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REPORTS

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JAQUEZ COM. C #1 AND JAQUEZ COM. E #1

SOIL AND GROUNDWATER REMEDIATION WORK PLAN

June 1999

Prepared For

EL PASO FIELD SERVICES
FARMINGTON, NEW MEXICO

Project 20992

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1 INTRODUCTION

At the request of El Paso Field Services Company (EPFS), Philip Services Corporation (Philip) has prepared the following Work Plan for soil and groundwater remediation at the Jaquez Com. C #1 and Jaquez Com. E #1 meter sites (the site).

The Jaquez Com. C #1 and Jaquez Com. E #1 meter sites are currently operated by EPFS. The meter sites are located in Section 6, Township 29N, Range 9W, in San Juan County, New Mexico, four miles north of the town of Blanco, New Mexico on San Juan County Rd. 4599.

Citizen's Irrigation Ditch (the ditch) separates the gas wells from the meter locations. Hydrocarbons were initially found in soil and groundwater on both sides of the ditch. The two meter stations are located within 40 feet of one another. Past practices include discharge of pipeline liquids into earthen pit(s) at the site.

2 OBJECTIVE

This Work Plan was generated to design a site-specific Pilot study. The objective of the Pilot Study is to determine the feasibility of using bio-venting, volatilization, and soil venting technologies to reduce levels of hydrocarbons in soil and groundwater below regulatory standards. Regulatory drivers for soil and ground water at this site include the following:

- New Mexico Oil Conservation Division Guidelines for Production Pit Closures
- State of New Mexico Water Quality Control Commission Regulations 3-103

3 SITE BACKGROUND

Listed below is a brief description of past activities at the site. Figure 1 shows the locations of existing monitor wells.

- Late 1992 - Landowner expressed concern regarding potential hydrocarbon contamination in a garden area near the meter site location.
- March 1993 - Comprehensive soil and groundwater investigation performed on meter site location and nearby garden area.
- June 1993 - EPFS submits a remedial plan to New Mexico Oil Conservation Division (NMOCD).
- July 1993 - NMOCD approves the remedial plan.
- August 1993 - Remediation activities initiated. Remediation activities resulted in the excavation of 5,222 yards^3 of hydrocarbon-impacted soils. A total of 1766 yards^3 of soil were excavated from the impacted area north of the ditch and 3,456 yards^3 of soil were excavated from south of the ditch.

- September 1993 - Monitor wells R-1 through R-5 and M-1 through M-5 were installed north and south of Citizen's Ditch. Initial sampling for benzene, toluene, ethylbenzene, and total xylene (BTEX) indicated monitor wells R-1, R-2, R-4, M-3, and M-4 were above New Mexico Water Quality Control Commission (NMWQCC) standards. Monitoring wells at the site were initially sampled monthly and are currently sampled quarterly. A passive venting interceptor trench was installed.
- September 1993 - Remediation activities completed.
- October 1993 to October 1996 – Free phase hydrocarbons were observed in monitor wells R-1 and R-2 during the months of seasonally low groundwater levels (i.e., January through May). Passive skimmer systems were installed to remove the free phase hydrocarbons during periods of free phase hydrocarbon accumulation.
- November 1996 - A pumping test was initiated to determine if light non-aqueous phase liquids (LNAPL) could be removed during high seasonal groundwater by depressing the water table in and around R-1 and R-2.
- December 1996 - Philip injected approximately 500 gallons of urea nitrate in water into the passive vent system and installed magnesium peroxide socks in monitoring wells M-3 and M-4 to supply oxygen to enhance natural biodegradation of hydrocarbons in groundwater.
- January 1997 - Philip installed a belt skimmer in R-2 to remove free phase hydrocarbons.
- February 1997 - Philip installed a belt skimmer in R-1 to remove free phase hydrocarbons.
- November 1997 - Philip installed two temporary monitor wells inside the formerly excavated area north of R-1 to determine if free phase hydrocarbons could be recovered during high groundwater season.
- June 1997 - Belt skimmer free phase hydrocarbon recovery system shut down due to seasonal reduction of free phase hydrocarbon thickness related to local irrigation.
- January 1998 - Philip restarts belt skimmer in R-1 and R-2.
- April 1998 - Belt skimmer free phase hydrocarbon recovery system shut down due to seasonal reduction of free phase hydrocarbon thickness related to local irrigation.
- July 1998 - Philip injected approximately 500 gallons of urea nitrate in water into the passive vent system and installed magnesium peroxide socks in monitor wells M-3, M-4, R-3 and R-4 to supply oxygen to enhance natural biodegradation of hydrocarbons in groundwater.
- November 1998 - EPFS conducts investigation of possible hydrocarbon seep of groundwater into the surface water of an arroyo to the south of the property. No hydrocarbons are found during this investigation.
- 1998 - Quarterly groundwater sampling of the following monitor wells was conducted during the first two quarters of 1998: R-3; R-4; R-5; M-1; M-2; M-3; M-4; and, M-5.

- 1998 - Quarterly groundwater samples were collected for four quarters from monitor wells M-3 and M-4.
- May 1999 – Recoverable free phase hydrocarbons (free product in excess of 0.2 feet thick) have not been observed in any of the monitor wells this year. No free phase hydrocarbons have been recovered from the site in 1999.

3.1 Free Phase Hydrocarbon Removal

Free phase hydrocarbon removal at the site is currently being performed seasonally during the late winter and early spring months when water levels typically are at their lowest and free phase hydrocarbons accumulate in monitor wells R-1 and R-2. Free phase hydrocarbons are removed from monitor wells R-1 and R-2 with a belt skimmer. The belt skimming system is housed in a standard lockable meter house and consists of an intrinsically safe electric motor which turns a 7/8-inch hydrophobic urethane belt suspended in the well by a weighted pulley. With each revolution, hydrocarbons are collected on the belt, brought to the surface, and then removed by specially designed wiper blades. The hydrocarbons are then deposited into the unit's collection box, where the hydrocarbons drain by gravity into a 55-gallon drum. The drum and control switch is housed in a secondary containment system to contain any potential spills.

On February 14, 1997 the belt skimming system in R-2 was installed and free phase hydrocarbon removal initiated. Free phase hydrocarbon removal continued sporadically until May 28, 1997 when the skimmer was shut down for the season. From February 14, 1997 to May 28, 1997, approximately 11.48 gallons of free phase hydrocarbons were removed from R-2.

On January 14, 1998, 1.91 feet of free phase hydrocarbons were measured in recovery well R-2 and free phase hydrocarbon removal was again initiated. Again free phase hydrocarbon removal continued intermittently until April 15, 1998 when the skimmer was shut down for the season. Approximately 15 gallons of free phase hydrocarbons have been recovered from R-2 since the belt skimming system was installed. No free phase hydrocarbons have been recovered from R-2 in 1999.

On April 4, 1997, free phase hydrocarbon removal was initiated in recovery well R-1 using the belt skimming system. Free phase hydrocarbon removal continued until June 27, 1997, when free phase hydrocarbon disappeared from the well for the season. From April 4, 1997 to June 27, 1997, 99.92 gallons of free phase hydrocarbons were recovered from monitor well R-1.

On January 14, 1998, 2.08 feet of free phase hydrocarbons was measured in R-1 and free phase hydrocarbon removal was reinitiated. From January 14, 1998 to March 4, 1998, 99.04 gallons of free phase hydrocarbons were recovered from R-1. No free phase hydrocarbons have been recovered from R-1 in 1999. Approximately 199 gallons of free phase hydrocarbons have been recovered from R-1 since the belt skimming system was installed.

3.2 Quarterly Sampling

Garden Area South of Citizen's Ditch

BTEX concentrations remain below New Mexico Water Quality Control Commission (NMWQCC) groundwater standards in monitor wells MW-1, MW-2, MW-3 and MW-5. Monitor well M-4 has fluctuating benzene levels that remain above NMWQCC groundwater standards, although the levels often decrease significantly when the water table is high. Toluene, ethyl-benzene and total xylene concentrations remain below NMWQCC groundwater standards. Since the installation of the oxygenate socks and the injection of nutrients into the passive venting system, monitoring well M-3 has been below NMWQCC standards for BTEX in groundwater for four out of the last five quarters sampled.

Nitrate sampling has been performed on the monitor wells to help determine the effect of nutrients injected into the passive venting system on the south side of Citizen's Ditch (see Oxygenate Socks Below). Nitrate data is inconclusive with regards to the effectiveness of the nutrient injection activities for groundwater remediation.

Meter Site Location North of Citizen's Ditch

Free phase hydrocarbons continue to accumulate in R-1 and R-2 during periods of low groundwater. Free phase hydrocarbon accumulation decreases rapidly with the beginning of the irrigation season and increased flow in Citizen's Ditch. Significant amounts of free phase hydrocarbons continue to be removed from R-1. Dissolved phase hydrocarbons are decreasing in R-4, which is down gradient of R-1.

Groundwater samples are not collected from wells when LNAPL are present, which is the case for monitor wells R-1 and R-2. Groundwater samples were collected from eight monitor wells, R-3 through R-5 and M-1 through M-5, and analyzed for BTEX during the first two quarters of 1998. Currently, all eight monitoring wells are sampled annually for polynuclear aromatic hydrocarbons (PAH's) and BTEX. Monitor wells M-3 and M-4 are sampled quarterly for BTEX and nitrates.

3.3 Oxygenate Socks and Nutrient Injection

On December 19, 1996, Philip injected approximately 500 gallons of urea nitrate-water solution into the passive vent system on the south side of Citizen's Ditch. The nutrient solution consisted of seven parts potable water to one part urea nitrate. The solution was mixed thoroughly in a 500-gallon poly tank and pumped directly into the vent stacks of the passive vent system. ORC® magnesium peroxide socks were then installed in monitor wells M-3 and M-4 to supply oxygen to enhance natural biodegradation of hydrocarbons in groundwater.

On July 8, 1998, Philip injected another 500 gallons of urea nitrate-water solution into the passive vent system and installed magnesium peroxide socks in monitor wells M-3, M-4, R-3 and R-4 to supply oxygen to enhance natural biodegradation of hydrocarbons in groundwater.

The socks continue to be used in monitor wells M-3, M-4, R-3 and R-4. The socks are removed 30 days prior to sample collection and are reinstalled after sampling is complete. Following nutrient injection, nitrate monitoring was initiated on a quarterly basis. Nitrate analyses indicate elevated nitrate levels in M-3 and M-4 for three quarters after injection. Nitrate levels have declined steadily and are now below detection limits in both M-3 and M-4.

4 REMEDIAL ACTION TECHNOLOGY SELECTION

Remediation techniques used at the site to date include excavating contaminated soil to the greatest practical extent and using a belt skimmer to remove phase separated hydrocarbons from the surface of the groundwater. Over 5,222 yards^3 of hydrocarbon impacted soil has been removed to date. Approximately 214 gallons of free phase hydrocarbons have been recovered to date with belt skimming technology.

Groundwater samples, product recovery data, and boring logs indicate that free phase hydrocarbons remain entrapped at the vadose zone/groundwater interface (smear zone). Philip believes that the most cost effective technology to treat the hydrocarbons at this site is a combination of bioventing and volatilization, using air injection to supply oxygen to the subsurface. Soil venting will also be utilized to control vapor emissions.

4.1 Bioventing

Bioventing is the process of aerating subsurface soil to stimulate in situ biologic activity and promote bioremediation. Bioventing may utilize air extraction or air injection as the physical method to supply oxygen for biodegradation of hydrocarbon constituents.

4.2 Volatilization

Subsurface volatilization of light end hydrocarbons is accomplished by supplying a vigorous flow of air to soil and groundwater by either air injection or air extraction techniques.

4.3 Soil Venting

Soil venting (soil vapor extraction) is designed and operated to maximize the volatilization of low-molecular-weight compounds. Soil vapor extraction can be incorporated into an air injection system to increase both pressure differentials and the airflow in the subsurface. Soil venting can also help control the direction of vapor migration, reducing the risk of moving toxic and explosive vapors into nearby structures.

4.4 Proposed Technology

Philip proposes to enhance both bioventing and soil gas volatilization at the site by injecting a vigorous flow of air into the formation (volatilization) and pulsing that flow by turning the system off for a period of 12 hours every day to help induce bio-venting. A vigorous flow of air into the groundwater will help volatilize the contaminants and encourage migration of these components into the vadose zone. Once in the vadose zone the air supplied by the sparging system will encourage natural microbial activity.

Air sparging is the technology proposed to volatilize hydrocarbons and enhance bio-venting. Air sparging is the injection of air under pressure into an aquifer. One advantage of using air injection as the methodology to biovent and volatilize hydrocarbons is that volatile organic hydrocarbons are not directly discharged to the atmosphere. Air injection is also less expensive to operate and maintain than extraction systems. Air injection systems produce no condensate, no liquid wastes, and no contaminated air stream, and usually do not require air permitting.

Soil vapor extraction will also be utilized to control volatile organic (vapor) migration and aid in adding oxygen to subsurface soils, thereby enhancing the bio-venting process.

5 FIELD TREATABILITY TEST

A Field Treatability Test will be conducted for the proposed bioventing/soil gas volatilization technology. The purpose of the field test methods is to measure the soil gas permeability, microbial activity (biodegradation) and volatilization rate at the site and to evaluate the potential application and design of the technology to remediate the site. The Field Treatability Test includes an air permeability test and an in situ respiration test.

5.1 Air Permeability

The technology of soil venting has not advanced far enough to provide firm quantitative criteria for determining the applicability of venting based solely on values of soil gas permeability (k) or radius of influence (R_I). In general, k must be sufficiently high to allow movement of oxygen in a reasonable time frame (1 or 2 days) from either the vent well, in the case of injection, or from the atmosphere and uncontaminated soil, in the case of extraction. If such a flow rate cannot be achieved, O_2 cannot be supplied at a rate to match the demand. The estimated radius of influence (R_I) is actually an estimate of the radius in which measurable soil gas pressures are affected and does not always equate to gas flow. In low-permeability clay, a small pressure gradient may not result in significant gas flow. For our purposes, the assumption will be made that the R_I does equate to the area of significant gas flow; however, care must be taken in applying this assumption. During air permeability testing, an increase in O_2 concentration within the monitoring points is often an additional indicator of R_I. Additionally, an increase in volatile organic concentrations within the monitoring points will also be considered an indication of R_I.

The R_I will show if the system has the coverage needed to remediate impacted soils that may continue to act as a source for continued groundwater contamination. If more coverage is needed after field measurements of the R_I, then additional injection and vent points can be added to the system at a later date.

5.2 Biodegradation Rate

Other final design criteria will be based on the results of the degradation rate calculations. From previous studies done by the Air Force Center for Environmental Excellence (AFCEE), the oxygen utilization rates that can be expected from sites contaminated with jet fuel are between 0.05 to 1.0% O_2/hour. If rates are observed that are significantly greater than background, there is sufficient evidence to assume that some microbial activity is occurring and that the addition of O_2 in these contaminated areas will enhance biodegradation. If soil gas O_2 levels are above 2 to 5% prior to any air injection, or if oxygen utilization rates are not greater than background, venting will most probably not stimulate biodegradation and consideration will be given to enhancing the volatilization effects of the system (i.e. increased/consistent air flow).

5.3 Volatilization Rates

Volatile organic vapors will be measured at the soil venting points and a mass balance equation will be solved in order to measure volatilization rates per volume of air moved.

6 INSTALLATION METHODOLOGY

The following sections detail the installation of monitoring points, air sparging and soil gas venting wells.

6.1 Methodology Introduction

A single sparge well and a single vent well will be installed for the purposes of gathering enough data to complete design of the final system. Small diameter monitoring points at two depths and nested in a single boring at 5, 10, and 20 foot distances from sparge well S-1 will be installed.

The wells will be installed using hollow stem auger technology. The eight-inch outside diameter auger will allow for an annular space of approximately 4 inches around the well screen. The annular space around the screened interval will consist of 10-20 Colorado Silica Sand. A two foot seal of bentonite pellets will be installed on top of the silica sand and a bentonite/cement grout will complete the well to the surface with a 2 foot diameter concrete surface slab installed at the ground surface. Protective bumper posts will be used where traffic might damage the wellhead.

6.2 Monitoring Points

Monitoring points will be used for pressure and soil gas measurements and will be installed at three locations, and nested at two depths at each location, based on the geology of the site. To the extent possible the monitoring points will be located in contaminated soil in order to collect meaningful data for the in situ respiration test.

The monitoring points will consist of small diameter (half inch) schedule 40 polyvinyl chloride (PVC) with a six inch long by one inch diameter screen. The point will be installed in an eight-inch nominal size diameter gravel-pack. A two-foot thick bentonite seal will be placed both above and below the gravel pack. The bentonite seal will be installed with bentonite pellets rather than bentonite chips to ensure a tight seal. Each monitoring point will be nested so that data can be collected from two discreet depths.

6.3 Sparge Well Installation

One initial sparge well will be installed for testing purposes at the location shown on Figure 1. The sparge well will be constructed of two inch inside diameter PVC casing and screen. The screen size will be 0.01 inches and the screened intervals will be continuous from 17.5 to 22.5 feet below ground surface (completely submerged). Philip anticipates that a total of four sparge wells will be needed to remediate the site although the exact location and number of wells will not be known until the air permeability test is complete.

6.4 Soil Venting Wells

Water table elevation in the areas of monitor wells R-1 and R-2, where free product has been observed should be avoided for the following reasons:

- An elevated water table submerges contaminants in the smear zone that the bioventing sparge system is designed to remediate;
- An elevated water table in areas that are known to have phase separated hydrocarbons would result in migration of those hydrocarbons;
- An elevated water table may prevent oxygenated waters from the sparge wells to migrate (up-gradient) to those wells that need oxygen the most.

In the event the water table rises in any of the wells even at low flow rates, then soil venting wells will be installed at the outermost points of the areas of contamination. The soil venting wells would be located up-gradient from contamination and away from any structures that might accumulate vapors.

The exact location for the extraction wells will not be known until the air permeability tests are completed. They will be two inch diameter wells screened from 6 to 13 feet below ground surface (above the water table) with bentonite pellets set above and below the screen interval. They should be slightly up-gradient and are anticipated to be located as in Figure 1.

7 TEST METHODOLOGY

The following section describes the testing procedures that will be used to gather the data necessary for the final design of the system.

7.1 Soil Gas Permeability Test

This section describes the field procedures that will be used to gather data to determine k and to estimate R_I. Figure 1 shows the configuration of the monitoring wells, the initial groundwater sparge test well, the initial vapor extraction test point, and monitoring points. The soil gas permeability test will be performed by air sparging into the initial sparge test well and will then be performed a second time by using soil vapor extraction technology on the initial vapor extraction test point.

7.1.1 System Check

Before proceeding with this test, soil gas samples will be collected from the vent well, the background well, and all monitoring points, and analyzed for O_2 and CO_2. Monitor wells R-1 through R-5 will be field tested for dissolved oxygen. After the blower system has been connected to one vent well and the power has been turned on, a brief system check will be performed to ensure proper operation of the blower and the pressure and airflow gauges, and to measure an initial pressure response at each monitoring point. This test is essential to ensure that the proper range of Magnehelic ™ gauges are available for each monitoring point at the onset of the soil gas permeability test. Generally, a 10- to 15-minute period of air injection will be sufficient to predict the magnitude of the pressure response, and the ability of the blower to influence the test volume.

7.1.2 Soil Gas Permeability Test

After the system check, and when all monitoring point pressures have returned to zero, the soil gas permeability test will begin. Two technicians will be required during the initial hour of this test. One person will be responsible for reading the Magnehelic ™ gauges, and the other person will be responsible for recording pressure (P) vs. time on the data sheet. This will improve the consistency in reading the gauges and will reduce confusion. The following test sequence will be utilized for testing soil gas permeability of the sparge well and the vapor extraction well:

1. Measure monitor wells R-01 through R-05 for dissolved oxygen.
2. Connect the Magnehelic ™ gauges to the top of each monitoring point with the stopcock opened. Return the gauges to zero.
3. Turn the blower unit on, and record the starting time to the nearest second. Initial blower flow rates will be controlled by the amount of backpressure measured at the wellhead and the blower. The general rule of thumb is not to exceed 1 lb. of pressure for every foot of cement in the annular space of the well.
4. At 1-minute intervals, record the pressure at each monitoring point beginning at t = 60 s.
5. After 10 minutes, extend the interval to 2 minutes. Return to the blower unit and record the pressure reading at the well head, the temperature reading in the sparge or vent well, and the flow rate from the vent well.

6. After 20 minutes, measure P at each monitoring point in 3-minute intervals. Continue to record all blower data at 3-minute intervals during the first hour of the test.
7. Continue to record monitoring point pressure data at 3-minute intervals until the 3-minute change in P is less than 0.1 in. of H_2O. At this time, a 5- to 20-minute interval can be used. Review data to ensure accurate data were collected during the first 20 minutes. If the quality of these data is in question, turn off the blower, allow all monitoring points to return to zero pressure, and restart the test.
8. Begin to measure pressure at any groundwater monitoring points that have been converted to monitoring points. Record all readings, including zero readings and the time of the measurement. Record all blower data at 30-minute intervals.
9. Once the interval of pressure data collection has increased, collect soil gas samples from monitoring points, and analyze for O_2, CO_2, and hydrocarbons. Continue to gather pressure data for 4 to 8 hours. The test will normally be continued until the outermost monitoring point with a pressure reading does not increase by more than 10% over a 1-hour interval.
10. Calculate the values of k and R_I with the data collected during the test. (Section 5.0 Data Interpretation)
11. Measure monitor wells R-01 through R-05 for dissolved oxygen.

7.2 In Situ Respiration Test

The O_2 and CO_2 levels will be measured at the monitoring points before any air injection at the site is initiated. If soil gas levels of O_2 are above 2% -5% prior to air injection into any test well or point, the system will be evaluated primarily on the basis of its efficiency in volatilizing hydrocarbon constituents and less emphasis will be placed on the bioventing aspects of the system design.

The respiration test will be performed in conjunction with the soil gas permeability test. After air has been injected into the formation for about 24 hours the soil gas will be measured for O_2 and CO_2. Measurements of soil gas will occur at 2, 4, 6, and 8 hours and then at 4 to 12 hour increments depending on the speed of oxygen utilization. Measurements will be recorded in % O_2 and % CO_2.

Over sampling can result in removing too much formation air and can affect sampling results. Care will be taken to keep air volume required for testing to a minimum.

Oxygen utilization rates will be obtained from data obtained before, during, and after the soil gas permeability. The rates will be calculated as the percentage change in O_2 over time. The O_2 utilization rate is determined as the slope of the O_2% vs. time line.

The following test sequence will be utilized for testing soil gas permeability of the sparge well and the vapor extraction well:

1. O2 and CO_2 sampling will be performed one well at a time, beginning with the most contaminated monitoring point. Calculate volume of air in the monitoring point casing.

2. Connect the O_2 meter sample pump to the stopcock at the top of individual monitoring points. The sample pump is calibrated to pump a known volume of air over time.
3. Measure the time that the sample pump operates and take readings from O_2 meter every 10 seconds from the time the sample pump begins operation until the pump has evacuated 1.5 X the volume of air contained in the monitoring point casing.
4. Record O_2 values.
5. Repeat the above procedures with a CO_2 meter to collect CO_2 measurements.

8 DATA INTERPRETATION

8.1 Soil Gas Permeability Test

Data will be collected that will allow the use of a dynamic methods for determining soil gas permeability (K). Permeability measurements will help in determining the rate at which the system can be expected to remove hydrocarbon constituents from the subsurface.

For a dynamic equation:

K will be determined by the following formula:

$K= Q\mu/4A(3.14)m$

Where: Q= volumetric flow rate (cm^3 /s)

μ= viscosity of air (1.8 x 10-4 g/cm-s at 18°C

A= slope of measured pressure –vs-ln(time)

M= vent well screen interval or stratum thickness

The radius of influence (R_I) can be determined by actual field measurements or by plotting the pressure at each monitoring point vs. the log of its radial distance from the vent well and extrapolating the straight line to zero vacuum. In general, if the R_I is greater than the depth of the vent well the site is probably suitable for bioventing.

8.2 In Situ Respiration Test

The decision to ultimately operate the system primarily as a bioventing system or as a more conventional venting/volatilization system depends upon the biodegradation rate observed during the in situ respiration test. The approximate time that is needed to complete remediation of the site is a function of the biodegradation rate and the amount of hydrocarbons that are available as a food supply to the naturally occurring microbes in the local soils. AFCEE experience indicates that at sites contaminated with jet fuel, oxygen utilization rates of 0.05 - 1% O2 /hr can be expected.

Respiration tests can also be conducted during the operation and maintenance of the system in order to estimate the quantity and speed of hydrocarbon degradation.

9 REPORTING

The results of the initial permeability and in situ respiration tests will be included in a report that will be submitted to EPFS within 30 days of completing the test. A final design of the system will be submitted with the results of the initial permeability and respiration test.

A second respiration test will be conducted after the final design has been in operation for one month. The results of the second respiration test, and any recommendations for design or operational changes, will be submitted to EPFS in a second report within forty five days of completion of the second test. The second report will include groundwater sample results, conclusions, and recommendations regarding continued application of the system.

10 REGULATORY REQUIREMENTS

10.1 Air

The soil venting activities described herein are subject to air permitting considerations. During the test drilling and equipment planning stage, the field data can be collected under an exemption to permitting under New Mexico's air regulations 20 NMAC 2.72, section 202, A.7. After field data is collected and collection rate targets are established, the site will be subject to air permitting under 20 NMAC 2.72 if the estimated hydrocarbon air emissions exceed 10 pounds per hour or 25 tons per year. Even if the estimates do not exceed these applicability levels, if they are estimated to be greater than 10 tons per year a Notice of Intent will need to be filed with the New Mexico Environment Department 30 days prior to the commencement of soil venting operations. Philip will estimate the air emissions using information gathered during the test drilling phase and the recommended equipment processing rates. EPFS will confirm the calculations, and if needed, submit the Notice of Intent or the air permit application.

10.2 Groundwater

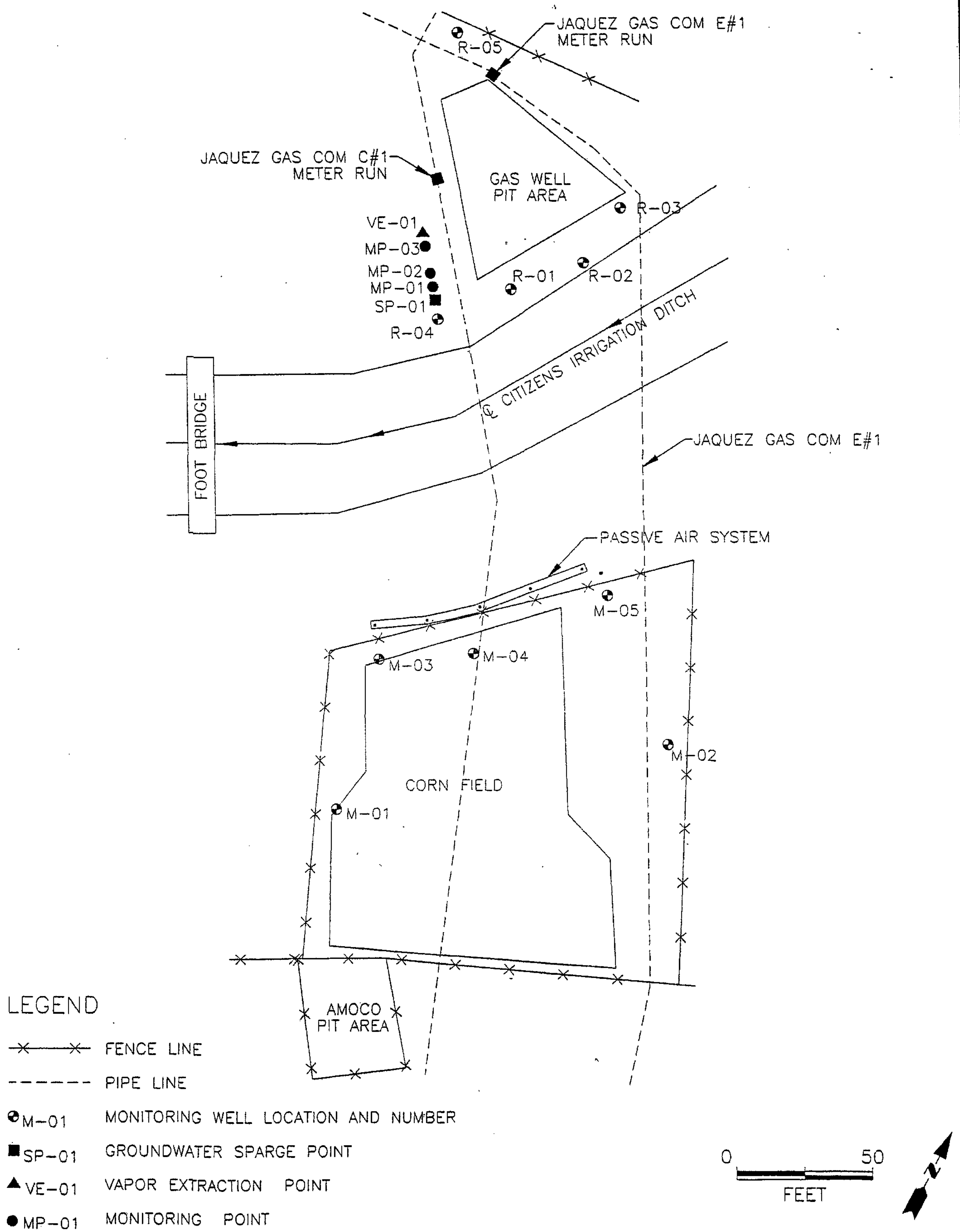
The Jaquez Com. C#1 and Jaquez Com. E#1 is subject to quarterly groundwater sampling requirements that are submitted to the NMOCD in an annual report.

The system will be turned off one week prior to any scheduled groundwater sampling event to allow the groundwater conditions to stabilize prior to groundwater sampling activities.

11 SUMMARY

Philip proposes to perform a Pilot Test to determine the feasibility of remediating subsurface soil at the Jaquez Com. #1 and Jaquez Com. E#1 sites using air sparging and soil vapor extraction technologies. Air sparging is proposed to supply air in order to promote the volatilization and bioventing hydrocarbons in the subsurface. Soil vapor extraction is proposed to control the migration of subsurface organic vapors and to supply air, thereby enhancing biological activity and volatilization.

Figure 1 – Location of Existing and Proposed Wells



PHILIP SERVICES CORP.	TITLE: PROPOSED LOCATIONS FOR VAPOR EXTRACTION, GROUNDWATER SPARGE POINT AND MONITORING POINTS	DWN: TMM / DES.: CI / CHKD: SP / APPD: / DATE: 6/18/99 / REV.: 0	PROJECT NO.: 17444 EL PASO FIELD SERVICE COMPANY
			FIGURE 1