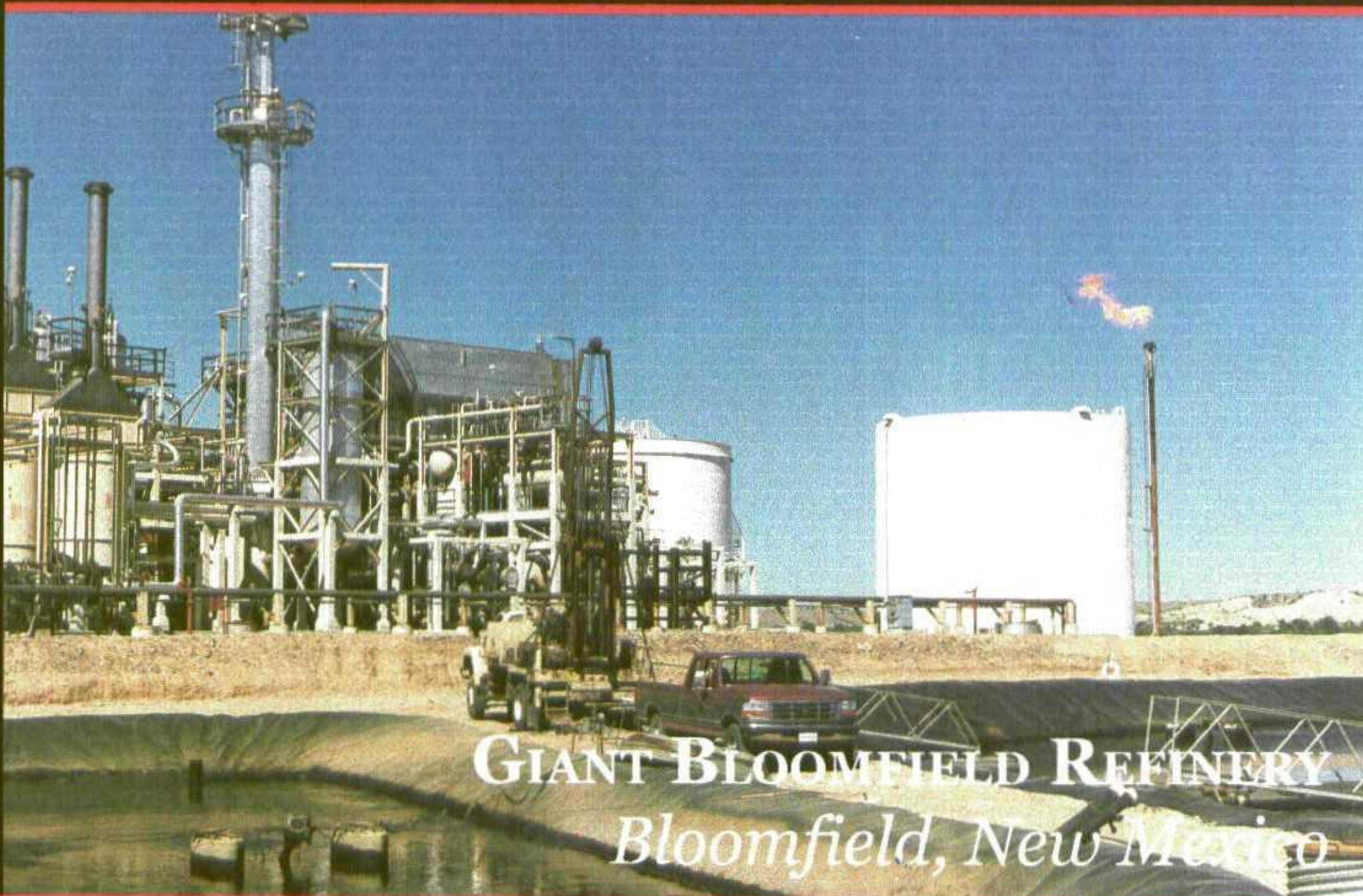
GW - 1

WORK PLANS

1999

February 8, 1999

STAGE 1 ABATEMENT PLAN PROPOSAL



GIANT BLOOMFIELD REFINERY

Bloomfield, New Mexico

R.T. HICKS CONSULTANTS, LTD.

4665 INDIAN SCHOOL NE, SUITE 106, ALBUQUERQUE, NM 87110

February 8, 1999

Stage 1 Abatement Plan Proposal

GIANT BLOOMFIELD REFINERY

Prepared for:

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1.0 EXECUTIVE SUMMARY

Under contract to Giant Refining Company, R.T. Hicks Consultants, Ltd. proposes to implement an environmental program at the Bloomfield Refinery. This document is a Stage 1 Abatement Plan Proposal. It presents the work elements and methods of investigation necessary to:

- Complete the requirements under the existing RCRA 3008(h) Administrative Order on Consent;
- Submit to EPA a revised Corrective Measure Study;
- Submit to NMOCD a Final Site Investigation Report; and
- Submit to NMOCD a proposed remediation strategy that is in the form of either a Stage 2 Abatement Plan Proposal or a modification of the approved Discharge Plan (GW-1)

Specific work elements described in this Stage 1 Abatement Plan Proposal and the accompanying Quality Assurance/ Quality Control (QA/QC) Project Plan are:

Task 1: Review existing data and determine which data meet QA/QC criteria for inclusion in final reports

Task 2: Conduct additional field campaigns to collect water quality data, install groundwater sampling points and collect soil samples.

Task 3: Update the Human Health and Ecological Risk Assessment

Task 4: Conduct BIOPLUME III aquifer simulation modeling of hydrocarbon transport

Task 5: Prepare reports to fulfill obligations under the RCRA 3008(h) Order and the Water Quality Control Commission (WQCC) Regulations at either Subpart III (Discharge Plan Regulations) or Subpart IV (Abatement Regulations).

A revision to the previously-submitted Corrective Measure Study (CMS) is required due to what appears to be the presence of subsurface petroleum hydrocarbons between the Hammond Ditch and the San Juan River, north of the Refinery. The existing CMS does not address abatement of these hydrocarbons. As outlined in this proposal, Giant will prepare a remediation strategy under WQCC Regulations to address abatement of petroleum hydrocarbons in soil and groundwater that are not subject to RCRA regulation. These non-RCRA hydrocarbons originated from petroleum storage tanks and other sources in the refinery process areas.

2.0 INTRODUCTION

Giant Refining Company retained R.T. Hicks Consultants (Hicks Consultants) to complete the regulatory measures mandated by the December 31, 1992, 3008(h) Administrative Order on Consent (AOC) and to recommend a program that will comply with Water Quality Control Commission (WQCC) regulations. The five tasks Hicks Consultants will address at the refinery with this program are:

Task 1: Review existing data and determine which data meet QA/QC criteria, as outlined in the accompanying QA/QC Project Plan, for inclusion in the final reports;

Task 2: Conduct additional field campaigns to collect water quality data, install groundwater sampling points and collect soil samples;

Task 3: Update the Human Health and Ecological Risk Assessment;

Task 4: Conduct BIOPLUME III aquifer simulation modeling of hydrocarbon transport; and

Task 5: Prepare reports to fulfill obligations under the RCRA 3008(h) Order and the WQCC Regulations at either Subpart III (Discharge Plan Regulations) or Subpart IV (Abatement Regulations).

Two state agencies and one federal agency currently have regulatory jurisdiction at the Giant Refinery. These are: The United States Environmental Protection Agency (EPA), the New Mexico Oil Conservation Division (NMOCD) and the New Mexico Environment Department (NMED).

This document proposes a data collection program that will provide the basis for satisfying all requirements set forth by the AOC and by the WQCC regulations.

2.1 SITE DESCRIPTION

The Giant Refining Company Bloomfield Refinery (the Refinery) is located south of Bloomfield, New Mexico in San Juan County, latitude N36° 41′ 87″, longitude W107° 58′ 70″ (see Plate 1). The Stage 1 Abatement Plan Investigation study area (Study Area) consists of the Refinery process areas, storage tanks and waste management areas, as well as adjacent areas which exhibit subsurface petroleum hydrocarbons. Some of the waste management units are in the northewest quadrant of Section 26, T29N and R11W. The process and storage areas are in the east central portion of Section 27, T29N, R11W. Previously installed monitor wells define an area south of the Refinery where petroleum hydrocarbons are present in the subsurface. Studies also define an area north of the Refinery, along the San Juan River, where subsurface hydrocarbons exist. Plate 2 shows the Study Area with respect to Sections 26 and 27.

The Refinery is located on a bluff 120 feet above the south side of the San Juan River (see Plate 3). The top of the bluff is relatively flat, at an elevation of 5,540 feet above sea level. An unnamed arroyo flows toward the San Juan River on the southern and western edges of the study area. East of the study area, a well-defined arroyo cuts a small canyon from the bluff to the San Juan River. Hammond Ditch, an unlined irrigation ditch, lies on the bluff between the cliff face and the Refinery.

Portions of the Study Area are associated with the following activities (as indicated in Plate 4):

- Petroleum processing
- Crude and product storage
- Crude unloading and product loading
- Waste management (closed units and existing facilities)
- Offices and non-petroleum material storage

As Plate 4 shows, Refinery offices are on the western end of the facility, along with warehouse space, maintenance areas, raw (clean) water ponds for temporary storage of fresh water from the San Juan River, and one storage yard containing used material (e.g. pipe, valves). The former drum storage area, identified as a solid waste management unit (SWMU) by the EPA, is also in this area. Process units, located north of the refinery offices, include the crude unit, fluidized catalytic polymerization unit and hydrodesulfurization unit. Several product storage tanks are located east of the process area. The API separator and wastewater treatment ponds are east of the process area. The wastewater treatment ponds are the north oily-water pond (NOWP) and the south oily-water pond (SOWP) identified by the EPA as RCRA hazardous waste management units.

In the central portion of the Study Area, aboveground storage tanks (ASTs) occupy a large portion of Refinery property. South of the Refinery and across Sullivan Road are terminals for loading product and off-loading crude, gas storage and the hazardous waste storage area.

The eastern portion of the study area contains closed and operational waste management facilities. Until the end of 1994, the Refinery used two clay-lined evaporation ponds and a spray irrigation area to treat and dispose wastewater. At present, two double-lined five-acre evaporation ponds and a Class I underground injection well handle all Refinery wastewater. The former spray irrigation area is closed and overlaid by an office complex. The fire training area and the former landfill are also located at the eastern end of the facility.

Plate 4 also shows monitor wells south of the Refinery fence line and west of the crude unloading and product loading area. These wells define an area where petroleum hydrocarbons exist in groundwater. The US Bureau of Land Management controls this part of the Study Area. Subsurface hydrocarbons may exist north and west of the process area, between the San Juan River and the cliff that defines the limit of the Jackson Lake Terrace deposits. This area is owned by Giant Refining Company.

2.2 PREVIOUS INVESTIGATIONS

Between 1984 and 1990, the former owner of the refinery, Bloomfield Refining Company (BRC), contracted with several environmental consultants to install thirteen groundwater monitoring wells (MW-1 through MW-13), three recovery wells (RW-1 through RW-3) and three piezometers. These investigators also carried out a conductivity survey and a soil vapor survey to assist in placement of the wells. These field campaigns were conducted in accordance with New Mexico WQCC Discharge Plan requirements, a RCRA 3013 Administrative Order investigation, and a RCRA 3008 Order and Consent Agreement to close certain land disposal facilities. Some elements of the field investigations also supported a voluntary effort to recover separate-phase hydrocarbons (SPH). To that end, BRC installed six additional SPH recovery wells (RW-14 through RW-19), two monitor wells (MW-20 and MW-21) and an air sparging well, now inoperable, labeled MW-24. All of these wells are displayed on Plate 4 except MW-2 and MW-10; MW-2 was destroyed and MW-10 was converted to RW-3 as explained in Section 2.2.4 of this document.

In December 1992, BRC signed an Administrative Order on Consent (AOC) with the EPA. This Order required several work elements, including a RCRA Facility Investigation and a Corrective Measure Study. In order to fulfill the requirements in the AOC order, BRC contracted with Groundwater Technology, Inc. (GTI). In the course of their work, GTI and Layne Environmental installed two recovery wells (RW-22 and RW-23) and ten monitoring wells (MW-25 through MW-34).

In 1995, Giant Refining Company (Giant) purchased the Refinery. In 1997, Giant had three monitor wells (MW-40 through MW-42) installed south of the process units, to monitor hydrocarbon distribution within the Refinery. Giant also had four monitoring wells (MW-35 through MW-38) installed on Bureau of Land Management property adjacent to the Refinery, as a voluntary action to delineate the southern extent of hydrocarbons in groundwater.

In March 1997, Giant contracted with Precision Engineering to investigate an area adjacent to the San Juan River. Eleven borings identified hydrocarbons in recent alluvial sediments. These hydrocarbons appear to have flowed from cliffside seeps, through the talus slope and into the alluvium.

Table 1 provides a summary of Previous site investigations.

Following are more detailed descriptions of work performed in response to various orders and voluntary initiatives.

2.2.1 RCRA 3008 ORDER INVESTIGATION (1985)

In April 1985, in accordance with a RCRA 3008 Order on Consent Agreement, BRC closed the south and north oily-water wastewater ponds (SOWP and NOWP), the onsite landfill, and the landfill runoff pond. Sediment and some underlying soil were removed from the unlined SOWP and NOWP and a synthetic liner installed in each. Engineering Science sampled the material removed from the ponds; subsequent analytical results showed that the material did not meet criteria for classification as hazardous waste (reactivity, ignitability, explosivity or toxic characteristics).

In October 1985, Engineering Science collected and analyzed soil samples from each of the oily water ponds from beneath the recently installed synthetic liners. The analytical results demonstrated that the material beneath the ponds did not exhibit hazardous waste constituents (Engineering Science, 1986).

During this same investigation, Engineering Science also sampled the landfill runoff pond, which had been created as a result of blockage of an arroyo during construction of Hammond Ditch. Again, the results were consistent with the requirements for clean closure for the unit as required by the 3008 order.

The EPA issued closure approval for the NOWP, SOWP and the landfill runoff pond in January 1994. To date the EPA has not issued a closure letter for the onsite landfill.

2.2.2 RCRA 3013 ORDER INVESTIGATION (1985)

In April 1985, the EPA issued a 3013 Order requiring a groundwater study at the site (Docket No. RCRA 3013-00-185), as well as analysis of surface water during low-flow conditions.

The groundwater study, according to Engineering Science's final report (Engineering Science, 1987), included:

- an electrical resistivity survey;
- installation of four groundwater monitoring wells (MW-7 through MW-10);
- monthly fluid level measurements;
- quarterly groundwater sampling of wells MW-1 through MW-5 and MW-7 through MW-10 for a one-year period; and
- a series of slug tests.

Surface water sampling was performed in Hammond Ditch and the San Juan River in April and July 1987, respectively. Engineering Science submitted the results to the EPA on September 14, 1987.

BRC finished all aspects of the order. The EPA released BRC from the order after submission of the final report.

2.2.4 INVESTIGATION TO ADDRESS NEW MEXICO OIL CONSERVATION DIVISION DISCHARGE PLAN REQUIREMENTS(1988)

In 1988, in response to various inquiries from the New Mexico Oil Conservation Division (NMOCD), BRC engaged Geoscience Consultants, Ltd., (GCL) to conduct a soil vapor survey on Bureau of Land Management property located adjacent to the Refinery. Results of this study were detailed in a report submitted in August 1989 (GCL, 1989). During this field program, GCL installed three piezometers, two recovery wells and one monitoring well. GCL also converted MW-10 to a recovery well (RW-3). BRC then installed pneumatic skimmer pumps in nine recovery wells, and implemented a product recovery program on January 4, 1989. NMOCD approved the Discharge Plan in June 1989.

2.2.5 RCRA 3008(H) AOC (1992)

On December 31, 1992, the EPA issued another RCRA 3008 Administrative Order on Consent regarding the Refinery. This order required several work elements, as described below.

INTERIM MEASURES (IM) PLAN

An IM work-plan was submitted and received EPA approval in May 1993. Interim measures proposed in the plan included the installation of two additional recovery wells, surveying and gauging of all wells, deployment of pumping systems in the new wells (if appropriate) and startup of a hydrocarbon recovery operation. The "Interim Measures Report," dated March 3, 1994, describes these activities.

RCRA FACILITY INVESTIGATION (RFI)

In fulfillment of the RFI requirements, two reports ("Task I: Description of Current Conditions" and "Task II: RCRA Facility Investigation Work") were submitted, both in March 1993. GTI revised and resubmitted the RFI work-plan, and the EPA approved it in November 1993. As detailed in these reports, the RFI work was conducted in five phases:

Phase I: Soil Gas Survey;

Phase II: Soil Boring Investigation;

Phase III: Well Installation/Groundwater Sampling;

Phase IV: Aquifer Testing;

Phase IV: Soil Vapor Extraction/Air Sparging Pilot Studies; and

Phase V: Stream Sediment and Surface Water Sampling.

CORRECTIVE MEASURE STUDY (CMS)

A RCRA Facility Investigation/Corrective Measures Report was submitted in November 1994, summarizing each phase of the RFI and compiling and evaluating the data collected. After review of the document, the EPA recommended submission of a separate CMS along with additional groundwater characterization down-gradient of MW-34. GTI submitted the CMS in December 1995.

During a March 3, 1997, site visit by the EPA, Giant Industries obtained verbal permission from the EPA to submit a substantial revision of the CMS. Proposed revisions to the CMS will address recently identified hydrocarbons in the San Juan River Alluvium. The CMS will also provide a more thorough evaluation of natural restoration (monitored natural attenuation or intrinsic remediation) as a stand-alone restoration strategy for areas not presently addressed by the active hydrocarbon/groundwater pumping system.

2.3 REGULATORY CONSIDERATIONS

Investigation and abatement of petroleum hydrocarbons and related constituents beneath and adjacent to the Bloomfield Refinery are subject to one or all of the following regulations:

> Water Quality Control Commission (WQCC) Regulations, which address non-RCRA waste management and abatement measures
>
> New Mexico Hazardous Materials Management (NMHWM) Regulations, which address management of hazardous waste and abatement of such releases
>
> Federal Regulations (40 CFR 264 and 265) promulgated under the Resource Conservation and Recovery Act (RCRA), which address compliance with orders previously issued by the EPA

2.3.1 WQCC WASTE MANAGEMENT AND ABATEMENT OF HYDROCARBONS IN GROUNDWATER

The Refinery currently maintains a WQCC Discharge Plan (GW-1) permit with the NMOCD for management and disposal of non-RCRA waste. This Discharge Plan addresses many processes in the refinery, including:

> active evaporation ponds;
>
> refinery sewer systems;
>
> Class I non-hazardous waste injection well; and

groundwater pumping to capture hydrocarbons associated with the past release of petroleum products from storage tanks.

After termination of the 3008(h) AOC, abatement of subsurface petroleum hydrocarbons may proceed under either the NMHWM Regulations or, if the study shows the hydrocarbons originated from non-RCRA sources, the WQCC Regulations. Compliance with the WQCC Regulations will take the form of either a Stage 2 Abatement Plan or a modification of the existing Discharge Plan.

2.3.2 RCRA WASTE MANAGEMENT

The Refinery also manages RCRA waste, currently operating under interim status pending approval of a Part A and Part B RCRA permit. RCRA waste managed by the Refinery includes API Separator Sludge (K051), Heat Exchanger Bundle Cleaning Sludge (K050), Leaded Tank Bottoms (K052), Primary Oil/Water/Solids Separation Sludge (F037), Ignitable Wastes (D001) and Benzene Toxic Wastes (D018) with generation potential. Permits to manage these wastes are issued by the New Mexico Environment Department under the NMHWM regulations.

2.3.3 ADMINISTRATIVE ORDERS ON CONSENT

As detailed above in Section 2.2.5, in 1992 the EPA and BRC entered into an Administrative Order on Consent (AOC) pursuant to the authority of Section 3008(h) of the Solid Waste Disposal Act. The order suggests that petroleum hydrocarbons in the subsurface may have originated from the North and/or South Oily Water Ponds, which are considered hazardous waste management units, regulated under RCRA. As detailed above in Section 2.2.5, the AOC requires three main work elements:

implementation of interim measures to mitigate potential threats to human health or the environment;

RCRA Facility Investigation (RFI) to fully determine the nature and extent of any release(s) of hazardous waste or hazardous waste constituents at or from the Refinery; and

Corrective Measure Study (CMS) to identify and evaluate alternatives for corrective action(s) to prevent or mitigate any migration of release(s) of hazardous waste or hazardous waste constituents at or from the facility.

Hicks Consultants understands that all work elements up to and including submission of the Corrective Measure Study are complete. Giant has obtained permission from the EPA to submit a revised CMS. The EPA's selection of the corrective measure will presumably result in termination of the AOC; the EPA should also issue a closure letter for the onsite landfill.

2.3.4 FUTURE REGULATION OF GROUNDWATER ABATEMENT ACTIVITIES

Abatement of groundwater should proceed under the NMHWM. Regulations in any areas where the propesed investigation determines that hazardous waste constituents originated from RCRA solid waste management units, such as the North or South Oily Water Ponds. Groundwater abatement should proceed under the WQCC Regulations in any areas where the source of hydrocarbons is a spill from stroage tanks or process units. There are a number of reasons why RCRA Subtitle C should not apply to these latter releases, as explained below.

First, these petroleum hydrocarbon spill sites were never identified as solid waste management units (SWMUs) by any EPA directive. A RCRA corrective action program at a treatment, storage or disposal facility addresses abatement of contamination released from SWMUs identified as part of that program. There is no reason why other contaminants cannot be remediated by a non-RCRA program under state law.

Second, there is no indication that these spilled petroleum hydrocarbons meet the definition of hazardous waste under RCRA. Petroleum products are not specifically listed as hazardous wastes in 40 C.F.R. 261, Subpart D. Therefore, the so-called "mixture rule" at 40 C.F.R.§ 261.3(a)(2)(iv) does not apply. Even if these materials were listed as hazardous, it is doubtful that the mixture rule would apply in view of the fact that the soil into which the materials spilled is not a solid waste. The mixture of petroleum hydrocarbons and affected media (soil or groundwater) could be defined as a hazardous waste if testing showed that the mixture is ignitable, corrosive, reactive or toxic, as defined in 40 C.F.R. 261, Subpart C. However, none of the extensive testing of media contaminated by these spills has indicated that the media would exhibit a hazardous characteristic.

Third, EPA has a policy that if media do not exhibit a hazardous characteristic and if the contaminants are not known to originate from listed hazardous wastes, then the media is not subject to RCRA Subtitle C regulations.

> It has been [EPA's] longstanding policy that in cases where the origin of the contaminants is unknown, the lead agency may assume that contaminants in media did not originate from listed hazardous wastes. (See e.g., 55 FR 8666, 8758, March 8, 1990, and 53 FR 51394, 51444, (December 21, 1988)). It is generally the responsibility of the owner/operator or responsible party to make a good faith effort to determine whether hazardous constituents in media have originated from listed hazardous wastes. If the origin of constituents in media cannot be determined, and the media do not exhibit a hazardous characteristic, then the media would not be subject to Subtitle C regulations in the first place. (61 Fed. Reg. 18780, 18792 (1966).

At present, data concerning the provenance of hydrocarbons in groundwater do not confirm releases from SWMUs. This study proposes additional evaluation to determine the provenance of these hazardous waste constituents in groundwater.

Fourth, abatement of petroleum hydrocarbons released from pipelines, bulk storage terminals or refineries in New Mexico has typically been conducted under WQCC Regulations rather than under federal statutes such as RCRA or CERCLA. An excellent example of this division between State and Federal authority is the South Valley Superfund Site in Albuquerque. Here, petroleum hydrocarbon releases from a bulk terminal and a pipeline overlie

South Valley Superfund Site in Albuquerque. Here, petroleum hydrocarbon releases from a bulk terminal and a pipeline overlie groundwater subject to action under CERCLA. Although petroleum hydrocarbon spills are exempt from CERCLA, RCRA does not explicitly exempt such substances from its jurisdiction. Nevertheless, at the South Valley Superfund Site and throughout New Mexico, restoration of petroleum hydrocarbon releases from pipelines and aboveground storage tanks is implemented under WQCC Regulations, rather than under the RCRA or CERCLA program.

2.4 PURPOSE OF THIS STUDY

The purpose of the current study is to fulfill the requirements of the EPA's AOC and implement site restoration activities pursuant to applicable regulations. To this end, the study will focus on three main objectives:

- determine the origin of hydrocarbons present in groundwater beneath and adjacent to the Bloomfield Refinery site;
- adequately characterize the extent, magnitude and fate of hydrocarbons in groundwater; and
- provide data to determine the best abatement strategy for the site.

2.4.1 DETERMINE ORIGINS OF HYDROCARBONS IN GROUNDWATER

As a result of past refinery activities, petroleum hydrocarbons are present in soil and groundwater beneath and adjacent to the Refinery. Identification of the original refinery source(s) of the observed subsurface petroleum hydrocarbons will dictate which regulations will govern site restoration activities: EPA RCRA Regulations (under a new AOC with the EPA), WQCC Regulations (if hydrocarbons in groundwater are not regulated by RCRA) or NMHWM Regulations.

Since 1984, numerous field programs provided groundwater chemistry data for the study area. Surprisingly, recent submissions to the EPA have not fully evaluated these fourteen years of data.

Therefore, evaluation of existing data, as well as additional investigations, are required to define the origin of subsurface hazardous waste constituents, such as benzene. This objective is stated as Hypothesis 1 in the QA/QC Project Plan.

2.4.2 CHARACTERIZE EXTENT, MAGNITUDE AND FATE OF HYDROCARBONS

Previous investigations have defined the eastern and southern extent of subsurbace hydrocarbons, but not the northern or northwestern lateral extent, or the vertical extent.

Previous investigations presented an aquifer simulation model (BIOPLUME II) that predicted continued migration of hydrocarbons in groundwater. This prediction is not consistent with site data. We will re-evaluate the fate and transport of hydrocarbons using a new model, BIOPLUME III, which is calibrated to site data. This objective appears as Hypothesis 2 in the QA/QC Project Plan.

2.4.3 PROVIDE DATA TO DETERMINE BEST ABATEMENT STRATEGY

BRC engaged various contractors to evaluate several mechanical processes for groundwater restoration. Whereas these previous studies adequately evaluated the most feasible restoration alternatives, they could not take advantage of recent scientific advances associated with natural restoration. The current investigation will collect data necessary to test the effectiveness of natural restoration as a stand-alone restoration strategy for much of the Bloomfield Refinery site. The scientific statement of this objective appears as Hypothesis 3 in the QA/QC Project Plan.

3.0 SCOPE OF WORK

3.1 EVALUATION OF EXISTING INFORMATION

The Study Area has been the subject of numerous investigations. The first task of this program is to examine existing information—including chemical analyses, boring logs and other data—and determine which data meet QA/QC requirements outlined in the Quality Assurance/Quality Control Project Plan (QA/QC Project Plan) submitted with this proposal. Data that meet QA/QC criteria will be incorporated into the final reports; data that cannot meet the criteria may be used with qualification or discarded.

3.2 ADDITIONAL FIELD CAMPAIGNS

Hicks Consultants will perform additional investigation as described below.

3.2.1 SOIL BORINGS, SOIL SAMPLING, MONITOR WELL INSTALLATION AND SEEP SAMPLING POINTS

The soil boring data for the Study Area is not sufficient to determine the provenance of the subsurface hydrocarbons. We believe two deep soil borings near the North and South Oily Water Ponds, one soil boring north of RW-22 and one soil boring near RW-18, are sufficient, as an initial step, to fill in several data gaps. Table 2 describes the location of these borings. The investigation report will compare these data to soil chemistry collected by GTI and Engineering Science. The report will also compare the soil chemistry to the chemistry of the underlying groundwater.

Earlier soil vapor surveys by GTI and GCL provide useful screening information to select locations for groundwater wells and soil borings. GTI and Precision Engineering's well installation program delineates the southern and eastern extent of hydrocarbons. However, the western extent is not defined north of MW-12, nor is the northern extent defined between Hammond Ditch and the San Juan River. The vertical extent of hydrocarbons is also poorly defined, including the water quality in the underlying Nacimiento Formation.

In September 1998, Hicks Consultants and Precision Engineering, Inc., sampled soil at these four locations. During this same field program, the team installed three monitoring wells. Table 2 provides the locations and justifications for these wells. Plate 4 shows their locations.

One well between the NOWP and SOWP (MW-43) will permit correlation of the chemistry of the groundwater to the overlying soil chemistry. To determine the vertical extent of hydrocarbons, and test the water quality of the Nacimiento Formation, we propose installation of two additional wells. One deep well will be located north of the process area, adjacent to RW-23; the other will be adjacent to MW-30. In these proposed locations, the clay lithology of the Nacimiento may prevent water from entering the well, as in MW-6. Lithologic review of the site shows that the underlying Nacimiento Formation is dominantly clay and may be an effective aquiclude.

In order to characterize the water seeping from the cliffside into the San Juan River alluvium, Hicks Consultants has installed four seep sampling points (S1–S4). The location of the water seepage along the cliff necessitated three unique procedures to install sampling points.

Seep sampling point 1 (S1) employs a simple method to direct surface flow from a small spring into a discharge tube. We dug a small basin at the discharge point, inserted the plastic tube into the basin and placed gravel and cobbles over and around the tube. Water now flows through the tube, permitting uniform sampling of this location.

We required a safety harness to install the sampling tubes at S2 and S3. These sampling points are in the middle of a sheer cliff. At these locations, the basin into which the plastic tube is inserted was excavated into the Nacimiento Formation. Cobbles and gravel hold the sampling tubes in place.

S4 is constructed in a manner similar to S1. At this site, however, a sampling tube was not necessary because the sampling point is readily accessible. We used a well bailer as the sampling port for this site.

Groundwater also seeps to the surface due west of the Refinery. Here Hicks Consultants installed a temporary drive point to permit uniform sampling of groundwater. This location is named S5. This location serves to define the lateral extent of hydrocarbons north of MW-12.

3.2.2 GROUNDWATER SAMPLING

Only two groundwater-sampling events (May and August 1994) provide sufficient lateral coverage to define the geometry of the hydrocarbon plume.

To determine the current geometry of the hydrocarbon plume, we propose two groundwater sampling events. The first event has already been conducted, in August/September 1998; the second is planned for March 1999. The list of wells and analytes is presented in Table 3. Data from the existing and proposed groundwater sampling points will provide sufficient data to define the magnitude and extent of hydrocarbons in groundwater. Comparison of the 1994 plume geometry to the 1998 plume geometry and evaluation of chemical trends over time will assist in determining the migration rate of hydrocarbons. Historical data from individual wells will be used to confirm the predicted plume behavior.

3.3 RISK ASSESSMENT UPDATE

Since 1995, when GTI performed the Human Health and Ecological Risk Assessment, several parcels of real estate have changed hands. As part of the update of the Risk Assessment, we will identify these changes in land status. We will also review all input parameters to the Assessement and update the final report as necessary.

3.4 BIOPLUME III SIMULATION MODELING

GTI's evaluation of the migration rate and fate of hydrocarbons in groundwater relied upon simulation modeling using the BIOPLUME II computer model. GTI did not calibrate the computer model to site conditions and, as a result, the model grossly overestimates petroleum hydrocarbon transport. For example, the model predicts that benzene concentrations in MW-34 will rise from 300 ppb at time zero (presumably 1995) to nearly 2,000 ppb after ten years. Benzene concentrations, as predicted in the model, will continue to rise in MW-34 until year 70, reaching a maximum concentration of 8,573 ppb (see Table 2 of GTI Report).

These predictions are not supported by the fourteen years of ground chemistry from MW-4 and ten years of data from MW-11, which show consistent benzene concentration of about 8000 ppb and 5,000 ppb respectively (Figures 1 and 2). MW-11 is 540 feet up-gradient from MW-34; MW-4 is 1,380 feet up-gradient from MW-34. Both MW-11 and MW-4 are down-gradient from identified petroleum hydrocarbon source areas. Prediction of rising benzene concentration in MW-34 is not consistent with historic benzene concentrations in these two wells.

Natural restoration of groundwater can be simulated by a number of computer models. The BIOPLUME III model, which has several enhancements over the previously submitted BIOPLUME II model, may be sufficiently robust to test the suitability of natural restoration for the Bloomfield Refinery site. Alternatively, we may employ MT3D or another model that can effectively predict hydrocarbon movement and biodegradation from multiple source areas.

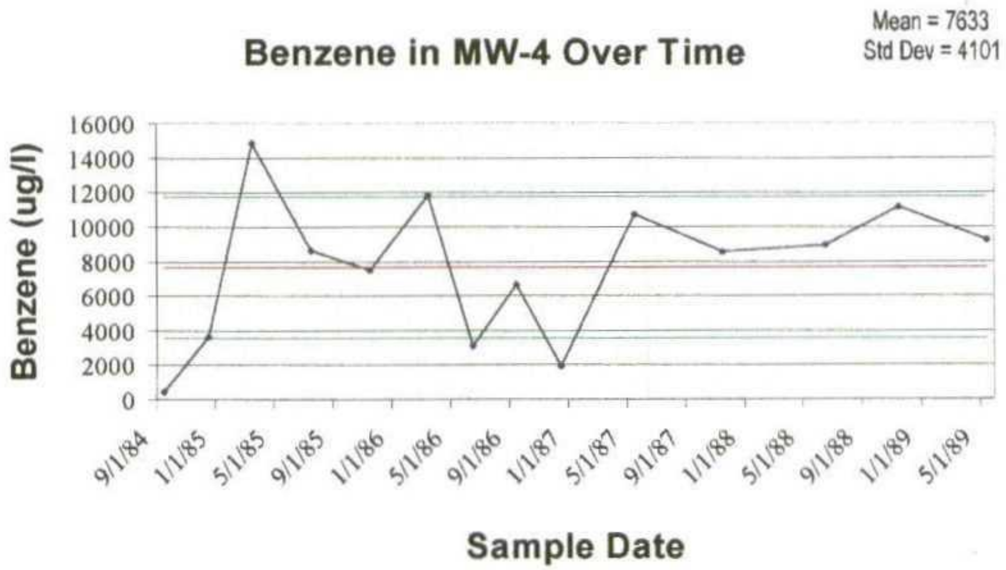


Figure 1: Benzene in MW-4 over time

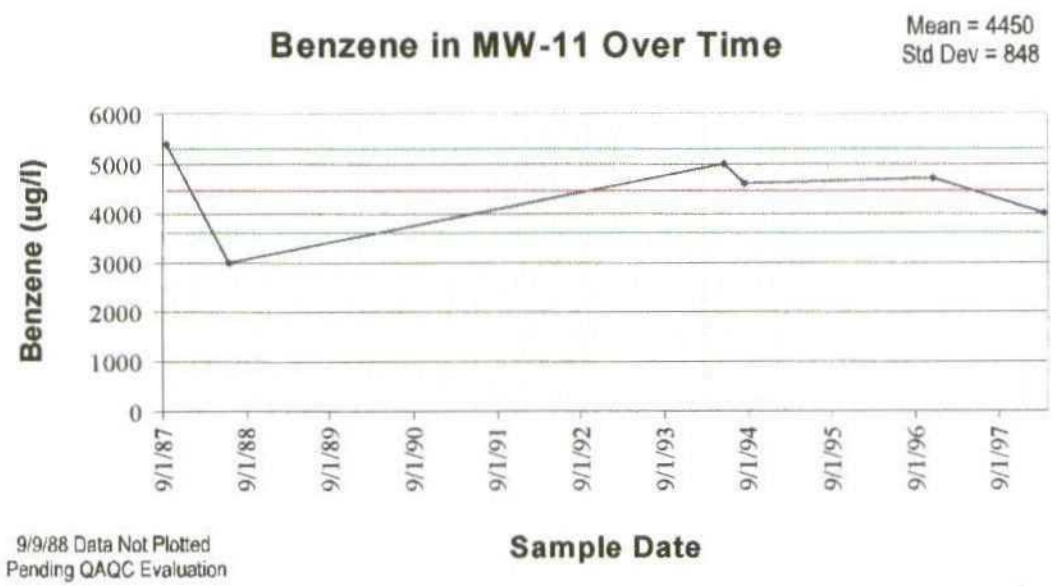


Figure 2: Benzene in MW-11 over time

Preliminary data suggest that a two-dimensional model will be adequate for the site. If the Nacimiento Formation does not contain hydrocarbons, it may be an effective aquiclude. If that is the case, It need not be modeled as a separate layer *and* Hydrocarbon transport would be limited to the thin (4–12 foot) Jackson Lake Terrace deposits. If the Nacimiento Formation is found to contain elevated hydrocarbon levels, then it will need to be included in the plume transport model.

3.5 REPORT PREPARATION

The work elements outlined above will result in the following reports:

Final Site Investigation Report;

Revised Corrective Measures Study and either a Stage 2 Abatement Plan or a Discharge Plan modification; *and*

1999 Monitoring Report.

The original Corrective Measures Study (GTI, 1994) recommended water table depression and Separate Phase Hydrocarbon removal from a network of wells within the Refinery property; soil vapor extraction to remove hydrocarbons sorbed to the alluvium beneath the Refinery; and air sparging or bioremediation to address continued migration of the dissolved-phase hydrocarbons.

Hicks Consultants measured water levels and SPH thickness in all monitor wells and most recovery wells in October 1998. We detected SPH in only four wells: MW-20, MW-26, MW-41 and RW-18. We propose to shut down the recovery system in February 1999 and monitor SPH in the recovery well system over time. We propose semi-annual monitoring of water levels and SPH thickness. We will use these data to determine if continuation of the SPH recovery is necessary. A final recommendation will be presented in the Revised Corrective Measures Study and either a Stage 2 Abatement Plan or a modification of the approved Discharge Plan.

The Stage 2 Abatement Plan (or Discharge Plan Modification) and Revised Corrective Measures Study will also re-evaluate monitored natural restoration as a stand-alone remedial option for groundwater in areas not presently addressed by the active hydrocarbon/ groundwater pumping system. Since 1995, the environmental industry has made significant technical advances in understanding natural restoration. The study will employ these new data in the final evaluation.

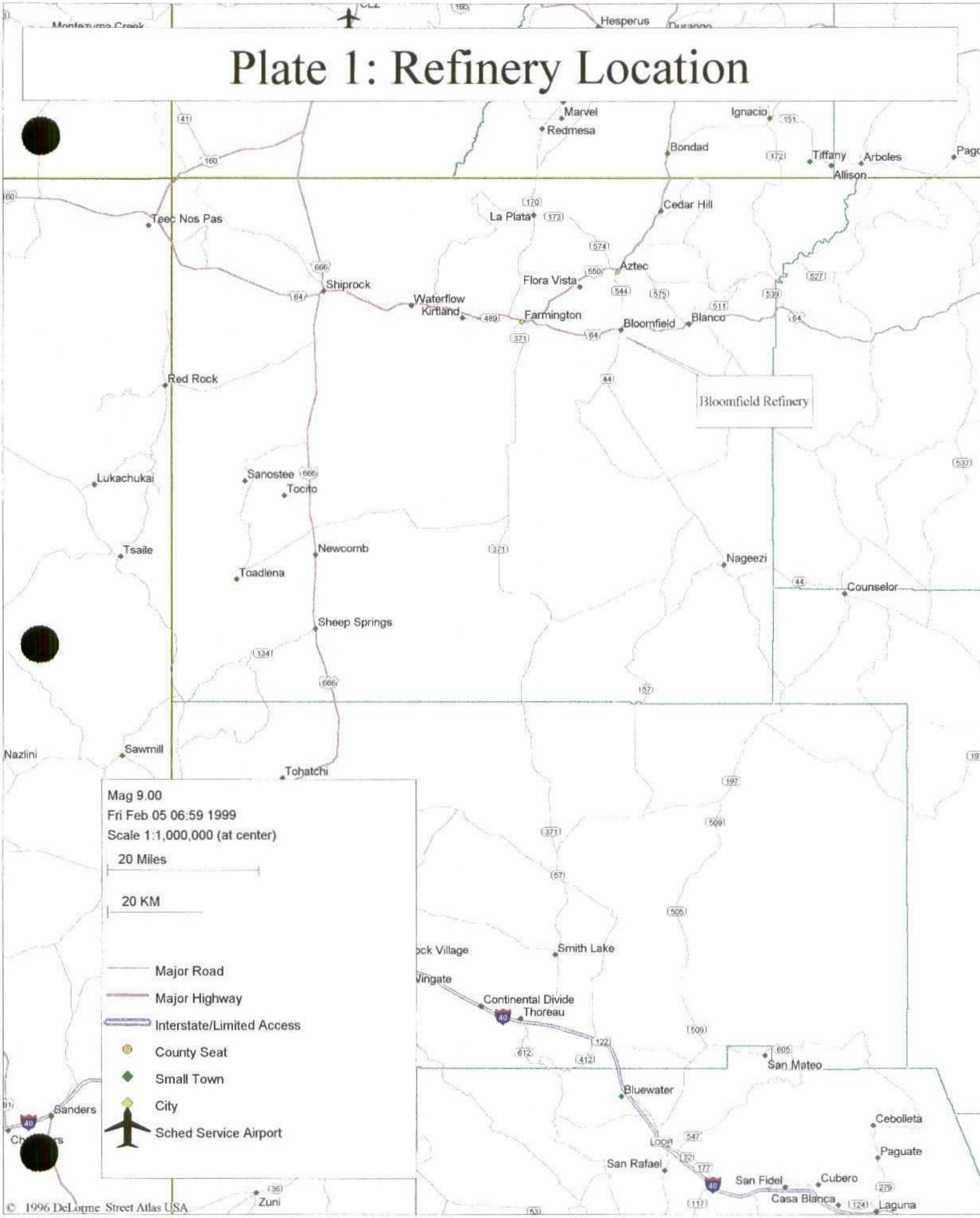
A calibrated hydrocarbon transport model will provide the basis for determining if natural restoration is a viable remedial strategy for the site. BIOPLUME III predictions may show that dissolved hydrocarbons in groundwater do not migrate beyond the current observed extent. If this is the case, re-evaluation of the recommended air sparging and soil vapor extraction remedy is warranted.

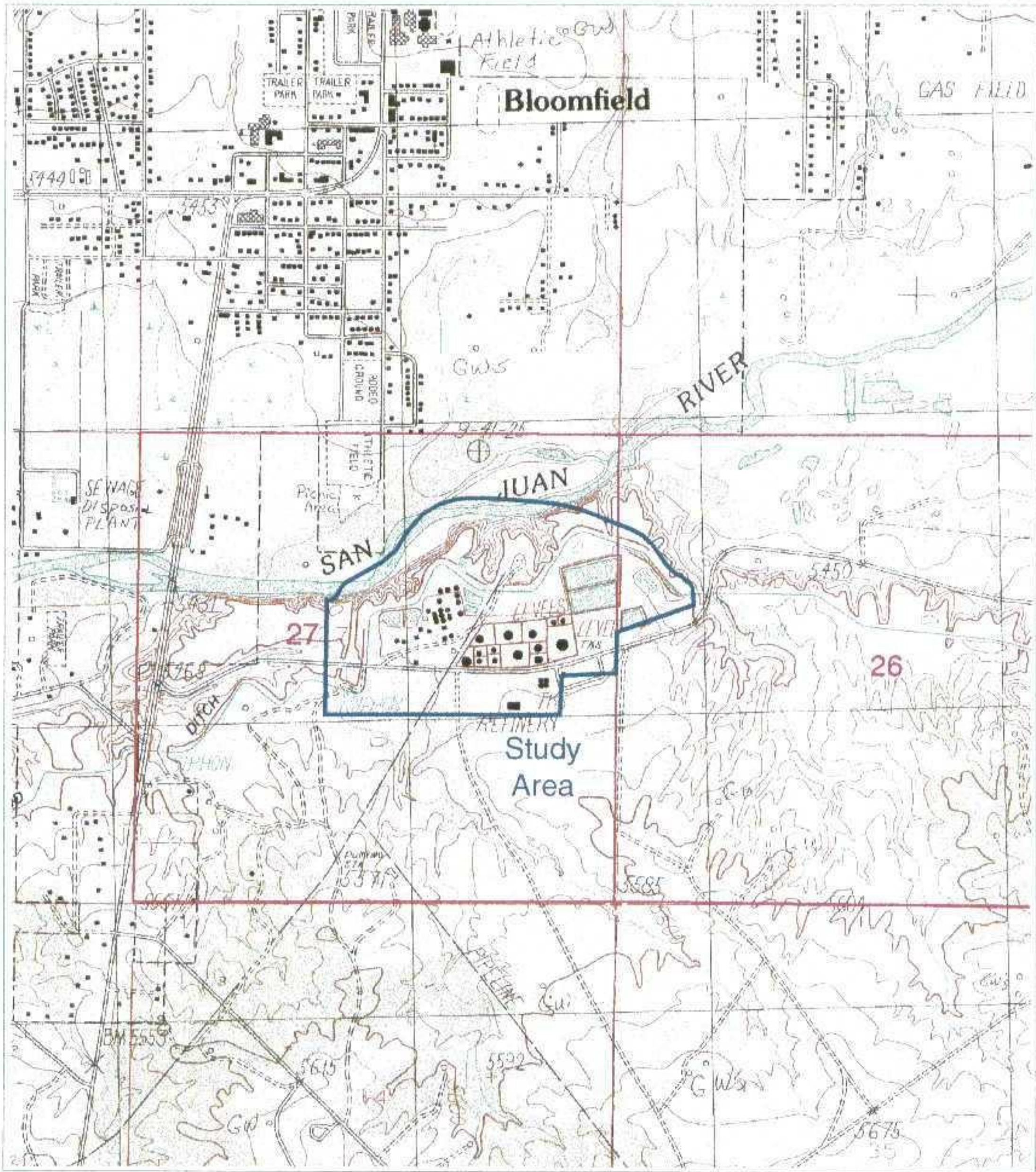
The revised and updated Corrective Measure Study will provide the basis for the Stage 2 Abatement Plan (or modification of the approved Discharge Plan). The format of the report will be consistent with WQCC Regulations, Subpart IV.

We plan several appendices to these reports. The most important of these are a revised Human Health and Ecological Risk Assessment and a revised BIOPLUME modeling report (using BIOPLUME III).

PLATES

Plate 1: Refinery Location



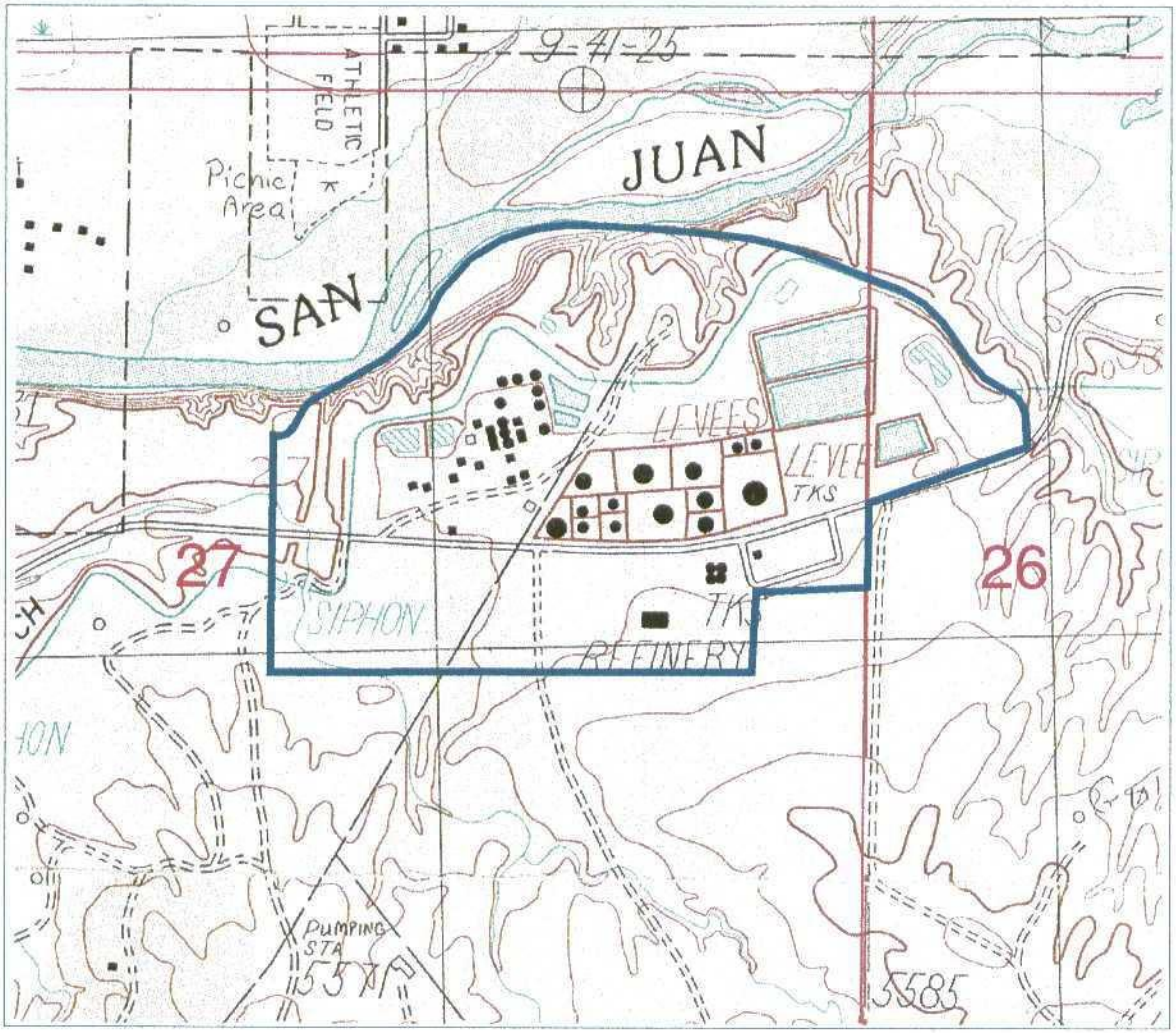


Map source: USGS Bloomfield, New Mexico 7.5 minute quadrangle

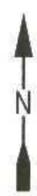
N

1000 0 2000 ft

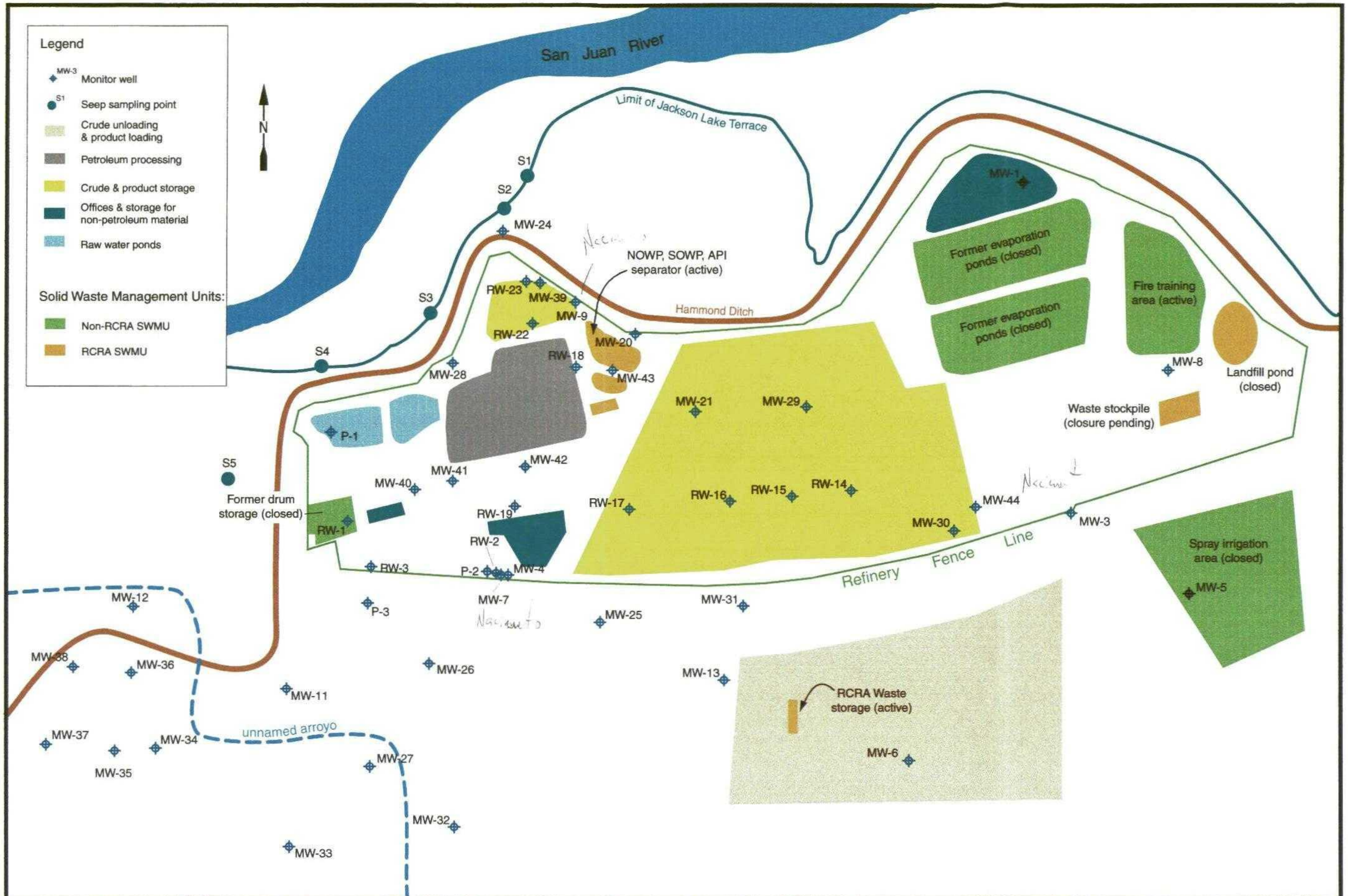
R.T. HICKS CONSULTANTS, LTD.	Giant	Plate 2
4665 Indian School Road NE Suite 106 Albuquerque, NM 87110 505.266.5004 Fax: 505.266.7738	Location of Bloomfield Refinery Study Area	November 3, 1998



Map source: USGS Bloomfield, N Mex. 7.5 minute quadrangle map



R.T. HICKS CONSULTANTS, LTD.	Giant	Plate 3
4665 Indian School Road NE Suite 106 Albuquerque, NM 87110 505.266.5004 Fax: 505.266.7738	Close-up of Bloomfield Refinery Study Area	November 3, 1998



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Giant Refining Company

Possible Petroleum Hydrocarbon Source Areas
Northern Portion Study Area

Plate 4

November 2, 1998

TABLES

Table 1
Previous Site Investigations

Date	Title	Author	Summary
8-5-85	RCRA 3013 Final Workplan	Bloomfield Refining Company	A Comprehensive Groundwater Study Proposal to determine the extent of the hydrocarbon plume. Monitor wells MW-1 through MW-6 installed in February 1984 in preparation for the workplan submittal.
6-2-86	Report on Subsurface Hydrocarbon Data	Bloomfield Refining Company	This study first identified hydrocarbons outside of the refinery boundaries. Bloomfield Refining Company installed monitoring wells MW-7 through MW-10.
8-20-86	Final Closure Plan for the API Wastewater Ponds, Landfill, and Landfill Pond at the Bloomfield Refinery	Engineering Science	This study provides data on waste material and underlying soils associated with these solid waste management units. All analytical results were consistent with clean closure for all of the subject areas.
2-6-87	A Final Report on Section 3013 Administrative Order Work Elements	Engineering Science	Identification of hydrocarbons in the unsaturated zone.
4-4-88	Site Investigation and Remedial Action Conceptual Design for the Bloomfield Refining Company	Geoscience Consultants, Ltd. (GCL)	Computer modeling determined that a three well recovery system would be optimal to minimize further hydrocarbon migration.
8-3-89	Final Report on Soil Vapor Survey, Well Installation and Hydrocarbon Recovery System	Geoscience Consultants Ltd. (GCL)	Hydrocarbons are evident south of the site on BLM land. The study proposed a recovery well system to minimize hydrocarbon migration from the refinery.
2-11-92	Interim Measures Work Plan	Groundwater Technology (GTI)	The proposed Interim Measures were: install two additional recovery wells, implement a pumping system, survey wells, gauge liquid levels in the wells, perform startup tests for the two new recovery wells and monitoring of all new equipment.
3-29-93	RCRA Facility Investigation (RFI)-Task 1 and Task II	GTI	The report describes surface and subsurface conditions and provides a draft work plan to conduct the RFI.
2-2-94	RFI-Phase I-Soil Gas Survey	GTI (subcontracted to Burlington Environmental)	The highest levels of hydrocarbons are the areas around the flare, the roadway south of Tanks 11 and 12, and the area surrounding Tanks 24 and 28.
4-22-94	RFI-Phase II-Soil Boring Investigation	GTI (Drilling contracted to Western Technologies)	The area around the product loading area was not found to be significantly impacted by a product release or to be a hydrocarbon source area.
6-23-94	RFI-Phase III-Well Installation/1st Groundwater Sampling Event	GTI	All wells not containing SPH were sampled (16). See analytical table for specific results.
9-30-94	RFI-Phase III-2nd Groundwater Sampling Event	GTI	All wells not containing SPH were sampled (16). See analytical table for specific results.

Table 1, cont.

Date	Title	Author	Summary
7-30-94	RFI- Phase IV-Uppermost Aquifer Hydraulic Testing and Modeling	GTI	Values calculated for transmissivity and hydraulic conductivity were indicative of a high-permeability saturated zone. Fast accumulation of SPH in the cone-of-depression during pumping indicated that dual liquid removal is an alternative for the collection of the SPH.
8-16-94	RFI-Phase IV-Soil Vapor Extraction/Air Sparging Pilot Studies	GTI (Subcontracted drilling to Layne Environmental Services)	Calculated effective radii of influence for the shallow zone ranged from 2 feet to 36 feet. Any vapors generated as a result of sparging can be captured and contained by the vacuum system. Hydrocarbon mass removal rates ranged from .20 lb./hr to 5.5 lb./hr.
8-14-94	RFI-Phase V-Stream and Sediment Sampling	GTI	Stream and sediment sample analysis show no significant impact to the Hammond Ditch or the San Juan River.
12-21-95	Human Health and Ecological Risk Assessment	GTI	There are no unacceptable risks to human health and environment unless the shallow unsaturated zone is used for potable water.
12-21-95	Corrective Measures Study	GTI	A summary using the previous investigations to determine the best course of action at the GRC site. The study recommended air sparging, SPH recovery and vapor extraction.

Table 2
Soil Borings, Soil Sampling, Monitor Well Installation and Seep Sampling Points

Sampling Point	Location	Parameters Tested	Rationale
Cliffside Seep S1	NE of flare	Water: BTEX	Groundwater from the Jackson Lake Terrace deposits flows from seeps along the cliff between the Hammond Irrigation Ditch and the San Juan River. These flows must be tested for petroleum hydrocarbons.
Cliffside Seep S2	N of flare and MW-24	Water: BTEX	As above
Cliffside Seep S3	W of flare	Water: BTEX	As above
Cliffside Seep S4	West of S3, N of P-1	Water: BTEX	As above
Seep S5	N of MW-12, W of P-1	Water: BTEX	A man-made excavation created a groundwater seep in this area. A sampling point in this area will determine the northwestern extent of hydrocarbons in the Jackson Lake Terrace deposits.
MW-39	E of RW-23	Water: BTEX	Well MW-7 penetrates the Nacimiento Formation. Three wells are required to determine the general hydraulic gradient in Nacimiento Formation and to characterize water quality in this unit across the Refinery. This well in addition to MW-7 and MW-44 will define the hydraulic gradient in the Formation.
MW-43	Between NOWP and	Soil: BTEX, PAHs, metals Groundwater: BTEX, PAHs, metals	In previous AOCs, the EPA suggests that the NOWP and/or SOWP may have contributed hazardous waste constituents to groundwater. This soil and groundwater sampling point will add data to assist in the determining if these RCRA units contributed hydrocarbons or other constituents to groundwater.
MW-44	Near MW-30	Water: BTEX	Well MW-7 penetrates the Nacimiento Formation. Three wells are required to determine the general hydraulic gradient in Nacimiento Formation and to characterize water quality in this unit across the Refinery. This well in addition to MW-7 and MW-39 will define the hydraulic gradient in the Formation.
SB-1	South of RW-23 and north of RW-22	Soil: BTEX, PAHs, metals Groundwater: BTEX, PAHs, metals	Shallow hand auger borings in this area show petroleum hydrocarbons in soil. Tanks within this berm overflowed and leaked. Results of the analyses will be compared to results of borings near the NOWP and SOWP in order to assist with determining the source(s) of subsurface hydrocarbons
SB-2	Between the NOWP and SOWP, west side of ponds	Soil: BTEX, PAHs, metals Groundwater: BTEX, PAHs, metals	In previous AOCs, the EPA suggests that the NOWP and/or SOWP may have contributed hazardous waste constituents to groundwater. This soil sampling point will add data to assist in the determining if these RCRA units contributed hydrocarbons or other constituents to groundwater.
HA-1	East of RW-18, west of NOWP	Soil: BTEX, PAHs, metals Groundwater: BTEX, PAHs, metals	In this area that formerly housed aboveground storage tanks, product overflow and tank leakage is documented. Results of the analyses will be compared to results of borings near the NOWP and SOWP in order to assist with determining the source(s) of subsurface hydrocarbons

Table 3
Groundwater Sampling Program

Location	Analysis Requested	Date Sampled
MW-1	BTEX, Metals, EC, Nitrogen	11-23-98
MW-4	BTEX, Anions, Cations, DO, EC	9-2-98
MW-5	BTEX, Metals, EC, Nitrogen	11-23-98
MW-7	BTEX, Anions, Cations, DO, EC	9-2-98
MW-8	BTEX	11-23-98
MW-9	BTEX, SVOC, Pb, Cr BETX, TOC, Nitrate	8-27-98 11-23-98
MW-11	BTEX	11-24-98
MW-12	BTEX, SVOC, DO, EC	9-2-98
MW-13	BTEX, Cations, Anions	8-26-98
MW-20	BTEX, Cr, Pb, Cations, Anions, Nitrogen BTEX, TOC, EC	8-27-98 11-23-98
MW-21	BTEX, TOC, EC	8-27-98
MW-25	BTEX and BTEX duplicate	8-26-98
MW-26	BTEX, SVOC	8-26-98
MW-27	BTEX, Methane	11-24-98
MW-28	BTEX, SVOC, DO, EC	9-2-98
MW-29	BTEX, Anions, Cations	8-27-98
MW-31	BTEX, Anions, Cations	8-27-98
MW-32	BTEX	8-20-98
MW-33	BTEX	8-26-98
MW-34	BTEX	11-24-98
MW-36	BTEX, Anions	9-2-98
MW-37	BTEX, Anions, Cations, Nitrogen	8-26-98 and 8-27-98
MW-38	BTEX, Anions, DO, EC	9-2-98
MW-39	BTEX BTEX	10-28-98 11-24-98
MW-40	BTEX, SVOC, DO, EC Anions, Cations	9-2-98
MW-41	SPH	10-28-98
MW-43	BTEX	10-27-98
MW-44	BTEX	10-28-98

Table 3, cont.

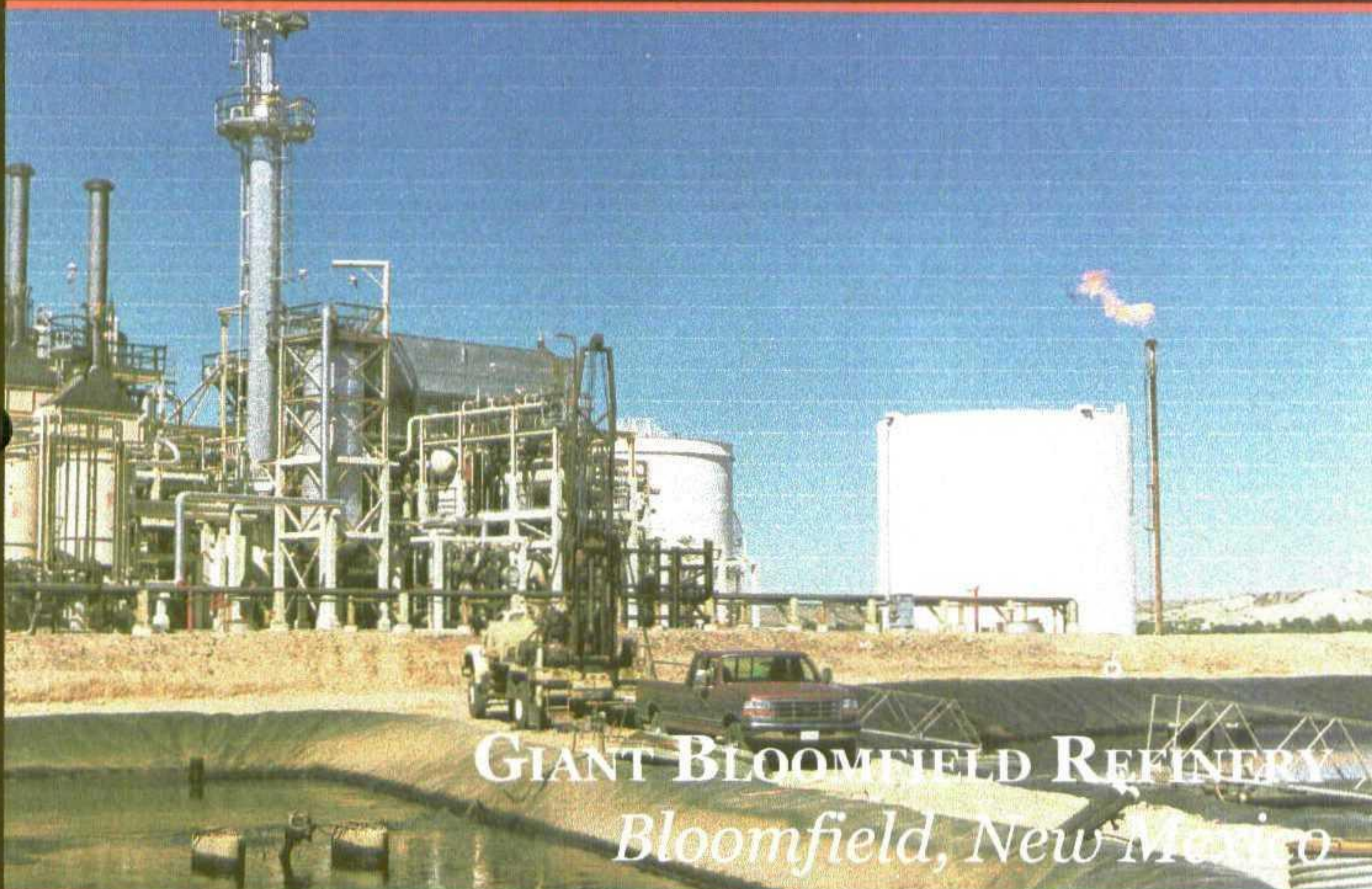
Location	Analysis Requested	Date Sampled
RW-1	BTEX, Cr, Pb	9-2-98
RW-15	BTEX, TOC, EC	11-23-98
RW-18	BTEX, TOC, Cl, EC	11-24-98
RW-22	BTEX	8-27-98
RW-23	BTEX, Cr, Pb, SVOC	8-27-98
S-1	BTEX (sampled on two different dates)	8-27-98 and 11-24-98
S-2	BTEX (sampled on two different dates)	8-20-98 and 8-27-98
S-3	BTEX	8-27-98
S-4	BTEX	10-2-98
S-5	BTEX	10-2-98

Table 4
Schedule

	Work Element Description	Start	Finish
Task 1	Evaluate existing data	9-1-98	4-1-99
Task 2	Borings, wells and sampling points	9-1-98	11-30-98
	1st Groundwater Sampling	9-1-98	11-30-98
	2nd Groundwater Sampling	3-1-99	3-5-99
	Water level measurements	9-1-98	3-12-99
Task 3	Collect data for Risk Assessment	9-1-98	3-12-99
	QA of model results	2-15-99	3-30-99
Task 4	Bioplume III modeling	2-15-99	3-15-99
Task 5	Final Site Investigation Report	2-15-99	4-15-99
	Stage 2 Abatement Plan or Discharge Plan Modification	2-15-99	5-15-99
	Revised CMS to EPA	2-15-99	6-15-99

February 8, 1999

QUALITY ASSURANCE/QUALITY CONTROL PLAN



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February 8, 1999

Quality Assurance/Quality Control Plan
Stage 1 Abatement Plan Proposal

GIANT BLOOMFIELD REFINERY

Prepared for:

Giant Refining Company
P.O. Box 159
Bloomfield, New Mexico 87413

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Table of Contents

TABLES

1.0 INTRODUCTION

This Quality Assurance/Quality Control Project Plan (QA/QC Plan) is provided as a supplement to the Giant Refinery Stage 1 Abatement Plan Proposal. The purpose of the QA/QC Plan is to outline the specific protocols used in the execution of the Stage 1 Abatement Plan Investigation. The implementation of the protocols and procedures described herein improve project quality, accuracy and precision of data and results.

The QA/QC Plan discusses techniques used in drilling, field sample collection and handling, decontamination of equipment, evaluation of data, modeling and all other work elements required to provide submittals to the appropriate regulatory agency. Established standard operation procedures are used to provide accurate and precise information. Data Quality Objectives are also identified and discussed in this document.

1.1 SITE DESCRIPTION

Plate 1 of the Stage 1 Abatement Plan Proposal, which is included herein, shows the location of the Giant Refining Company Bloomfield Refinery (the Refinery) south of Bloomfield, New Mexico, in San Juan County (latitude N36° 41′ 87″, longitude W107° 58′ 70″). The Stage 1 Abatement Plan Investigation Study Area (Study Area) consists of the Refinery process areas, storage tanks and waste management areas as well as adjacent areas that exhibit subsurface petroleum hydrocarbons.

Plate 4 identifies portions of the Study Area associated with the following activities:

- Petroleum Processing
- Crude and product storage
- Crude unloading and product loading
- Waste management (closed units and existing facilities)
- Offices and non-petroleum material storage
- Bureau of Land Management (BLM) property where subsurface hydrocarbons are present
- San Juan Riverbank area where subsurface hydrocarbons are present

1.2 PREVIOUS SITE INVESTIGATIONS AND SITE HISTORY

Table 1 is a summary of previous site investigations. A complete history of the Refinery site, including improvements, expansions, spills and investigations, is provided in the March 1993 "RCRA Facility Investigation -Task I: Description of Current Conditions" report by Groundwater Technology (GTI).

2.0 SCOPE OF WORK

The Stage 1 Abatement Plan Proposal identifies the project objectives and the overall scope of work. In order to meet our objectives discussed in the Stage 1 Abatement Plan Proposal, the following data are required:

ELEVATION MEASUREMENTS

- Groundwater in Jackson Lake Terrace Sediments
- Groundwater in Nacimiento Formation
- Groundwater in San Juan River Sediments
- Separate Phase Hydrocarbons (SPH) in monitor wells
- Top of Nacimiento Formation/base of Jackson Lake Terrace Sediments
- Top of Jackson Lake Sediments

GEOLOGIC AND HYDROLOGIC OBSERVATIONS AND MEASUREMENTS

- Lithology of saturated zone
- Lithology of unsaturated zone
- Hydraulic conductivity and storage coefficient of Jackson Lake Sediments
- Hydraulic conductivity and storage coefficient of Nacimiento Formation
- Location of groundwater recharge areas (natural and artificial)
- Location of groundwater discharge areas (natural and artificial)

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

- Property ownership
- Zoning and land use
- Sources of drinking water
- Proposed or anticipated changes to status quo (e.g. future lining of Hammond Ditch)
- Endangered species
- Wetlands and sensitive habitats

GROUNDWATER CHEMISTRY

- Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)
- Naphthalene
- Total Dissolved Solids (TDS)
- Field Parameters: Temperature, Conductance, pH
- Natural restoration Parameters: Dissolved Oxygen, Sulfate, Nitrate, Ferrous/Ferric Iron, Methane, Manganese
- Arsenic, Barium, Chromium, Lead
- Additional Cations and Anions: Sodium, Calcium, Chloride, Carbonate

SOIL AND SEDIMENT CHEMISTRY

- Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)
- Naphthalene
- Total Organic Carbon
- Arsenic, Barium, Chromium, Lead

SEPARATE PHASE HYDROCARBON CHEMISTRY

- Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)
- Naphthalene
- Lead
- EPA Method 8015 (modified) for Fuel Typing

WASTE CHARACTERIZATION

- Arsenic, Barium, Chromium, Lead by TCLP
- Volatile Organic Compounds by TCLP
- Semi-volatile Organic Compounds by TCLP

2.1 TASK 1: VALIDATION OF EXISTING DATA

The Refinery site has been the subject of numerous studies. Our first task is to examine existing chemical analyses, boring logs and other data to determine if they meet the QA/QC requirements outlined in this document. Data that meet QA/QC criteria will be incorporated into the final reports; data that cannot meet the criteria may be used with qualification or discarded.

2.2 TASK 2: FIELD CAMPAIGNS

From August to November 1998, Hicks Consultants obtained samples from groundwater wells in the Study Area. Table 2 identifies the wells, analytes and rationale for sampling. Plate 4 from the Stage 1 Abatement Plan Proposal (included herein) shows the locations of wells and other sampling points.

In order to increase the number of data points and thus our confidence level for hypothesis testing (discussed in a later section of this document), Hicks Consultants will conduct another groundwater sampling event. The groundwater will be sampled in March 1999 in accordance with the data quality objectives outlined in Section 3.4. One month prior to the sampling event, we will submit a list of wells and analytes to the EPA and NMOCD.

In order to characterize the water seeping from the cliffside into the San Juan River alluvium, Hicks Consultants has installed four sampling points (S1, S2, S3, S4). We have also installed a temporary drive point (S5) in an area west of the Refinery and north of MW-12.

In September 1998, Hicks Consultants and Precision Engineering, Inc., sampled soil at four locations. Table 2 presents the location and rationale for each soil boring. During this same field program, the team installed three monitoring wells (MW-39, MW-43, MW-44). Table 2 also provides the locations and justifications for these wells.

2.4 TASK 3: UPDATE RISK ASSESSMENT

Several parcels of real estate have changed hands since 1995, when GTI performed the Human Health and Ecological Risk Assessment. As part of the update of the Risk Assessment, we will identify these changes in land status. We will also examine the data used in the assessment and determine if revision is required. We will use the ASTM RBCA toolkit (following Standard E1739-95e1) as a quality control check of the Risk Assessment.

2.5 TASK 4: BIOPLUME III SIMULATION MODELING

Natural restoration of groundwater can be simulated by a number of computer models. BIOPLUME III is sufficiently robust to test the suitability of natural restoration as a stand alone remedy for much of the Bloomfield Refinery site. Previous investigations into the site used an older version of Bioplume and did not calibrate model output to historic data from the site. We will employ the 14 years of groundwater data to calibrate the model and, consequently, provide a more realistic prediction of natural restoration at the site.

2.6 TASK 5: REPORT PREPARATION

Tasks 1–4 will result in the following reports:

- Final Site Investigation Report
- Revised Corrective Measures Study
- Stage 2 Abatement Plan or a Revised Discharge Plan addressing abatement activities
- 1999 Monitoring Report

We plan several appendices to these reports, the most important of which are:

- Revised Human Health and Ecological Risk Assessment
- Revised BIOPLUME modeling report (Using BIOPLUME III)

3.0 DATA QUALITY OBJECTIVES

The proposed project consists of several distinct phases, each requiring a different set of data quality objectives. The Stage 1 Abatement Plan Proposal describes the methods used in the first phase of the project (field investigation), and is the subject of this document. Data collected in the investigation are used to support the Abatement Plan process (Stage 1 and Stage 2). This process includes:

- Definition of the environmental setting (Final Site Investigation Report);
- Evaluation of site restoration/abatement alternatives (Stage 2 Abatement Plan); and
- Description and design of the appropriate remedy to address identified environmental concerns at the Refinery (Stage 2 Abatement Plan).

The final phase of the project, compliance monitoring, will meet more stringent data quality objectives. Because agencies use these data to determine compliance with regulations or commitments made in permit documents, the tolerance for error is less than for the investigation described herein. The Data Quality Objectives associated with compliance monitoring are not discussed in this document.

This section of the QA/QC Plan follows the protocol suggested in the Guidance for the Data Quality Objectives Process (EPA QA/G-4, September 1994).

3.1 PROBLEM STATEMENT

As a result of past refinery activities, petroleum hydrocarbons are present in soil and groundwater beneath and adjacent to the Bloomfield Refinery site. Because the original source of subsurface hydrocarbons dictates which Regulations site restoration activities will follow, identification of the original refinery source(s) of the observed subsurface petroleum hydrocarbons is a principal objective of this study.

Another objective of the study is to collect sufficient information to permit appropriate examination of potential abatement strategies for the observed subsurface petroleum hydrocarbons. Environmental consultants contracted by the previous owners of the refinery evaluated several mechanical processes for groundwater restoration. Whereas these previous studies adequately evaluated most feasible restoration alternatives, they could not take advantage of recent scientific advances associated with natural remediation (monitored natural attenuation or intrinsic remediation). This investigation will collect data necessary to test the effectiveness of natural restoration as a stand-alone restoration strategy for much of the Bloomfield Refinery site.

Other elements of the problem statement identified by EPA publication QA/G-4 are discussed in the following sections and/or submittals:

- Regulatory Context: Stage 1 Abatement Plan Proposal
- Project Personnel and Organization: Section 5.0 of this document
- Previous Study Results: Stage 1 Abatement Plan Proposal
- Persons or Organizations Involved or Participating in This Study: Stage 1 Abatement Plan Proposal

The ultimate purpose of this study is to fulfill the requirements of the EPA's AOC and implement site restoration activities pursuant to the applicable regulations.

3.2 DESCRIPTION OF WORKING HYPOTHESES

Specifically, this investigation is designed to test the working hypotheses listed in Table 3. In accordance with EPA publication QA/G-4, we have organized the hypotheses into a null hypothesis and an alternative hypothesis. The null hypothesis is defined as the hypothesis that would cause the most adverse potential consequences if it were incorrectly rejected. In a later section of this document, we provide examples of decision rules that we must address in order to test these three principal project questions.

3.3 IDENTIFICATION OF DATA NEEDS

Section 2.0 of this submission lists the data needs for the project. Many required parameters may be developed from collection of these data. For example, mapping the thickness of SPH on groundwater is an important element in determining whether natural restoration as a stand-alone remedy may be effective for areas not currently affected by the hydrocarbon/water removal system at the site. The thickness of SPH is not directly measured but is derived from the elevation of the groundwater surface, the elevation of the SPH and the thickness of the capillary fringe. Whereas the groundwater and SPH elevations are directly measured from monitor wells, we must estimate the capillary fringe thickness from the lithologic characteristics of the upper saturated zone and lower unsaturated zone. The lithology of these zones is determined by a direct observation.

Table 4 presents the sources of data that we plan to use in the testing of the project hypotheses.

3.4 BOUNDARIES OF THE STUDY

The geography of the Study Area is specified in the Stage 1 Abatement Plan Proposal. Plate 3 from that document, which shows the Study Area, is attached to this QA/QC Plan.

The time period to which this study applies is from the present to the "foreseeable future" as defined by the New Mexico Water Quality Control Commission. We understand that the Commission has defined the "foreseeable future" as a time span longer than 200 years. For the purposes of selecting an appropriate abatement strategy for the Refinery, we will use computer models to predict the response of the groundwater system to the proposed remedy for 200 years. For the purposes of determining the provenance of hazardous waste constituents in groundwater, the time period for data collection is from the early 1980s, when samples of waste were first analyzed, to the end of 1999, when our sampling program is complete.

We selected March 1999 as the optimum time to sample the groundwater hydrocarbon concentration. In March, before the start of the irrigation season, groundwater levels will presumably be low. The last sampling event occurred in August through November 1998 at the end of the irrigation season when groundwater levels were high. A Spring sampling event will give us more complete data regarding the hydrocarbon plume at different groundwater stages. Comparison of Fall and Spring measurements will aid in selecting the best time for annual monitoring.

We will define various subsets of data based on the geographic location of samples or measurements and/or the time of the sampling. For example, data from monitoring wells located immediately down gradient of and between the North and South Oily Water Ponds will be used to determine whether these units are releasing hazardous waste constituents and thus subject to RCRA regulation. Data from monitoring wells located in and around product storage areas will be evaluated to determine whether these units are releasing constituents subject to WQCC regulation. All foreseeable practical constraints such as lack of proper equipment, time, and personnel have been identified and addressed in order to ensure efficient data collection.

3.5 DECISION RULES

For the chemical data subsets, we will calculate the mean value for each sampling event. We will evaluate the rate of chemical changes over time. We will also use average values for data from aquifer tests that provide estimates of hydraulic properties. The remaining data, such as land ownership or lithologic characteristics, will be used as absolute values.

For the majority of the data, establishing an action level is not applicable. An action level is the numerical value that would cause the decision-maker (Giant Refining Company) to choose between alternative actions. Table 5 presents the action levels and their associated decision rules.

3.6 SPECIFICATION OF TOLERABLE LIMITS ON DECISION ERRORS

Data collected at a site, such as the Refinery, provide only an estimate of the "true" environmental conditions. One could arrive at a decision that is incorrect (a decision error) if the data used during analysis of the decision rules (above) do not represent the "true" conditions. The QA/G-4 Guidance provides a description of tolerance limits to permit better control of decision errors. The proposed study of the Refinery does not lend itself to strict statistical evaluation of tolerance limits, as discussed in the EPA Guidance. Testing the three principal hypotheses (Table 3) involves numerous input parameters as well as professional judgment. Below is a discussion of the proposed qualitative tolerance limits associated with these hypotheses.

If null hypothesis 1 is incorrectly rejected, implementation of a remedy at the site will go forward, albeit under another regulatory program, presumably the WQCC Regulations. Based on our understanding, regulation of the abatement strategy under the WQCC Regulations will not result in an increased threat to human health or the environment. Therefore, the gray area associated with data used to test this hypothesis is relatively large, as is the tolerance for error.

If null hypothesis 2 is incorrectly rejected, the site will not be adequately characterized and an inappropriate remedy may be selected. This could lead to human exposure to regulated constituents (e.g. benzene) or degradation of habitat. Although the consequences of a decision error are great, compliance monitoring permits recognition of the decision error. Once the error is detected, Giant can implement additional characterization. Because of the environmental setting and existing demographics, a well-designed monitoring program will detect a potential exposure route long before actual exposure.

The site may be adequately characterized, but incorrect data or faulty predictive modeling could cause rejection of null hypothesis 3. The consequences of this decision error are the same as suggested for hypothesis 2. An appropriate monitoring program permits detection of this decision error and allows Giant to re-examine the Risk Assessment as well as the selected remedy.

3.7 RECOMMENDED DATA COLLECTION DESIGN

The recommended data collection design is described in Section 6.0 of this submission.

4.0 QUALITY ASSURANCE OBJECTIVES

Standard operating procedures (SOPs) for the collection of precise and accurate data to support regulatory, legal and abatement requirements are described in Appendix A of this submission. The procedures are used to improve the quality of project implementation, and provide an efficient and effective abatement strategy. Activities conducted by Hicks Consultants will adhere to the SOPs outlined in this document. We will review the protocols described by previous investigators to determine if data used in this study conform to the QA/QC objectives described herein.

For each data set used in final submissions, we will provide quality assurance assessment for each of the following parameters:

- Precision: A measure of mutual agreement among individual measurements of the same parameter, usually under prescribed similar conditions. For example, we can compare analytical results from duplicate samples to provide a qualitative measure of this parameter.
- Accuracy: The degree of agreement of a measurement (or an average of measurements of the same parameter) with an accepted reference or true value. The laboratory QA/QC protocol (e.g. surrogate recovery tests) will be examined to measure the accuracy of chemical data.
- Representativeness: The degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition or an environmental condition. For groundwater monitoring data, for

example, we will examine a result relative to other data from the same well and data from nearby wells taken during the same sampling event.

- Comparability: The confidence with which one data set can be compared to another. We can assess comparability by determining if data sets used similar or identical methods.
- Completeness: A measure of the percentage of valid data obtained from a data collection event compared to the percentage of valid data obtained from other events. Any event that generates an unusually high volume of spurious data is suspect. This can occur, for example, when field instruments malfunction.

As outlined in various EPA guidelines, the following factors will be considered in evaluating precision, accuracy, representativeness, comparability and completeness (PARCC parameters) of data and the data collection process:

- Sample identification documentation: This requirement consists of keeping detailed records of samples in logbooks, on chain-of-custody forms and in data management systems.
- Sample preservation and holding times: Various types of samples must be preserved, stored and analyzed within appropriate time frames, so that data generated will be representative of the true value of the concentrations of analytes in a sample.
- Field sampling methodology: Correct sample collection methods will create comparability of data and representativeness of results. Evaluation of sample collection techniques in the field and of data generated from the analysis of field replicates provides a basis for evaluation of sampling methodologies.
- Analytical laboratory methodology: Quality of the analytical technique affects data precision and accuracy. Laboratory technique is determined by evaluating data generated from the analysis of sample duplicates, laboratory spikes and performance evaluation samples.

The EPA-approved protocols outlined herein are designed to provide analytical data of consistent, known and documented quality. In order to meet this requirement, Hicks Consultants has obtained the services of an A2LA-certified laboratory. The laboratory's QA/QC manual and SOPs are available upon request.

As required by EPA, qualified data reviewers must officially validate data before it is considered valid. The entire laboratory process of data generation, data review and general laboratory operations, including specific detail as to Quality Assurance policies, is described in ASTM Standard Designation D 5283-92.

5.0 PROJECT ORGANIZATION

Mr. Randall T. Hicks serves as Hicks Consultants project manager and will have ultimate responsibility for monitoring all aspects of the Stage 1 Abatement Plan Investigation, as well as proposal of and implementation of an appropriate remediation strategy. He is also the on-site hydrogeologist and will oversee drilling operations, monitoring well construction and development and completion of all applicable documentation. Ms. Danita Whelan will serve as the Quality Control and Quality Assurance officer for the project. Ms. Michelle Hunter is the on-site environmental scientist performing tasks associated with monitoring-well installation and groundwater sampling activities. Ms. Melissa Snodgrass will compile the analytical dataand revise the Corrective Measures Study and develop the remedial strategy for the site. Precision Engineering of Las Cruces, New Mexico will be working with Hicks Consultants during drilling activities. All analytical work associated with this investigation is to be contracted through Giant to Assaigai Analytical Laboratories of Albuquerque, New Mexico.

Although Mr. Hicks maintains responsibility for all project deliverables and Ms. Whelan will submit QA/QC reports, Hicks Consultants has assigned the following staff as primary authors of the planned deliverables:

Final Site Investigation Report
Hicks

Revised Corrective Measures Study
Snodgrass

Stage 2 Abatement Plan or Modified Discharge Plan
Whelan

1999 Monitoring Report
Hunter

Revised Human Health and Ecological Risk Assessment
Hunter

Revised Bioplume modeling report (Using Bioplume III)
Whelan/Hicks

Resumes for each staff member are in Appendix B.

6.0 DESCRIPTION OF METHODS

6.1 VALIDATION OF PREVIOUSLY COLLECTED DATA

We do not posses all the field notes, chain of custody forms or laboratory QA/QC protocols associated with data collected by others. A data validation exercise, similar to that outlined in EPA document EPA QA/G-4 Guidance for Data Quality Assessments is, therefore, not possible. For data used to test decision rules and used in our final analysis, we will use the following method to determine the quality of previously collected data.

For elevation measurements (See Table 4), we will plot data from single measurement events and create surface maps. We will compare these surfaces and identify any anomalies. Data points that appear anomalous will be examined for measurement or recording errors. We will also compare the older measurement with new data and reject any data that fall outside of two standard deviations of the mean value, i.e. we will accept 95% of data surrounding the mean.

Unlike certain elevation measurements (e.g. water levels), the geologic and hydrologic data do not vary with time. Determining the quality of geologic observations is tested by a repeat of the visual observation. The team has completed several borings to examine the geology of the Refinery site. Exposures of the Jackson Lake Terrace provide ample opportunity to examine the lithology and depositional environment of the geologic unit outside the Refinery boundary. We do not plan additional hydraulic testing. Three consultanting firms conducted such tests over the 12-year period of the previous investigations. Instead we will review their data and protocols and compare the results with published values for sediments of similar lithology. We will also compare the results of each testing campaign and accept the results that most closely match literature values and that display the best sampling protocol.

In answering questions unique to the Risk Assessment, we plan to collect new data. Land ownership and zoning may change over time.

Like certain elevation data, groundwater chemistry varies over time and with location. We will evaluate these data in the same way as described for elevation data and reject all points that fall outside of two standard deviations from the best fit curve of hydrocarbon concentration over time.

Soil and sediment chemistry will not change significantly over the time boundaries of this study. Unfortunately, the precision of soils analysis is poor due to the nature of the media. Even under the best QA/QC protocols, "duplicate" analyses may vary by an order of magnitude. Determining the quality of soil and sediment data is, therefore, a subjective process. The Bioplume III simulation model will be used to determine the soil and sediment parameters. The values input to the model that lead to the best match to the observed plume behavior will be accepted as the true soil and sediment parameters.

A principal source of dissolved-phase petroleum hydrocarbons is separate phase hydrocarbons (SPH) on the groundwater surface. Like soil, SPH does not change character over the time of the study. Unlike soil, precision of replicate SPH analysis can be very good. We will test the quality of previous data by comparing it to new data collected by Hicks Consultants.

The chemical data from previous waste disposal/management programs cannot be reproduced. The waste previously characterized by others has either been removed from the site or modified by treatment. We must therefore use professional judgement, as well as a comparison of old data with newer data and published reports for similar waste to evaluate the validity of this data.

6.2 GROUNDWATER SAMPLING

Collection of groundwater samples will occur several times during the investigation. Following delivery, the contract laboratory will analyze the groundwater samples and report the results . The ASTM sampling protocol and QA guidelines for the purging and sampling of monitoring wells are provided in the ASTM Standard Guide Designation D5903-96 and D4448-85a and Appendix A. The laboratory will analyze selected groundwater samples for BTEX (Benzene, Toluene, Ethylbenzene and Xylenes), SVOC (Semi-Volatile Organic Compounds), Cations, Anions, Lead and Chromium by EPA methods 8020 (or 8260), 8270, 6010, 300, 7421 and 7190 respectively. In addition, field and laboratory analysis of bioremediation parameters will be performed to determine the possible effectiveness of natural restoration on the degradation and reduction of hydrocarbon constituents. Bioremediation parameters include methane, dissolved oxygen, conductivity and oxidized and reduced forms of manganese, iron, nitrogen, sulfur and carbon.

6.3 SOIL SAMPLING

We will collect soil samples during field-drilling and hand-boring operations. We will obtain deep samples (more than 10 feet deep) with a hollow-stem auger drill equipped with a split spoon sampler. Soil samples will be collected from the base of each 5-foot interval until the water table or clay aquitard is encountered. The ASTM standards for Hollow-Stem Auger Drilling (as above, Designation D5784-95) will be used as guidelines for these drilling activities. Appendix A provides further discussion of Hollow-Stem Auger Drilling and soil sampling techniques. All hand auger soil samples will be collected by following ASTM Standard Designation D4700-91. Retrieval of samples from the cobbles and gravel of the Jackson Lake Terrace is problematic, except where samples can be obtained from an outcrop.

Soil samples may be analyzed for BTEX and SVOC, using EPA Methods 8020 (or 8260) and 8270 respectively. Standard operating procedures for QA; sample control, custody and management; equipment calibration; equipment decontamination; analytical laboratory and field QA/QC; data management; and preventative maintenance are discussed in Appendix A.