, chrome alum 0.02 mg/m³ and chromium trichloride 0.01 mg/m³, all as Cr.

References

1. Akatsuka, K. and L.T. Fairhall: *J. Ind. Hyg.* 16:1 (1934).
2. Morris, G.E.: *Arch. Derm.* 78:612 (1958).
3. Fregert, S. and H. Rorsman: *Arch. Derm.* 90:4 (1964), abstracted in *J. Occ. Med.* 7:49 (1965).
4. Government of India: *Report No. 1*, p. 24. Ministry of Labour (1953).
5. Princi, F., L.H. Miller, A. Davis and J. Cholak: *J. Occup. Med.* 4:301 (1962).
6. Cumin, W.: *Edinburg Med. Sug. J.* 28:295-312 (1827).
7. Mackenzie, J.N.: *JAMA* 3:601-603 (1884).
8. DaCosta, J.C., J.P.X. Jones and R.C. Rosenberger: *Ann. Surg.* 63:155-166 (1916).
9. Parkhurst, H.J.: *Arch. Dermatol. Syphilol.* 12:253-256 (1925).
10. Bloomfield, J.J. and W. Blum: *Pub. Health Repts.* 43:2330-2347 (1928).
11. Medical Inspectorate of Factories: *J. Ind. Hyg.* 12:314-315 (1930).
12. McCord, C.P., H.C. Higginbottom and J.C. McGuire: *JAMA* 94:1043-1044 (1930).
13. Levin, H.M., M.J. Brunner and H. Rattner: *JAMA* 169:566-569 (1959).
14. Winston, J.R. and E.M. Walsh: *JAMA* 147:1133-1134 (1951).
15. Morris, G.E.: *Arch. Ind. Health* 11:368-371(1955).
16. Englebrigtsen, J.K.: *Acta. Derm. Venereol* 32:462-468 (1952).
17. Machle, W. and F. Gregorius: *Pub. Health Repts.* 63:1114-1127 (1948).
18. Federal Security Agency: *Health of Workers in Chromate Producing Industry — A Study*. U.S. Pub. Health Serv., Div. of Occupational Health (1953).
19. Gross, E. and F. Koelsch: *Arch. Gewerbepath. Gewerbehyg.* 12:164-170, Germany (1943).
20. Langard, S. and T. Norseth: *Brit. J. Ind. Med.* 32:62-65 (1975).
21. Equitable Environmental Health, Inc.: *An Epidemiological Study of Workers in Lead Chromate Plants*. Final report to The Dry Color Manufacturers Assoc., Arlington, VA (June 25, 1976).
22. Baetjer, A.M.: *Arch. Ind. Hyg. Occup. Med.* 2:505-516 (1950).
23. Mancuso, R.F. and W.C. Hueper: *Ind. Med. Sug.* 20:358-363 (1951).
24. Laskin, S., M. Kuschner and R.T. Drew: *Studies in Pulmonary Carcinogenesis, Inhalation Carcinogenesis*, pp. 321-351. M.G. Hanna, P. Nettesheim and J.R. Gilbert, Eds. U.S. Atomic Energy Commission, Oak Ridge, TN (1969).
25. Royle, H.: *Env. Res.* 10:39-53 (1975).
26. Major, R.H.: *Johns Hopkins Hosp. Bull.* 33:56-61 (1922).
27. Hunter, W.C. and J.M. Roberts: *Am. J. Pathol.* 9:133-147 (1933).
28. NIOSH: *Criteria for a Recommended Standard — Occupational Exposure to Chromic Acid* (1973).
29. NIOSH: *Criteria for a Recommended Standard — Occupational Exposure to Chromium (VI)* (1975).

BENZENE. Syns: *benzol, phenyl hydride, coal naphtha*. Clear colorless liquid. C_6H_6, mw: 78.11, mp: 5.51°, bp: 80.093°–80.094°, flash p: 12°F (CC), d: 0.8794 @ 20°, autoign. temp.: 1044°F, lel: 1.3%, uel: 7.1%, vap. press: 100 mm @ 26.1°, vap. d: 2.77, ulc: 95–100.

THR = Poisoning occurs most commonly through inhal of the vapor, though benzene can penetrate the skin, and poison in that way. Locally, benzene has a comparatively strong irr effect, producing erythema and burning, and, in more severe cases, edema and even blistering. Exposure to high conc of the vapor (3000 ppm or higher) may result from failure of equipment or spillage. Such exposure, while rare in industry, may result in acute poisoning, characterized by the narcotic action of benzene on the CNS. The anesthetic action of benzene is similar to that of other anesthetic gases, consisting of a preliminary stage of excitation followed by depression and, if exposure is continued, death through respiratory failure. The chronic, rather than the acute form, of benzene poisoning is important in industry. It is a recog leukemogen. [*14, 3, 1, 102*] There is no specific blood picture occurring in cases of chronic benzol poisoning. The bone marrow may be hypoplastic, normal, or hyperplastic, the changes reflected in the peripheral blood. Anemia, leucopenia, macrocytosis, reticulocytosis, thromocytopenia, high color index, and prolonged bleeding time may be present. Cases of myeloid leukemia have been reported. For the supervision of the worker, repeated blood examinations are necessary, including hemoglobin determinations, white and red cell counts and differential smears. Where a worker shows a progressive drop in either red or white cells, or where the white count remains below 5,000 per cu mm or the red count below 4.0 million per cu mm, on two successive monthly examinations, he should be immediately removed from exposure. Following absorption of benzene, elimination is chiefly through the lungs, when fresh air is breathed. The portion that is absorbed is oxidized, and the oxidation products are combined with sulfuric and glycuronic acids and eliminated in the urine. This may be used as a diagnostic sign. Benzene has a definite cumulative action, and exposure to relatively high conc is not serious from the point of view of causing damage to the blood-forming system, provided the exposure is not repeated. On the other hand, daily exposure to conc of 100 ppm or less will usually cause damage if continued over a protracted period of time. In acute poisoning, the worker becomes confused and dizzy, complains of tightening of the leg muscles and of pressure over the forehead, then passes into a stage of excitement. If allowed to remain in exposure, he quickly becomes stupefied and lapses into coma. In non-fatal cases, recovery is usually complete and no permanent disability occurs. In chronic poisoning the onset is slow, with the symptoms vague; fatigue, headache, dizziness, nausea and loss of appetite, loss of weight and weakness are common complaints in early cases. Later, pallor, nosebleeds, bleeding gums, menorrhagia, petechiae and purpura may develop. There is gr individual variation in the signs and symptoms chronic benzene poisoning. Benzene is a comm air contaminant.

Fire Hazard: Dangerous, when exposed to heat flame; can react vigorously with oxidizing ma rials, such as BrF_5, Cl_2, CrO_3, O_2NClO_4, O_2, perchlorates, ($AlCl_3$ + $FClO_4$), (H_2SO_4 + permanganates), K_2O_2, ($AgClO_4$ + acetic acid), Na [*19*]

Spont Heating: No.

Explosion Hazard: Mod. when its vapors are expo to flame. Use with adequate ventilation.

Disaster Hazard: Dangerous, highly flam.

To Fight Fire: Foam, CO_2, dry chemical.

TOLUENE. Syns: *methylbenzene, phenylmethane, toluol.* Colorless liquid, benzol-like odor. $C_6H_5CH_3$, mw: 92.13, mp: −95° to −94.5°, bp: 110.4°, flash p: 40°F (CC), ulc: 75–80, lel = 1.27%, uel = 7%, d: 0.866 @ 20°/4°, autoign. temp.: 896°F, vap. press: 36.7 mm @ 30°, vap. d: 3.14.

Acute tox data: Inhal TC_{LO} (human) = 200 ppm ⟶ CNS effects; inhal TC_{LO} (man) = 100 ppm ⟶ psychotropic effects; oral LD_{50} (rat) = 5000 mg/kg; inhal LC_{LO} (rat) = 4000 ppm for 4 hrs; ip LD_{50} (rat) = 1640 mg/kg; inhal LC_{50} (mice) = 5300 ppm; dermal LD_{50} (rabbit) = 14000 mg/kg. [*3*]

THR = MOD via oral, inhal and ip routes; LOW via dermal route. Toluene is derived from coal tar, and commercial grades usually contain small amounts of benzene as an impurity. Acute poisoning, resulting from exposures to high conc of the vapors, are rare with toluene. Inhal of 200 ppm of toluene for 8 hrs may cause impairment of coordination and reaction time; with higher conc (up to 800 ppm) these effects are increased and are observed in a shorter time. In the few cases of acute toluene poisoning reported, the effect has been that of a narcotic, the workman passing through a stage of intoxication into one of coma. Recovery following removal from exposure has been the rule. An occasional report of chronic poisoning describes an anemia and leucopenia, with biopsy showing a bone marrow hypoplasia. These effects, however, are less common in people working with toluene, and they are not as severe.

Exposure to conc up to 200 ppm produces few symptoms. At 200–500 ppm, headache, nausea, loss of appetite, a bad taste, lassitude, impairment of coordination and reaction time are reported, but are not usually accompanied by any laboratory or physical findings of significance. With higher conc, the above complaints are increased and in addition, anemia, leucopenia and enlarged liver may be found in rare cases.

A common air contaminant.

Fire Hazard: Slight, when exposed to heat, flame or oxidizers.

Explosion Hazard: Mod, when exposed to flame or reacted with ($H_2SO_4 + HNO_3$), N_2O_4, $AgClO_4$. [*19*]

Disaster Hazard: Mod dangerous; when heated, emits toxic fumes can react vigorously with oxidizing materials.

To Fight Fire: Foam, CO_2, dry chemical.

***m*-XYLENE.** Syn: *m-xylol.* Colorless liquid. $C_6H_4(CH_3)_2$, mw: 106.2, mp: −47.9°, bp: 139°, lel = 1.1%, uel = 7.0%, flash p: 84°F, d: 0.864 @ 20°/4°, vap press: 10 mm @ 28.3°, vap. d: 3.66, autoign temp.: 986°F.

Acute tox data: Oral LD_{50} (rat) = 5000 mg/kg; inhal LC_{LO} (rat) = 8000 ppm for 4 hrs; ip LD_{LO} (rat) = 2000 mg/kg; sc LD_{LO} (rat) = 5000 mg/kg. [*3*]

THR = MOD via oral, inhal, ip and sc routes. A common air contaminant.

Fire Hazard: Dangerous, when exposed to heat or flame; can react with oxidizing materials.

Explosion Hazard: Mod, in the form of vapor when exposed to heat or flame.

Disaster Hazard: Dangerous; keep away from open flame.

To Fight Fire: Foam, CO_2, dry chemical.

***o*-XYLENE.** Syn: *o-xylol.* Colorless liquid. $C_6H_4(CH_3)_2$, mw: 106.2, bp: 144.4°, fp: −25.5°, ulc: 40-45, lel = 1.0%, uel = 6.0%, flash p: 90°F (CC), d: 0.880 @ 20°/4°, vap. press: 10 mm @ 32.1°, vap. d: 3.66, autoign. temp.: 869°F.

Acute tox data: Oral LD_{LO} (rat) = 5000 mg/kg; ip LD_{LO} (rat) = 1500 mg/kg; sc LD_{LO} (rat) = 2500 mg/kg; inhal LC_{LO} (mice) = 6920 ppm. [*3*]

THR = MOD via oral, ip, sc and inhal routes. A common air contaminant.

Fire Hazard: Dangerous, when exposed to heat or flame; can react with oxidizing materials.

Explosion Hazard: Slight, in the form of vapor, when exposed to heat or flame.

To Fight Fire: Foam, CO_2, dry chemical.

***p*-XYLENE.** Syn: *p-xylol.* Clear liquid. $C_6H_4(CH_3)_2$, mw: 106.2, bp: 138.3°, lel = 1.1%, uel = 7.0%, fp: 13.2°, flash p: 81°F (CC), d: 0.8611 @ 20° / 4°, vap. press: 10 mm @ 27.3°, vap. d: 3.66, autoign. temp.: 986°F.

Acute tox data: Oral LD_{50} (rat) = 5000 mg/kg; ip LD_{LO} (rat) = 2000 mg/kg; sc LD_{LO} (rat) = 5000 mg/kg; inhal LC_{LO} (mice) = 3460 ppm. [*3*]

THR = MOD via oral, ip, sc and inhal routes. A common air contaminant.

Fire Hazard: Dangerous, when exposed to heat or flame; can react with oxidizing materials.

Explosion Hazard: Mod, in the form of vapor, when exposed to heat or flame.

To Fight Fire: Foam, CO_2, dry chemical.

***m*-XYLENE-α,α-DIAMINE.** $C_8H_{12}N_2$, mw: 136.1.

Acute tox data: Oral LD_{50} (rat) = 930 mg/kg. [*3*]

THR = MOD via oral route.

XYLENE HEXAFLUORIDE. Syn: *bis(trifluoromethyl) benzene.* Clear, water white liquid. $C_6H_4(CF_3)_2$, mw: 214.11, mp: −40° to −50°, bp: 115°, d: 1.395 @ 20°/15.5°.

THR = See xylene and fluorides.

XYLENES(MIXED *m*- AND *p*-ISOMERS). A clear liquid. bp: 138.5°, flash p: 100°F (TOC), d: 0.864 @ 20°/4°, vap. press: 6.72 mm @ 21°.

Acute tox data: Inhal TC_{LO} (human) = 200 ppm → irr effects; oral LD_{50} (rat) = 4300 mg/kg; ip LD_{LO} (rat) = 2000 mg/kg. [*3*]

THR = MOD via inhal and oral routes. Some temporary corneal effects are noted, as well as some conjunctival irr by instillation. Very little dermal toxicity. [*69, 27, 51*]

Fire Hazard: Mod, in the presence of heat or flame; can react with oxidizing materials.

To Fight Fire: Foam, CO_2, dry chemical.

References

Proctor, N.H. Ph.D. and Hughes, J.P., M.D, Chemical Hazards of the Workplace - J.B. Lippincott Company, Philadelphia, PA, 1978.

American Conference of Governmental Industrial Hygienists Inc., Documentation of the Threshold Limit Values and Biological Exposure Indices, 5th Edition, Cincinnati, OH, 1986.

APPENDIX E
Example Work Forms

Appendix E

EXAMPLE WORK FORMS

BECHTEL

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO. OF	HOLE NO.

SITE	COORDINATES	ANGLE FROM HORIZ.	BEARING

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANC / LENGTH CORE RU	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES						

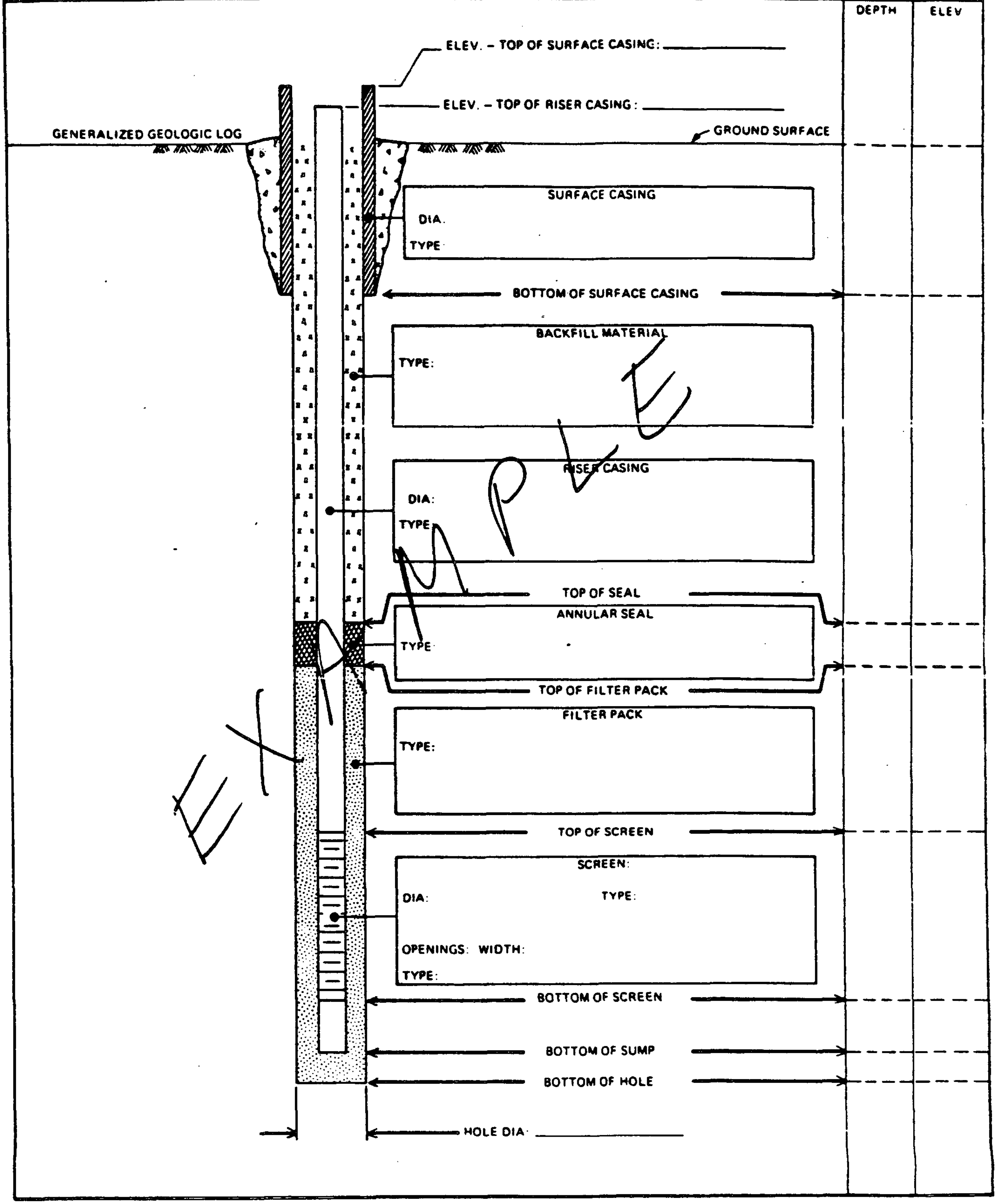
EXAMPLE

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER	SITE	HOLE NO.

H&CF 19-1

OBSERVATION WELL

PROJECT			WELL NO
JOB NO	SITE	COORDINATES	
BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS



EXAMPLE

WELL DEVELOPMENT

PROJECT
WELL NO
JOB NO
SITE
PREPARED BY

METHOD:

PUMP ________

BAILER ________

GAS ________

OTHER ________

DEVELOPMENT CRITERIA

REMARKS

HOLE DIAMETER d_h = _____

WELL CASING
INSIDE DIAMETER $d_w ID$ = _____

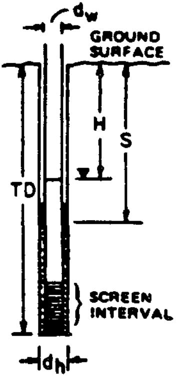
OUTSIDE DIAMETER $d_w OD$ = _____

DEPTH TO WATER LEVEL H = _____

BASE OF SEAL S = _____

BASE OF WELL TD = _____

EST. FILTER PACK POROSITY P = _____



WELL VOLUME CALCULATION

CASING VOLUME $= V_c = \pi\left(\frac{d_w ID}{2}\right)^2(TD-H) = 3.14\left(\frac{\quad}{2}\right)^2(\quad - \quad) =$ ________

FILTER PACK PORE VOLUME $= V_f = \pi\left[\left(\frac{d_h}{2}\right)^2-\left(\frac{d_w OD}{2}\right)^2\right]\left(TD-(S \text{ or } H)^*\right)(P) =$

(* if S>H use S, if S<H use H.)

$$3.14\left[\left(\frac{\quad}{2}\right)^2-\left(\frac{\quad}{2}\right)^2\right](\quad - \quad)(\quad) = \_\_\_\_\_\_$$

TOTAL WELL VOLUME $= V_t = V_f + V_c =$ ___ + ___ = _____ ft^3 x 7.48 = ________ gal.

DEVELOPMENT LOG:

DATE	TIME		METHOD	WATER REMOVED	CUMULATIVE TOTAL REMOVED		WATER CHARACTER			COMMENTS:
	BEGUN	FINISH			GAL/ LITERS	WELL VOLUMES	pH	CONDUCTIVITY	TURBIDITY	

EXAMPLE

BECHTEL

WELL SAMPLING

PROJECT

WELL NO

JOB NO

SITE

PREPARED BY

METHOD

HAND PUMP ____

SUBMERSIBLE PUMP ____

BAILER ____

OTHER ____

PURGING CRITERIA:

REMARKS:

HOLE DIAMETER d_h = ____

WELL CASING

INSIDE DIAMETER $d_w ID$ = ____

OUTSIDE DIAMETER $d_w OD$ = ____

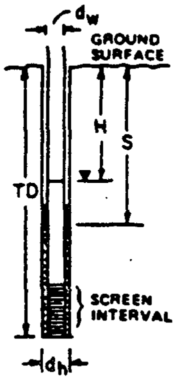
DEPTH TO

WATER LEVEL H = ____

BASE OF SEAL S = ____

BASE OF WELL TD = ____

EST. FILTER PACK POROSITY P = ____



DATE: ____

DEPTH TO WATER: ____

CALCULATED PURGE VOLUME: ____

SOURCE: ____

SUBCONTRACTOR: ____

ANALYSIS: ____

LABORATORY: ____

DATE SHIPPED: ____ VIA: ____

SPECIAL HANDLING/PRESERVATIVES: ____

PURGING LOG:

DATE	TIME		METHOD	WATER REMOVED	CUMULATIVE TOTAL REMOVED		WATER CHARACTER			COMMENTS:
	BEGUN	FINISH			GAL/ LITERS	WELL VOLUMES	pH	CONDUCTIVITY	TEMPERATURE	

CHAIN OF CUSTODY RECORD

BECHTEL PROJECT NO. ______________________ SAMPLER'S NAME ______________________

LABORATORY PROJECT NO. ______________________ SAMPLER'S SIGNATURE ______________________

SITE IDENTIFICATION ______________________ BECHTEL SUPERVISOR ______________________

DATE ______________

EXAMPLE

SAMPLE ID NUMBER	MATRIX OF SAMPLE	TIME TAKEN	PRESERVATIVES	ARCHIVE	ANALYZE		REMARKS

RELINQUISHED BY ______________ DATE/TIME ______________ RECEIV BY ______________

RELINQUISHED BY ______________ DATE/TIME ______________ RECEIV BY ______________

RELINQUISHED BY ______________ DATE/TIME ______________ RECEIV BY ______________

RECEIVED BY ______________________ FOR LABORATORY, DATE/T E ______________

AUTHORIZED FOR DISPOSAL BY ______________ TYPE OF DISPOSAL ______________

RELINQUISHED TO ______________________ FOR DISPOSAL, DATE/TIME ______________

SAMPLE LABEL

SAMPLE ID:__________

PROJECT:________________________________

DATE:_______________

INITIALS:___________

PROJECT NO.:________

SAMPLE CUSTODY SEAL

CUSTODY SEAL 2532

SIGNATURE____ DATE________________

APPENDIX E
Example Work Forms

Appendix E

EXAMPLE WORK FORMS

BECHTEL

GEOLOGIC DRILL LOG

PROJECT
JOB NO.
SHEET NO. OF
HOLE NO.
SITE
COORDINATES
ANGLE FROM HORIZ.
BEARING
BEGUN
COMPLETED
DRILLER
DRILL MAKE AND MODEL
HOLE SIZE
OVERBURDEN (FT.)
ROCK (FT.)
TOTAL DEPTH
CORE RECOVERY (FT./%)
CORE BOXES
SAMPLES
EL. TOP OF CASING
GROUND EL.
DEPTH/EL. GROUND WATER
DEPTH/EL. TOP OF ROCK
SAMPLE HAMMER WEIGHT/FALL
CASING LEFT IN HOLE: DIA./LENGTH
LOGGED BY:

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE / LENGTH CORE RUN	SAMPLE RECOVERY / CORE RECOVERY	SAMPLE BLOWS "N" / PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES						

EXAMPLE

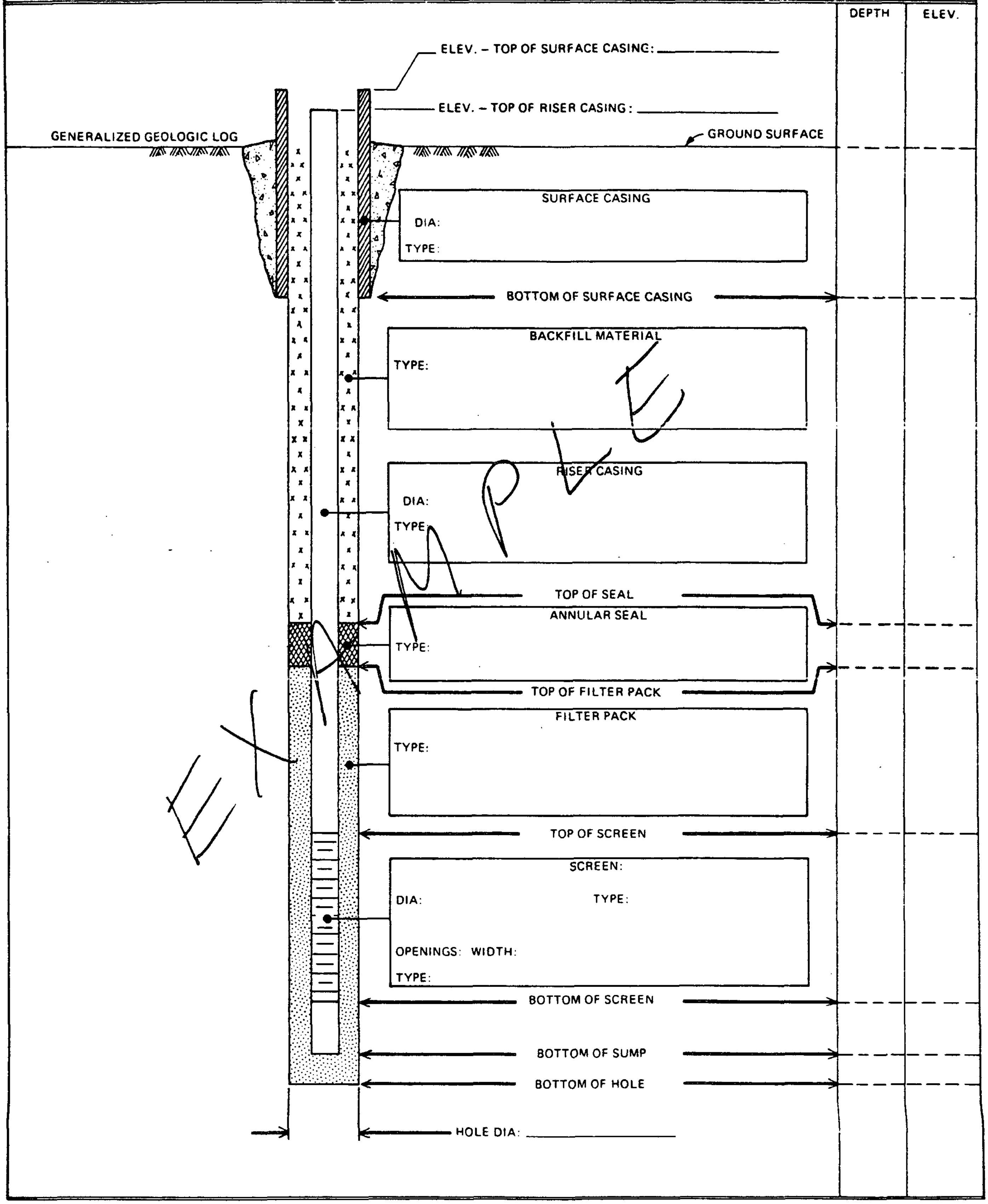
SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE
HOLE NO.

H&CF 19-1

OBSERVATION WELL

PROJECT			WELL NO.
JOB NO.	SITE	COORDINATES	
BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS



EXAMPLE

BECHTEL

WELL DEVELOPMENT

PROJECT		WELL NO.
JOB NO.	SITE	PREPARED BY

METHOD:

PUMP ____________

BAILER ____________

GAS ____________

OTHER ____________

DEVELOPMENT CRITERIA:

REMARKS:

HOLE DIAMETER d_h = ______

WELL CASING

INSIDE DIAMETER d_wID = ______

OUTSIDE DIAMETER d_wOD = ______

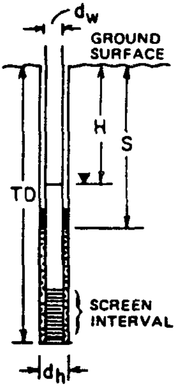
DEPTH TO:

WATER LEVEL H = ______

BASE OF SEAL S = ______

BASE OF WELL TD = ______

EST. FILTER PACK POROSITY P = ______



WELL VOLUME CALCULATION:

CASING VOLUME $= V_c = \pi\left(\frac{d_wID}{2}\right)^2 (TD-H) = 3.14\left(\frac{\quad}{2}\right)^2(\quad - \quad) =$ ______

FILTER PACK PORE VOLUME $= V_f = \pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_wOD}{2}\right)^2\right]\left(TD-(S \text{ or } H)^*\right)(P) =$

(* if $S>H$ use S, if $S<H$ use H.)

$3.14\left[\left(\frac{\quad}{2}\right)^2 - \left(\frac{\quad}{2}\right)^2\right](\quad - \quad)(\quad) =$ ______

TOTAL WELL VOLUME $= V_t = V_f + V_a = \quad + \quad =$ ______ $ft^3 \times 7.48 =$ ______ gal.

DEVELOPMENT LOG:

DATE	TIME		METHOD	WATER REMOVED	CUMULATIVE TOTAL REMOVED		WATER CHARACTER			COMMENTS:
	BEGUN	FINISH			GAL/ LITERS	WELL VOLUMES	pH	CONDUCTIVITY	TURBIDITY	

EXAMPLE

BECHTEL

WELL SAMPLING

PROJECT

WELL NO.

JOB NO.

SITE

PEPARED BY

METHOD:

HAND PUMP ________

SUBMERSIBLE PUMP ________

BAILER ________

OTHER ________

PURGING CRITERIA:

REMARKS:

HOLE DIAMETER d_h = ____

WELL CASING

INSIDE DIAMETER d_wID = ____

OUTSIDE DIAMETER d_wOD = ____

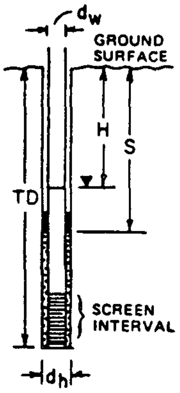
DEPTH TO:

WATER LEVEL H = ____

BASE OF SEAL S = ____

BASE OF WELL TD = ____

EST. FILTER PACK POROSITY P = ____



DATE: ________

DEPTH TO WATER: ________

CALCULATED PURGE VOLUME: ________

SOURCE: ________

SUBCONTRACTOR: ________

ANALYSIS: ________

LABORATORY: ________

DATE SHIPPED: ________ VIA: ________

SPECIAL HANDLING/PRESERVATIVES: ________

PURGING LOG:

DATE	TIME		METHOD	WATER REMOVED	CUMULATIVE TOTAL REMOVED		WATER CHARACTER			COMMENTS:
	BEGUN	FINISH			GAL/ LITERS	WELL VOLUMES	pH	CONDUCTIVITY	TEMPERATURE	

CHAIN OF CUSTODY RECORD

BECHTEL PROJECT NO. ____________________

SAMPLER'S NAME ____________________

LABORATORY PROJECT NO. ____________________

SAMPLER'S SIGNATURE ____________________

SITE IDENTIFICATION ____________________

BECHTEL SUPERVISOR ____________________

DATE ____________________

SAMPLE ID NUMBER	MATRIX OF SAMPLE	TIME TAKEN	PRESERVATIVES	ARCHIVE	ANALYZE	REMARKS

EXAMPLE

RELINQUISHED BY ____________________ DATE/TIME ____________________ RECEIVED BY ____________________

RELINQUISHED BY ____________________ DATE/TIME ____________________ RECEIVED BY ____________________

RELINQUISHED BY ____________________ DATE/TIME ____________________ RECEIVED BY ____________________

RECEIVED BY ____________________ FOR LABORATORY, DATE/TIME ____________________

AUTHORIZED FOR DISPOSAL BY ____________________ TYPE OF DISPOSAL ____________________

RELINQUISHED TO ____________________ FOR DISPOSAL, DATE/TIME ____________________

SAMPLE LABEL

SAMPLE ID:__________

PROJECT:______________________________

DATE:______________

INITIALS:__________

PROJECT NO.:________

SAMPLE CUSTODY SEAL

CUSTODY SEAL 2532

SIGNATURE______________________________________ DATE_______________