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RCRA FACILITY INVESTIGATION
TASK II: DRAFT WORK PLAN
(Revision 1)

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Bloomfield, New Mexico 87413

October 1, 1993

Submitted to:

United States Environmental Protection Agency
Region VI
RCRA Technical Enforcement
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1.0 INTRODUCTION

This "Task II: Draft RCRA Facility Investigation Work Plan" (RFIWP) has been prepared in accordance with item IV.2.a of the Administrative Order on Consent (Order; Docket No. VI-303-H) dated December 31, 1992 between the United States Environmental Protection Agency (USEPA) Region VI and Bloomfield Refining Company (BRC). This work plan has been prepared according to the requirements of Attachment II - Corrective Action Plan (CAP) of the Order, and is submitted concurrently with the "Task I: Description of Current Conditions" report.

The Task I report summarizes the background of the BRC facility, provides information on the nature and extent of contamination and presents the results of a preliminary evaluation of corrective measures technologies. The Task I report provides the basis for the technical approach of this work plan, by identifying additional investigative work tasks needed to complete the delineation of the nature and extent of contamination resulting from facility operations and to evaluate additional corrective measure technologies for application at the facility.

The purpose of the facility investigation is to determine the nature and extent of releases of hazardous waste or hazardous waste constituents (if any) from regulated units, solid waste management units, and other source areas at the facility. In addition, the investigation will be utilized to further define the nature and extent of releases of petroleum intermediates and products at the site. The data will be used to support a Corrective Measures Study. The investigative tasks are proposed to provide a comprehensive assessment of the site and potential areas of concern. The work plan components are as follows:

- <u>Project Management Plan</u>

  The Project Management Plan explains the overall management approach to conducting the investigation, as well as including qualifications of key personnel and subcontractors. The technical approach, schedule and budget are also identified in this plan.

- <u>Data Collection Quality Assurance Plan</u>

  The Data Collection Quality Assurance Plan describes procedures for monitoring and collection and analysis of environmental samples in order to ensure that all data is technically sound. This plan includes a data collection strategy, sampling procedures, field methods, and analytical laboratory quality assurance control procedures.

- Data Management Plan

  The Data Management Plan identifies methods used to track investigative data collected. The plan refers to sampling documentation, and establishes project filing, tabular formats and graphical displays for presenting data.

- Health and Safety Plan

  The Health and Safety Plan describes potential health hazards at the site that may be encountered during the investigation. Responses to any health hazards are described to protect the site workers.

- Community Relations Team

  The Community Relations Plan explains how the public will be informed of the environmental investigation and remediation activities conducted during the RFI process. The plan illustrates the procedures to be followed when responding to inquires and developing a repository for information.

An "Interim Measures Work Plan" was submitted to USEPA for review on February 12, 1993. The proposed interim measures consisted of adding two recovery wells to the existing subsurface hydrocarbon recovery system, equipping these wells with pumping devices, professionally surveying all wells at the site, collecting monthly water level measurements, and operating/maintaining the recovery system. Implementation of these interim measures in the short term will minimize the potential contaminant hazards and control the migration of hydrocarbons in groundwater.

1.1 Facility Description

The 287 acre BRC facility is located at 50 County Road 4990 (Sullivan Road), immediately south of the town of Bloomfield, New Mexico in San Juan County. The site is on a bluff approximately 100 feet above the south side of the San Juan River, a perennial river that flows to the west. On the bluff and between the river and the process area of the facility is the Hammond Ditch, a man-made channel for irrigation water supply that borders all but the southern portion of the site. Bordering the facility is a combination of undeveloped federal and private properties, with the majority of undeveloped land in the vicinity of the refinery used extensively for oil and gas production. The El Paso Natural Gas pipeline runs northeast to southwest bisecting the site. The topography of the active portion of the site is generally flat.

The BRC facility was originally constructed in the late 1950s, with a number of expansions since that time. The refinery currently has a crude capacity of 18,000 barrels per day. Seventy percent of the refinery's current crude supplies are delivered by pipeline and thirty percent arrive by tanker trucks. The following products are produced at the facility:

- leaded gasoline
- unleaded gasoline
- premium unleaded gasoline
- diesel fuels
- jet-A fuel
- JP-4 jet fuel
- kerosene
- heavy burner fuel
- butane
- propane
- liquefied petroleum gas

The products are transported for delivery by tanker truck from product terminals at the facility.

The current facility layout identifying all major aboveground structures is depicted in Figure 1. The refinery offices are located on the west end of the facility about one-half mile east on Sullivan Road, along with warehouse space, maintenance and shop areas, a drummed chemical storage area, raw water ponds (for temporary storage of fresh water from the San Juan River), and one cooling tower (#1). Process units are located just east of the offices and include: the crude unit, the fluidized catalytic cracking unit, the gas con unit, the treater unit, one cooling tower (#2), reformer/hydrotreater, catalytic polymerization unit, API separator, and oily water ponds (SOWP and NOWP).

Aboveground storage tanks (ASTs) occupy a large portion of the facility from north of the process units east along Sullivan Road. Two clay-lined evaporation ponds are located to the east of the tank farms for treated wastewater discharge, and the fire training and "landfill" areas are east of the evaporation ponds. South of Sullivan Road are the terminals where product trucks are loaded and crude trucks are off-loaded. The spray irrigation area and double-lined evaporation ponds are located east of the terminals.

From previous investigations, a separate-phase hydrocarbon (SPH) plume has been partially delineated at the BRC site, extending from the western area of the site (near the offices) to the eastern portion of the AST farm. The sources of this plume are believed to be product releases which occurred from ASTs and associated piping over the many years of the facility's operation as a petroleum refinery. BRC has made numerous improvements to the facility's storage and processing units and has established a systematic tank inspection and maintenance program.

1.2 Environmental Setting

The BRC facility is located within the San Juan Basin, a subprovince of the Colorado Plateau physiographic province. The site is underlain by Quaternary Jackson Lake terrace deposits, consisting of 10 to 15 feet of coarse-grained fluvioglacial outwash and loess. A permeable cobble layer directly overlying the bedrock at the site (the Tertiary Nacimiento Formation) has been encountered between five (MW-1) and 40 (MW-6) feet below ground surface at the site. The Nacimiento Formation is an interbedded, black, carbonaceous mudstone/claystone with white, medium to coarse-grained sandstones approximately 570 feet thick in this area. The bluff that crops out along the San Juan River near the site is similarly composed of these lithologies. Underlying the Nacimiento are the Ojo Alamo, Kirtland Shale, and Fruitland Formations.

Groundwater at the site occurs at depths ranging from 6 to 40 feet below ground surface, increasing in depth from west to east across the site. Groundwater flow direction is generally to the north-northwest, toward the Hammond Ditch and San Juan River. BRC dikes the Hammond Ditch during the non-irrigation season (October 15 through April 15) to maintain a year-round mounding effect to keep hydrocarbons from migrating across the ditch. Groundwater in the perched aquifer migrates through the permeable sands, silts and cobble zone along the relatively impermeable Nacimiento Formation, which is reported to dip toward the north. Periodic seeps along the bluff occur at the interface between the cobble zone and the Nacimiento.

Slug tests performed at the site to estimate characteristics of the cobble zone indicated that average hydraulic conductivity and transmissivity values of 2.08×10^{-4} feet/second and 171 square feet/day, respectively. The average saturated thickness was estimated at 9.6 feet. Using an estimated average gradient of 0.0025, the calculated flux over a 2,500 square foot area was 8,500 gallons per day or 6 gallons per minute (E-S, 1987).

Surface waters in the vicinity of the facility include the San Juan River (to the north) and the Hammond Ditch. The Hammond Ditch and the surface impoundments that are part of refinery operations distributed across the site contribute significantly to groundwater recharge at the site. The unlined Hammond Ditch is actively flowing during the irrigation season (April 15 through October 15) for agricultural purposes and is diked by BRC during the non-irrigation season. When full, the Hammond Ditch creates a mounding effect, keeping the banks loaded with relatively fresh water and inhibiting groundwater flow.

The climate is characterized by dry, cool winters with some snow and warm, dry summers. The annual average precipitation in the area is approximately nine inches. The annual average minimum and maximum temperatures are 38 and 66 degrees Fahrenheit, respectively.

1.3 Hazardous Waste Activity

A RCRA notification form of hazardous waste activity was filed on August 18, 1980 by Plateau, Inc., the previous refinery owner. A Part A application for a RCRA operating permit was filed on November 19, 1980 for the treatment, storage and/or disposal of refinery-listed hazardous wastes K049 through K052. In 1982, Plateau withdrew the Part A permit to reflect their status as a generator-only of hazardous waste. Plateau also applied for delisting of the hazardous wastes codes K049, K050, and K051, which was denied by USEPA because of petition deficiencies. On October 31, 1984 BRC acquired the facility.

In March 1985, the USEPA issued a RCRA 3013 Administrative Order (as a result of several agency inspections in the 1981 to 1984 period) identifying alleged violations and/or technical deficiencies and directing BRC to complete an investigation of geologic and hydrogeologic site conditions. A RCRA 3008(a) Compliance Order was issued to BRC one month later. BRC conducted several subsurface investigations at the site to satisfy USEPA and New Mexico Oil Conservation Division (NMOCD) directives. In response to a RCRA 3008 Order, BRC prepared plans, submitted the plans for review and implemented the clean closure plans for NOWP, SOWP, Landfill, and Landfill Pond. Additionally, BRC has subjected the waste from the Landfill (originally excavated from the SOWP and NOWP) to a delisting petition (April 1991).

The NOWP and SOWP (lined with a single 100-mil HDPE liner in late 1992) are scheduled to be double-lined by early 1994. A RCRA Part A Operating Permit Application for these units was submitted in September 1990. In September 1991, BRC submitted a Part B Operating Permit Application for these units to treat the refinery wastewater stream for benzene concentrations. The facility is currently operating the SOWP and NOWP under interim status pending approval of the permit application. All other hazardous wastes generated at the facility are disposed offsite. Hazardous waste generation is summarized as follows:

HAZARDOUS WASTES GENERATED BY BRC

HAZARDOUS WASTE	USEPA REASON FOR LISTING	AMOUNT GENERATED
Heat exchanger bundle (HEB) cleaning sludge (K050)	Hexavalent chromium	5,000 lb/3 yrs
API separator sludge (K051)	Hexavalent chromium & lead	250,000 lb/2 yrs
Leaded tank bottoms (K052)	Lead	8,000 lb/tank/5 yrs
1,1,1-Trichloroethane and methanol in naphtha (D001, F002)	Ignitable, spent halogenated solvent	None Recent - Potential Waste
Spent Solvent (D001)	Ignitable	2,000 lb/yr
Process Wastewater containing benzene (D018)	Benzene	100,800 gals/day

1.4 Areas and Hazardous Waste Constituents of Concern

A RCRA Facility Assessment (RFA) was conducted by USEPA contractors in June 1987. The purpose of an RFA is to identify releases or potential releases of hazardous waste which may require further investigation. The RFA also identifies sources for potential releases known as solid waste management units (SWMUs) or other potential areas of concern. The 1987 RFA identified a total of 13 SWMUs, including five units considered RCRA-regulated by the USEPA. It was since determined that the evaporation ponds are not considered to be RCRA-regulated. Each of these units was discussed in the Task I report with associated sampling that has been performed.

BRC considers product releases (both documented and undocumented) to be the primary source of soil and groundwater contamination at the site. Documented releases were listed in the Task I report. Undocumented releases are believed to have occurred in the process and bulk storage tank areas in the many years of operation of the refinery. The facility established in 1987 a more rigorous inspection/maintenance and repair program for storage tanks and associated piping. In addition, records of all reportable releases have been maintained since BRC acquired the refinery in 1984.

The Task I report divided the site into four geographic areas for the purposes of discussion. These are summarized below:

SOLID WASTE MANAGEMENT UNITS/POTENTIAL SOURCE AREAS

UNIT	UNIT TYPE	PREVIOUS CHARACTERIZATION
GEOGRAPHIC AREA 1		
API Oil/Water Separator	Process Unit	None needed-Structure intact.
Oily Water Ponds (SOWP and NOWP)	RCRA-regulated SWMUs since Sept 25, 1990	Underliner soil samples and downgradient wells MW-9, MW-20 and RW-18 monitored quarterly.
Spent Caustic Tank	Product Tank	None needed-new tank and concrete dike.
Former Drum Storage Area	SWMU (EPA's RFA)	Wells RW-1 and P-1.
Crude Unit	Spill Area (Documented)	None. Access Limited.
Tanks 3, 4, 5 Areas and Former Tanks 6 and 7 Areas	Spill Area (Suspected) - Tank Leaks Known	Wells MW-9, RW-18 and proposed wells RW-22 and RW-23.
Overall Geographic Area 1 (Process Area)	Spill Area (Suspected)	Seven RWs, 3 piezometers, 4 MWs.
GEOGRAPHIC AREA 2		
Tank 19 Area	Spill Area (Documented)	RWs 14 and 15 - active recovery.
Tanks 21 and 22 Area	Spill Area (Documented)	None.
Tank 26 Area	Spill Area (Documented)	RW-16 - active recovery.
Underground Piping (minimal)	SWMU (EPA's RFA)	RWs 14, 15, 16, 17 - active recovery.
Aboveground Storage Tanks	Spill Area (Suspected) - Tank Leaks Known	RWs 14, 15, 16, 17 - active recovery and MW-21.
GEOGRAPHIC AREA 3		
Transportation Terminal Sump	SWMU (EPA's RFA)	None.
Heat Exchanger Bundle (HEB) Cleaning Area	SWMU (EPA's RFA)	MW-13 and good condition.
Crude Loading Area	Spill Area (Documented)	None.
Product Loading Rack	Spill Area (Documented) - Paved area	None.
Underground Piping	SWMU (EPA's RFA)	None.

UNIT	UNIT TYPE	PREVIOUS CHARACTERIZATION
GEOGRAPHIC AREA 4		
Evaporation Ponds (north and south)	SWMU (EPA's RFA)	MW-1 and MW-5 sampled semi-annually.
Landfill (wastepile)	Alleged RCRA-regulated SWMU	1985 soil samples, 1990 delisting char. composite soil samples, and MW-8.
Landfill Pond	Alleged RCRA-regulated SWMU	1985 soil samples.
Fire Training Area	SWMU (EPA's RFA)	None.
Spray Irrigation Area	SWMU (EPA's RFA)	MW-5 sampled semi-annually.

RW = Recovery or pumping well.
MW = Monitoring well.

Data Gaps Identified

As discussed in the Task 1 report, BRC's approach to the investigation treats the entire site as one SWMU. Likewise, based upon the present knowledge of site conditions and the anticipated filling of data gaps, BRC anticipates Corrective Actions will be performed on a site-wide basis in a manner consistent with Corrective Action Management Unit (CAMU) regulations. The Task I report indicated that data gaps have been identified in the northwestern portion of the site (between the fire house and the transformer station), in the northeastern portion of the site (between the evaporation ponds and the aboveground storage tanks [ASTs]), in the southern portion of the facility (along Sullivan Road south of the ASTs and near the truck loading/off-loading terminal), and southeast of the site (on Bureau of Land Management [BLM] property). A soil vapor survey will be performed at the site to optimize the locations of additional borings/monitoring wells in these areas. Additional groundwater investigation will be conducted in order to fully delineate the nature and extent of impairment and obtain data required for corrective measures. Further, data collected during the investigation will be useful in development of the groundwater monitoring program.

Soil characterization has only been performed beneath the oily water ponds (SOWP and NOWP), the landfill, landfill pond and southeast of the site on the BLM property. Because of limited access and the dimensions of the SPH plume, additional soil characterization in the process area of the site test, (Area 1) is not proposed. Unsaturated soils in this area are assumed to be impacted by petroleum hydrocarbons to the water table. A pilot study for soil vapor extraction/air sparging technology is proposed to be conducted in this area for corrective measures evaluation purposes. As part of the pilot study, soil and vapor samples will be collected for laboratory analysis.

Additional soil sampling for laboratory analysis in SWMUs/potential source areas identified by USEPA will be performed. These areas include the transportation terminal sump, the clay-lined evaporation ponds, and the fire-training area. Soil samples will also be collected in the crude loading area and producing loading rack, and AST farm area since releases have/may have occurred in these areas. Soil sample locations will be determined by a soil vapor survey to minimize the number of soil samples submitted for laboratory analysis. The soil quality laboratory analyses will delineate impacts, characterize source/potential source areas and will provide design parameters for corrective measure technologies (if any are determined necessary) to be employed at the site.

Surface water and sediment sampling of both the Hammond Ditch and the San Juan River will also be performed as part of the facility investigation. Although surface water sampling was performed in 1986 and 1987, more recent and comprehensive data will be obtained.

Finally, an aquifer test will be performed to determine design parameters for the corrective measures implementation. Slug tests performed in 1986 provide preliminary information on the characteristics of the perched groundwater zone beneath the site. However, for design of a site-wide remediation program, a longer-term aquifer test is proposed to produce more reliable data.

Constituents of Concern

Groundwater sampling has been performed at the site since 1984. The analyses performed on groundwater samples have varied, although several sampling events have included comprehensive parameter lists. According to the Administrative Order on Consent (December 31, 1992) samples must be analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (BNAs), total petroleum hydrocarbons (TPH), and metals for soil and new groundwater monitoring wells.

Analyses during the soil vapor survey will be limited to total volatile hydrocarbons, benzene, toluene, ethylbenzene, and total xylenes (BTEX). Groundwater samples collected from existing wells (that do not contain separate phase hydrocarbons [SPH]) will be analyzed only for VOCs (USEPA Method 8240) and BNAs (USEPA Method 8270). Data from this sampling will provide current, comprehensive information on the dissolved plume at the site. However, it should be noted that historic sampling for VOCs has indicated that BTEX are the primary constituents of concern, suggesting that future groundwater sampling events target only these compounds.

1.5 Data Acquisition Objectives

Data collected during the facility investigation will be used to: characterize the subsurface conditions at the site (geology, soil and aquifer properties); identify and quantify hydrocarbon contamination at potential source areas; delineate the limits of impacts identified; and evaluate corrective measure alternatives. Five analytical levels can be used to assess the soil and groundwater quality at the Bloomfield Refining Company - Bloomfield, New Mexico facility:

Level I -	field screening or analysis using portable instruments. Results are often not compound- specific and not quantitative but results are available in real-time.
Level II -	field analyses using more sophisticated portable analytical instruments such as a portable GC. Results are available in real-time or several hours.
Level III -	SW-846 routine analytical services (RAS). All analyses are performed in an off-site approved analytical laboratory following SW-846 protocols. Level III is characterized by rigorous QA/QC protocols and documentation.
Level IV -	analytical analysis by preapproved non-standard methods. All analyses are performed in an off-site approved analytical laboratory. Method development or method modification may be required for specific constituents or detection limits. Level IV is characterized by rigorous QA/QC protocols and documentation.
Level V -	physical property and engineering material analysis by approved standard or non-standard methods. All analyses are performed in an off-site laboratory. QA/QC protocols and documentation may be required for some analyses.

The technical approach of the facility investigation is presented in the following section (Section 2.0 - Project Management Plan) and consists of four phases of investigation. It should be noted that BRC intends to address the entire site as one SWMU for investigation purposes. Based upon the information available to date BRC anticipates remediation will be accomplished using corrective action management (CAMU) processes. Phases I, III and IV have been designed to characterize impacts across the site, while Phase II specifically addresses individual potential source areas. The phases and corresponding analytical levels are as follows:

Phase I: Level II and Level III analytical data will be generated during this phase.

Phase I field work consists of conducting a soil vapor survey using a laboratory-grade gas chromatograph at two depths (3 and 10 feet below ground surface) for vertical and horizontal delineation of volatile hydrocarbon compounds. It is estimated that the soil vapor survey will consist of 50 locations (two depths at each location), and that a total of 10 soil samples (or 10 percent) will be collected for laboratory analysis. Additionally, four (4) additional soil vapor points will be installed between Hammond Ditch and the San Juan River. The stations will be location in close proximity to the seep.

Phase II: Level I, Level III and Level V analytical data will be generated during this phase.

Phase II field work will be based on the results of Phase I activities. Soil borings will be installed in the areas indicated in Section 1.4 above. A field geologist will log lithologies and screen soil samples with a photoionization detector (PID) during soil boring installations. Depending on the water table elevation, two samples from each boring location (one exhibiting the highest PID readings and one directly above the water table interface) will be collected for laboratory analysis of VOCs, BNAs, TPH and metals. If the cobble layer is encountered during drilling, the borehole will be terminated. If the water table has not been encountered at the depth at which the cobble zone is encountered, a second soil sample will not be collected for laboratory analysis.

Select soil samples (maximum of three) from lithologically representative areas of the site will also be analyzed for soil property analyses (including grain size distribution, dry bulk density, moisture content, ion exchange capacity, total organic carbon, pH, specific conductance, total/effective porosity and hydraulic conductivity). It is estimated that 10 borings will be installed: two in the transportation terminal sump area; four around the evaporation ponds; two in the fire training area; one at the crude loading area; and one at the product loading rack area. Additional borings may be installed depending on the results of the Phase I investigation.

Phase III: Level I and Level III analytical data will be generated during this phase.

Phase III activities will be based on the results of Phase I and Phase II investigation activities. Additional groundwater monitoring wells will be installed at approximately seven locations for groundwater delineation and monitoring purposes. Preliminary locations include one in the northwest section of the site, one in the northeast (near former MW-2), and five along Sullivan Road and south on the BLM land. Wells will be constructed of fiberglass reinforced epoxy materials. The wells will be developed and surveyed (tied into the site survey to be performed as part of the Interim Measures Work Plan). The new wells that do not contain SPH will be sampled for VOCs, BNAs, TPH and metals analyses. All other site monitoring/recovery wells (not piezometers) that do not contain SPH will also be sampled for VOCs and BNAs only. Select groundwater samples (maximum of two) will also be analyzed for water quality parameters (including pH, temperature, dissolved oxygen, total dissolved solids, total organic carbon, alkalinity, hardness, and specific cations [e.g., iron, manganese]). A second round of groundwater samples will be collected after 60 days for chemical analyses only.

Phase IV: Level I and Level III analytical data will be generated during this phase.

Phase IV consists of field studies, including an aquifer test and a soil vapor extraction/air sparging pilot study. The configuration and design of these field tests will depend on the results of the Phase I, Phase II and Phase III investigations. However, in general, the aquifer test will be developed to determine the aquifer characteristics (transmissivity, hydraulic conductivity) from which a groundwater remediation system may be designed, if warranted. Similarly, the soil vapor extraction/air sparging pilot study will be conducted to observe the radius of influence of at different vacuum flow rates and determine the maximum effective radius of influence at the site. This information is used to design the extraction/sparge point layout and equipment specifications, if soil vapor extraction/air sparging technology is selected for the site.

Seventeen (17) Stream sediment and surface water samples will be collected during low flow conditions (July) which may correspond with Phase I, II, III or IV of the facility investigation. Fourteen (14) of the 17 water and sediment samples will be collected from Hammond Ditch, while three (3) samples will be collected from the San Juan River. Samples will be collected at approximately 500 foot intervals (as illustrated in Figure 2). The sample density, however, will increase in the area of the seep. Level I and Level III analytical data will be generated during these investigations. Samples will be analyzed for VOCs, BNAs, TPH, and metals. In addition, one surface water sample will be analyzed for water quality parameters, including temperature, pH, dissolved oxygen, conductivity, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), total organic carbon (TOC) and nutrients. Stream velocity and sediment thicknesses will also be field measured.

Section 3.0 of this plan consists of the Data Collection Quality Assurance Plan, Section 4.0 the Data Management Plan, and Section 5.0 the Community Relations Plan. Appendix A contains the site-specific Health and Safety Plan.

2.0 PROJECT MANAGEMENT PLAN

The purpose of the Project Management Plan is to identify the work that will be conducted to investigate the sources of contamination, determine the nature and extent of contamination at the facility, and evaluate corrective measure alternatives. This work is conducted to meet the requirements of a RCRA Facility Investigation and supplements existing site data described in the Task I: Description of Current Conditions report. The technical approach to addressing known and potential releases to soil, groundwater, and surface water from the SWMUs/potential source areas identified in the Task I report is described in this section. Additionally, personnel qualifications, a schedule and a budgetary estimate for the implementation of the facility investigation activities are included herein.

2.1 Technical Approach

The objectives of the RFI are to characterize the site, delineate both horizontally and vertically the extent of contamination and obtain information necessary to evaluate and design corrective measures that will reduce environmental contamination to levels that pose minimum threats to human health and the environment as appropriate for the site. Investigative data will identify the source(s), nature, and extent of contamination at the facility and will provide information on aquifer and vadose zone properties necessary to evaluate and design corrective measures. The work will be conducted to meet the requirements of a RCRA Facility Investigation.

As described in Section 1.4 - Data Acquisition Objectives, the technical approach consists of four phases of investigation. Each phase is dependent on the results of its preceding phase and therefore the actual number and locations of data points are approximate, subject to change. All proposed changes will be reported to USEPA verbally for approval and in written form with the monthly progress reports. The four phases of investigation, rationale for the approach, and collection measures are described in the following subsections. Detailed information about data collection procedures is provided in Section 3.0.

2.1.1 Phase I: Soil Vapor Survey/Soil Sampling

A soil vapor survey will be conducted to provide additional information on the nature and extent of the hydrocarbon contamination at the BRC site. Since the BRC property is 287 acres in size and the separate phase hydrocarbon (SPH) plume may extend over as much as 25 acres, the soil vapor survey will serve as an effective tool in delineating the horizontal extent of SPH and dissolved hydrocarbon impacts across the site. A soil vapor survey may be useful for indicating the vertical extent of hydrocarbon contamination in unsaturated soils, and determining the optimum locations for additional groundwater monitoring wells. Because the cobble layer overlying the Nacimiento Formation at the site makes drilling and/or hydropunch conditions difficult or impossible for soil sample retrieval, the smaller diameter (3/4-inch) soil vapor probes may penetrate this lithology, should it be encountered. Typically, low recovery of soil samples would be experienced and the integrity of soil samples may be compromised by the collection method (VOCs may be lost due to turbulence and volatilization).

Benzene, toluene, ethylbenzene and xylenes (BTEX) are volatile constituents of the lighter-end petroleum products which are readily identified during soil vapor surveys using gas chromatography. These compounds and total volatile hydrocarbons will be analyzed in soil vapor samples directly injected into a laboratory-grade gas chromatograph equipped with a flame ionization detector (FID). Tracer Research Corporation (Tucson, AZ) will be contracted to perform the soil vapor survey. Tracer has provided the following typical detection limits for the soil vapor analyses:

TYPICAL DETECTION LIMITS

COMPOUND	SOIL GAS (ug/l)	DETECTOR
Benzene	0.05	FID
Toluene	0.05	FID
Ethylbenzene	0.05	FID
Xylenes	0.05	FID
Total Volatile Hydrocarbons	0.1	FID

The direct injection method of analysis will allow for real-time analytical results and rapid field decisions. For example, survey points may be added or moved to delineate hot spots while the survey is being performed instead of waiting weeks for laboratory analyses and performing several iterations of investigation to complete delineation.

Soil vapor sampling and quality assurance procedures are described in Section 3.2.7 of this work plan. Essentially, a 3/4-inch galvanized steel sampling probe is driven to the desired depth(s), the probe is backlifted approximately six inches, a vacuum pump evacuates soil gas, a vapor sample is extracted using a syringe, and the vapor sample is directly injected into the gas chromatograph for analysis. Quality assurance/quality control (QA/QC) measures employed during the survey include the collection of field blank samples (one per day at the start), duplicate samples (one per 20 samples) and calibration standards (water blank samples and nitrogen blank samples).

The survey will consist of approximately 50 locations and two depths (three and ten feet below ground surface) at each location, for a total of 100 soil vapor samples. Approximate survey locations are shown in Figure 2. Initial soil vapor sampling locations are based on a 150-foot grid across the southern and eastern portions of the site to complete the delineation of hydrocarbon impacts. Actual locations will be based on field conditions (access, presence of above and below ground structures), and added or moved according to real-time survey results. If contamination is found at the expected plume perimeter locations, the spacing of grid points may be increased and survey locations will be added to further delineation the contamination found.

Each location will be staked for field survey and plotted on a scaled site plan. Analytical results for each constituent will be tabulated and contour maps of each at the two depths will be constructed.

2.1.2 Phase II: Soil Borings/Soil Sampling and Analysis

As described in Section 2.1.1 above and based on the conditions encountered during the installation of the 26 wells onsite, drilling for sample retrieval is difficult at the BRC site due to the presence of cobbles in the unconsolidated sediments overlying the Nacimiento Formation. The depth at which the cobble layer is encountered varies across the site, generally increasing to the south and southwest. When cobbles are encountered, the boring will be terminated. Otherwise, borings will extend to the water table. Drilling and soil sampling procedures and quality assurance measures are discussed in more detail in the Data Collection Quality Assurance Plan (Section 3.0).

Soil borings will be installed in the potential source areas identified by USEPA during the 1987 inspection and in spill areas where data is not available from previous investigations at the facility. These borings will be used to: characterize the lithology of the areas using field observations and physical property analyses; determine whether the area has been impacted; identify and quantify impacts; and vertically delineate the extent of impacts based on field screening and laboratory analyses. It is estimated that 10 borings will be installed: two in the transportation terminal sump area; four around the clay-lined evaporation ponds; two in the fire training area; one at the crude loading area; and one at the product loading rack area. These locations are shown in Figure 2. Actual boring locations will depend on field conditions (access, presence of above and below ground structures). Additional borings may be installed depending on the results of the Phase I investigation, should hot spots be identified requiring further characterization.

Samples will be collected continuously during boring installations using a split-spoon sampling device. A field geologist will log lithologies and screen soil samples with a photoionization detector (PID). Depending on the water table elevation, two samples from each boring location (one exhibiting the highest PID readings and one directly above the water table interface) will be collected for laboratory analysis of VOCs (USEPA Method 8240), BNAs (USEPA Method 8270), TPH (USEPA Method 418.1) and metals (USEPA Method 6010/7000 series). As previously mentioned, if the cobble layer is encountered during drilling, the borehole will be terminated. If the water table has not been encountered at the depth at which the cobble zone is encountered, a second soil sample will not be collected for laboratory analysis.

Select soil samples (maximum of three) from lithologically representative areas of the site will be collected in Shelby tubes for soil property analyses, including grain size distribution, dry bulk density, moisture content, ion exchange capacity, total organic carbon, pH, specific conductance, total/effective porosity and hydraulic conductivity. These parameters will provide site-specific information which influence contaminant migration in the subsurface.

2.1.3 Phase III: Groundwater Monitoring Well Installations/Development/Surveying, Groundwater Sampling and Analysis

As described in the Task I report, a total of 26 wells (14 monitoring, nine recovery, and three piezometers) have been installed at the site. Seven of the recovery wells are currently active in the facility's subsurface hydrocarbon recovery system, five wells are monitored for RCRA compliance, and two wells are monitored semi-annually for discharge plan approval compliance. The Interim Measures Work Plan (GTI, 1993) proposed an additional two recovery wells. Additional groundwater delineation is proposed as part of the facility investigation in areas where data gaps have been identified.

Based on the results of the Phase I and Phase II investigations, additional groundwater monitoring wells will be installed at approximately seven locations for groundwater delineation and monitoring purposes. Preliminary locations include: one well in the northwest section of the site, one in the northeast (near former MW-2), and five in the area along Sullivan Road to include the BLM land to the south. Approximate well locations are shown in Figure 2, although actual locations will depend on field conditions (access, presence of above and below ground structures) and results of the preceding investigation phases. Well installation, development, surveying, and groundwater sampling procedures and quality assurance measures are discussed in more detail in Section 3.0.

Wells will be installed using driven casing (percussion hammer) drilling methodology by Beeman Drilling Co. The wells will be installed to a total depth of approximately 20 feet below grade (depending on the depth of the water table occurrence) or approximately 7.5 feet into the water table and constructed of four-inch diameter fiberglass-reinforced epoxy (FRE) 0.020-inch slot well screen and casing. The well screen will extend from five feet above the water table to at least the top of the Nacimiento Formation (estimated to be about 10 feet). Above the screen, the well assembly will consist of FRE casing extending to the surface. A silica sandpack will be installed in the annulus between the well screen and the borehole. A two-foot thick bentonite seal will be placed at the top of the sand pack. Cement/bentonite grout will be added above the bentonite seal to fill the annulus to a level slightly below grade. Those wells installed in high traffic areas will be finished with a bolt down, flush-mounted road box assembly and a locking cap. The remaining wells will be completed above-grade inside 3-foot protective steel surface casing.

A field geologist will supervise drilling activities and will log drill cuttings. The wells will be developed by purging water until it appears sediment-free (or is purged dry) and surveyed (tied into the site survey to be performed as part of the Interim Measures Work Plan). Soil cuttings will be characterized and disposed in accordance with state and federal regulations. Purge water will be directed to the facility's wastewater treatment plant.

All site wells will be gauged using an Interface Probe for depth to water and SPH thickness (the Interface Probe is capable of measuring SPH to an accuracy of 0.01 feet). Wells from which samples will be collected will be purged of three volumes of water, and water will be directed to the facility's wastewater treatment plant. Groundwater samples will be collected with disposable polyethylene bailers and monofilament cord into containers provided by the laboratory. The new wells that do not contain SPHs will be sampled for VOCs (USEPA Method 8240), BNAs (USEPA Method 8270), TPH (USEPA Method 418.1) and metals (USEPA Method 6010/7000 series) analyses. All other site monitoring/recovery wells (not piezometers and excluding MW-7) that do not contain SPHs will also be sampled for VOCs and BNAs only. This analytical data will provide a current, comprehensive view of the dissolved plume at the site from which corrective measures can be evaluated.

Select groundwater samples (maximum of two) will also be analyzed for water quality parameters (including pH, temperature, dissolved oxygen, total dissolved solids, total organic carbon, alkalinity, hardness, and specific cations [e.g., iron, manganese]). These samples will be collected from wells in areas (if any) which might require corrective measures. These parameters provide valuable design information (such as the potential for scaling) that must be accounted for in any corrective measure.

A second groundwater sampling event will be conducted at least 60 days following the first event. Only chemical analyses (no water quality parameter) will be performed on the second round of samples.

2.1.4 Phase IV: Field Studies

Phase IV consists of field studies, including an aquifer test and a soil vapor extraction/air sparging pilot study. These studies are specifically designed to assist in the evaluation of corrective measures technologies and were identified during the preliminary evaluation included in the Task I report. The configuration and design of these field tests will depend on the results of the Phase I, Phase II and Phase III investigations.

Aquifer Test

One of the existing recovery wells will be utilized for the aquifer test, presumably one located proximate to existing piezometers or monitoring wells which will facilitate monitoring during the aquifer test. Additional piezometers may need to be installed. The operating recovery wells will be temporarily shut down during the test and groundwater allowed to re-equilibrate prior to the start of the test. Either existing pumping equipment set below the water table or other pump will be used during the test. A step-drawdown test will be performed to determine the optimum pumping rate for a 24-hour constant-rate pump test. Drawdown will be monitored in the pumping and observation wells with pressure transducers or continuous water level recorders.

Based upon the results of the step-drawdown test, a discharge rate for a constant-rate pump test will be selected. A 24-hour constant-rate pump test will then be performed with continuous monitoring of drawdown in the pumping and observation wells. The recovery of water levels in the recovery well and observation wells after pumping has stopped will be monitored. Finally, the drawdown and recovery data collected will be analyzed for determination of aquifer hydraulic conductivity (k), transmissivity (T), and storativity (S), to determine groundwater recovery/containment flow rates, and to evaluate other aquifer properties including anisotropy, heterogeneity, and boundary influences.

All pump test data will be analyzed using Graphical Well Analysis Package (GWAP) (or an equivalent modeling program such as Aquifer Test Solver (AQTESOLV)) and all resultant test data will be incorporated into the facility investigation report.

Soil Vapor Extraction/Air Sparging Pilot Test

A soil vapor extraction/air sparging pilot test will be conducted to determine the feasibility of these technologies for application at the BRC site. Soil vapor extraction consists of applying a vacuum to wells installed in the unsaturated zone which induces air flow through soil pore space. The air flowing through the soil pore space contains volatilized contaminants which are extracted from the subsurface by the vacuum device. Air sparging consists of the application of pressurized air below the water table, allowing bubbles of air to pass through contaminated soil and water as they rise to the water table surface. While passing through contaminated zones, volatile constituents are removed by the air bubbles. Air sparging works in concert with soil vapor extraction so that once the air and volatilized contaminants reach the water table surface, they are extracted from the subsurface by the vacuum system.

Constituents of the SPHs at the BRC site are sufficiently volatile based on their individual vapor pressures and will readily volatilize based on their Henry's Law constants for these technologies:

Compound	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m^3/mol)
Benzene	9.52E+01	5.59E-03
Toluene	2.81E+01	6.37E-03
Ethylbenzene	7.00E+00	6.43E-03
Xylenes	1.00E+01	7.04E-03

The pilot study will provide information on the radius of influence of vapor extraction points and sparge wells for use in designing the sparge well/vapor extraction point configuration and equipment specifications. Air sampling of the offgas will be used in permitting and design of a vapor emissions control device. The pilot study will be performed in a contaminated area, specifically near RW-19, to obtain air samples representative of worst-case operating conditions.

Activities for the soil vapor extraction/air sparging pilot test will include the following:

- Drilling and installation of approximately five nested pairs of soil probes at distances of 5 to 25 feet from the extraction well at approximately 72 degree spacings. This array will provide multidirectional data at varying distances from the test well, and provide information concerning potential vertical differences in response both in the unsaturated and saturated zones;
- Drilling and installation of one two-inch diameter air sparge well with approximately two feet of screen and a two-foot sand trap, and approximately 20 feet of casing. The well screen will be set at least 10 feet below the water table, if conditions permit.
- Performance of an 8-hour soil vapor extraction pilot test using an existing monitoring well (possibly RW-19) as the extraction well;
- Performance of an 8-hour air sparging pilot test with a temporary SVE system operating to control the vapor migration; and
- Field and laboratory analysis of air samples collected during the pilot tests.

Compressed air for the air sparging pilot test will be provided by the refinery. A vacuum blower will be used for the vapor extraction portion of the test. Air effluent from the vacuum blower will be treated with two portable, 55-gallon carbon-adsorption units placed in series. Prior to test commencement, notification will be made to the proper local and state air quality agencies regarding the temporary discharge of vapors during the short-term pilot test.

The following parameters will be monitored at regular time intervals during the test:

- Pre- and post-filter vacuum at the blower;
- Induced vacuum at surrounding monitor points;
- Applied vacuum at the vapor extraction wellhead;
- Pre- and post-blower air stream temperature;
- Process air stream velocity; and
- Air influent (pre-treatment) and effluent (post-treatment) organic vapor concentrations and percent lower explosive limit (LEL).

To aid in specifying the optimal air flow for a full-scale air sparge/vapor extraction system (AS/VES), a pilot vapor extraction step-test will also be conducted on the test well. During the step-test, varying degrees of vacuum (100%, 66%, and 33% blower capacities) will be applied to the test well. The vacuum and air flow rate at the wellhead will be measured. During the step-test, induced vacuums will be measured in surrounding monitoring wells.

Six vapor samples will be collected during the pilot test, three during the vapor extraction test and three during the air sparge test. Air samples will be collected immediately following test start-up, midway through the test, and at the end of the test. The vapor samples will be collected in Tedlar bags from an air sampling port located prior to the vacuum blower and will be analyzed for total nonmethane hydrocarbons (Method TO-18), purgeable aromatics and hydrocarbons (USEPA Method 8010/8020), and methane, carbon dioxide, and oxygen (GC-TCD).

Following completion of the pilot test, air sample analytical results will be used to calculate the projected mass emissions rate of hydrocarbons from a full-scale AS/VES. Field monitoring of vapor emissions and vacuum pressure in the vent monitoring probes and observation wells will be used to calculate the effective radius of influence of the system.

2.1.5 Stream Sediment and Surface Water Sampling

Stream sediment and surface water samples will be collected from both the Hammond Ditch and San Juan River to provide current information during low flow conditions (July) which may correspond with Phase I, II, III or IV of the facility investigation. Sample collection procedures and quality assurance measures are discussed in detail in Section 3.0. Samples will be collected at three locations in the San Juan River: upstream of the facility, at the facility, and downstream of the facility. Samples will be collected every 500 feet for the length of the facility (between 10 to 12 samples). A surface water and sediment sample will be collected at each location.

All samples will be analyzed for VOCs (USEPA Method 8240), BNAs (USEPA Method 8270), TPH (USEPA Method 418.1), and metals (USEPA Method 6010/7000 series). In addition, one surface water sample from the Hammond Ditch and one from the San Juan River will be analyzed for water quality parameters: including temperature, pH, dissolved oxygen, conductivity (field determined), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), total organic carbon (TOC) and nutrients. Stream velocity and sediment thicknesses will also be field measured.

2.2 Company Profiles & Project Organization

2.2.1 Groundwater Technology Qualifications and Experience

Groundwater Technology is an international corporation providing environmental consulting and contracting services to a variety of industrial and petroleum clients. Our capabilities include planning, implementing, and documenting comprehensive site investigations, as well as the design and construction of contaminant remediation systems for soil and groundwater. We also offer analytical, health risk assessment, and pollution control equipment manufacturing services through our business units and subsidiaries: GTEL Environmental Laboratories, Risk Assessment Services, and ORS Environmental Equipment.

Founded in 1975, Groundwater Technology is among the largest and most successful environmental consulting firms, with 1992 sales of more than $190,000,000. The company employs more than 1,700 people located in over 60 offices throughout the United States, Canada, Europe, and Australia. The company has developed a strong technical team and quality assurance/quality control (QA/QC) program to assure the integrity of the work which it performs.

Groundwater Technology is, and has been, involved in many RCRA related projects including RFI workplan implementation at multiple locations. Our offices are staffed with professionals specializing in engineering, geology, hydrogeology, chemistry, biology, and administrative disciplines. The offices are supported by a broad variety of technical disciplines from our Corporate Headquarters, Regional and District offices. Additional information on Groundwater Technology is provided in Appendix B of this plan.

2.2.2 Subcontractor Qualifications

In order to successfully complete the proposed scope of work on time and within budget, selected subcontractors will be utilized to perform various tasks of the facility investigation. Groundwater Technology will coordinate closely with all subcontractors throughout the project. For all subcontractors, the Groundwater Technology project manager will prepare a specific technical statement of work, listing subcontractor requirements, and will monitor performance. Besides complying with their own safety procedures, the subcontractors will adhere to and abide by all Groundwater Technology safety procedures and protocols. Before costs are incurred, all subcontractors will be clearly briefed on their responsibilities, scheduling constraints, required work products, product formats, coordination requirements, and budgets.

All subcontractors hired directly by Groundwater Technology are currently under service contracts with Groundwater Technology and have been prequalified with respect to experience and qualifications, health and safety requirements, and insurance coverage.

Groundwater Technology anticipates using the services of the subcontractors listed below to provide soil vapor survey services, drilling services, surveying services and laboratory analytical services.

Soil Vapor Survey Services:

Tracer Research Corporation
3855 North Business Center Drive
Tucson, Arizona 85705
(602) 888-9400
Contact: Paige Santo

Drilling Services:

Beeman Bros.
31502 Highway 160
Durango, Colorado 81301
(303) 259-1195
Contact: Leo Beeman

Surveying Services:

To be determined

Laboratory Analytical Services:

Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
(505) 326-4737
Contact: Charles Ballek - Laboratory Manager

2.2.3 Project Organization

Groundwater Technology will implement the RFIWP for and under the guidance of BRC. The project organization is illustrated in Figure 3, showing lines of authority and reporting structure, and resumes for all of the key personnel proposed in this project are provided in Appendix B.

Ms. Sara Brothers will serve as the project director for the facility investigation based on her management and technical experience at numerous sites in New Mexico, including petroleum and chemical manufacturing facilities. She has worked for over four years for Groundwater Technology and has over six years experience in providing environmental consulting services. Ms. Brothers is the Operations Manager of the Groundwater Technology Albuquerque, New Mexico office. Her primary responsibilities on the BRC project will be to provide technical oversight and regulatory compliance review, assist in regulatory negotiations as necessary, and ensure that the appropriate resources are available to complete the project as proposed. Ms. Brothers will also serve as client advocate to address any concerns that BRC may have regarding the project during its implementation.

Ms. Cymantha Diaz will serve as the project manager based on her previous management and technical experience at similar sites, including numerous chemical and industrial manufacturing facilities. She has worked for over five years for Groundwater Technology and has over seven years experience in providing environmental consulting services. Because of her experience and strong credentials in the investigation and remediation of RCRA-regulated facilities, Ms. Diaz acts as project coordinator for two of Groundwater Technology's major industrial clients, providing consistency and oversight for all of Groundwater Technology's projects. Her primary responsibilities on the BRC project will be the daily management of the project with respect to directing field personnel and subcontractor activities, to communicate with the BRC staff regarding the progress and the results of the project, and to assure that all technical aspects of the project are addressed. Ms. Diaz will also be responsible for adherence to the proposed project schedule and budget.

Health and safety administration for the project will be provided by Mr. Paul Kelly and Ms Dawn Nickols. A site-specific safety plan has been prepared addressing the potential chemical and physical exposures that may be encountered in the project. Any modifications to the work scope or accidents/incidents that occur during the facility investigation will be documented by the field crew and reported to the health and safety coordinators who will prescribe actions to be taken.

Ms. Jan Whiffin will provide assistance in maintaining regulatory compliance with respect to waste disposal, and in the identification and pre-approval of waste disposal facilities. Ms. Whiffin is also the project quality assurance/quality control manager and will review documents and field procedures to ensure compliance with approved QA/QC measures. Mr. Richard Lewis, CPG, Dr. Richard Brown, PhD, Dr. Peter Kroopnick, PhD, and Ms. Marion Barnes will serve as technical consultants for the project, to provide assistance and review as needed in their areas of expertise.

2.3 Facility Investigation Schedule

The schedule for the RFI activities is shown in Figure 4. As indicated, investigative activities will require approximately six months after USEPA's approval of the RFI Work Plan. The RFI Report is anticipated to be submitted within 60 to 90 days following completion of the field activities, which is well within the 365 days from USEPA approval of the work plan specified in the Administrative Order on Consent.

2.4 Facility Investigation Budget

Appendix C summarizes the estimated cost for the RFI activities. Costs are based on Level D personal protective equipment (PPE) and assume no unusual delays are encountered while in the field.

3.0 DATA COLLECTION QUALITY ASSURANCE PLAN

The Data Collection Quality Assurance Plan documents all monitoring procedures to be used for sampling, field measurements, and laboratory analysis performed during the RFI. The plan includes quality assurance objectives and quality control procedures for field and laboratory measurements. This plan will ensure that all data collected during the investigation is properly documented and technically sound.

3.1 Data Collection Strategy

The data collected during the RFI will be used to meet the following project objectives:

- Identify and characterize the contamination source areas.
- Characterize the nature and extent of contamination in soil, soil gas, groundwater, surface water, and sediment.
- Evaluate and characterize the pathways by which contaminants can migrate.
- Supplement existing data to evaluate the potential risk to human health and the environment.
- Evaluate effectiveness of potential remediation technologies.

A QA/QC plan has been designed to ensure that all data generated will be technically sound, statistically valid, and properly documented.

3.1.1 Data Quality Objectives

The level of precision and accuracy required will be dependent on the specific uses of the data. Data Quality Objectives (DQOs) have been developed and will be used to specify the quality of data required to support RFI activities. Data quality is defined as the degree of certainty of a data set with respect to precision, accuracy, reproducibility, comparability, and completeness. The five levels of data quality and the intended uses of each are as follows:

1. DQO Level 1 - This data quality level will be used for health and safety monitoring, field screening of soil samples for organic vapors using a photoionization detector, and bench scale tests used for determining remediation alternatives. This level of data provides the most rapid results.

2. DQO Level 2 - This level of quality will be used for field measurements performed in accordance with laboratory standard operating procedures but providing real-time results. DQO Level 2 data includes field measurements of pH, temperature, and specific conductance. On-site gas chromatograph analyses (soil vapor survey) will be performed using this level of quality. DQO Level 2 provides intermediate level data quality and is used for site characterization.

3. DQO Level 3 - This level of quality uses an off-site approved analytical laboratory following SW-846 protocols. Level 3 is characterized by rigorous QA/QC protocols and documentation. The Level 3 data are used for purposes of risk assessment, engineering design, and cost analyses. Data collected using this level of quality includes analysis of groundwater, surface water, sediment, and soil samples by a certified laboratory using USEPA methodologies.

4. DQO Level IV - This level of quality includes analyses performed by preapproved non-standard methods. All analyses are performed in an off-site approved analytical laboratory. Method development or method modification may be required for specific constituents or detection limits. Level IV is characterized by rigorous QA/QC protocols and documentation. The RFI activities proposed do not entail Level IV data.

5. DQO Level V - Level 5 data includes physical property and engineering material analyses by approved standard or non-standard methods. All analyses are performed in an off-site laboratory. QA/QC protocols and documentation may be required for some analyses.

Table 1 below presents a summary of the DQOs for the site.

TABLE 1
DATA QUALITY OBJECTIVES
BLOOMFIELD REFINING COMPANY RFI

PROJECT OBJECTIVES	TECHNICAL APPROACH	DATA TO BE COLLECTED	DQO LEVEL
Background Characterization	Soil vapor survey	Soil gas chemical composition	2
		Chemical composition	3
Extent of Contamination	Soil sampling	Chemical composition	3
		Organic vapor concentration (PID)	1
		Material property analysis	5
	Sediment sampling	Chemical composition	3
		Chemical property analysis-check	2
	Groundwater sampling	Water quality	3
		Water quality field parameters	2
	Surface water sampling	Water quality	3
		Water quality field parameters	2
Source Characteristics	Soil sampling	Chemical composition	3
		Organic vapor concentration (PID)	1
	Groundwater sampling	Water quality	3
		Water quality field parameters	2
Health and Safety	On-site monitoring	Organic vapor concentration (PID)	1
Risk Assessment	Soil sampling	Chemical composition	3
	Groundwater sampling	Water quality	3
	Surface water sampling	Water quality	3
	Sediment Sampling	Chemical composition	3
Assessment of Remediation Alternatives	Soil vapor extraction/air sparge pilot study	Soil gas chemical composition	3
		Organic vapor concentration (PID)	1
		Radius of influence	3
	Aquifer Pump Test		

Procedures used to assess the quality of data are specified in Section 3.6.3 of this Quality Assurance Plan and Section 5 of the Quality Assurance Project Plan, Laboratory Analyses in Appendix D.

3.1.2 Representativeness of Data

The technical approach for the facility investigation was presented in Section 2.0 - Project Management Plan. The sampling network was designed to provide data representative of site conditions. Data gaps identified in the Task 1 report were used to determine sampling locations. Selection of the specific sampling locations and sample analyses was based on existing knowledge of the release configuration, existing analytical data, and potential sources of contamination. Soil vapor survey points, soil borings and monitoring well locations were placed near the perimeter of the plume and in areas of potential contamination in order to supplement existing data. Surface water and sediment samples will be collected along the entire length of the Hammond Ditch surrounding the facility on all but the southern sides in order to obtain a representative set of samples.

3.1.3 Comparison of Data

All RFI data will be generated according to the Data Collection Quality Assurance Plan and the Data Management Plan. The following measures will be taken to ensure comparability of data sets:

- Standardized written field sampling procedures;
- Standardized written sample preparation and analytical procedures;
- Standard handling and shipping procedures used for all samples collected;
- Results reported in consistent formats and units.

Data previously generated by BRC will be used as a guideline for planning additional monitoring efforts, qualitative trend analysis, and selection of target parameters for future analyses.

3.1.4 Internal Quality Control Checks

Internal quality control procedures for laboratory analyses are described in Section 11 of the Quality Assurance Project Plan, Laboratory Analyses in Appendix D. Internal quality control procedures for field measurements include checking the reproducibility of measurements using duplicate samples, using field blanks to check for contamination that may be introduced during sampling procedures, and calibrating instruments prior to use.

3.1.5 Data Reduction, Validation, and Reporting

Data reduction and validation procedures for laboratory analyses are described in Section 10 of the Quality Assurance Project Plan, Laboratory Analyses in Appendix D. The format for laboratory analytical reports prepared by Inter-Mountain Laboratories, Inc. is outlined in Section 11 of the laboratory plan. Any data reduction and validation procedures used for field measurements will be described in the RFI report.

3.1.6 Performance and System Audits

Performance audits for laboratory activities are described in Section 12 of the Quality Assurance Project Plan, Laboratory Analyses in Appendix D. The Project Quality Assurance Manager will ensure proper execution of RFI field activities by routinely reviewing field notes and documentation. The objectives of project quality assurance are:

- To verify that a system for project documentation is established and the documentation plan is being followed.
- To verify that quality control procedures are established for all activities that generate environmental data and information.
- To identify non-conformance with the established system of quality control procedures.
- To recommend corrective actions for identified non-conformance.
- To verify implementation of corrective action.
- To provide written reports of audits.

The Project Quality Assurance Manager will ensure compliance with the following items:

- Written procedures for sample collection are available and are being followed.
- Chain-of-custody procedures are being followed.
- Appropriate QC checks are being performed and QC checks are documented.
- Equipment is available, calibrated, and in proper working order.
- Field personnel are properly trained.
- All field procedures are being documented in field notebooks and appropriate tracking forms.

3.1.7 Preventative Maintenance

Preventative maintenance for laboratory instruments and equipment is described in Section 13 of the Quality Assurance Project Plan, Laboratory Analyses in Appendix D. Preventative maintenance for field instruments will be conducted in accordance with the manufacturer's specifications described in each instrument's manual. The field personnel will be responsible for implementing and documenting the maintenance procedures.

3.1.8 Corrective Action

Any non-conformance with the established QC procedures in the Data Collection Quality Assurance Plan will be identified and corrected. Corrective action for laboratory instruments, procedures, or personnel is described in Section 15 of the Quality Assurance Project Plan, Laboratory Analyses in Appendix D. Corrective action for field measurements may include repeating a measurement, checking batteries on a field instrument, checking calibration of instruments, replacing an instrument, or stopping work until equipment is functioning properly. The Groundwater Technology Project Manager is responsible for controlling and tracking any necessary corrective action. The field personnel are responsible for implementing the corrective action and documenting the action in a field notebook.

3.2 Sampling

The sampling program includes the collection of soil, soil gas, surface water, groundwater, and sediment samples. Table 2 summarizes the RFI sampling and analysis program, with more detailed information included in Section 2.0 of the Project Management Plan. Field equipment checklists for each sample matrix are included in Appendix E.

TABLE 2
SUMMARY OF SAMPLING AND ANALYSIS PROGRAM
BLOOMFIELD REFINING COMPANY

SAMPLE MATRIX	FIELD PARAMETERS	LABORATORY PARAMETERS	INVESTIGATIVE SAMPLE NO.*	INVESTIGATIVE SAMPLE FREQ.
Groundwater	pH	VOCs (EPA 8240)	26	2
	Temperature	BNAs (EPA 8270)	26	2
	Specific conductance	TPH (EPA 418.1)	6	2
		PP Metals (EPA 6010/7000 Series)	6	2
Surface Water	pH	VOCs (EPA 8240)	14	1
	Temperature	BNAs (EPA 8270)	14	1
	Specific conductance	TPH (EPA 418.1)	14	1
	Dissolved Oxygen	PP Metals (EPA 6010/7000 Series)	14	1
		BOD	2	1
		COD	2	1
		TSS	2	1
		TDS	2	1
		TOC	2	1
		Nutrients	2	1
Soil	PID screening	VOCs (EPA 8240)	20	1
		BNAs (EPA 8270)	20	1
		TPH (EPA 418.1)	20	1
		PP Metals (EPA 6010/7000 Series)	20	1
		Grain size	3	1
		Effective/total porosity	3	1
		Hydraulic conductivity	3	1
		TOC	3	1
		Dry bulk density	3	1
		Ion exchange capacity	3	1
		pH	3	1
		Moisture content	3	1
		Specific conductance	3	1
Sediment	PID Screening	VOCs (EPA 8240)	14	1
		BNAs (EPA 8270)	14	1
		TPH (EPA 418.1)	14	1
		PP Metals (EPA 6010/7000 Series)	14	1
		pH	2	1
		Specific conductance	2	1
		TOC	2	1
		Nutrients	2	1
Soil Gas	On-site GC Analysis for: BTEX Total Volatile Hydrocarbons	N/A	100	1

* - In addition to the samples listed in the table, field blanks and duplicates will also be submitted for laboratory analysis.

3.2.1 Background Characterization

Prior to determining final locations of soil borings and monitoring wells, a soil vapor survey will be conducted to assist in delineating the contaminant plume. The data obtained during this survey will be used to determine the optimum boring/monitoring well locations. Since the contaminants of concern have high volatility, soil gas sampling will be an effective investigative measure.

Soil Vapor Survey

Tracer Research Corporation will be contracted to conduct the soil vapor survey under the supervision of Groundwater Technology personnel. The soil vapor survey is designed to cover the southern and eastern portions of the site with a grid of sampling locations based on 150 foot centers. The southern and eastern portions were selected because additional contaminant delineation is required in this area of the site. The proposed sampling locations are shown in Figure 2. These locations are subject to modification based on field conditions, such as the presence of aboveground or underground structures.

The specific objectives of the soil vapor survey are:

- To identify areas of contaminant impact and delineate contaminated zones.
- To identify and quantify specific contaminants of concern and map their areal distribution across the site.
- To determine the optimum locations for borings and monitoring wells.

The soil vapor survey will be conducted using the direct injection method to a laboratory-grade gas chromatograph equipped with a flame ionization detector (FID). Samples will be collected from two depths, three feet and ten feet below grade, at each location. The sampling procedures and quality assurance/quality control procedures are outlined in Appendix F, Soil Gas Sampling Procedures. The samples will be analyzed for benzene, ethylbenzene, toluene, total xylenes, and total volatile hydrocarbons (TVHC). Typical detection limits for these compounds are listed in Appendix F.

3.2.2 Soil Borings

As described in Section 2.0, approximately 10 soil borings will be installed in areas identified by USEPA during the 1987 inspection or other potential source areas based on the facility's spill history or the results of the soil vapor survey. These borings will be installed in order to characterize the horizontal and vertical extent of soil contamination. The number of borings may be adjusted based on the results of the soil vapor survey. Soil samples will be analyzed in order to characterize the nature and extent of contamination at these areas.

The borings will be advanced just beyond the depth of detectable contamination, which will be determined by PID screening. However, borings will not be advanced into the cobble layer, if encountered, the water table interface, or the top of the Nacimiento Formation (which is the impermeable lower boundary of the gravel and cobble aquifer). Samples will be collected continuously and will be screened in the field using a PID as described in section 3.2.2.3 below. Two soil samples from each boring (the sample exhibiting the highest PID reading and the sample collected at the water table interface) will be submitted for laboratory analysis. The parameters to be analyzed for are outlined in section 3.2.2.2 below. Borings will be properly abandoned following sample collection.

3.2.2.1 Monitoring Well Locations

The locations for the monitoring wells will be determined based on the results of the soil vapor survey. Preliminary locations for an estimated seven monitoring wells are presented in Figure 2. The wells are located in areas near the anticipated perimeter of the plume. The intent of these locations is to define the contaminant plume boundaries and to obtain data that will supplement existing information on the extent of contamination.

3.2.2.2 Measurement Parameters

Soil samples selected for laboratory analysis will be analyzed for volatile organic compounds (VOCs) using USEPA Method 8240, base/neutral/acid extractable semivolatile organic compounds (BNAs) using USEPA Method 8270, total petroleum hydrocarbons (TPH) using USEPA Method 418.1, and priority pollutant metals using USEPA Method 6010/7000 Series. Laboratory measurement parameters were determined based on the composition of known or suspected sources of soil contamination and in accordance with the requirements of the Administrative Order on Consent. In addition, a maximum of three representative soil samples will be analyzed for soil property analyses, including: grain size distribution, total porosity, effective porosity, hydraulic conductivity, total organic carbon (TOC), dry bulk density, ion exchange capacity, pH, moisture content, and specific conductance.

3.2.2.3 Field Measurements

Field Screening

Field screening of soil samples for VOCs will be used to evaluate the relative degree of contamination in the samples. The screening will be conducted by performing a headspace analysis on air in contact with a soil sample in a closed container. Selection of soil samples for laboratory analysis will be based on the field screening results.

A MicroTIP® MP-100 hand held air monitoring device will be used for the field screening during soil boring installations. This instrument is a microprocessor controlled instrument used for measuring the presence of photoionizable chemicals in air at parts per million levels. A pump continuously pulls air to be tested through the MicroTIP's PID. The PID measures the concentration of ionizable chemicals in the gas stream and produces an electrical signal for the microprocessor. Chemicals are ionized by a 10.6 electron-volt (eV) ultraviolet lamp. If the ionization potential of any molecule present in the air sample is less than or equal to 10.6 eV, ionization will take place and an electrical signal will be sent to the microprocessor.

Isobutylene at a known concentration (100 parts per million; ppm) will be used to calibrate the instrument. Therefore, concentrations are expressed in units equivalent to ppm of isobutylene. The instrument has a medium sensitivity to isobutylene and may respond more or less readily to other chemicals. The MicroTIP® does not distinguish one type of chemical from another, but displays a number indicating the total concentration of all ionizable compounds in the sample relative to isobutylene. The instrument will be calibrated once a day prior to use. The calibration procedure is summarized in Appendix G.

The MicroTIP® has the following limitations:

- Individual compounds are not identified.
- Compounds with ionization potentials greater than 10.6 eV will not be detected.
- Methane gas will not be detected.
- During cold weather, condensation may form on the UV lamp window. This could produce an erroneous reading.
- Instrument readings can be affected by humidity.

- Concentrations are expressed in units relative to isobutylene.

If the weather is cold, field screening will be performed inside a heated vehicle or building.

Measurement Procedure

The procedure to be used for measuring sample headspace relative VOC concentration is as follows:

1. Record the background ambient air concentration in a designated site field notebook. Locations with background readings greater than 3.0 ppm should not be used for field screening.
2. Fill a clean 8 ounce glass jar with the soil sample until the jar is one-third full. Immediately cover the top of the jar with a sheet of aluminum foil and screw on the jar cap.
3. Shake the jar vigorously for approximately 15 seconds and place the sample in an environment with a temperature of 55 degrees Fahrenheit or greater. Allow ten minutes for headspace development of VOCs and then shake the jar again.
4. Remove the jar cap and puncture the foil with the MicroTIP® sampling probe. Lower the probe into the jar until it reaches one-half of the headspace depth.
5. Record the maximum reading displayed on the instrument. Maximum response should be displayed within 5 seconds. If the instrument response is erratic due to high moisture content in the headspace, this should be noted.

Data Recording

PID data will be recorded in a site field notebook and on the Soil Boring Log shown in Appendix H - Field Documentation Forms. The PID data recorded in the field notebook will include verification of calibration, sample identification, sample depth, background reading, sample reading, time sample collected, time sample analyzed, instrument user, date, and instrument identification number. Additionally, instrument calibration records and maintenance records will be generated and kept up to date.

3.2.2.4 Field Sampling Operations and Procedures

Drilling Procedures

The drill-through casing driver method (percussion hammer) will be used for drilling since gravel and cobbles of the Quaternary Jackson Lake Terrace deposits will be encountered. This method has been selected since high drilling rates are achieved in gravel and cobble formations, drilling fluids are not introduced into the formation, and disturbance of subsurface materials is minimized. Boreholes used for the installation of monitoring wells will be advanced using an eight-inch diameter tungsten button bit to obtain an eight-inch diameter borehole. Steel casing (8 and 5/8-inch outer diameter, 8-inch inner diameter) will be driven simultaneously during drilling. Four-inch diameter boreholes will be drilled when monitoring wells will not be installed. A four-inch diameter button bit and four-inch diameter steel casing will be used for these boreholes. Boreholes that will not be used to install monitoring wells will be properly abandoned by filling with a cement-bentonite grout, which will be pumped into place, and sealing with a concrete cap.

Samples will be collected continuously during soil boring installations in advance of the drill bit using standard split-barrel sampling techniques as specified in ASTM Method D-1586-84. A portion of each sample will be placed in a 4 oz., wide mouth, glass jar with a teflon lined cap for possible laboratory analysis. The jar will be filled to the top to minimize loss of volatile organic compounds to headspace. If an adequate amount of sample is recovered, separate 4 oz. jars will be filled for each analysis required. Otherwise, one 4 oz. jar will be filled for VOC analysis and one 8 oz. jar will be filled for BNA, TPH, and metals analyses.

Another portion of each split-spoon sample will be transferred to an 8-ounce glass jar for headspace analysis. The procedure for headspace analysis and data recording is described in section 3.2.2.3. The soil sample above the water table exhibiting the highest PID reading will be submitted for laboratory analysis. The QA/QC sampling plan is described in Section 3.6.

Due to the nature of the cobble and gravel formation, it may not be possible to obtain samples from this formation using the split-barrel technique. Other sample collection techniques were evaluated and discussed with the drilling company. In the event that undisturbed samples cannot be obtained, drill cuttings will be collected for PID screening only.

All sample jars submitted to the laboratory will be labeled with the project number, borehole identification (B-sample #), sample depth (in feet from surface), date, time collected, sample type (grab or composite), and sampler name. All soil samples will be preserved by cooling to approximately four degrees Celsius. Samples to be analyzed will be placed on ice for delivery within 24 hours of sample collection to Inter-Mountain Laboratories in Farmington, New Mexico using proper chain-of-custody procedures. Chain-of-custody procedures are described in Section 3.2.7 and shipping procedures are described in Section 3.2.8.

In addition, a minimum of three representative soil samples will be collected and analyzed for grain size, total porosity, effective porosity, hydraulic conductivity, total organic carbon (TOC), dry bulk density, ion exchange capacity, pH, moisture content, and specific conductivity. Above the cobble and gravel formation, grab samples will be collected using thin-walled sampling tubes. Composite samples of the gravel formation will be collected from the drill cuttings for these analyses. The sample containers required for each analysis are shown in Table 3 below.

TABLE 3
SAMPLE CONTAINERS AND PRESERVATION FOR GEOTECHNICAL AND CHEMICAL TESTING SOIL SAMPLES

Analysis	Sample Container	Number of Containers	Preservation
Grain size distribution	4 oz. plastic or glass jar	1/2	N/A
Effective/total Porosity	4 oz. plastic or glass jar	1/2	N/A
Hydraulic conductivity	1 inch diameter, 1 ft. long sampling tube	1	N/A
TOC	8 oz. glass jar with teflon cap	1	Cool to 4°C
Dry bulk density	8 oz. glass jar with teflon cap	1	N/A
Ion exchange capacity	8 oz. glass jar with teflon cap	1	N/A
pH	8 oz. glass jar with teflon cap	2	Cool to 4°C
Moisture content	8 oz. glass jar with teflon cap	1	Cool to 4°C
Specific conductivity	8 oz. glass jar with teflon cap	1	N/A

Soil cuttings will be directed away from the drill crew during drilling operations using a directional pipe. The cuttings will be directed onto plastic sheeting, characterized and disposed of in accordance with state and federal regulations.

Data Recording

Each sample will be visually classified by a Groundwater Technology geologist in accordance with ASTM Method D2488-84 using the Unified Soil Classification System (USCS). Descriptions will be recorded in a designated site field notebook. The descriptions will include soil type, soil color, organic material content, grain size distribution, odor, consistency, density, grain shape and lithology, and PID reading. In addition, the borehole identification, sample depth, date, time collected, sample type (grab or composite), and sampler name will be recorded in the field notebook. This information will be used to prepare a lithologic borehole log for each borehole using the Boring/Monitoring Well Log shown in Appendix H - Field Documentation Forms. Each borehole location will be marked on the site map and distances from the borehole to at least three reference points will be measured and recorded on the map.

Decontamination Procedures

Prior to drilling, the drill rig and associated drilling equipment will be steam cleaned to minimize the potential for cross-contamination between locations. All downhole drilling equipment and associated tools will also be steam cleaned between each borehole to minimize cross contamination between boreholes. In addition, excess soil on the drill rig will be removed by using steel brushes. If it is necessary to store drill pipe or casing prior to use, the pipe and casing will be stored on racks and covered with plastic sheeting until used. All downhole sampling equipment will be cleaned between samples by scrubbing with potable water to remove soil particles, washing with an Alconox® solution, and rinsing with potable water.

A designated decontamination area will be set up for cleaning operations. The area will be lined with heavy plastic sheeting which will be bermed to prevent run off of decontamination water. The water collected on the plastic will be allowed to evaporate daily. At the close of each working day, the remaining water will be pumped into containers and transferred to BRC's oil/water separator, which is part of the facility's wastewater treatment system, for treatment.

3.2.3 Monitoring Well Installation

Based on the results of the Phase I and Phase II investigations, additional groundwater monitoring wells will be installed at approximately seven locations. Monitoring wells will be installed to determine the water table elevations over time, the presence or absence of separate-phase hydrocarbons on the groundwater surface, the presence or absence of specific contaminant compounds in the groundwater, and the concentration distribution of dissolved contaminants. Additionally, monitoring well data will be used to evaluate the mechanisms and direction of groundwater flow within the subsurface.

Monitoring wells will be installed using a drill-through casing driver method. Boreholes will be advanced using an eight-inch diameter tungsten button bit. Steel casing will be driven simultaneously during drilling. Monitoring wells will be installed to a depth of approximately ten feet below the water table.

3.2.3.1 Well Materials

Monitoring wells will be constructed using fiberglass-reinforced epoxy (FRE) casing and well screen. This material is resistant to most forms of corrosion, is not conductive, and has a strength similar to steel. All joints are flush threaded connections. Well casings and screens will be steam cleaned and sealed in plastic prior to use or will remain sealed in factory plastic until use. Well materials will be visually inspected for defects and defective material will not be used.

Typical monitoring well constructions are illustrated in Figures 5 and 6. Figure 5 illustrates a flush-mounted well and Figure 6 illustrates a well with casing extended above the ground surface. Monitoring wells will be constructed using four-inch diameter, 15 foot, 0.020-inch continuous slotted screens. Well casing length will depend on depth to the groundwater table. Wells located in high traffic areas will be set approximately six inches below grade and will be protected with an eight-inch diameter manhole cover, which will be secured in concrete and set at grade. Each flush-mounted well will be equipped with a vented, compression sealing well cap and lock. Wells located in non-traffic areas will extend approximately two feet above grade and will be protected with a six foot long metal protective casing. The protective casing will have an inside diameter of six inches and will be equipped with a locking cap. In addition, a compression sealing, vented well cap will be placed on each above grade well.

Clean, Global No. 5 silica sand filter pack will be used to fill the annular space surrounding the well screen. Based upon previous work at the facility, No. 5 sand is the optimum size filter pack. If conditions are different filter pack selection will be based upon screen analysis. The effective size of this pack is 90 percent retained on 0.020-inch slot openings. The filter pack will extend from 0.5 feet below the screen to two feet above the screen. A two foot thick bentonite seal will be placed above the filter pack. The remaining annular space will be sealed with a five percent bentonite-cement grout. The protective casing or manhole around each well will be set in concrete.

3.2.3.2 Installation Procedures

Upon borehole completion, six inches of filter pack will be placed in the bottom of the borehole. The well screen and casing will be lowered through the center of the steel-cased borehole by personnel wearing clean gloves. Monitoring wells will be installed to a depth of approximately ten feet below the water table. Filter pack will be placed in the annular space between the well screen and the borehole, pulling the temporary casing out of the hole as the filter pack is installed. A tape measure will be used to ensure the pack material is installed evenly and over the proper depth interval. After installing the two-foot bentonite seal, the bentonite-cement grout will be tremied into place. The protective casing or manhole cover will be centered over the well casing and set into place with a concrete cap. Protective casing for above ground wells will extend from 3.5 feet below grade to 2.5 feet above the ground surface. A concrete seal will be placed between the protective casing and the borehole. The concrete seal will extend from 3.5 feet below grade to above the ground surface and will be finished to slope away from the protective casing. The well will be set such that it is six inches below the top of the protective casing. Flush-mounted monitoring wells will be set six inches below grade.

3.2.3.3 Well Development

Well development will be conducted to remove the effects of drilling and monitoring well installation. The wells will be developed using a stainless steel, submersible pump. Groundwater will be purged from each well until approximately three well volumes have been removed, until sediment free water is produced, or until the well is purged dry. Well volumes will be calculated using the following equations:

$X - Y = Z$
$Z \times B = C$

Where:

X = Total depth of well
Y = Depth to water
Z = Linear feet of water column
B = Gallons/linear foot of casing
C = Amount of standing water in well

The volume of standing water in the well (C) will be multiplied by three to identify the appropriate gallons of water to be removed from the well. Periodic measurements of temperature, specific conductance, and pH will be made on purged water to check the stability of these parameters. Water level measurements will be obtained prior to development and after water levels have stabilized following development.

The pumping equipment will be decontaminated between wells by disassembling and scrubbing with an Alconox® solution, rinsing with tap water, and rinsing with distilled water. The purge water and decontamination water will be pumped to BRC's oil/water separator for treatment.

3.2.3.4 Data Recording

The calculated and actual amounts of each type of material used to construct the monitoring wells will be recorded. Well construction data will be recorded in a site field notebook and on a Boring/Monitoring Well Log. The data will include date and time of construction, drilling method used, well location, borehole and well casing diameter, well depth, well construction materials used (filter pack, casing, screen, and sealants) and a detailed drawing of the well. Each monitoring well location will be marked on the site map and the distance from each well to at least three reference points will be measured and recorded on the map.

Measurements taken during well development, the amount of purged water, and visual appearance of water will be recorded on the Well Development Form, which is included in Appendix H.

3.2.4 Groundwater Sampling

Groundwater sampling will be performed to determine the nature, extent, and magnitude of groundwater impacts. In addition, the groundwater data will be used to further characterize the site environmental setting and potential pathways of contaminant migration.

Groundwater samples will be collected from all new and existing recovery and monitoring wells that do not contain separate-phase hydrocarbons, with the exception of MW-7 and the three piezometers (P-1, P-2 and P-3). Two groundwater sampling events will be conducted during the investigation. The first round of samples will be collected shortly after development of all the new wells is complete. The second round will be collected after a minimum of 60 days from the date of the first sampling event.

3.2.4.1 Measurement Parameters

Groundwater water samples collected from the new wells will be analyzed for VOCs using USEPA Method 8240, BNAs using USEPA Method 8270, total petroleum hydrocarbons (TPH) using USEPA Method 418.1, and priority pollutant metals using USEPA 6010/7000 Series. Groundwater samples collected from previously installed wells will be analyzed for VOCs and BNAs only using USEPA Methods 8240 and 8270. Laboratory measurement parameters were determined based on the composition of known or suspected sources of groundwater contamination.

3.2.4.2 Groundwater Sampling Procedures

Prior to sampling, static liquid levels will be measured in all new and existing wells. The measurement procedures are outlined in Section 3.4. In addition, the total well depth will be measured in the new monitoring wells. This data will be recorded on the Well Gauging Data Form shown as in Appendix H.

Stagnant water will be purged from each well prior to sampling so that samples will be representative of in-situ groundwater quality. Approximately three well volumes of groundwater will be removed from each well using a stainless steel, pneumatic, submersible pump. The pump will be operated at a rate that does not cause recharge water to be excessively agitated. The pumping equipment will be decontaminated between wells by scrubbing with an Alconox® solution, rinsing with tap water, and rinsing with distilled water.

During purging, measurements will be made periodically of pH and temperature using a Cole-Parmer Model 5985-80 Digi-Sense pH meter while specific conductance will be measured using a YSI 33 S-C-T Meter. A minimum of three standing well volumes will be purged prior to sampling. During purging, measurements of pH, temperature and specific conductance will be collected. Purging beyond three standing volumes will proceed until stabilization of these parameters has occurred. Stabilization will be reached when three consecutive measurements of pH, temperature and specific conductance are within

10 percent. After sample collection, pH, specific conductance, and temperature will be measured again to check stability of the water. Measurements will be recorded on the Conductivity/Temperature/pH Meter Calibration and Results Log shown in Appendix H.

Groundwater samples will be collected using dedicated, disposable bailers and monofiliment cord or a pneumatic driven bladder pump (stainless). If the pump is used for sampling and/or purging, it will be operated in a continuous manner during purging and sampling. While sampling for volatile constituents, the pumping rate will not exceed 100 milliliters per minute. Sampling equipment will be decontaminated between uses by scrubbing with an Alconox solution followed by rinses with tap water and distilled-deionized water. All purged water and decontamination solutions will be containerized and placed in BRC's oil/water separator for treatment.

Samples will be transferred directly from the sampling equipment into the container that has been specifically prepared for each type of analysis. The sample containers for volatile organic analyses will be filled so that there is no headspace in the sample container to minimize the possibility of volatilization.

The wells will be sampled from least impacted to most impacted based on results of previous groundwater analyses. For wells not previously sampled, upgradient wells (MW-3, MW-5, MW-8 and MW-13) will be sampled before downgradient wells and suspected degree of contamination will be taken into account. Sample containers will be filled in the following order as recommended by EPA:

- VOCs
- TPH
- BNAs
- metals

All sample containers will be labeled with the following information:

- Project identification number
- Sample identification number, which will include sample type, i.e. groundwater and sample location (MW-#)
- Name of sampler
- Date and time of sample collection
- Analysis required
- Preservation used

Replicate groundwater samples, field blanks, and trip blanks will be collected to monitor quality assurance objectives. The QA/QC sampling plan is described in Section 3.6. All samples will be transported to the laboratory following procedures described in Sections 3.2.7 and 3.2.8.

3.2.4.3 Sample Containers and Preservation

Groundwater samples will be collected in clean, pre-labeled containers supplied by the laboratory. Table 4 below summarizes the sample containers and preservation that will be used for each analysis. The table also specifies how many containers will be collected per sample for each analysis.

TABLE 4
SAMPLE CONTAINERS AND PRESERVATION
GROUNDWATER SAMPLING

Analysis	Sample Container	Number of Containers	Preservative
VOCs	40 ml glass vial with teflon septum cap	3	adjust pH to <2 with 1:1 HCl, cool to 4°C or cool to 4°C (7 day holding time)
BNAs	1 liter amber glass bottle with teflon lined cap	3	cool to 4° C
TPH	1 liter amber glass bottle with teflon lined cap	2	adjust pH to <2 with 1:1 HCl, cool to 4° C
Metals	500 ml plastic bottle	1	adjust pH to <2 with HNO_3
Specific Conductance	16 ounce glass jar	field determined	N/A
pH/Temperature	16 ounce glass jar	field determined	N/A

3.2.4.4 Field Measurements

During purging prior to groundwater sampling, measurements will be made periodically of pH, specific conductance, and temperature. Measurements will be recorded on the Conductivity/Temperature/pH Meter Calibration and Results Log shown in Appendix H. Calibration procedures for these instruments are outlined in Appendix I and quality control procedures are described in Section 3.6.2. All instrument probes will be cleaned in between each sample measurement according to the instrument manufacturer's cleaning instructions.

pH Measurement/Temperature Measurement

Groundwater sample pH will be measured in the field using a Cole-Parmer Model 5985-80 Digi-Sense® pH meter. The pH meter will be calibrated daily prior to sample measurement. After calibration, the instrument will be used to measure pH and temperature as follows:

1. Connect the pH electrode and the automatic temperature compensation probe (ATC) to the meter.
2. Push the ON/OFF switch to turn the unit on.
3. Then push RANGE until the display indicates the desired mode. Note: When the instrument is switched on, it is in the pH mode.
4. Dip the pH electrode and the temperature sensor into the water sample. The pH value displayed will stabilize within a few seconds.
5. Remove the electrode and sensor from the water sample.
6. Press the RANGE key until the symbol °C appears on the display.
7. Dip the temperature sensor in the solution until the reading stabilizes.
8. Press the ON/OFF switch again to turn the unit off.

Specific Conductance Measurement

Specific conductance of groundwater will be measured in the field using a YSI 33 S-C-T Meter. The conductivity meter will be calibrated daily prior to sample measurement. Conductivity will be measured according to the following procedure:

1. Plug the conductivity/temperature probe into the jack on the side of the instrument.
2. Put the probe in the sample to be measured.
3. Switch the scale to X100. If the reading is below 50 on the 0-100 range, switch to X10. If the reading is still below 50, switch to the x1 scale. Read the meter scale and multiply the reading by the appropriate factor. The result is expressed in micromhos/cm. Note: Measurements are not temperature compensated.
4. When measuring on the X100 and X10 scales, depress the CELL TEST button. The meter reading should fall less than 2%. If the decrease is greater, clean the probe and remeasure conductivity of the sample.

3.2.4.5 Data Recording

Groundwater sampling data will be recorded on the Well Sampling Field Log and the Well Sampling Chart shown in Appendix H. Any additional information will be recorded in the site field notebook.

3.2.5 Surface Water Sampling

The surface water sampling plan is designed to determine whether surface water bodies are carrying contaminants from the facility to off-site locations. Surface water samples will be collected from the Hammond Ditch and the San Juan River. Three water samples will be collected from the San Juan River: one upstream, one downstream, and one midway between the first two. Surface water samples will be collected every 500 feet from the Hammond Ditch. Sample density will increase in the immediate area of the seep as illustrated in Figure 2.

3.2.5.1 Measurement Parameters

Surface water samples will be analyzed for VOCs using USEPA Method 8240, BNAs using USEPA Method 8270, total petroleum hydrocarbons using USEPA Method 418.1, and priority pollutant metals using USEPA 6010/7000 Series. Additional water samples will be collected from one representative location and analyzed for pH, temperature, specific conductance, dissolved oxygen, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), total organic carbon (TOC), and nutrients. Temperature, specific conductance, dissolved oxygen and pH will be measured in the field following procedures described in Section 3.2.4.4 above. The remaining analyses will be performed by Inter-Mountain Laboratories, Inc. in Farmington, New Mexico following procedures listed in Table 5.

3.2.5.2 Sampling Procedures

The water samples will be collected in clean containers supplied by the laboratory and specifically prepared for each type of analysis. Samples will be collected from mid-depth at a point as close as possible to the center of the water body at each selected sampling location. The sample containers will be lowered into the water while still capped, uncapped and allowed to fill, and then recapped before removing from the water. The mouth of the container will face into the flow of water and the sampler will be downstream of the sample bottle to minimize disturbance of the bottom sediments. For VOC analyses, the sample containers will be completely filled to avoid volatilization.

The samples will be collected in the following order as recommended by the USEPA:

- VOCs
- BNAs
- TOC
- TPH
- Dissolved metals
- BOD
- COD
- TSS
- TDS
- Nutrients

The sample containers will be labeled with the following information:

- Project identification number
- Sample identification number, which will include sample type, i.e. surface water and sample location
- Name of sampler
- Date and time of sample collection
- Analysis required
- Preservation used

All laboratory samples will be packaged and transported to the laboratory following procedures described in Sections 3.2.7 and 3.2.8. Replicate field samples and field blanks will be collected to monitor quality assurance objectives. The QA/QC sampling plan is described in Section 3.6.

3.2.5.3 Sample Containers and Preservation

Sample containers and preservation for each analysis are listed in Table 5 below.

TABLE 5
SAMPLE CONTAINERS AND PRESERVATION SURFACE WATER SAMPLING

Analysis	Sample Container	Number of Containers	Preservative
VOCs	40 ml glass vial with teflon septum cap	3	2 drops HCL, cool to 4°C for 14-day holding time or cool to 4°C for 7-day holding time.
TOC	40 ml glass vial with teflon septum cap	2	adjust pH to <2 with 1:1 H_2SO_4, cool to 4°C
TPH	1 liter amber glass bottle with teflon lined cap	2	adjust pH to <2 with 1:1 HCl, cool to 4°C
BNAs	1 liter amber glass bottle with teflon lined cap	1	Cool to 4°C
Dissolved metals	500 ml plastic bottle	1	adjust pH to <2 with HNO_3
BOD	1 liter plastic bottle	1	cool to 4° C
COD	100 ml plastic bottle	1	adjust pH to <2 with 1:1 H_2SO_4, cool to 4° C
TSS	500 ml plastic bottle	1	cool to 4° C
TDS	500 ml plastic bottle	1	cool to 4° C
Nutrients	250 ml plastic bottle	1	adjust pH to <2 with 1:1 H_2SO_4
Specific Conductance/Dissolved Oxygen	16 ounce glass jar	field determined	N/A
pH/Temperature	16 ounce glass jar	field determined	N/A

3.2.5.4 Data Recording

Field data will be recorded in a site designated field notebook and on the Sediment/Surface Water Sampling Field Log shown in Appendix H. Each sampling location will be marked on the site map and distances from the sample location to at least three reference points will be measured and recorded on the map.

3.2.6 Sediment Sampling

The sediment sampling plan is designed to assess the potential for sediment in the San Juan River and the Hammond Ditch to impact groundwater quality and surface water quality. Three sediment samples will be collected from the southern bank of the San Juan River: one upstream, one downstream, and one midway between the first two. Sediment samples will be collected every 500 feet from the banks of the Hammond Ditch. A estimated total of 14 sediment samples will be collected. Sample density will increase in immediate proximity of the seeps.

3.2.6.1 Measurement Parameters

Sediment samples will be analyzed for VOCs using USEPA Method 8240, BNAs using USEPA Method 8270, TPH using USEPA Method 418.1, and priority pollutant metals using USEPA Method 6010/7000 Series. Sample analyses will be performed by Inter-Mountain Laboratories, Inc. in Farmington, New Mexico following procedures listed in Table 6. Measurement parameters were determined based on the composition of known or suspected sources of sediment contamination.

3.2.6.2 Sampling Procedures

The sediment samples will be collected in clean containers supplied by the laboratory and specifically prepared for each type of analysis. Bottom sediment samples will be collected along the banks of each water body. If possible, the upper six inches of sediment will be removed using a clean stainless steel trowel. After decontamination of the trowel, a sediment sample will be collected. A second sample will be collected from each location for field screening using a PID. PID measurements will be performed following procedures described in Section 3.2.2.3.

The trowel will be decontaminated by scrubbing with potable water to remove soil particles, washing with an Alconox® solution, and rinsing with potable water. The sediment sample will be packed tightly into the appropriate containers and the containers will be immediately sealed. All sample jars will be labeled with the project number, sample identification, sample depth, date, time collected, sample type (grab or composite), and sampler name.

The samples will be collected in the following order as recommended by the USEPA:

- VOCs
- BNAs
- TOC
- TPH
- Metals

Replicate field samples and field blanks will be collected to monitor quality assurance objectives. The QA/QC sampling plan is described in Section 3.6. All samples will be placed on ice to cool to 4° Celsius and transported to the laboratory for analysis following the procedures described in Sections 3.2.7 and 3.2.8.

3.2.6.3 Sample Containers and Preservation

TABLE 6
SAMPLE CONTAINERS AND PRESERVATION
SEDIMENT SAMPLING

Analysis	Sample Container	Number of Containers	Preservative
VOCs	4 oz. glass jar with teflon cap	1	cool to 4° C
BNAs	8 oz. glass jar with teflon cap	1	cool to 4° C
TPH	4 oz. glass jar with teflon cap	1	cool to 4° C
Metals	8 oz. glass jar with teflon cap	1	cool to 4° C

3.2.6.4 Data Recording

Field data will be recorded in a site designated field notebook and on the Sediment/Surface Water Sampling Field Log shown in Appendix H. Each sampling location will be marked on the site map and distances from the sample location to at least three reference points will be measured and recorded on the map.

3.2.7 Sampling During the Pilot Tests

An aquifer pump test and a soil vapor extraction/air sparge pilot test will be performed as part of the RFI activities at the BRC site. No chemical analyses are proposed to be performed during the aquifer test. Monitoring of drawdown will be conducted automatically using an ORS Environmental Equipment DL-120 Data Logger and pressure transducers at pre-programmed time intervals and manually using an ORS Interface Probe at regular time intervals. The Data Logger will be calibrated at the factory and shipped directly to the site. The Interface Probe will be calibrated and maintained in the field using manufacturer's recommendations. Manual gauging will serve as quality assurance of the programmed logger.

Magnehelic gauges will be used to monitor vacuum rates during the air sparge/soil vapor extraction pilot study. Calibration and maintenance of these gauges and Kurz flow meters, the MSA LEL/O_2 meter, thermometer, and PID used during the pilot study will be performed in accordance with manufacturer's specifications. During the test, the following measurements will be recorded:

- Pre- and post-filter vacuum at the blower;
- Induced vacuum at surrounding monitor points;
- Applied vacuum at the vapor extraction wellhead;
- Pre- and post-blower air stream temperature;
- Process air stream velocity; and
- Air influent (pre-treatment) and effluent (post-treatment) organic vapor concentrations and percent lower explosive limit (LEL).

Air bag sampling will be conducted during the soil vapor extraction/air sparging pilot study as described in Section 2.0. Three air bag samples will be collected during the soil vapor extraction test and three during the combined soil vapor extraction/air sparging test. Samples will be collected right after startup, midway and right before the end of the tests, at a sampling port located prior to the blower and before the treatment units (granular activated carbon). These samples will provide information for the permitting of a full-scale system should pilot testing indicate that the technology is feasible. Additionally, air bag sample concentrations will be used to design vapor abatement equipment for the full-scale system.

3.2.7.1 Measurement Parameters

The six air bag samples will be analyzed for total nonmethane hydrocarbons (USEPA Method TO-18), purgeable aromatics and hydrocarbons (USEPA Method 8010/8020), and methane, carbon dioxide, and oxygen (GC-TCD). Sample analyses will be performed by Inter-Mountain Laboratories, Inc. in Farmington, New Mexico following procedures listed above. Measurement parameters were determined based on the composition of known or suspected soil vapor contamination.

3.2.7.2 Sampling Procedures

The air samples will be collected in clean Tedlar air bags supplied by the laboratory and labeled with the project number, sample identification, date, time collected, sampler name and notation about which point (beginning, midway, end) of the pilot study the sample was collected.

3.2.7.3 Data Recording

Field data will be recorded in a site designated field notebook. Each bag will clearly indicate whether it was taken at the beginning, midpoint or end of the test, and whether the soil vapor extraction system was operating alone or in conjunction with the air sparging system.

3.2.8 Sample Custody Procedures

The chain of custody program will allow for the tracking of possession and handling of each sample from the time of field collection through completion of laboratory analysis. The chain-of-custody program includes:

- Sample labels - The information required on sample labels for each type of sample has been described in previous sections (Sections 3.2.2.4, 3.2.4.2, 3.2.5.2, and 3.2.6.2).
- Sample seals - Seals will be placed on individual sample containers to ensure that the samples were not disturbed during transportation.

- Field notebook - All field sampling data will be recorded in a designated site field notebook.
- Chain-of-custody record - A chain-of-custody will be filled out and accompany every sample submitted to the lab. The chain-of-custody will include project identification, sample identification, signature of sampler, date and time of sample collection, sample type, sample preservation, number of containers, parameters requested for analysis, signatures of all persons involved in the chain of possession, dates of possession, and temperature of each container upon receipt by the laboratory. The original chain-of-custody will accompany the shipment and the sampler will retain one copy as a record of samples submitted to the laboratory. A copy of the chain-of-custody form that will be provided by Inter-Mountain Laboratories, Inc. is included in Appendix D.
- Laboratory logbooks - The laboratory chain-of custody procedures and documentation of the processing steps that are applied to samples once they have been received by the laboratory are described in the Quality Assurance Project Plan, Laboratory Analyses prepared by Inter-Mountain Laboratories, Inc. This plan is included as Appendix D.

3.2.9 Sample Shipping Procedures

Samples will either be hand delivered to the laboratory by Groundwater Technology personnel or picked up from the site by Inter-Mountain Laboratories, Inc. personnel. All glass containers, except VOA vials, will be wrapped in bubble pack, which will be secured with tape. VOA vials will be placed in their original foam packing containers. A sturdy cooler will be used as a transporting container. The drain plug on the cooler will be taped shut and a large plastic bag will be used as a liner for the cooler. Approximately one inch of packing material will be placed in the bottom of the liner. Samples will be placed in the cooler and covered with bagged ice. Enough ice will be packed in the cooler to keep the samples cooled until the laboratory receives the samples. The remaining space in the cooler will be filled with packing material and the plastic liner will be taped shut. The chain-of-custody form will be placed in a plastic "zip-lock" bag, which will be sealed and taped to the inside of the cooler lid. The cooler will be closed and taped shut with packing tape.

3.3 Sample Analysis

3.3.1 Analytical Laboratory Procedures

The Quality Assurance Project Plan, Laboratory Analyses (Appendix D) prepared by Inter-Mountain Laboratories, Inc. specifies the following information:

- USEPA analytical methods to be used for sample analysis, including potential interferences, detection limits, and the required precision and accuracy
- Sample preparation methods
- Sample storage and handling procedures
- Chain-of-custody procedures
- Responsibilities of the laboratory staff
- Quality assurance objectives and criteria
- Internal quality control procedures
- Calibration and quality control parameters
- Data reduction and validation procedures
- Preventative maintenance procedures
- Corrective action procedures
- Quality assurance reporting procedures
- Laboratory results reporting

The third addition of SW-846 (Test Methods for Evaluating Solid Waste, November 1986) and EPA-600/4-79-020 (Methods for Chemical Analysis of Water and Waste, March 1983) specify the analytical procedures to be used for sample analyses.

3.3.2 Field Procedures

The procedures for field measurements of pH, specific conductivity, temperature, and PID field screening are described in Sections 3.2.2.3 and 3.2.4.4. These procedures follow instrument manufacturer guidelines and USEPA guidelines.

3.3.3 Material Property Testing

Material property testing, which will be performed by Inter-Mountain Laboratories, Inc., includes grain size analysis, total and effective porosity, hydraulic conductivity, dry bulk density, ion exchange capacity, and moisture content. The methods used for these analyses will follow American Society for Testing and Materials (ASTM) procedures or other standard procedures.

3.4 Fluid Level Measurement

Water level measurements will be performed to determine the configuration and the temporal variation of the water table elevation. This information will be used to determine vertical and horizontal groundwater flow directions, hydraulic gradient(s), and potential fluid migration pathways. Liquid level measurements will be collected once a month during the RFI.

3.4.1 Static Liquid Level Measurement

Static liquid level measurements will be collected using an ORS Interface Probe®. The probe is capable of measuring depth to fluids to the nearest 0.01 foot. After removing the well cap, the air in the casing will be screened using a PID to determine if vapors are present. The interface probe will be lowered into the well until it reaches the fluid level. The probe indicates the presence of separate phase hydrocarbons by producing a solid tone and the presence of water by a beeping tone. The thickness of each layer will be determined by measuring the length of cable in the well at each interface. Measurements will be taken from the north side of the casing, which will be permanently marked. The probe will be lowered to the bottom of the well to determine the total well depth.

The fluid elevations will be calculated using the depth to fluid and the top of casing elevation data. If separate phase hydrocarbons are detected, the water table elevation will be corrected to account for water table depression resulting from the hydrocarbon layer.

To minimize the potential for cross contamination, liquid level measurements will be collected from least impacted to most impacted wells. The probes will be decontaminated between wells by washing with an Alconox® solution and triple rinsing with distilled water. All decontamination water will be placed into appropriate containers and transferred to BRC's oil/water separator for treatment.

3.4.2 Data Recording

Measurements will be recorded to the nearest 0.01 foot in a designated site field notebook and on the Well Gauging Data Form included in Appendix H. The well location, diameter, depth, date and time of measurement, and any additional comments will also be recorded on the gauging form.

3.5 Surveying

The location, elevation of the top of casing and elevation of the ground surface for each monitoring well and boring will be surveyed by professional certified surveyors. Elevations will be measured to the nearest 0.01 foot and will be referenced to a United States Geological Survey (USGS) benchmark. All elevations will be documented on the Boring/Monitoring Well Log form and recorded in a field notebook. Lateral locations will be determined to the nearest 0.1 feet, and the monitoring well locations will be presented on a scaled site map.

3.6 Quality Assurance Objectives for Measurement Data

The overall quality assurance objective is to develop and implement procedures for field sampling, sample analysis, and reporting that will provide legally defensible data. Specific procedures for sampling, sample custody, field measurements, laboratory analysis, data reduction and validation, reporting, internal quality control, audits, preventative maintenance, and corrective actions are provided in other sections of this Data Collection Quality Assurance Plan. This section defines the goals for the parameters used to evaluate data quality.

3.6.1 Regulatory Requirements

The laboratory analytical methods and detection limits required to meet the data quality objectives and the regulatory requirements are listed in the Quality Assurance Project Plan, Laboratory Analysis prepared by Inter-Mountain Laboratories. This plan is included as Appendix D.

3.6.2 Field Measurement Quality Control Procedures

Field duplicates and field blanks will be collected and submitted to the laboratory for analysis to assess the quality of the data resulting from the field sampling program. Duplicate samples will be analyzed to check for sampling and analytical reproducibility. Blank samples will be analyzed to check for contamination that may be introduced during sampling procedures.

One field duplicate will be collected for every ten aqueous samples, i.e. groundwater and surface water. Duplicates will not be collected for soil or sediment samples. One trip blank will be included along with each shipment of aqueous VOA samples. Equipment blanks will be prepared each day that groundwater monitoring wells are sampled. Blanks will not be collected for soil or sediment samples.

Trip blanks will be prepared by the laboratory using laboratory demonstrated analyte-free water. The trip blank sample will be transported to the site, handled like a sample, and returned to the laboratory for analysis. Equipment blanks will be prepared by pumping deionized water through the sampling pump after cleaning, collecting a sample of the water running through the pump, and submitting the sample to the laboratory for analysis (or rinsing a disposable bailer and collecting the rinse water).

The quality control effort for the field measurement of pH and specific conductance consists of daily calibration prior to measurement and post-measurement verification using standard reference solutions. Post-measurement verification will be performed for each sample tested.

If sufficient sample is available, headspace analysis will be performed in duplicate. In addition, a blank sample will be measured after every 10 soil samples measured to determine if any contamination is being introduced during the measurement procedure. The same procedure outlined in Section 3.2.2.3 will be followed for the blank except no soil will be placed in the jar.

Quality control of liquid level measurements consists of comparing the current field measurement to the previous measurement, site conditions, and monthly rainfall. If discrepancies are observed, liquid levels will be remeasured.

Quality control procedures to be used during the soil vapor survey are specified in the document prepared by Tracer Research Corporation titled Soil Gas Sampling Procedures, Quality Assurance and Quality Control Procedures. This document is included in Appendix F.

3.6.3 Field Measurement Quality Assurance Objectives and Criteria

The accuracy of field measurements of pH will be assessed through daily calibration and post-measurement verifications using at least two standard buffer solutions. Each of the measurements must be within plus or minus 0.05 standard units of the buffer solution values. Precision will be assessed through duplicate measurements. The electrode will be withdrawn, rinsed with distilled water, and immersed in the duplicate sample. The relative percent difference (RPD) for the duplicates will be calculated. Verification will be performed after the second replicate measurement. Temperature measurements will be to the nearest degree (plus or minus 0.5 degrees).

Specific conductance measurements will be assessed through daily calibration and post-measurement verification using a standard solution. Each verification measurement must be within plus or minus 6 % of the standard solution value. Precision will be assessed through duplicate measurements. The RPD for the duplicates will be calculated. Verification will be performed after each replicate has been measured.

Duplicate PID readings will be compared. Replicate values should be within plus or minus 20 percent. Accuracy will be verified by confirming instrument calibration after every 20 measurements. Verification of calibration should provide readings within one percent of the calibration gas concentration. If the reading is not with one percent, calibration of the instrument will be repeated.

Quality assurance procedures to be used during the soil vapor survey are specified in the document prepared by Tracer Research Corporation titled Soil Gas Sampling Procedures, Quality Assurance and Quality Control Procedures. This document is included in Appendix F, and includes equipment calibration, blank samples and duplicate samples.

3.6.4 Laboratory Quality Control Procedures

Quality control parameters used within the laboratory are described in Section 8 of the Quality Assurance Project Plan, Laboratory Analyses in Appendix D. Method blanks, duplicate analysis, spiked analysis, spiked duplicate analysis, and laboratory control samples will be used to evaluate the validity of the laboratory results.

3.6.5 Laboratory Quality Assurance Objectives and Criteria

The accuracy, precision, representativeness, completeness, and comparability requirements are specified in Section 5 of the Quality Assurance Project Plan, Laboratory Analyses Included in Appendix D.

3.7 Contaminated Material Disposal

All purge water and decontamination water generated during RFI field activities will be placed into temporary labeled containers and transferred daily to BRC's oil/water separator, which is part of the water treatment system, for treatment.

Soil cuttings will be screened during the investigation using a PID. Clean soils and cuttings will be left in place. Contaminated cuttings will be characterized and disposed of in accordance with state and federal regulations.

4.0 DATA MANAGEMENT PLAN

This Data Management Plan identifies procedures which document data collected under the RCRA Facility Investigation (RFI) at the Bloomfield Refinery Company in Bloomfield, New Mexico. The management plan insures that the data is correct, readily available, and of high quality to support the Corrective Measures Study. The plan identifies field documentation procedures, transfer of data to organized forms, tabulation of data for evaluation and report presentation, project file format, and the contents of monthly progress reports.

Data will be collected from: drilling of soil borings, installation of monitoring wells, surveying wells, gauging wells, collecting soil gas, soil, sediment, surface water, and groundwater samples; and performing an aquifer and a soil vapor extraction/air sparge pilot test. Data collection procedures and detailed field documentation procedures are identified in the Data Collection and Quality Assurance Plan. This plan further identifies the documentation procedures as well as procedures for tabulation and presentation of the data.

4.1 Field Documentation Procedures

Field activities will be recorded in various forms including the field notebook, field documentation forms, chains of custody, and sample labels. Field personnel will review their data documentation before leaving the site each day to ensure it is complete and correct. The project manager or a technically qualified individual will also review the field notes for accuracy and completeness prior to having them filed.

4.1.1 Field Notebook

The primary document for recording information is the field notebook. The field notebook is a hard cover bound book, to which entries are made legibly using waterproof ink. Data in the field book will be organized similar to the data required in the field logs. The field notebook will contain the following information, with general information included daily regardless of the specific field activity.

General Information

- Site name, project number, task number;

- Date, weather, time of arrival;
- Workers, subcontractors, and visitors to the site;
- Time of each activity conducted throughout the day;
- Health and safety monitoring equipment and results;
- Equipment used and identification number;
- Unusual occurrences;
- Number, type of containers, and management of waste materials generated; and
- Signature.

Well Gauging, Sediment, Surface Water, and Groundwater Sampling

- Condition of well casing, well box, locks, and plugs;
- Gauging data - depth to water, depth to other liquid material, bottom of well;
- Volume of water evacuated and method, approximate rate of recovery;
- Order of wells sampled;
- Time and method of sample collection;
- Field analysis equipment and results;
- Sample containers and preservatives used;
- Sample analysis, laboratory, and shipment method; and
- Other observations.

Logging, Soil Sample Collection and Monitoring Well Installation

- Drilling contractor, names, license;
- Drilling method and equipment used;
- Boring identification, sketch map showing location;
- Time of boring and well installation;
- Sample collection and decontamination procedures;
- Field equipment used and field screening results;
- Soil sample identification, description, moisture;
- Depth to water;
- Monitoring well construction and listing of materials used;
- Well development procedures and observations;
- Sample analysis, laboratory, and shipment method;

- Well gauging data;
- Decontamination procedures, water containment and time; and
- Other observations.

4.1.2 Field Documentation Forms

Field documentation forms include similar information to that contained in the field notebook. However, the information is more readable and specific data can be easily extracted for evaluation. Standard forms are included in Appendix H. The forms are identified below with a summary of their contents. All forms require the identification of the field person responsible for the given activity, date, and site name.

- Conductivity/Temperature/pH Meter Calibration and Results Log to document the calibration of the meter and present the results of each sample.
- Boring/Monitoring Well Log to document the boring/well installation procedures, well construction, field analysis, and soil lithology.
- Well Gauging Data Form to record the depth to water and the depth to product (other liquid material) in monitoring wells.
- Well Sampling Field Log to document the well development and sample collection procedures.
- Well Sampling Chart which includes gauging and purging data.
- Chain-of-Custody supplied by Inter-Mountain Laboratories to identified sample collection and analysis information and to document personnel responsible for sample custody from sample collection to delivery of the sample to the laboratory for analysis.
- Soil Gas Investigative Background Information to identify general site conditions relevant to the soil gas survey such as depth to water, target VOCs, and sources of contamination.
- Soil Vapor Extraction Test Data form to record the time, sample number, probe, vacuum, sample volume and time evacuated, and other notes.
- Daily Summary to document the days activities and decontamination procedures used (Log Book).
- Aquifer Test Data Form to record the time of water level measurements, elapsed time since the start of the test, flow rate, water level measurements and drawdown.
- Surveying will be conducted by a licensed surveyor and will be documented by the surveyor according to standard industrial practice.

4.1.3 Sample Identification Procedures

Samples of media collected from the site will be identified by a label or other appropriate techniques. Labels will be completed with waterproof ink and firmly affixed to the sample containers. The labels are typically provided by the laboratory. The following information will be included on the label.

- Project name and number;
- Name of the individual collecting the sample;
- Date and time of sample collection;
- Preservative used, if any;
- Sample identification indicating areal and depth (if appropriate) of collection point; and
- Analysis required.

The sample identification will be according to Section 3.0. Each sample collected will be recorded in the field book, and if appropriate, the field log and chain-of-custody form.

4.2 Data Tabulation and Storage

4.2.1 Data Tabulation

Data collected during the RFI will be tabulated to facilitate evaluation and clear presentation. Gauging data will be presented in tabular form to include the following information:

- Date of gauging (DD-MM-YY);
- Well ID No.;
- Surveyed well elevation [feet above mean sea level (MSL)];
- Depth to water from top of well casing (in feet);
- Depth to separate-phase hydrocarbon (SPH) layer from top of well casing, if present (in feet);
- Calculated SPH thickness, if present (in feet); and
- Calculated water table elevation (in feet above MSL).

Groundwater laboratory analytical data may be tabulated several different ways, depending upon the use of data. One method of tabulation presents well identification, chemical parameters, and multiple dates of sampling to show variations through time. Another tabulation presents multiple well identification, chemical parameters, and a single data of sampling (see Table X below).

TABLE X: LABORATORY ANALYTICAL RESULTS (GROUNDWATER)		
Sample ID	MW-1	MW-2
Sample Date		
Analyte #1 (ppb)		
Analyte #2 (ppb)		

Soil laboratory analytical results will also be tabulated to help identify contaminants by the vertical or horizontal extent of selected chemicals (see Table Y below).

TABLE Y: LABORATORY ANALYTICAL RESULTS (SOIL)				
Sample ID (Depth)	MW-1 5'-6.5'	MW-1 16.5'-18'	MW-2 10'-11.5'	MW-2 17'-18.5'
Sample Date				
Analyte #1 (ppm)				
Analyte #2 (ppm)				

Data collected from the soil vapor extraction pilot test will be tabulated identifying wellhead vacuum, vent flow rate, emission rate, and radius of influence. Semilogarithmic graphs will also be used presenting the log of the vacuum at a point versus distance from the vapor extraction point (wellhead) for a given flow rate.

The aquifer test data will be presented on tabular form showing time elapsed, water table elevation, and drawdown for each observation well monitored. This data will be directly downloaded from the field instruments to the computer to eliminate mistakes by manual re-entry of data. A time-drawdown curve will be generated for each observation well using the GWAP software program.

Facility and areal maps will also be used to tabulate certain data such as groundwater elevations and contaminant concentrations. Data will be numerically identified on the map at the point of collection. This mechanism for tabulating data allows data to be evaluated from an areal perspective. Data points may also be contoured.

4.2.2 Data Storage

Data collected under the RFI and any other environmental activities being conducted at the site will be stored in a central file system in the environmental consultant's office. A copy of selected investigative information and all community relations documents (local contacts, press releases, fact sheets) will be stored at a central location at the facility. The laboratory will also maintain a filing system for documents necessary for the analytical process. The standard file system contains the following folders:

- Project Management - (project organization, contracts, billing, quality issues, etc...);
- Correspondence - (phone logs, correspondence, meeting notes, etc...);
- Reports - (monthly status, quarterly status, permit compliance, end of phase, etc...);
- Permits & Licenses - (well records, water discharge, air emissions, construction, waste activity, waste compliance, etc...);
- Site Safety - (site safety plan, signed acknowledgements, safety monitoring, etc...);
- Data - (site visit forms, well logs, liquid level and well monitoring data, lab analysis, etc...);
- Analysis/Design - (potentiometric surface maps, APT data, SVE data, hydrographs, product recovery forms, etc...);
- Miscellaneous - (photos, legal, newspaper articles, etc...).

Field notes will be reviewed by the project manager or another technical person for completeness and accuracy. The field notes will then promptly be filed in a central file system in the consultant's office. Correspondence, contracts, billing information, and reports and all other information will be added to the file promptly after review and finalization. A project administrator will be responsible for maintaining the project file.

4.3 Reports

4.3.1 Monthly Progress Reports

Monthly progress reports, as required by Task VI of Attachment II to the Consent Order, will be submitted to the New Mexico Environmental Division and the USEPA throughout the duration of the RFI. Three copies of the progress reports will be submitted to USEPA on the 10th day of the following months, by hand or by certified mail (return receipt requested). The progress reports will contain the following information:

- A description and estimate of the percentage of the RFI completed;
- Summaries of all findings for the month;
- Summaries of all changes made in the RFI during the reporting period;
- Summaries of all contacts with representatives of the local community, public interest groups, or the New Mexico government during the reporting period;
- Summaries of all problems or potential problems encountered during the reporting period;
- Actions being taken to rectify problems;
- Projected work for the next reporting period;
- Copies of all field data notes; and
- Copies of laboratory analytical results and laboratory quality control data obtained during the reporting period.

4.3.2 RFI Report

A draft RFI report (Task III) will be submitted to the USEPA following the completion of the investigation activities. The report will contain an analysis and summary of all facility investigations implemented pursuant to the workplan. Specifically, the RFI Report will describe the nature and extent of contamination, potential impacts to human health and the environment, and the results of pilot tests or bench scale studies. The RFI report will consolidate information provided in the monthly status reports and present a complete evaluation of data. Data will be presented in a report narrative and data summaries in the form of figures, maps, tables, and graphs. Field notes, laboratory analytical results, and other raw data will be contained in the Appendices. The report will be submitted to USEPA as a draft for review and comment. A final report including USEPA's comments will be submitted within 30 days of receipt of USEPA comments.

4.3.3 Other Reports

Other reports specific to the interim measures, pilot tests, or community relations (if necessary) may be written during the course of the RFI. The reports may contain data, evaluations, and conclusions to meet the purpose of the report. A copy of these reports would be mailed to USEPA, as well as stored in the comprehensive filing system.

5.0 COMMUNITY RELATIONS PLAN

5.1 Purpose

This Community Relations Plan describes how the public will be informed of environmental investigation and remediation activities conducted at the Bloomfield Refining Company's (BRC) Bloomfield, New Mexico facility. To date, there has been little, if any, public inquiry regarding petroleum releases to the environment, or regarding environmental investigations and remediation. Although the amount of public interest is not expected to change, BRC is prepared to respond to inquiries as explained in this Community Relations Plan.

A RCRA Facility Investigation (RFI), interim measures, and an evaluation of remediation technologies (Corrective Measures Study, CMS) are being/will be conducted under the Administrative Order on Consent issued under Section 3008(h) of the Resource Conservation and Recovery Act (RCRA) finalized by the USEPA on December 31, 1992. The RCRA federal law requires that environmental investigations be conducted at all facilities that treat, store, or dispose of hazardous waste when there is a potential for a contaminant release to the environment. Corrective action provides protection of human health and the environment from hazardous wastes or hazardous waste constituents released to the environment.

5.2 Facility Description

The Bloomfield Refining Company facility is located at #50 County Road 4990 (Sullivan Road), south of the Town of Bloomfield. The facility is directly surrounded by undeveloped private and public land primarily used for oil and gas production. The refinery is constructed on 287 acres of land owned by the company, and was originally constructed in 1959, with a number of expansions since that time. The refinery has a crude capacity of 18,000 barrels per calendar day. Currently, seventy percent of the refinery's crude supplies are delivered by pipeline and thirty percent arrive by tanker truck. The following products are produced by BRC at the facility: leaded and unleaded gasoline, diesel fuels, jet-A fuel, JP-4 jet fuel, kerosene, heavy burner fuel, butane, propane and liquified petroleum gas (LPG). Most of the products are sold from a product terminal located at the facility into trucks. Some LPG is sold into a pipeline.

The refinery property is bordered on the south by federal property managed by the Bureau of Land Management. The San Juan River and the Town of Bloomfield are located north of the refinery.

Portions of the San Juan River are considered recreational areas (Navajo Lake and up to 1/4 mile downstream of the Navajo Dam). Undeveloped private and public lands, including several gravel pits border the property to the east, south and west. Highway 44 is located approximately 1/4 mile west of the facility. An El Paso Natural Gas Pipeline easement runs southwest through the center of the facility property.

The nearest residences are two homes located about 400 feet south of the eastern half of the facility. Additional residences are located in Bloomfield, approximately 1,400 feet north of the facility across the San Juan River.

5.3 Response to Inquiries and Repository

Inquiries from the public regarding RCRA corrective action at the facility will be directed to Mr. Chris Hawley, Environmental Manager at the facility. Inquiries can be made to Mr. Hawley by mail or he can be contacted at telephone number (505) 632-8013. Mr. Hawley is usually available at the facility during normal working hours. If Mr. Hawley is not available, the manager of the refinery, Mr. David Roderick, can be contacted at the same telephone number. Mr. Hawley and Mr. Roderick will respond to public inquiries on an as-needed basis.

The community surrounding the facility will have access by appointment to critical RCRA corrective action documents. The documents will be located in an information repository at the facility. The repository will contain the following documents:

- Final Interim Measures Workplan
- Final Interim Measures Report
- Preliminary Report: Description of Current Conditions
- Final RFI Workplan
- Final RFI and CMS Report

Documents will be added to the repository promptly after they are approved by USEPA. Other documents may be added to the repository if BRC or USEPA determines the need exists for the public to have available the additional information contained in those reports.

5.4 Public Notice

Upon approval by USEPA of the RFI and CMS Final Report(s), the RFI and CMS Reports will be placed in the repository for public review and comment for at least 30 calendar days. This public comment period is required by the consent order. A summary and justification of the proposed corrective measure(s), selected by USEPA will also be made public at that time. A public notice will be published in the Sunday edition of the Farmington Daily Times. The newspaper selected for the public notice will ensure that potentially concerned people will be aware of corrective actions at the facility since the Farmington Daily Times is the major newspaper servicing the area. The notice will be placed in the news section of the paper where it will attract the most attention. The public notice will identify the following:

- repository location,
- hours of operation,
- documents that are available for review,
- the names and phone numbers of contact persons at the repository,
- the names and phone numbers of USEPA contact persons, and
- the names and phone numbers of facility contact persons.

Following the public comment and review period, the RFI/CMS Final Reports may need modification based on public comment, at the direction of USEPA. USEPA will consider public comments when selecting the final remedy. Upon selection of the final remedy(s), EPA will notify BRC of the remedy(s).

5.5 Fact Sheet and Public Meeting

A fact sheet, if warranted by questions from the public, will be prepared to communicate specific, complex issues to the public. The fact sheet will be placed in the repository and distributed by BRC, upon request. Fact sheets are generally four to six pages in length and contain an introduction, facility background, map, and specific information dependent upon the phase of work. The specific information may include the purpose and scope of an RFI and/or CMS; or the clean up levels, point of compliance, corrective measure technologies, anticipated duration of cleanup, and the rationale for selecting the technology and cleanup levels.

A public meeting will be held upon request from a number of citizens or if USEPA and BRC deems a public meeting is appropriate based on public concern and misunderstandings. The major objective of a public meeting is to give the public the opportunity to discuss the corrective measures with USEPA, and for USEPA to further describe and explain the remediation technologies that were evaluated. USEPA will lead the public meeting effort, identifying the location, date, notice of the meeting, agenda, and written summary.

5.6 Directory

Bloomfield Refining Company (Repository)
#50 County Road 4990
P. O. Box 159
Bloomfield, New Mexico 87413
Mr. Chris Hawley - Environmental Manager
Mr. David Roderick - Facility Manager
Tel:(505) 632-8013

Farmington Daily Times
201 North Allen Avenue
Farmington, NM 87401
Tel:(505) 325-4545

Groundwater Technology, Inc.
2501 Yale Boulevard S.E., Suite 204
Albuquerque, New Mexico 87106
Ms. Cymantha Diaz, Project Manager
(505) 242-3113

New Mexico Environmental Division
Hazardous Waste Bureau
P.O. Box 26110
Santa Fe, NM 87502
Mr. Ed Horst
Tel:(505) 827-4300

New Mexico Oil Conservation Division
P.O. Box 2088
Land Office Building
Santa Fe, NM 87504-2088
Mr. Roger Anderson
Tel:(505) 827-5800

U. S. EPA, Region VI
RCRA Technical Enforcement
First International Building
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733
Mr. Greg J. Lyssy
Tel:(214) 655-8317

APPENDIX A

HEALTH AND SAFETY PLAN

BRC disk 1
task2.brc

APPENDIX B

QUALIFICATIONS AND EXPERIENCE

APPENDIX C

FACILITY INVESTIGATION COST ESTIMATE

BRC disk 1
task2.brc

GROUNDWATER
TECHNOLOGY

APPENDIX D

INTER-MOUNTAIN LABORATORIES
QUALITY ASSURANCE PROJECT PLAN

BRC disk 1
task2.brc

APPENDIX E
EQUIPMENT CHECKLIST

BRC disk 1
task2.brc

GROUNDWATER
TECHNOLOGY

APPENDIX F
SOIL GAS SURVEY PROCEDURES

APPENDIX G
FIELD INSTRUMENT CALIBRATION

BRC disk 1
task2.brc

GROUNDWATER
TECHNOLOGY

1.0 Calibration of MicroTip® MP-100 Air Monitor

The MicroTip MP-100 field screening instrument will be calibrated on a daily basis prior to use. Calibration results will be recorded in a field notebook and documented on the Instrument Calibration form shown in Figure [ ] of Appendix [ ]. The documentation includes recording the date of calibration, person who performed calibration, instrument ID number, calibration results, and span gas type and concentration. Clean ambient air will be used as zero air and isobutylene at 100 ppm will be used as span gas.

The instrument calibration procedure is outlined below:

1. Connect the supplied gas regulator to the span gas cylinder.

2. Open the valve of the Tedlar® bag (gas bag) and connect the bag valve to the gas regulator using the supplied adapter and tubing.

3. Turn the regulator knob counterclockwise about half a turn to start the flow of gas.

4. Fill the gas bag about half full and then turn off the flow of gas. Disconnect the bag from the adaptor and empty it. Flush the bag a few times with span gas and then fill it. Close the gas bag by turning the valve clockwise.

5. Press CAL and enter the response factor, which is 1 since a specific compound is not being measured.

6. Expose the instrument to zero air and press ENTER.

7. Enter the known span gas concentration (100 ppm) as requested by the instrument.

8. Connect the span gas bag adaptor to the instrument inlet and open the bag valve so that span gas is flowing into the instrument.

9. Press ENTER and the sensitivity of the instrument will be set.

10. When the MicroTIP® display reverts to normal, the instrument is calibrated and ready for use. Remove the span gas from the inlet.

2.0 Calibration of the Cole-Parmer Model 5985-80 DigiSense pH Meter

The Digi-Sense® pH meter will be calibrated on a daily basis prior to use. Calibration results will be recorded in a field notebook and documented on the Conductivity/Temperature/pH Meter Calibration and Results Log shown in Figure [ ] of Appendix [ ]. The documentation includes recording the date of calibration, analyst who performed calibration, and calibration results. The calibration procedure is as follows:

1. Place the electrode in a pH 7.00 buffer solution. Wait approximately 30 seconds for the sensor to stabilize and then press CAL.

2. The exact pH value will appear on the display in accordance with pH and temperature charts. If this is not the case, use a fresh buffer solution.

3. Wait 30 seconds and then push CON to accept the buffer value.

4. Take the electrode out of the pH 7.00 solution, rinse it with distilled water, and dip it into a pH 4.01 or pH 10.01 solution. Use pH 4.01 solution for measurements between 0 and 7 pH and pH 10.01 solution for measurements between 7 and 14 pH. The value of the chosen buffer will appear on the display. Wait 30 seconds and press CON. The instrument is now calibrated.

3.0 Calibration of the YSI 33 S-C-T Meter

The YSI 33 S-C-T meter will be calibrated on a daily basis prior to use. Calibration results will be recorded in a field notebook and documented on the Conductivity/Temperature/pH Meter Calibration and Results Log shown in Figure [ ] of Appendix [ ]. The documentation includes recording the date of calibration, analyst who performed calibration, and calibration results. The calibration procedure is as follows:

1. Adjust the zero, if necessary, by turning the screw on the meter face until the meter needle coincides with the zero on the conductivity scale.

2. Calibrate the meter by turning the MODE control to REDLINE and adjusting the REDLINE control so that the meter needle lines up with the redline on the meter face.

APPENDIX H
FIELD DOCUMENTATION FORMS

BRC disk 1
task2.brc

GROUNDWATER
TECHNOLOGY

Inter-Mountain
Laboratories, Inc.

2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

GROUNDWATER TECHNOLOGY, INC.
BLOOMFIELD REFINERY RFI

QUALITY ASSURANCE PROJECT PLAN LABORATORY ANALYSES

INTER-MOUNTAIN LABORATORIES, INC.

September, 1993

Inter-Mountain Laboratories, Inc.

2506 W. Main Street
Farmington, New Mexico 87401

GROUNDWATER TECHNOLOGY, INC.
BLOOMFIELD REFINERY RFI

Quality Assurance Project Plan
Analytical Laboratory Services
September, 1993

Inter-Mountain Laboratories, Inc.
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Sheridan, Wyoming 82801

2506 West Main Street
Farmington, New Mexico 87401

1160 Research Drive
Bozeman, Montana 59715

Version: GTI / BRC
09/93

Jay O. Stender
Vice President - IML Corporate

Date Submitted: __________

Inter-Mountain Laboratories, Inc.

2506 W. Main Street
Farmington, New Mexico 87401

BLOOMFIELD REFINERY RFI

TABLE OF CONTENTS

QUALITY ASSURANCE PROJECT PLAN

Ver: 1.4

3.0 PROJECT DESCRIPTION

The project tasks will include the receipt, inventory, storage, analyses, and reporting of chemical analytes from environmental samples obtained from the Bloomfield Refinery Co. facility in New Mexico. The quality assurance objectives and requirements mandate documented control of sample and analytical data generated within the laboratory. Specifically, this project will have dedicated procedures and staff to receive, inventory, analyze and store samples to prevent any possible contamination or loss. Analytical procedures addressing the sample preparation will follow methods described in SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", USEPA, 1986. The primary analytical instruments will be ICP, CVAA, IR, GC, and GC/MS.

Due to the confidential nature of this project, samples, raw data, finished data, and quality assurance reports will be secured for the client. IML will store, in a secured fashion, samples for 30 days following data package submission. At this time, samples will be returned to the client or a client representative or stored for an additional period by IML. Samples will not be transferred from IML unless directed by Groundwater Technology Inc. via letter.

Raw data, not submitted as part of the deliverables, will be stored by IML in a secure fashion for three (3) years from report. At this time, the client will be notified prior to disposal of records. The client will have the option to secure additional storage at IML or to archive records at a place of their choice. Deliverables are defined in section 11.0.

This QAPP follows and complies with project outlines suggested through negotiations with the client (Bloomfield Refinery Co.) and their authorized representative (Groundwater Technology Inc.). In addition, QA/QC checklist parameters provided by GTI with the QAPP are recognized and addressed under this document.

The analytical data submitted to GTI will be in Sample Data Batches of no more than 20 field samples. Quality control parameters dictated by USEPA will be included within respective sample data packages. Raw data, if requested by the client, will be available for additional validation purposes. Costs for documentation will be charged to the client.

3.0 PROJECT DESCRIPTION (Continued)

Project contact personnel are as follows:

Cymantha Diaz	GTI	Project Manager
Chris Hawley	BRC	BRC Project Manager
Cymantha Diaz	GTI	Project Quality Assurance
Jay Stender	IML	Project Administrator
Charles Ballek	IML	Laboratory Manager
Denise Bohemier	IML	Laboratory Quality Assurance

IML will submit detailed invoices against a specified identification number, to Cymantha Diaz at GTI unless otherwise notified.

4.0 PROJECT ORGANIZATION and RESPONSIBILITIES

Introduction:

Chart 4-1 identifies the analytical flow of responsibility throughout the laboratory. Responsible staff for each task are identified in table 10.1. Field Activities will not be covered under this document.

Project Administration: Jay Stender

Responsible for:

A. Review and compliance with contract conditions.

B. Verifying and reporting of analytical procedures.

C. Resolution of contract/QA/laboratory operations conflicts.

D. Final review of package for contract completeness.

Project QA/Technical Operations:
Mike Terry - Inorganic, Sheridan
Denise Bohemier - Organic, Farmington

Responsible for:

A. Maintaining and auditing laboratory activities for compliance with contract QC objectives.

B. Identifying and documenting any procedures that may 1) not be performed in accordance with contract requirements, or 2) are not being documented at a level indicated by the contract.

C. Coordinating and documenting any changes in activities associated with procedures for lab QC.

D. Maintaining records of all pertinent laboratory QC functions.

E. Issuing stop work orders if QC criteria are violated and issue CR.

4.0 PROJECT ORGANIZATION and RESPONSIBILITIES (Continued)

F. Report directly to laboratory project administrator and/or section leader any laboratory activities that may affect data.

G. Review data production to verify calculations, reporting units, and completeness.

Section Leader: Charles Ballek

Responsible for:

A. Schedule and monitor ongoing work in progress.

B. Organization and verification of preparation of samples, reagents, and method blanks for analysis.

C. Review and monitor bench level analytical procedures for compliance with methods and QC frequency.

D. Review and monitor all instrumental activities for compliance with procedures.

E. Presentation of data to QC for review and final reporting.

Sample Custodian: Fran Armenta

Responsible for:

A. Acceptance of samples from client.

B. Verification and confirmation of sample inventory, analytes, holding time requirements, and storage.

C. Notify section leaders and client of sample receipt for scheduling and QC.

D. Storage and organization of custody documents associated with the samples.

4.0 PROJECT ORGANIZATION and RESPONSIBILITIES (Continued)

The principal staff are dedicated to this project. IML reserves the right to utilize other equally qualified staff if needed. If any significant staff changes occur, IML will notify the project managers (GTI, BRC), in writing, of changes.

4.0 PROJECT ORGANIZATION and RESPONSIBILITIES (Continued)

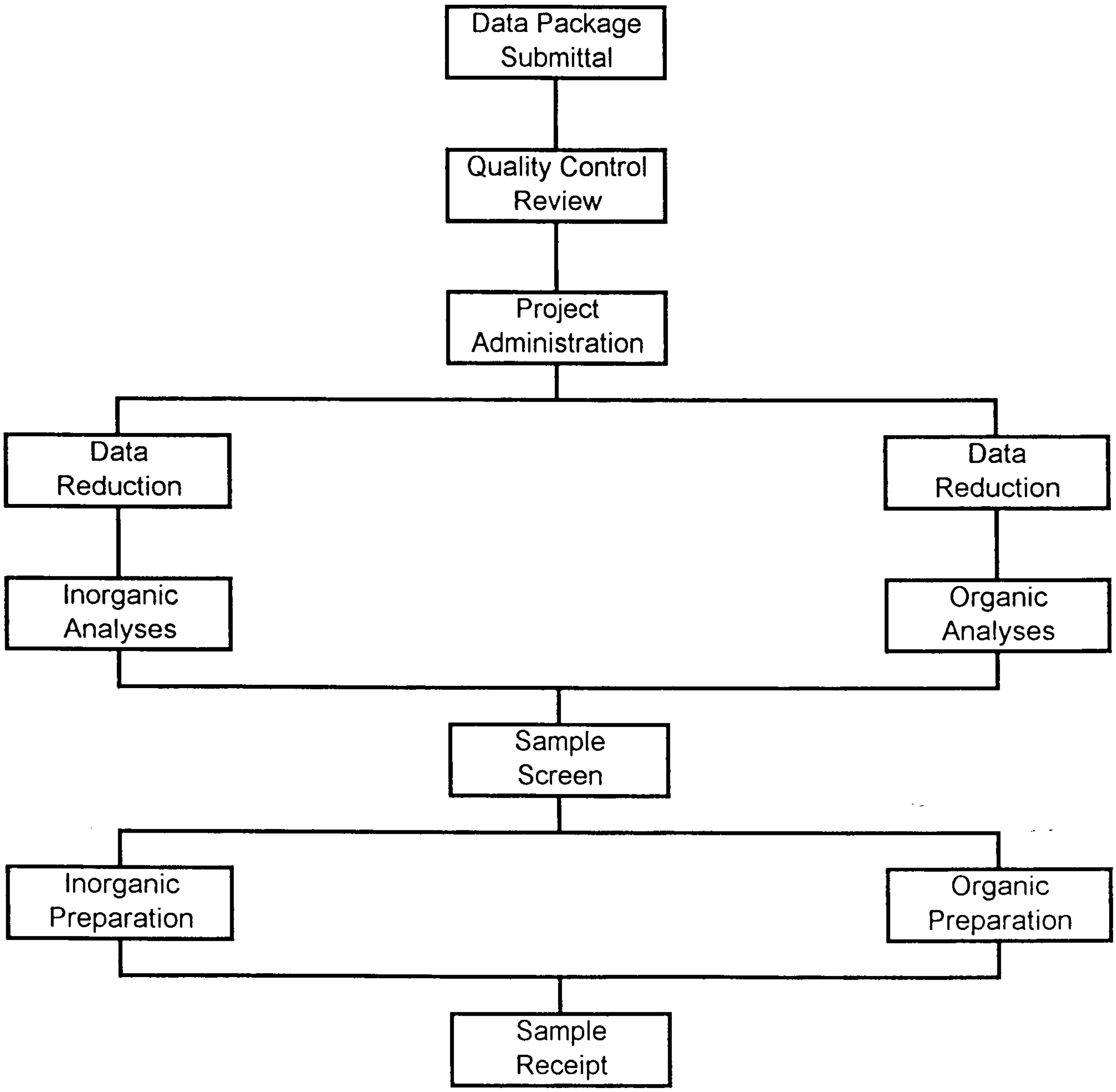


CHART 4 - 1: Project Flow

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA

It is the objective of IML to analyze and report environmental samples in a consistent and reproducible manner. This objective is met by using standard procedures, effective documentation of the procedures, and peer review.

Quality control may be defined as those operations undertaken within the laboratory to assure that the data produced are generated within known probability limits of accuracy and precision.

Precision and accuracy are determined from the results of the laboratory QC samples. The audits consist of duplicates (or matrix spike duplicates), matrix spikes, and method blank standards. The quality assurance objectives for precision and accuracy are listed in Tables 5-1 through 5-3C.

To meet our precision and accuracy objective, five concepts are addressed.

1. Accuracy:

Accuracy is defined as the degree to which the analytical measurement reflects the true concentration level present. Accuracy will be measured as percent recovery for matrix spikes as the primary criteria.

$$\text{Percent Recovery} = \frac{SSR - SR}{SA} \times 100$$

SSR = Spikes sample result
SR = Sample result, 0 if < CRDL
SA = Spike added from known spike solution

Accuracy, or the measure of nearness to the actual value, is determined using spike recoveries. By tracking the recovery of known spiking concentrations on given samples one can chart the analytical method performance. The data quality objective of spike recoveries on soil matrix will match method-specific limits set by the EPA in SW-846. Analytical results not meeting these criteria will be reviewed by laboratory staff and evaluated for fitness. Data qualifiers "J" or "N" defined by the EPA in CLP SOW OLM01 or ILM01 may be used. Spike materials may be added prior to sample preparation to evaluate the digestion procedure. Post digestion spikes indicate accuracy of the analytical technique. If the sample concentration exceeds 4X the matrix spike recovery, the calculation may not be applicable for validation purposes.

5.0 QUALITY ASSURANCE OBJECTIVE and CRITERIA (Continued)

2. Precision:

Precision is defined as the agreement among individual measurements of the same chemical constituent in a sample (duplicates) secured under the same analytical protocols. The calculated value addressing precision is "Relative Percent Difference (RPD)".

$$RPD = \frac{|\,SR - DR\,|}{((\,SR + DR\,)\,/\,2)} \times 100$$

SR = Original sample result
DR = Duplicate sample result

Within each analytical run, a sample batch of twenty (20) samples or less, at least one duplicate analysis will be run.

Duplicate data qualifiers, for inorganic and organic parameters, will use the following criteria:

Quantitation Value	Qualifier
$SR < 5 \times DL$	$\|SR - DR\| < CRDL$
$5 \times DL < SR < 10 \times DL$	$RPD < 35\%$
$SR > 10 \times DL$	$RPD < 20\%$

Where: DL = Method Detection Level for Soil Matrix and
CRDL = Contract Required Detection Level

If samples are less than 5 times the CRDL, the CRDL is the limit of the duplicate difference. Samples that are 5 to10 times the detection level will fall into the second criteria. Samples that are greater than 10 times the CRDL fall into the third criteria. Data qualifiers may be used as a result of laboratory duplicate analysis. Field duplicates will not be evaluated by RPD.

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA (Continued)

3. Representativeness:

Representativeness should be considered an objective to be achieved rather than a characteristic which can be described in quantitative terms. Representativeness can be defined as the degree to which the data accurately and precisely represent actual sample matrix conditions. Representativeness is addressed by the use of a logical and thorough sampling and analysis project plan which is based on all available knowledge of the site.

4. Completeness:

Analytical completeness is the percentage of reported analytical data that is usable. IML achieves a high level of analytical completeness by assuring that the work is performed by well-trained analysts who know the program-specific objectives. IML has a detailed record keeping system that documents the details of each analysis. This assures that the analytical data will be defensible. IML's objective for completeness is 95%.

Completeness is calculated by:

$$\frac{\Sigma \text{SM}}{\text{SA}} \times 100 = \% \text{ Completeness}$$

SM = samples analyzed that meet contract required QC parameters of 1) holding times, 2) duplicate recoveries, 3) spike recovery, and 4) method blanks

SM_1 = Holding Time
SM_2 = Duplicate
SM_3 = Spike Recovery
SM_4 = Method Blank

SA = Total number of samples received and analyzed

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA (Continued)

5. Comparability:

Comparability is a measure of the confidence with which one data set can be compared to another. The following measures are taken to assure the comparability of the data:

- Appropriate selection of analytical procedures;
- Standardized written preparation and analysis procedures;
- Standard handling and shipping procedures used for all collected samples;
- Results reported in consistent formats and units.

In addition to the above techniques, the use of Laboratory Control Samples (LCS) prepared of similar analytes in a similar matrix allow the analysts to track, over a series of events, the effectiveness of the technique.

Method blanks, reagent and laboratory water samples that are prepared in a similar fashion to the samples will be analyzed at a frequency which satisfies data quality objectives (see Section 8.0). The method blanks will be used to verify consistent baseline response of the instrument and verify no carryover of analytes from one sample to another. Method blank results will be considered to confirm IDL and detection level performance of instruments. "B" qualifiers may be used within the inorganic analytical reports to denote positive analyte values on blanks.

Calibration Verification Standards (CVS's) are used within the laboratory to verify the linear response of the instrument's calibration curves. These materials are made a source different from the instrument calibration standards with analyte concentrations within the calibration range. CVS's for ICP are used every seven (7) analytical shots. CVS's for the IR are analyzed following every twenty (20) sample analyses. CVS's are used during calibration on GC/MS and GC.

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA (Continued)

Data qualifiers that address calibration issues are "E" for results that are greater than the GC/MS calibration range, and/or "D" for samples that are diluted to bring analyte concentration into range.

TABLE 5-1 FOR INORGANICS
QUALITY ASSURANCE OBJECTIVES

PARAMETER	REFERENCE	CRITERIA/ CONTROL	UNITS
Calibration (ESS)	ICAL	0.995	r
	CCAL-ICP	90-110	%R
	Hg	80-120	%R
Blanks (ESS)	Prep blank	<CRDL	ug/L
Lab Control Samples	LCS	90-110%	%R
Duplicate (per batch)	Dup	± CRDL	(< 5X CRDL)
		± 35%	(5X to 10X DL)
		± 20%	(> 10X DL)
Matrix Spike (per batch)	MS	75-125%	%R

Matrix spike recoveries are pre-digestion spikes of aqueous samples.

Control levels apply to aqueous samples only.

r = regression coefficient.

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA (Continued)

TABLE 5-1A
HOLDING TIMES - SOIL

PARAMETER	REFERENCE	HOLDING TIME (days)	START OF TIMING
Metals *	RCRA 6010/7000	180	Sampling
Mercury	RCRA 7741	28	Sampling
Volatile Organics	RCRA 8240	14	Sampling
Semivolatile Organics	RCRA 8270	14 **	Sampling
TPH	EPA 418.1	14 **	Sampling
Grain Size	Handbook 60 / #42	N/A	N/A
Total/Effective Porosity	Handbook 60 / #40	N/A	N/A
Hydraulic Conductivity	RCRA 9100	28	Sampling
Specific Conductance	RCRA 9050	7	Sampling
Total Organic Carbon	RCRA 9060	N/A	N/A
Dry Bulk Density	EPA 600/2-78-054	N/A	N/A
Ion Exchange Capacity	Handbook 60 / #19	N/A	N/A
Moisture Content	Handbook 60 / #26	N/A	N/A
pH	RCRA 9045	14	Sampling

* Mercury is an exception to metal holding times.
** 14 days to extraction of soil, analysis performed within 40 days from extraction.
VTSR - Verified Time of Sample Receipt at laboratory
N/A - No holding time established

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA (Continued)

TABLE 5-1B
HOLDING TIMES - WATER / SEDIMENT

PARAMETER	REFERENCE	HOLDING TIME (days)	START OF TIMING
Metals *	RCRA 6010/7000	180	Sampling
Mercury	RCRA 7741	28	Sampling
Volatile Organics	RCRA 8240	14	Sampling
Semivolatile Organics	RCRA 8270	7 **	Sampling
TPH	EPA 418.1	7 **	Sampling
pH	EPA 150.1	ASAP	VTSR
Conductivity	EPA 120.1	ASAP	VTSR
Dissolved Oxygen	EPA 360.1	ASAP	VTSR
Biological Oxygen Demand	EPA 405.1	2	VTSR
Chemical Oxygen Demand	EPA 410.1	28	Sampling
Total Suspended Solids	EPA 160.3	7	Sampling
Total Dissolved Solids	EPA 160.1	7	Sampling
Total Organic Carbon	EPA 415.1	28	Sampling
Nutrients	EPA 300 Series	14/28	Sampling

* Mercury is an exception to metal holding times.
** 7 days to extraction for water, analysis performed within 40 days from extraction.
VTSR - Verified Time of Sample Receipt at laboratory

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA (Continued)

TABLE 5-2
QUALITY ASSURANCE OBJECTIVES
VOLATILE ORGANIC COMPOUNDS

PARAMETER	CRITERIA/CONTROL
Holding Time	14 days (preserved)
GC/MS Mass Calibration	BFB ion abundance ratios
GC/MS Initial Calibration	<30% RSD for SPCC and CCC RRF's
GC/MS Continuing Calibration	<25% RSD for CCC RRF's
Minimum RRF	SPCC RRF >0.30 and Bromoform >0.25
Internal Standard Responses	CCAL area response 50-200% of ICAL Sample area response 50-200% of CCAL
Internal Standard Retention Time	CCAL within 0.5 minutes of ICAL
Internal Standard Retention Time	Sample within 0.5 minutes of CCAL
Method Blank	<CRDL
Extraction Blank	<CRDL
Surrogate Recoveries	By matrix, see Table 2B
Matrix Spike/Duplicate	By matrix, see Table 2C

TABLE 5-2A
BFB ION ABUNDANCE CRITERIA

m/z	Ion Abundance Criteria
50	15-40% of mass 95
75	30-60% of mass 95
95	Base peak, 100% relative abundance
96	5-9% of mass 95
173	Less than 2% of mass 174
174	50-100% of mass 95
175	5-9% of mass 174
176	95-101% of mass 174
177	5-9% of mass 176

Source: SW-846

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA (Continued)

TABLE 5-2B
SURROGATE RECOVERIES
VOLATILE ORGANIC COMPOUNDS

COMPOUND	Water	Soil
	% Recovery	% Recovery
1,2-Dichloroethane-d4	76-114	70-121
Toluene-d8	88-110	81-117
Bromofluorobenzene	86-115	74-121

TABLE 5-2C
MATRIX SPIKE / MATRIX DUPLICATE
VOLATILE ORGANIC COMPOUNDS

COMPOUND	Water		Soil	
	% Recovery	RPD	% Recovery	RPD
1,1-Dichloroethene	61-145	14	59-172	22
Trichloroethene	71-120	14	62-137	24
Benzene	76-127	11	66-142	21
Toluene	76-125	13	59-139	21
Chlorobenzene	75-130	13	60-133	21

Source: SW-846

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA (Continued)

TABLE 5-3
QUALITY ASSURANCE OBJECTIVES
SEMIVOLATILE ORGANIC COMPOUNDS

PARAMETER	CRITERIA/CONTROL
Holding Time	7 days - extraction of solid/sludge
GC/MS Mass Calibration	DFTPP ion abundance ratios, see Table 3A
GC/MS Initial Calibration	<30% RSD for CCC RRF's
GC/MS Continuing Calibration	<30% RSD for CCC RRF's
Minimum RRF	0.05> for SPCC
Internal Standard Responses	Sample area response 50-200% of ICAL
Internal Standard Retention Time	Sample within 0.5 minutes of CCAL
Method Blank	<CRDL
Extraction Blank	<CRDL
Surrogate Recoveries	By matrix, see Table 3B
Matrix Spike/Duplicate	By matrix, see Table 3C

TABLE 5-3A
DFTPP ION ABUNDANCE CRITERIA

m/z	Ion Abundance Criteria
51	30-60% of mass 198
68	Less than 2% of mass 69
69	Reference only
70	Less than 2% of mass 69
127	40-60% of mass 198
197	Less than 1% of mass 198
198	base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	Greater than 1% of mass 198
441	0-100% of mass 443
442	40-100% of mass 198
443	17-23% of mass 442

5.0 QUALITY ASSURANCE OBJECTIVES and CRITERIA (Continued)

TABLE 5-3B
SURROGATE RECOVERIES
SEMIVOLATILE ORGANIC COMPOUNDS

COMPOUND	Water	Soil
	% Recovery	% Recovery
2-Fluorophenol	21-100	25-121
Phenol-d5	10-94	24-113
Nitrobenzene-d5	35-114	23-120
2-Fluorobiphenyl	43-116	30-115
2,4,6-Tribromophenol	10-123	19-122
p-Terphenyl	33-141	18-137

TABLE 5-3C
MATRIX SPIKE/MATRIX SPIKE DUPLICATE
SEMIVOLATILE ORGANIC COMPOUNDS

COMPOUNDS	Water		Soil	
	% Recovery	RPD	% Recovery	RPD
Phenol	12-110	42	26-90	35
2-Chlorophenol	27-123	40	25-102	50
1,4-Dichlorobenzene	36- 97	28	28-104	27
n-Nitroso-di-n-propylamine	41-116	38	41-126	38
1,2,4-Trichlorobenzene	39- 98	28	38-107	23
4-Chloro-3-methylphenol	23- 97	42	26-103	33
Acenaphthene	46-118	31	31-137	19
4-Nitrophenol	10- 80	50	11-114	50
2,4-Dinitrotoluene	24- 96	38	28- 89	47
Pentachlorophenol	9-103	50	17-109	47
Pyrene	26-127	31	35-142	36

DEFINITIONS:

BFB	Bromofluorobenzene
DFTPP	Decafluorotriphenylphosphine
CCAL	Continuing Calibration
ICAL	Initial Calibration
CCC	Continuing Calibration Compounds
SPCC	System Performance Calibration Compounds
RRF	Relative Response Factor
RSD	Relative Standard Deviation
CRDL	Contract Required Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate

6.0 SAMPLING PROCEDURES

IML will not be directly involved with sampling.

As part of our response to Groundwater Technology, Inc., IML will assist the contracted samplers by providing bottles, preservatives, packing, and shipping to meet EPA requirements. To enhance the analytical performance, it is essential to clearly identify sampling variables, to utilize proven field sampling techniques, and to document events. Validity of analytical data depends on good, consistent sampling.

7.0 CUSTODY DOCUMENTS

IML will provide sample Chain of Custody documents for the sampling team. The Chain of Custody form will require complete identification of sample location, time, and date. Sample data sets will utilize the form as the initial guiding information for holding time criteria and analytical parameters. The laboratory will keep the front, white, sheet with the samples. Any transfer of sample material will initiate a new Chain of Custody.

Sample custody will also be maintained and documented within the laboratory. At the time of sample receipt, a unique laboratory identification will be assigned to each sample. Each sample container will be labeled with this unique identification. Once the samples are inspected, logged in, and labeled, they will be stored in a secure area (locked refrigerator for samples requiring storage at 4°C). Transfer of samples from the secure areas will be accompanied by completion of an Internal Sample Custody form utilizing the laboratory identification.

Example Chain of Custody and Internal Sample Custody forms are found in Appendix A.

8.0 CALIBRATION / QC PROCEDURES

8.1 Laboratory Analysis:

Laboratory analysis of environmental samples is performed using state of the art instrumentation and by following standard methods. IML follows the procedural guidelines described by RCRA. The analytical methods are identified in Section 9.0. Under contract, IML can utilize modified methods to reach specific detection levels or to handle unusual matrix effects.

General calibration and QC procedures, based on type of analysis, are outlined in the following sections. Additional information can be provided by section leaders and project coordinators.

Inorganic Chemistry:

Inorganic parameters can be measured in water, soil, waste and air. Parameters include but are not limited to: pH, EC, temperature and color, and total metals.

General items of consideration under quality control include reagents, instruments, training, and reporting.

Ion-Selective Analysis:

Ion-Selective Electrodes are calibrated prior to analyses using freshly made or commercial solutions. Ion-selective probes are subject to maintenance regimes to insure correct response. EPA or commercial known solutions with acceptance criteria such as confidence intervals are used as QC parameters along with duplicates and method blanks.

Total Organic Carbon (TOC) Analysis:

The TOC analyzer is calibrated prior to analyses using a blank and a freshly made or commercial solution. Continuing calibration of the instrument is performed following every tenth sample. Four replicates are performed on each sample and the average is reported.

8.0 CALIBRATION PROCEDURES (Continued)

Atomic Absorption (AA) Spectroscopy:

IML will use Flame, Furnace and Cold Vapor Atomic Absorption Spectroscopy. QC parameters include the use of method blanks, 4 point-calibration, laboratory control samples for evaluation of matrix effect, and matrix spike analyses. IML's procedures satisfy USEPA quality control requirements.

Inductively Coupled Argon Plasma (ICP) Spectrometry:

The ICP allows versatile response to a variety of analytes due to extended linear response. QC parameters are similar to AA. Calibration checks are of a frequency that meet or exceed RCRA requirements.

To verify interelement and background correction factors, two NIST traceable ICP Interference Check Samples (ICS) will be analyzed. The ICS will be analyzed at the beginning and end of each analytical run or a minimum of twice per eight hour working shift. The results must fall within ±20% of the true value for each analyte in the ICS.

Techniques, not covered by usual methods, such as hydride generation on the ICP are available.

Infrared Spectrophotometry:

Initial calibration of the Infrared Spectrophotometer is performed at the beginning of each day using a solvent blank and nine standards from a certified source. Linearity standards are met prior to initiation of sample analyses. Method blanks, matrix spikes, spike duplicates, and matrix duplicates are performed on a frequency of one per ten analytical samples.

8.0 CALIBRATION PROCEDURES (Continued)

Gas Chromatography/Mass Spectrometry:

Tuning of GC/MS instruments using 4-Bromofluorobenzene (BFB) for systems used in analysis of volatile organic compounds and Decafluorotriphenylphosphine (DFTPP) for the semivolatile analysis systems will be performed at the beginning of each work shift and every twelve hours of operation following. Tuning results must meet requirements defined in the appropriate analytical methods (SW-846).

Initial calibration of the GC/MS instruments will be performed as described in each GC/MS analytical method in SW-846 utilizing a five point calibration curve. Relative standard deviations of Response Factors for the designated Calibration Check Compounds must be less than 30% and minimum average Response Factors will be achieved.

GC/MS continuing calibrations will be performed following successful completion of tuning and will follow procedures outlined in SW-846. Minimum Response Factor requirements will be met and the percent difference between initial and continuing Response Factors for the Calibration Check Compounds must meet the defined limits. Retention times of internal standards will be within 30 seconds of the last calibration and the peak areas will not vary by more than a factor of two (-50% to + 100%) from the previous calibration.

Gas Chromatography:

Initial Calibration of the GC instruments, using a 5 point calibration, will be performed as described in each GC analytical method in SW-846 to determine a calibration curve. Relative standard deviations of Response Factors for the target compounds must be less than 20%.

GC continuing calibrations will be performed at the beginning of each day and every 12 hours of operation following procedures outlined in SW-846. The difference between initial and continuing calibration Response Factors for all target compounds must be less than 15%.

8.0 CALIBRATION / QC PROCEDURES (Continued)

8.2 Quality control parameters used within the laboratory consist of the following:

Method Blanks:

This is type 1 laboratory-grade water or washed, baked sand that is subjected to the same preparation techniques as sample extracts. Results of method blanks are used to track any interferences introduced by reagent contamination or extract preparation procedures. Within spectroscopy, method blanks allow additional tracking of artifacts introduced to the system by highly concentrated samples. Method blanks may not be applicable to unprocessed samples.

Duplicate Analysis:

The duplicate analyses indicate the reproducibility of the analytical technique. Samples can be split prior to preparation or post-preparation. These variations allow the analyst and the project manager to determine the validity of the analytical run within the limits defined by sample homogeneity.

Spiked Analysis:

Samples have known aliquots of analyte added prior to preparation, or in the case of waste dilution, added after preparation. The resulting recovery allows determination of matrix effect on the known value. Spiking can be one of the best indicators of laboratory results for completeness.

8.0 CALIBRATION / QC PROCEDURES (Continued)

Spiked Duplicate:

This analysis is an evaluation of the duplicate and the spike response. It is most often used in trace organics, but may be applied to trace metal analysis.

Laboratory Control Sample:

A known matrix containing representative analytes at documented concentrations.

QC Parameter	Frequency
Method Blank	Each Sample Set / Each Calibration
Duplicate Analysis	Each Sample Set / Each Calibration
Matrix Spike	Each Sample Set / Each Calibration
Matrix Spike Duplicate	1 per calibration - Volatiles
Matrix Spike Duplicate	1 per calibration - Semivolatiles

*SDG = Batch of data from the field. A batch includes data produced from field samples and data generated through the quality control program.

9.0 ANALYTICAL PROCEDURES

List of EPA Approved Miscellaneous Test Procedures

Parameter and Method	SW-846[2]
Soil pH	9045
	EPA-600/4-79-020[3]
TPH - IR	418.1
	SW-846[2]
extraction for soil	3550

List of EPA Approved Inorganic Test Procedures

Parameter and Method	SW-846[2]
ICP Metals	6010
AA Metals	7000
Mercury cold vapor, manual	7471
Digestion, soil	3050
Digestion, surface/ground water	3010 / 3020

List of EPA Approved Organic Test Procedures

Compound Class[1]	SW-846[2]
Volatile Organics (sample prep included)	8240
Semivolatile Organics	8270
soil sample prep	3540

1. Analytes per compound class may not reflect common detection limits.
2. EPA. Test Methods for Evaluating Solid Waste, 3rd Edition. SW-846. November, 1986.
3. EPA. Methods for Chemical Analysis of Water and Waste. EPA-600/4-79-020, March 1983.

9.0 ANALYTICAL PROCEDURES (Continued)

EPA METHOD 8240
VOLATILE ORGANIC COMPOUNDS

Parameter	Practical Quantitation Limits (Soil - ug/kg)	(Water - ug/L)
Acetone	100	100
Benzene	5	5
Bromodichloromethane	5	5
Bromoform	5	5
Bromomethane	10	10
2 - Butanone	100	100
Carbon disulfide	100	100
Carbon tetrachloride	5	5
Chlorobenzene	5	5
Chloroethane	10	10
Chloroform	5	5
Chloromethane	10	10
Dibromochloromethane	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethane	5	5
1,1-Dichloroethene	5	5
1,2-Dichloroethene (total)	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5
trans-1,3-Dichloropropene	5	5
Ethylbenzene	5	5
2-Hexanone (MEK)	50	50
Methylene chloride	5	5
4-Methyl-2-pentanone	50	50
Styrene	5	5
1,1,2,2-Tetrachloroethane	5	5
Tetrachloroethene	5	5
Toluene	5	5
1,1,1-Trichloroethane	5	5
1,1,2-Trichloroethane	5	5
Trichloroethene	5	5
Vinyl chloride	10	10
Xylenes (total)	5	5

Reference:

Method 8240, Gas Chromatography/Mass Spectrometry for Volatile Organics, Test Methods for Evaluating Solid Wastes, SW-846, United States EPA, Third Edition, November 1986 and 1990.

9.0 ANALYTICAL PROCEDURES (Continued)

EPA METHOD 8270
SEMIVOLATILE COMPOUNDS

Parameter	Practical Quantitation Limits (Soil - mg/kg)	 (Water - ug/L)
Acenaphthene	0.66	10
Acenaphthylene	0.66	10
Anthracene	0.66	10
Benzo(a)anthracene	0.66	10
Benzo(b)fluoranthene	0.66	10
Benzo(k)fluoranthene	0.66	10
Benzo(g,h,i)perylene	0.66	10
Benzo(a)pyrene	0.66	10
4-Bromophenyl phenyl ether	0.66	10
Butylbenzylphthalate	0.66	10
di-n-Butylphthalate	0.66	10
Carbazole	0.66	10
4-Chloroaniline	1.3	20
bis(2-Chloroethyl) ether	0.66	10
bis(2-Chloroethoxy) methane	0.66	10
bis(2-Chloroisopropyl) ether	0.66	10
4-Chloro-3-methylphenol	1.3	20
2-Chloronaphthalene	0.66	10
2-Chlorophenol	0.66	10
4-Chlorophenyl phenyl ether	0.66	10
Chrysene	0.66	10
Dibenzo(a,h)anthracene	0.66	10
Dibenzofuran	0.66	10
1,2-Dichlorobenzene	0.66	10
1,3-Dichlorobenzene	0.66	10
1,4-Dichlorobenzene	0.66	10
3,3'-Dichlorobenzidene	1.3	20
2,4-Dichlorophenol	0.66	10
Diethylphthalate	0.66	10
2,4-Dimethylphenol	0.66	10
Dimethylphthalate	0.66	10
4,6-Dinitro-2-methylphenol	3.3	50
2,4-Dinitrophenol	3.3	50
2,4-Dinitrotoluene	0.66	10
2,6-Dinitrotoluene	0.66	10
bis(2-Ethylhexyl)phthalate	0.66	10
Fluoranthene	0.66	10
Fluorene	0.66	10

9.0 ANALYTICAL PROCEDURES (Continued)

EPA METHOD 8270 (continued)
SEMIVOLATILE COMPOUNDS

	Practical Quantitation Limits	
Parameter	(Soil - mg/kg)	(Water - ug/L)
Hexachlorobenzene	0.66	10
Hexachlorobutadiene	0.66	10
Hexachlorocylopentadiene	0.66	10
Hexachloroethane	0.66	10
Ideno(1,2,3-cd)pyrene	0.66	10
Isophorone	0.66	10
2-Methylnaphthalene	0.66	10
2-Methylphenol	0.66	10
4-Methylphenol	0.66	10
Naphthalene	0.66	10
2-Nitroaniline	3.3	50
3-Nitroaniline	3.3	50
4-Nitroaniline	1.3	20
Nitrobenzene	0.66	10
2-Nitrophenol	0.66	10
4-Nitrophenol	3.3	50
n-Nitrosodiphenylamine	0.66	10
n-Nitroso-di-n-propylamine	0.66	10
di-n-Octylphthalate	0.66	10
Pentachlorophenol	3.3	50
Phenanthrene	0.66	10
Phenol	0.66	10
Pyrene	0.66	10
1,2,4-Trichlorobenzene	0.66	10
2,4,5-Trichlorophenol	0.66	10
2,4,6-Trichlorophenol	0.66	10

Reference:

Method 8270, Gas Chromatography/Mass Spectrometry for Semivolatile Organics, Test Methods for Evaluating Solid Wastes, SW-846, United States EPA, Third Edition, November, 1986.

9.0 ANALYTICAL PROCEDURES (Continued)

EPA METHODS 3050, 6010 AND 7000
PRIORITY POLLUTANT METALS

Parameter	Detection Limit (Soil - mg/kg)	Detection Limit (Water - ug/L)
Antimony	5	60
Arsenic	10	10
Beryllium	0.5	5
Cadmium	0.5	5
Chromium	5	10
Copper	5	25
Lead	10	3
Mercury	0.2	0.2
Nickel	1	40
Selenium	10	5
Silver	5	10
Thallium	10	10
Zinc	1	20

GENERAL PARAMETERS

Parameter	Detection Limit (Soil - mg/kg)	Detection Limit (Water - mg/L)
TPH	10	0.25
TOC	10	0.1
pH	± 0.1 s.u.	± 0.1 s.u
Nutrients		0.01
TDS		1
TSS		1

Note: Detection Limits may vary depending on matrix effects and interferences.

10.0 DATA REDUCTION / VALIDATION

Data reduction occurs in a multi-level system.

Initial level of data reduction occurs with the custodian and section leaders to verify, by comparison, the dates of sampling, the analytes, any sampling notes, and preparation notes from the raw log books with COC. Information should track chronologically and methodically. Results generated that are impacted by raw sample information, such as mixed matrix or samples with significant moisture are flagged.

Second level rests on the review of the analytical runs. The section leaders will review the runs, the methods used for compliance, and the frequency of quality control analyses. The section leaders and QA officer will review the data at this level to validate basic procedures, results, and QC. Rerun analysis for parameters will be initiated at this level.

The third level will start once the laboratory section leaders are confident of the overall fitness of the package in terms of raw data, supporting log books, operating conditions, and completeness. The report will be formatted within the client-requested formats, reviewed by the QA officer and submitted to the Project administrator for final signoff and delivery to the client.

The validation of the data will address all information from the sample receipt inventory to the finished product. Supporting documentation that follows sample chronology will be complete and verified.

A survey of validation information to be checked is as follows:

- Sample acceptability vs. Chain of Custody
- Holding times (interval between sample receipt and preparation/analysis)
- Instrument calibration and verification (calibration and control sample analysis)
- Statement of minimum detectable concentrations (detection limits)
- Verification of laboratory contamination control (blanks)

10.0 DATA REDUCTION / VALIDATION (Continued)

- Verification of analysis interference control - (inductively coupled plasma and GC/MS) procedures.
- Verification of digestion and analysis control (reference standards) procedures.
- Verification of precision and accuracy of sample data (duplicate and spiked samples) generated.
- Verification of analysis control (duplicate injections and spike recoveries) within ICP and GC/MS runs.
- Table 10-1

10.0 DATA REDUCTION / VALIDATION (Continued)

TABLE 10-1
QUALITY CONTROL VALIDATION

Activity	First Tier	Second Tier
Receipt/Custody	Billie Perry	Fran Armenta
Inorganic Prep	Marlin Hopper	Mike Terry
Organic Prep	Jeff Poulson	Shawn Rettig
AA Spectroscopy	Bill Anderson	Laurel Main
IR Spectroscopy	Yvonne Imel	Denise Bohemier
GC Screen Lab	Rich Martoglio	Jack Felkey
GC/MS VOA	Scott Early	Wynn Sudtelgte
GC/MS/Semi-Vol	Ed Scruton	Tom Foubert
Data Control	Jack Felkey	Denise Bohemier
Package QC	Charles Ballek	Jay Stender

* If required, the above named individuals will be replaced with other similarly qualified individuals.

11.0 INTERNAL QUALITY CONTROL

A. Verify Parameter / Method with Chain of Custody and contract.

B. Verify instrumental calibrations by monitoring instrument conditions, wavelengths, and standards. Verify regression calculation for quantitation.

C. Perform method blank analysis by following the same procedure used for preparation of field samples.

D. Perform duplicate analysis of laboratory split sample. Relative percent difference will be calculated. Criteria for duplicates are given in Appendix B.

E. Perform matrix spike analysis of laboratory split sample to determine any matrix effect on known analyte spikes.

F. When appropriate, perform the analysis of a laboratory control sample with the analysis of each sample set and track recovery. IML uses USEPA or commercial grade control samples. The recovery of control samples are monitored using warning limits and control statistics as indicated by SW-846.

G. For IDL determinations, spiked blank solution will be analyzed a minimum of seven times on three non-consecutive run days.

H. Control charts of calibration materials to determine instrument changes by using control and warning statistics.

I. Daily calibration of analytical balances to NBS standards.

J. Mapping and rotation of reagents used within a project. Specific reagents for a project may be isolated to be used for the entire project. Records of reagents and dates are supplied by the laboratory section leaders and reviewed by the QC officer.

11.0 INTERNAL QUALITY CONTROL (Continued)

K. Develop and record instrument maintenance logs. Any changes in the parts or operation of an instrument are recorded and monitored.

L. Use laboratory record notebooks consistently and legibly.

Data deliverables will include:

1) Project narration

2) Quantitation Page
  a) Inorganic
  b) Organic - Volatiles
  c) Organic - Semivolatiles
  d) Organic - IR

3) Quality Control
  a) Method/preparation blanks
  b) Calibration controls - CCV for ICP, AA,
     CCAL for GC/MS,
     Calibration Curves for IR, ICP, AA
  c) Duplicate analyses
  d) Spike analysis - inorganic
  e) Spike and duplicate - organic
  f) Interference check - ICP

VOA quantitation report will include replicate analysis (3 results) if needed to verify detectable values. Any supporting data, such as replicate analysis, will be submitted as independent data in the QC report.

Analytical reports will be submitted as sample data batches. Estimated package turn, per Sample Delivery Group, will be 15 working days

12.0 PERFORMANCE AUDIT FOR LABORATORY ACTIVITIES

The QA/QC officer will perform system checks by the use of blind samples within the project.

IML participates in several Performance Evaluation Audits. Most specifically the WP and WS programs administered by Region VIII USEPA.

Audits by a variety of state and private concerns have occurred within the laboratory. In the last 12 months, the laboratory has been audited by USEPA, the State of Utah Department of Health, and the State of Washington Department of Ecology.

Ongoing certification projects with new states require submittal of QA manuals, the analysis of prepared evaluation samples, and on-site audits.

The data generated for this project will be Level IV, except for Level V parameters and methods which may be used to meet data quality objectives. Data detection levels will require some method modification that will impact validation procedures.

12.0 PERFORMANCE AUDIT (Continued)

Levels of data will include the following:

Analytical Level	TYPE OF ANALYSIS	LIMITATIONS	DATA QUALITY
Project Specific	Organics / Inorganics by GC/MS; IR; AA; ICP Low ppb detection limit	Tentative identification of non-HSL parameters Some time may be required for validation of packages	Goal is data of known quality Rigorous QA/QC

The data generated for this project will be level IV. Contract required detection levels may require some method modification that could impact validation procedures.

13.0 PREVENTATIVE MAINTENANCE:

This analytical project utilizes meters, auto analyzers, ion-chromatographs, atomic absorption spectrometers, inductively coupled plasma spectrometers, infrared spectrophotometers, gas chromatographs, and gas chromatographs/ mass spectrometers. Each instrument has a specific maintenance procedure. IML follows instrument manufacturer recommendations for maintenance.

Spectroscopy:	The AA's and ICP are maintained through contracted service from the manufacturer. Annually, and sometimes more frequently, the instruments are updated by the factory to meet contract specifications.
Auto-analyzers/IC/IR:	These instruments come with manufacturer recommendations addressing the maintenance and upkeep. IML utilizes these outlines and meets the minimum requirements for the instrument.
Meters & Probes:	Analysts and laboratory staff check surfaces and calibrate daily. Instruments are cleaned monthly, and checked for operations.
Gas Chromatography:	Daily maintenance of columns as determined by method blank or chromatographic shift. Section leaders monitor RF responses weekly.
Gas Chromatography/ Mass Spectrometry:	Contracted maintenance with Hewlett Packard.

14.0 PROCEDURES FOR PRECISION AND ACCURACY

Precision within the analytical laboratory is defined as an agreement of results between similar samples for similar analytes. The calculated value addressing precision is "Relative Percent Difference."

Within each analytical run, a maximum of twenty (20) samples, at least one duplicate analysis will be run. Additional duplicate analysis will be performed if the matrix conditions change. Duplicate analysis RPD must be less than 35% for samples 5 times the Contract Reported Detection Level (CRDL). If sample concentrations are below 5 times the CRDL, the difference between the original and duplicate values must be less than the CRDL. Samples that are near or at the detection level will fall into the second criteria. Data qualifiers may be used as a result of duplicate analysis.

Accuracy, or the measure of nearness to the actual value, is determined using spike recoveries. By mapping the recovery of known spiking concentrations on given samples one can track, or chart, the analytical method performance. IML matrix spike results will fall within the EPA defined recovery range for the method. Samples outside of this recovery limit will be evaluated by the laboratory section leader. Spike solutions are added prior to sample preparation and evaluate the digestion and analysis procedures. Post digestion spikes monitor the accuracy of analytical instrumentation. If the sample concentration exceeds 4 times the matrix spike added, the recovery may not be applicable in terms of validation. When the analytical data is lower than the CRDL, the sample result is assumed to be 0 for the % recovery calculation. Data qualifiers may be used as the consequence of matrix spike recoveries.

The use of Laboratory Control Samples (LCS) prepared of similar analytes in similar matrices allow the analysts to track, over a series of events, the reproducibility of the technique.

14.0 PROCEDURES FOR PRECISION and ACCURACY (Continued)

Method Blanks, reagent and laboratory water samples that are prepared in a similar fashion to the samples, will be analyzed at a minimum of one per SDG. Some analyses, such as ICP metals, may have more method and calibration blanks. The method blanks will be used to verify consistent baseline response of the instrument and verify no carryover of analytes from samples. Method blanks will be analyzed to verify Instrument Detection Limits and detection level performance of the instruments.

Calibration Verification Standards are used within the laboratory to verify the linearity of the calibration curves. These materials are made from differing sources with analyte concentrations in the calibration range. CVS for ICP are used every seven (7) analytical shots.

15.0 CORRECTIVE ACTION

Corrective Action, or the ability to change procedures, instruments, or personnel can originate from either the section leader or QA officer. The corrective action will be recorded in the laboratory log books and tracked throughout the project.

15.1 Immediate and effective action will be taken when control data indicates non-standard method or instrument performance. Since the analyst records all observations and monitors QC analytical results, he or she should be the first to determine that an analysis is not in control. Therefore, primary responsibility for initiation of appropriate corrective action will belong to the analyst. The reviewer of the data may also begin procedures to correct the deficiency if evidence exists indicating conditions warrant action.

15.2 Quality Assurance activities will be monitored on an appropriate basis (run-to-run, daily, quarterly,...) to determine the need for initiation of corrective action.

1) Abnormal instrument performance or chromatographic output will result in initiation of corrective action.

2) Run-specific Quality Control data (surrogate recoveries, internal standard areas) which are found to exceed control limits on two or more successive analyses will result in corrective action steps being taken.

3) Daily Quality Control data (duplicate RPD, matrix spike percent recovery, continuing calibration percent difference,...) found to be outside control limits established will be cause for initiation of corrective action.

4) Corrective action steps will be initiated following notification of unacceptable results on performance evaluation audits.

5) Corrective action will begin upon notification of unacceptable results on inter- or intra-laboratory performance studies.

15.0 CORRECTIVE ACTION (Continued)

15.3 Corrective action will follow a defined series of steps to identify and correct the problem.

1) Calculations will be checked for mathematical errors. Extraction logs will be examined for non-standard procedures or observations of sample abnormalities. The log books documenting the preparation of calibration standards, surrogates, internal standards, and spikes will be reviewed for errors. Recalculations will be performed to confirm final results.

2) The sample(s) failing the Quality Control limits will be reanalyzed to check the repeatability of the analytical method. If the results differ from the original data and fall within the control limits, identify any changes in system settings or performance and reanalyze all potentially affected samples.

3) System performance will be reviewed to assure that all gas flows are consistent with standard operation, programmed instrument controls are unchanged, integrator/computer settings are within standard limits, and all other external inputs meet analytical specifications. Analysis of appropriate QC samples will monitor system performance. If an instrument malfunction is discovered, the problem will be corrected and all samples analyzed during the affected period will be reanalyzed.

4) The samples will be reextracted and reanalyzed to check the extraction methodology. If the results differ from the original data and fall within the control limits, identification of non-standard extraction protocol will be made and all potentially affected samples will be reextracted and reanalyzed.

5) If none of the steps listed above identify and solve the problem, the data will be flagged as "J -estimated concentration".

16.0 QUALITY ASSURANCE REPORTING PROCEDURES

The QA officer of the project will issue status reports addressing the sample data set, analytical method used, quality control tools and response throughout the project. A QA memo will begin with the receipt of samples and cover preparation analysis and data reduction.

Laboratory Section Leaders and the QC Officer will issue hard copy memos to the project file addressing any QC anomaly or corrective action.

Quality assurance reports will be addressed to the project administrator, client, and the project manager. Reports will cover, at the minimum:

1. Topic covered - method, sample, data set
2. When noted and why
3. Any further action noted
4. Any resolution to topic
5. Any conversation, etc., with GTI / BRC.

17.0 REFERENCES

Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analysis. February 1, 1988.

Handbook of Quality Assurance for the Analytical Chemistry Laboratory. 1990.

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition. June 1990.

Method 8240, Gas Chromatography/Mass Spectrometry for Volatile Organics, Test Methods for Evaluating Solid Wastes, SW-846, United States Environmental Protection Agency, 3rd edition, November 1986 and 1990.

Method 8270, Gas Chromatography/Mass Spectrometry for Semivolatile Organics, Test Methods for Evaluating Solid Wastes, SW-846, United States Environmental Protection Agency, 3rd edition, November, 1986.

Method 3050: Acid Digestion of Sediments, Sludges, and Soils, SW-846, November 1986.

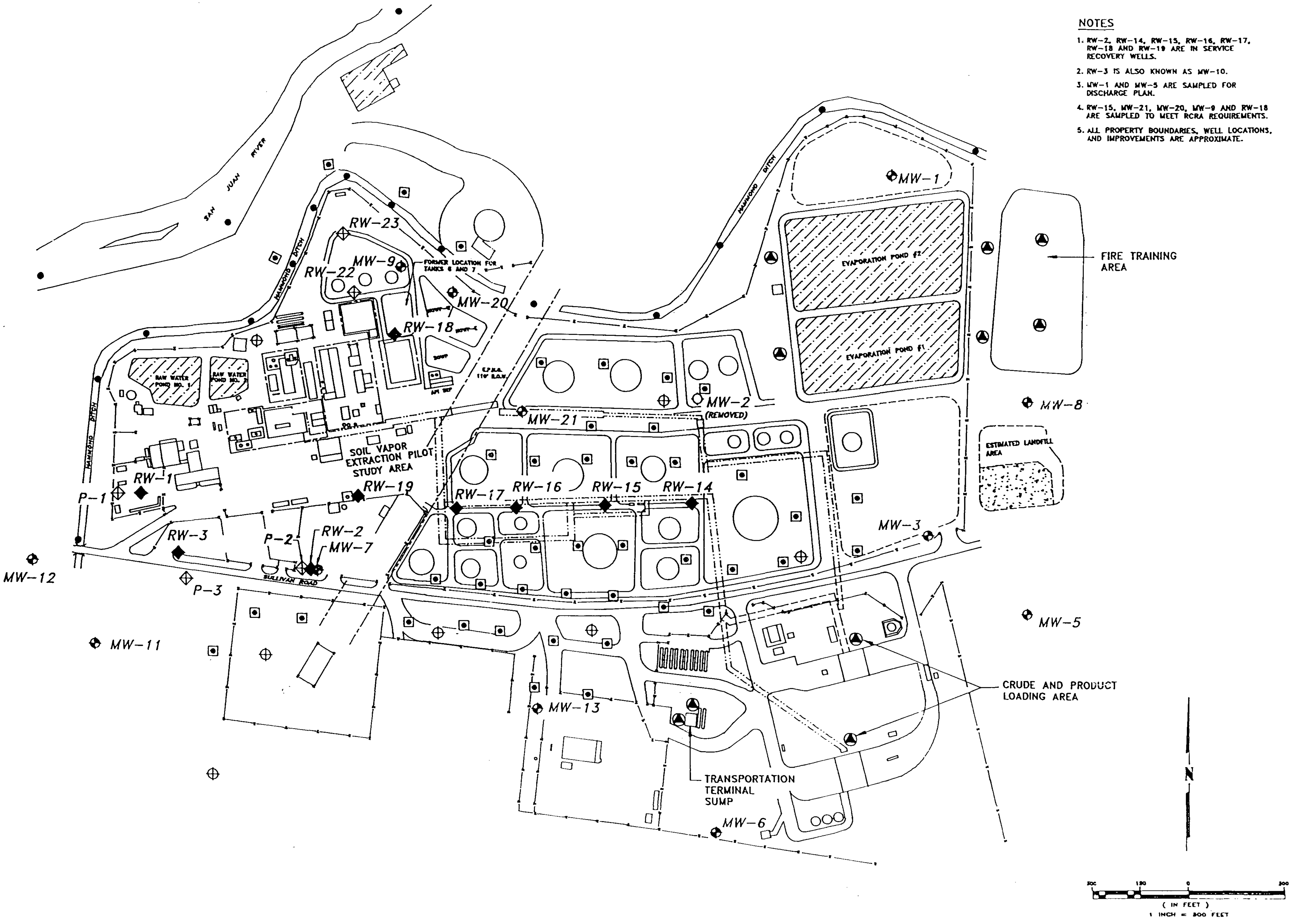
Method 6010: Inductively Coupled Plasma Atomic Emission Spectroscopy, SW-846, November, 1986.

Method 7000: Atomic Absorption Methods, SW-846, November, 1986.

Method 7471: Mercury in Solid and Semisolid Waste (Manual Cold-Vapor Technique), SW-846, November, 1986.

Method 418.1: Total Recoverable Petroleum Hydrocarbons, EPA-600/4-79-020, March, 1983.

Diagnosis and Improvement of Saline and Alkali Soils, Handbook 60, United States Department of Agriculture, August, 1969.



NOTES

1. RW-2, RW-14, RW-15, RW-16, RW-17, RW-18 AND RW-19 ARE IN SERVICE RECOVERY WELLS.
2. RW-3 IS ALSO KNOWN AS MW-10.
3. MW-1 AND MW-5 ARE SAMPLED FOR DISCHARGE PLAN.
4. RW-15, MW-21, MW-20, MW-9 AND RW-18 ARE SAMPLED TO MEET RCRA REQUIREMENTS.
5. ALL PROPERTY BOUNDARIES, WELL LOCATIONS, AND IMPROVEMENTS ARE APPROXIMATE.

NO.	DATE	BY	REVISION

LEGEND

-·-·-·-	PIPEWAY
- - - - -	UNDERGROUND PIPEWAY
—x—	FENCE
⊕ MW-1	EXISTING MONITORING WELL
◆ RW-1	EXISTING RECOVERY WELL
⟡ P-1	PROPOSED RECOVERY WELL
○ MW-2	FORMER MONITORING WELL
⊕	PROPOSED MONITORING WELL
▲	PROPOSED BORING
▣	PROPOSED SOIL VAPOR SURVEY POINT
●	SEDIMENT AND SURFACE WATER SAMPLE

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SIGNATURE	DATE
PROJECT GEO:	
PROJECT ENGR:	
PROJECT MGR:	
CLIENT:	

Bloomfield Refining Company
A Gary Energy Corporation Subsidiary
#50 COUNTY ROAD 4990
BLOOMFIELD, NEW MEXICO

GROUNDWATER TECHNOLOGY
2501 YALE BLVD. SE. SUITE 204
ALBUQUERQUE, NEW MEXICO 87106
(505) 242-3113

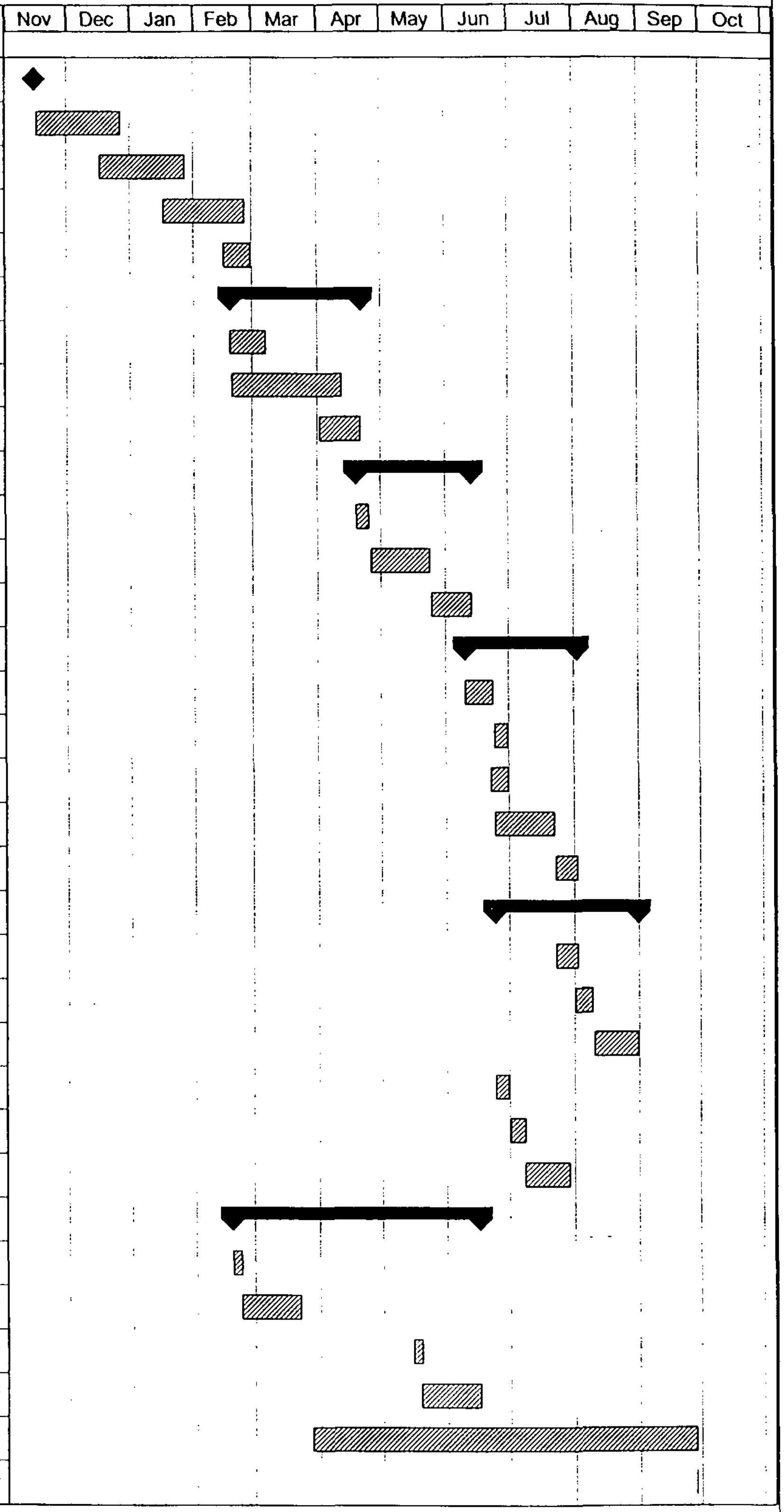
PROPOSED FACILITY INVESTIGATION

DESIGNED BY:	DRAFTED BY: J. ML	CHECKED BY:

DATE: SEPT. 14, 1993	FILE: FAC-B4.DWG
PROJECT NO.: 023353014	CONTRACT:
DRAWING: FIGURE 2	REVISION:

FIGURE 4
PROJECT SCHEDULE
RCRA FACILITY INVESTIGATION, BLOOMFIELD REFINING COMPANY BLOOMFIELD NEW MEXICO

TASK	Start	Finish
Submittal of Draft RFIWP	11/15/93	11/15/93
USEPA Review/Comments	11/16/93	12/27/93
Finalization of RFIWP	12/17/93	1/27/94
USEPA Review/Approval	1/17/94	2/25/94
Scheduling/Coordination	2/15/94	2/28/94
Phase I Facility Investigation	2/18/94	4/21/94
Soil Vapor Survey/Soil Sampling	2/18/94	3/7/94
Soil Sample Analyses	2/19/94	4/12/94
Data Evaluation/Phase II Prep	4/2/94	4/21/94
Phase II Facility Investigation	4/19/94	6/13/94
Soil Borings/Sampling	4/19/94	4/25/94
Soil Sample Analyses	4/26/94	5/24/94
Data Evaluation/Phase III Prep	5/25/94	6/13/94
Phase III Facility Investigation	6/10/94	8/2/94
Groundwater Well Installations	6/10/94	6/23/94
Groundwater Sampling	6/24/94	6/30/94
Survey	6/22/94	6/30/94
Sample Analyses	6/24/94	7/22/94
Data Evaluation/Phase IV Prep	7/23/94	8/2/94
Phase IV Facility Investigation	6/24/94	8/31/94
Aquifer Test Setup	7/23/94	8/2/94
Aquifer Test Perform	8/1/94	8/9/94
Data Evaluation	8/10/94	8/31/94
AS/VE Point Installations	6/24/94	6/30/94
VE Test/AS Test/AS/VE Test	7/1/94	7/8/94
Data Evaluation	7/8/94	7/29/94
Stream Sampling	2/18/94	6/16/94
San Juan River	2/18/94	2/22/94
Laboratory Analysis	2/22/94	3/22/94
Hammond Ditch	5/15/94	5/19/94
Laboratory Analysis	5/19/94	6/16/94
Draft RFI Report Prep	3/28/94	9/28/94
Submittal of RFI Report	9/28/94	9/28/94



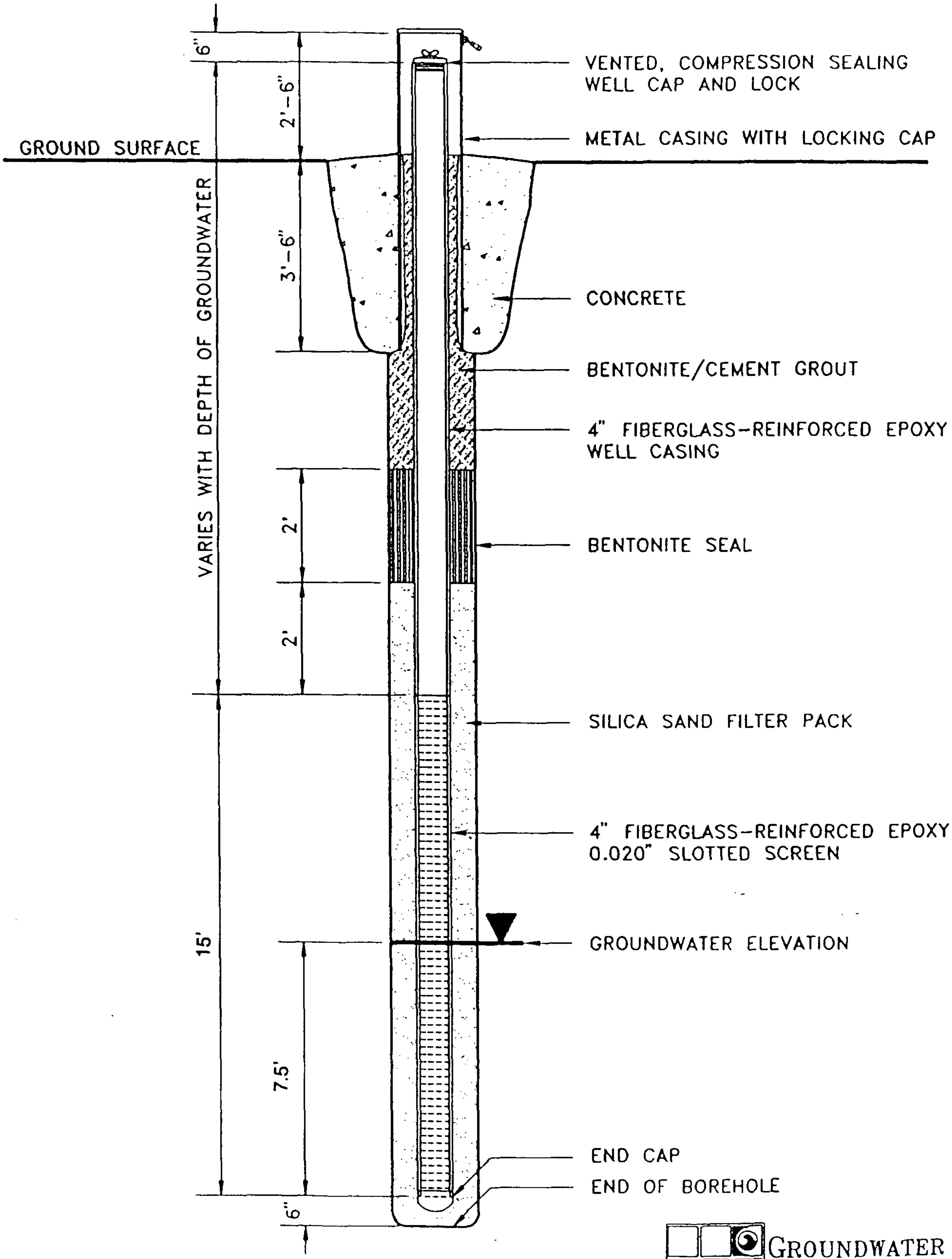
Project: 023353014
Date: 9/14/93

Critical	▨	Progress	▬	Summary	▬
Noncritical	■	Milestone	◆		

FIGURE 6

TYPICAL STICK-UP MONITORING WELL

NOT TO SCALE



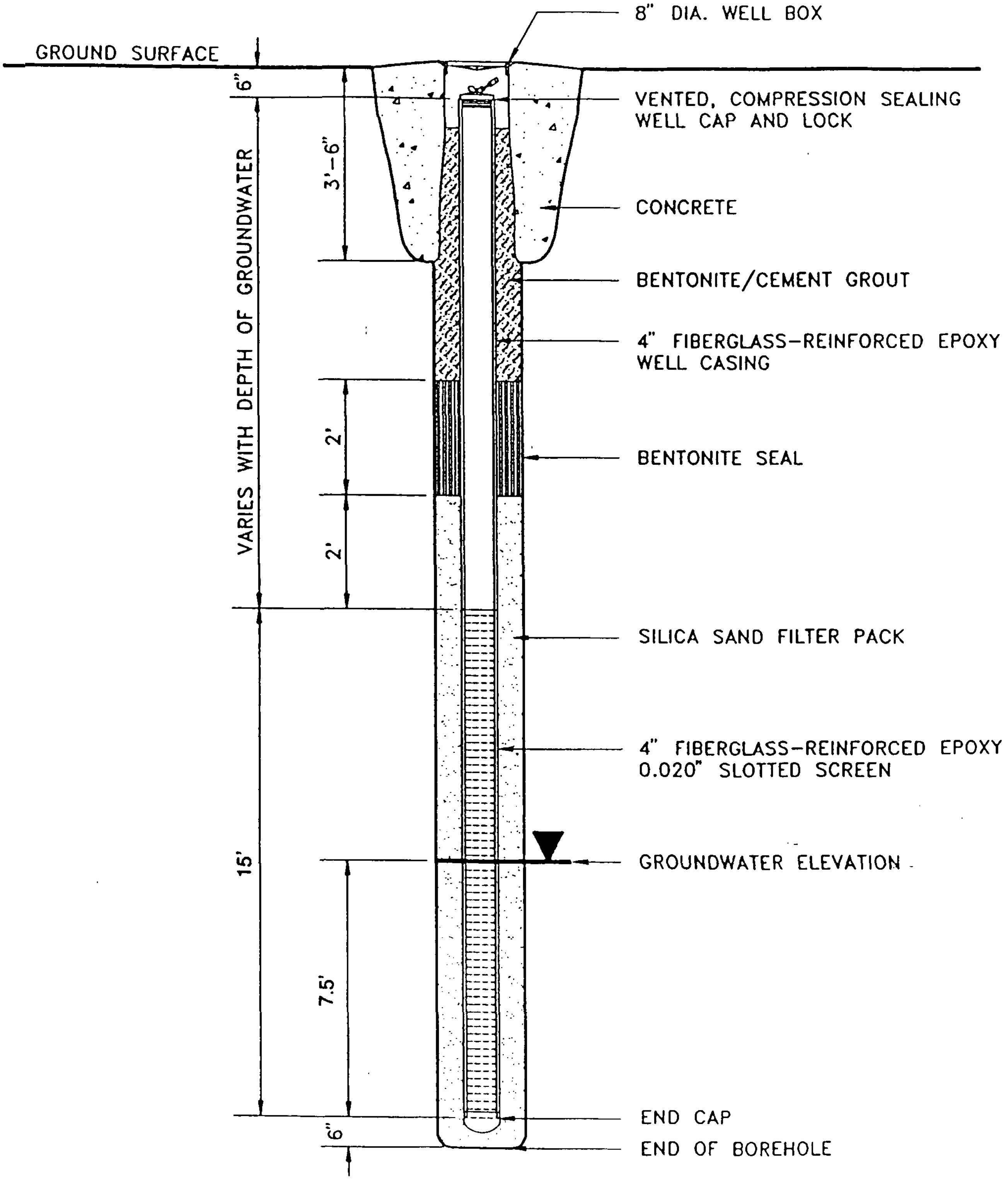
GROUNDWATER TECHNOLOGY

3014SU1/MWS/3-12-93

FIGURE 5

TYPICAL FLUSH-MOUNTED MONITORING WELL

NOT TO SCALE



GROUNDWATER TECHNOLOGY

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