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QUALITY ASSURANCE PROJECT PLAN AMENDMENT

CHEVRON ORLANDO SITE

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

Prepared by: TASK Environmental, Inc.

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REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

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USEPA Project Officer	Date	USEPA QA Officer	Date

2.0 INTRODUCTION

This document is the amendment to the Quality Assurance Project Plan for the Chevron Orlando Site (QAP, BCC, 1991). The Quality Assurance Project Plan Amendment (QAPPA) will be used for environmental monitoring to be conducted at the Chevron Orlando site as part of the Remedial Investigation and Feasibility Study (RI/FS). The RI/FS is being conducted through the Superfund Accelerated Cleanup Model (SACM) process. This QAPPA, including the QAP (BCC, 1991) by reference, specifies the procedures that must be implemented to assure that data gathered are consistent with specific quality goals of accuracy, precision, completeness, and representativeness.

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3.0 PROJECT DESCRIPTION

3.1 BACKGROUND

The Chevron Chemical Company site (site) is located in the 3100 block of North Orange Blossom Trail (Highway 441), Orlando, Orange County, Florida. The site is bordered to the east by Orange Blossom Trail, to the west by industrial facilities, to the south by railroad tracks, and to the north by a mobile home park. Lake Fairview is located approximately 1,000 feet northwest of the property. The total area of the site is approximately five acres.

Chevron Chemical Company (Chevron) owned and operated the site as a chemical blending facility for pesticides and other crop sprays from 1949 to 1976. Chemicals used as carrier solvents in the pesticide formulation include xylene, mineral oil, mineral spirits, and aromatic naphtha. A few of the pesticides formulated in large volumes include chlordane, DDT, BHC-lindane, dieldrin, and aldrin. A rinsate lagoon was used to collect drum rinsate and stormwater.

In 1978, the site was purchased "as is" by Mr. Robert R. Uttal, owner and operator of Central Florida Mack Truck Company. Mr. Uttal dismantled and sold much of the pesticide formulating and storage equipment and disposed of remaining inventory and cleaning residues on-site. The site was utilized as a truck sales and service facility until 1987. Waste oil, solvents, and motor fuels were stored and spilled or disposed of on-site. Various truck parts, including used oil filters, were disposed of on-site.

Mr. Uttal is the current property owner. Central Florida Mack Truck Company went out of business in 1987, with Mr. Uttal retaining ownership of the property.

On May 15, 1990 an Administrative Order on Consent, EPA Docket No. 90-37-c, was executed between the U.S. Environmental Protection Agency (EPA), Robert R. Uttal, and Chevron for the performance of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) removal action at the site. Chevron prepared and submitted the Contamination Assessment Report (Brown and Caldwell, 1990), which described the distribution and characteristics of contaminants in the soil and groundwater at the site. The Removal Action Plan (BCC, 1991), Sampling and Analysis Plan (BCC, 1991), Quality Assurance Project Plan (BCC, 1991), and Site Safety and Health Plan (BCC, 1991) were prepared to summarize the planned removal action activities.

The removal action was initiated in December 1991 and continued through September 1992. The removal action incorporated excavation and disposal of approximately 17,650 tons of non-hazardous pesticide/petroleum contaminated soil, the excavation and disposal of approximately 131 tons of parathion

contaminated soil, the excavation and disposal of approximately 4,500 tons of petroleum contaminated soil, and demolition and disposal of all on-site structures. Following excavation and demolition, the site was backfilled with clean native soil, graded, and seeded. The Removal Action Report (BCC, 1992) summarizes the removal action activities, and the results of sampling and analysis conducted during the removal action.

Groundwater samples collected prior to and during the removal action identified the presence of benzene, chlorobenzene, dichlorobenzene, ethylbenzene, xylene, toluene, and BHC isomers in the groundwater beneath and downgradient of the site. Based on the detection of these compounds, and Chevron's desire to proceed with the assessment and remediation of the groundwater, Chevron negotiated an Administrative Order by Consent (AOC) for a Remedial Investigation and Feasibility Study (RI/FS) with the EPA. The RI/FS will be conducted in accordance with the Superfund Accelerated Cleanup Model (SACM) program.

3.2 PROJECT OBJECTIVES

The objectives of the sampling and analysis for the RI/FS are to characterize the magnitude and extent of groundwater contamination associated with the site, and to measure attenuation and degradation of contaminants of interest (COIs) in the surficial aquifer for use in modeling solute fate and transport. Specific objectives are:

- To characterize the magnitude and extent of contaminant migration in the surficial aquifer.
- To identify the potential for continuing contaminant migration in the surficial aquifer.
- To identify the potential for contaminant migration through the Hawthorn formation (confining unit) into the Floridan aquifer.
- To determine the post-removal action geochemical conditions in the shallow aquifer, particularly with respect to the oxidation potential.
- To measure site-specific aquifer adsorption parameters to determine retardation of COIs in the aquifer relative to groundwater.
- To measure site-specific degradation rates for COIs in the groundwater.
- To determine whether contaminant migration through stormwater runoff has occurred to the extent that the soil quality to the north of the site has been affected.

3.3 SAMPLING PLAN

The proposed RI/FS sampling and analysis activities are summarized in the AOC Scope of Work, which was approved by the EPA on April 5, 1993. The Sampling and Analysis Plan (SAP, BCC, 1991), Sampling and Analysis Plan Amendment (SAPA; TASK, 1993), and Quality Assurance Project Plan (BCC, 1991) are included herein by reference, and describe the data collection and sample analysis procedures to be used during the RI/FS sampling. This QAPPA summarizes the RI/FS data collection activities, and describes the data collection and analytical procedures which may differ from the procedures described in the QAP (BCC, 1991).

The groundwater investigation will be conducted in two phases. Phase 1 will encompass the sampling of the monitor wells which remain on and adjacent to the site. The samples will be analyzed for purgeable aromatic compounds (EPA Method 602); purgeable halocarbon compounds (EPA Method 601); semi-volatile organic compounds (EPA Method 625); chlorinated pesticides (EPA Method 608); organophosphate pesticides (EPA Method 614); arsenic (EPA Method 206.2); chromium (EPA Method 200.7); and lead (EPA Method 239.2). The locations of the remaining monitor wells are shown on Figure 3-1. The Phase 1 sampling activities will also include collection field-measured redox parameters [i.e., dissolved oxygen, Fe(II), S^{-2}, Eh, and pH].

The Phase 1 data will be used, along with literature information and the results of previous investigations, to develop a contaminant fate and transport simulation for the surficial aquifer. The Phase 1 data will also be used to select the contaminants of interest (COIs) for future sampling activities.

The Phase 2 data collection activities will be designed, in part, based on the results of the groundwater model. The model-generated contaminant distribution will be used to determine the number of additional monitor wells to be installed, and to determine the optimum locations for monitor well installation. Site specific hydrologic, hydrogeologic, and geochemical data will be collected during the Phase 2 sampling to provide additional data for model validation.

The Phase 2 analytical methods and parameters will be consistent with the Phase 1 methods and parameters. The methods and parameters may be modified, with EPA approval, based on the Phase 1 results.

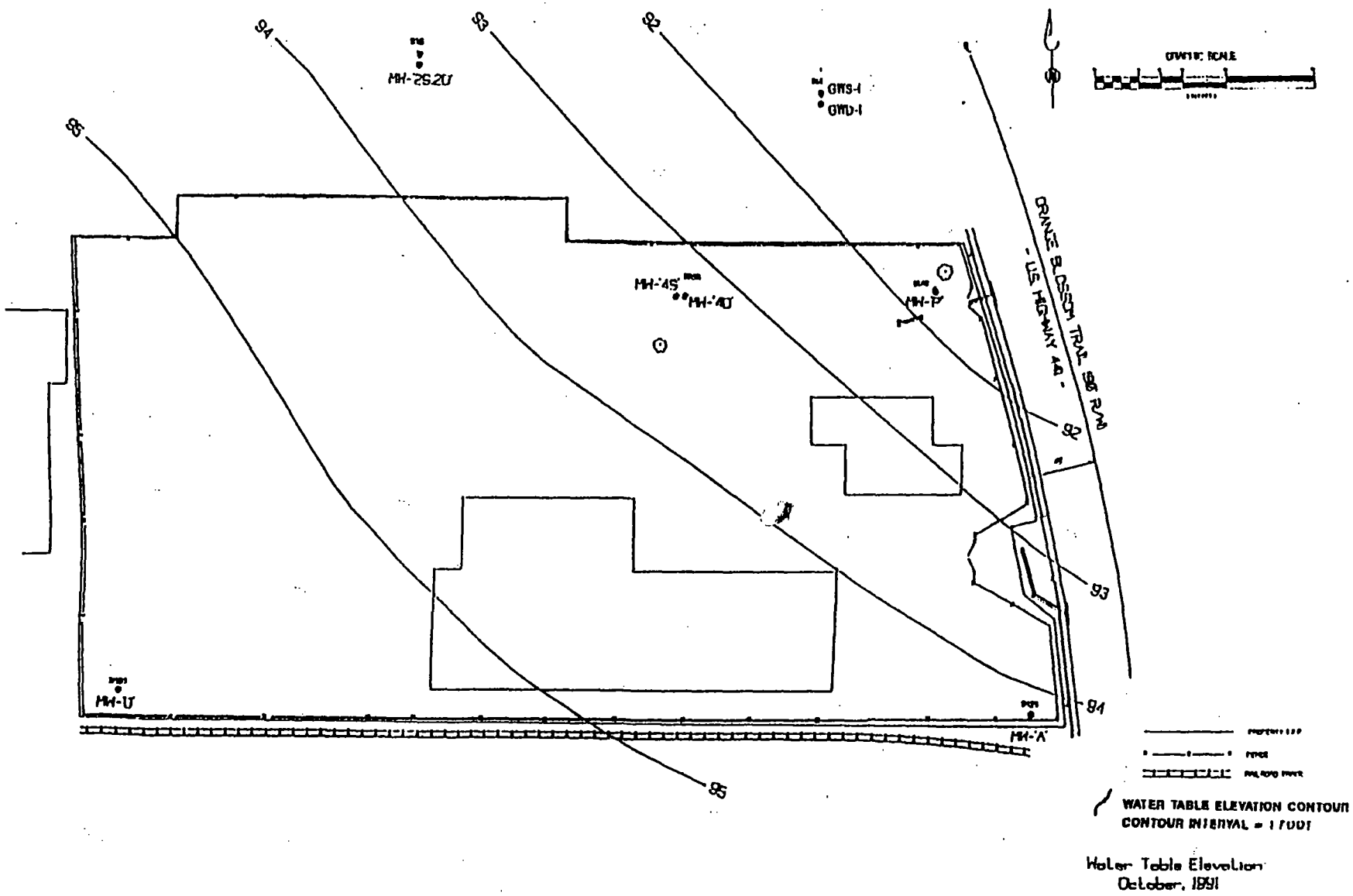

FIGURE 3-1 Existing Wells at the Chevron Orlando Site as of May 1993.

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4.0 ORGANIZATION AND RESPONSIBILITIES

A general organization chart is presented on Figure 4-1. Summaries of the responsibilities of the individuals identified in the organization chart are presented in the QAP (BCC, 1991). In addition, PTI Environmental Services, Inc. (PTI) will provide technical support services to Chevron and TASK Environmental, Inc. during the course of the RI/FS. PTI's primary project responsibility is for the geochemical investigation portions of the project.

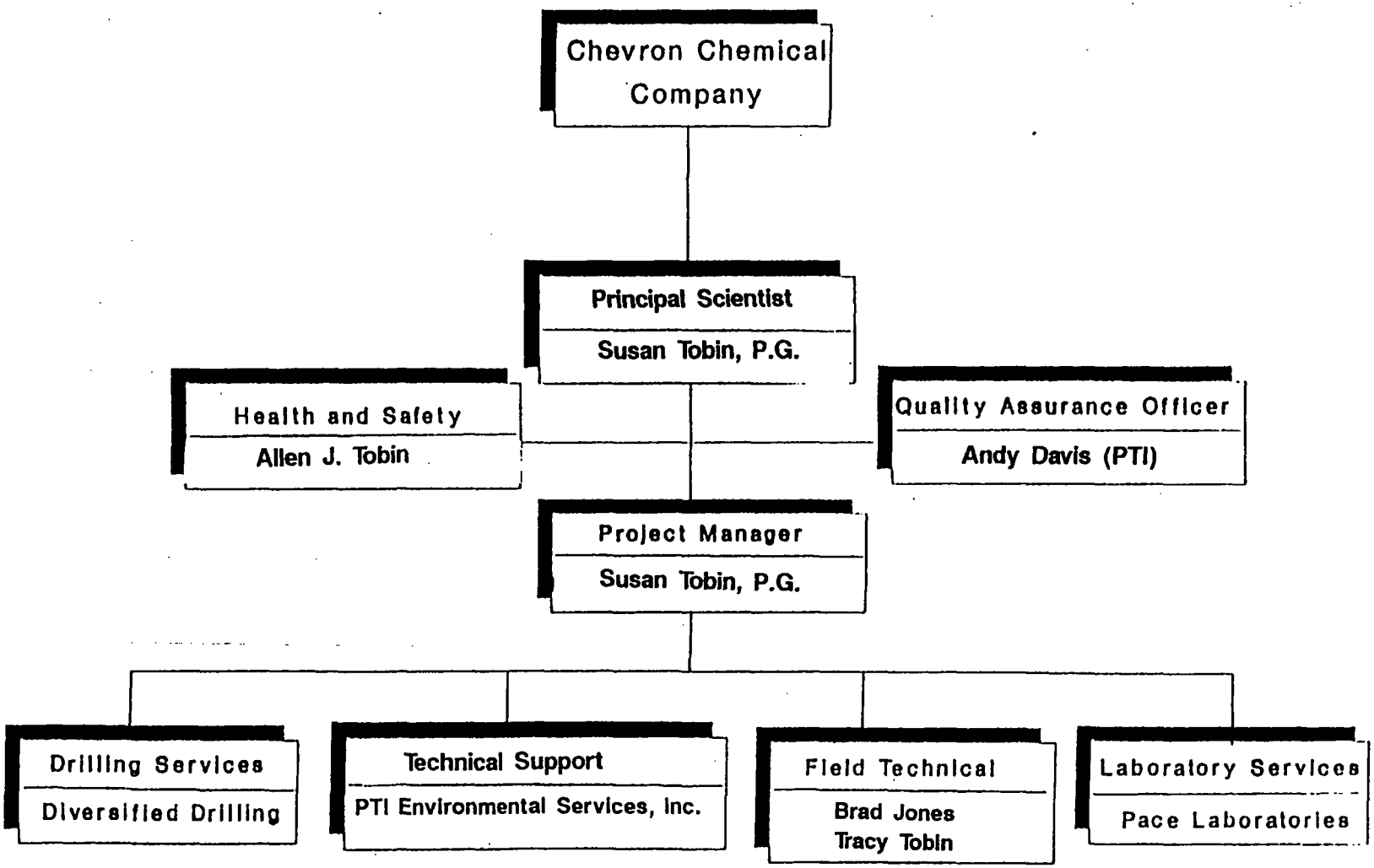

Figure 4-1. Project Organization

5.0 QUALITY ASSURANCE OBJECTIVES FOR PRECISION, ACCURACY, COMPLETENESS AND REPRESENTATIVENESS

The quality assurance objectives for the inorganic field measurements are presented in Table 5-1 in the QAP (BCC, 1991). Laboratory quality assurance objectives are provided in the laboratory quality assurance document found in Appendix B of the QAP (BCC, 1993).

6.0 SAMPLING PROCEDURES

Consistent collection of representative samples from a given environmental matrix depends on implementation and adherence to standard operating procedures of sample collection, handling, preservation, and documentation. Sampling procedures used for the field investigations will follow the guidelines set forth in Standard Operating Procedures and Quality Assurance Manual U.S. EPA Region IV, February 1991, Test Methods for Evaluating Solid Waste (SW-846), U.S. EPA, 1986, and the QAP (BCC, 1991).

6.1 SAMPLING PROCEDURES

Specific sampling procedures, equipment descriptions, and field instrumentation description are presented in the QAP (BCC, 1991). Project-specific deviations from the information presented in the QAP (BCC, 1991) are presented below.

6.1.1 Soil Vapor Survey

A soil vapor survey is not planned for the RI/FS field activities.

6.1.2 Groundwater

Existing permanent monitor wells will be purged and sampled during the Phase 1 field activities by the methods described in Section 6.1.2 of the QAP (BCC, 1991). Groundwater samples will be collected with closed-topped stainless steel or teflon bailers which are attached to the bailer cord with a teflon coated stainless steel leader.

It is anticipated that 18 additional stainless-steel monitor wells will be installed during the Phase 2 activities. The total number of wells may be modified based on the results of the modeling. The wells will be installed in clusters of two (2) wells, to include one (1) shallow well and one (1) intermediate depth well per cluster. The shallow wells will be constructed so that the 10-foot well screen intersects the water table. The intermediate depth wells will be constructed so that the 5-foot screen is placed at the base of the surficial aquifer. One of the intermediate depth wells will be constructed with 4-inch diameter stainless steel casing and screen. The screened interval will be 10-feet in length. This well will be used as the production well for the pumping test.

In addition, two (2) Hawthorn formation monitor wells will be constructed to monitor the first water producing zone in the Hawthorn formation. The Hawthorn formation monitor wells will be constructed using mud-rotary drilling techniques, and with double casing, to prevent the potential for interchange of water and contaminants between the aquifers.

The outer casing of the Hawthorn formation monitor wells will be 8 to 10-inch PVC. The outer casing will be set into a 12-inch borehole constructed to a

depth of approximately 40-feet (5 to 10 feet into the top of the confining layer). The casing will be pressure grouted into place, and the grout allowed to cure for 72-hours. A 2-inch diameter pilot hole will be drilled through the outer casing, to the depth of the first water producing zone in the Hawthorn formation. The pilot hole will be over-drilled to approximately 6-inches in diameter, and the 2-inch diameter stainless steel casing and screen installed to the selected monitoring zone. The well will be completed with gravel pack, a bentonite seal, and cement grout, as described in the SAP (BCC, 1991). The gravel pack, bentonite seal, and cement grout will be tremied into place, to ensure that these materials are placed at the proper depths.

The new and existing monitor wells will be sampled during Phase 2 of the field activities in accordance with the procedures described in the QAP (BCC, 1991).

6.1.3 Soil

Soil samples will be collected during the Phase 2 sampling activities. Surficial soil samples (0-3 inches below land surface) will be collected from drainage features and stormwater runoff pathways located within the trailer park to the north of the site. The surficial soil samples will be collected using stainless steel spoons, following the procedures specified in Section 6.1.3 of the QAP (BCC, 1991). Soil samples will be collected from a depth of 12-inches at 20 percent of the sampling locations, using stainless steel hand augers, following the procedures specified in the QAP (BCC, 1991).

6.1.4 Geochemical Sampling

Electrode analysis for pH, Eh, temperature, specific conductivity, and dissolved oxygen will be conducted in a flow-through cell under zero-headspace conditions to minimize alteration of the aquifer conditions. Immediately after purging the wells, oxygen-impermeable tubing connected to a Geofilter® peristaltic pump will be inserted to several feet below the water surface and within the screened interval of the well. This intake location minimizes collection of water from the reoxygenating zone at the surface. Water will be pumped directly into the bottom of a polycarbonate flow-through cell, where the pH, Eh, conductivity, temperature, and dissolved oxygen electrodes are mounted in air-tight fittings. Groundwater will be allowed to fill the cell, all bubbles bled off from the electrode fittings, and pumping will continue until the electrode readings stabilize (typically after approximately two additional cell volumes of groundwater have flushed through the system). Electrode measurements will be recorded while the water is actively flowing through the cell.

Ferrous iron [Fe(II)] will be determined colorimetrically following complexation by 1,10-phenanthroline. Groundwater will be retrieved from the well with a peristaltic pump, passed through an in-line 0.45-µm filter, and the sample collected by opening a glass AccuVac ampule under the surface of the water in the beaker. Ferrous iron method detection limits are approximately 0.01 mg/L.

Aquifer matrix and groundwater samples will be collected for partition coefficient (K_d) analysis and biodegradation studies. To avoid biological contamination of the aquifer material, a stainless-steel split spoon, containing three (3) 6-inch stainless steel sampling tubes, will be used for collection of aquifer matrix samples. The sampling tubes will be sterilized (by autoclave), capped with sterilized (by ultraviolet irradiation) end caps, sealed in a plastic bag, and shipped to the field. A hollow-stem auger will be used to drill from the ground surface to a depth of at least 1-foot below the water table. Prior to sampling, the split spoon will undergo standard decontamination procedures, followed by a final sterilizing rinse in technical-grade isopropanol. The sterilized sampling tubes will be placed into the split spoon by personnel wearing clean latex or vinyl gloves. The sample will then be collected by driving the split spoon into the aquifer material below the water table. A total of eight (8) samples (two from each of the four selected locations) will be collected from individual wells in this manner.

Immediately on retrieval of the split spoon, the stainless steel tubes will be removed, and the ends sealed with air-tight caps and a parafilm wrap. Two tubes from each of the four split-spoons sampling locations will be dedicated to the biodegradation experiment, while the third will be used to form the laboratory K_d sample. The tubes will be labeled, double wrapped in plastic bags, and shipped on ice (under chain of custody) by overnight courier to PTI's Boulder, Colorado laboratory for processing.

The water for the K_d experiment (10 L) will be collected in five pre-cleaned, 2-L glass bottles, while the water for the biodegradation experiment (26 L) will be collected in 13 pre-cleaned, sterilized (by autoclave), 2-L amber glass bottles. One well-casing volume will be purged from the well by bailing, after which the samples will be collected using a peristaltic pump and clean Tygon® tubing inserted down the well to below the water level. Each 2-L glass bottle will be filled with groundwater, capped, and sealed with parafilm. In the event that anoxic conditions are encountered in the aquifer, water for the biodegradation experiment will be collected by filling the containers from the bottom, and allowing at least two times the volume of the container to flush through to exclude atmospheric oxygen before sealing the bottle under zero-headspace conditions. The groundwater samples for the K_d and microcosm study will be shipped on ice and under chain of custody by overnight courier to PTI's Boulder laboratory.

Two (2) wells will be sampled by the above method (2 L each in precleaned glass bottles) during field activities and analyzed by EPA Method 8270 in the selective ion monitoring (SIM) mode for lindane daughter products, which include 1,2,4-trichlorobenzene, 1,2,3,5- and/or 1,2,4,5-tetrachlorobenzene, 1,2,3,4-tetrachlorobenzene, γ-2,3,4,5,6-pentachlorocyclohex-1-ene, and γ-3,4,5,6-tetrachlorohexene (Howard 1991). The analyte list will be limited to the availability of standards for the calibration of the mass spectrometer. Results of these analyses will facilitate estimation of the extent of in situ lindane biodegradation occurring in the aquifer.

Direct measurement of the soil/water partition coefficient, or K_d, requires concentration estimates for an analyte adsorbed to a solid matrix (dry weight concentration) and the aqueous concentration of the analyte that has equilibrated with the solid in water. The field zero-headspace extractor (ZHE) method for determining K_d uses pressure filtration of aquifer materials to separate the water from the solids. The aqueous and solid phases are then analyzed separately for COIs. ZHEs were designed to evaluate volatile constituents in the EPA's toxicity characteristic leaching procedure (TCLP) and are widely used in laboratory settings. The ZHE consists of a 6-inch-long cylinder, an airtight movable piston in a base, and a screened filter holder at the top. When sealed, up to 50 psi of air may be applied to the cylinder to force the water through the filter. Use of a zero headspace device avoids loss of volatile constituents from the sample, thereby permitting use of this method on volatile and semi-volatile constituents. The ZHE will be decontaminated before each use, and decontamination procedures are identical to those for other field sampling equipment (BCC 1991, Section 5.9.1).

Samples of aquifer material are obtained by drilling to below the water table with a hollow-stem auger, withdrawing the auger approximately 6 inches to allow the borehole walls to cave in, and retrieving samples of the aquifer/groundwater slurry with a stainless steel or Teflon® bailer. Aquifer slurry samples are placed immediately into a zero headspace extractor (ZHE).

When filled to within 5 cm of the top with slurry, the ZHE is capped, and the pressure cylinder attached to a portable compressed-air source. Any air space above the sample is immediately forced out by applying air pressure to the piston. The aqueous samples are collected in an 80-mL glass and Teflon® syringe attached directly to the ZHE to maintain zero headspace conditions. Aqueous samples can then be placed immediately into glass sample containers containing the required preservatives. Sample containers will be 40 mL for volatile organic analysis and 125 mL for pesticide analysis (e.g., EPA Method 8080).

The ZHE is then opened, and the solid fraction immediately placed in glass sample containers by hand using a stainless steel spatula. As with the aqueous fraction, containers will be 40 mL for volatiles and 125 mL for pesticides. In most cases, the high water content of the solids allows the removal of all visible headspace from the containers. Following collection, samples are stored in coolers at 4° C and shipped overnight to Pace, Inc. for chemical analysis.

The aqueous and solid fractions will be analyzed by EPA Method 8080 (gas chromatography, electron capture detector for organochlorine pesticides). In addition, the solid fraction will be analyzed for moisture content (SOP 5, Appendix A) to allow determination of a dry-weight K_d. Following analyses for volatiles, the remaining solid samples will be sent to Huffman Laboratories in Golden, Colorado, for determination of total organic carbon (TOC, EPA Method 9060), to allow comparison of the measured K_ds to the theoretical values predicted from the TOC measurements.

The laboratory procedure for determination of K_d is similar to the field ZHE procedure in terms of sample collection and analysis. Separate samples of aquifer material and groundwater are added to the decontaminated ZHE in known amounts (gravimetrically) to obtain a total volume of approximately 1.5 L in the ZHE. The actual soil/water ratio should be as high as possible to assure collection of a 500-mL aqueous sample from the pressure filtration. The mixture is spiked with the COI at the desired level, either by volumetric addition of a solvent carrier containing the COI, or by direct addition of a gravimetrically determined mass of COI. The mass of the COI spike will be determined following evaluation of the anticipated groundwater concentrations. Spiked COI levels will be selected so that the resulting K_ds can be applied to modeling fate and transport under site-specific conditions, i.e., the aqueous concentration in the equilibrated sample should range between the instrument detection limit for that analyte (e.g., 0.5 µg/L for lindane in a 100 mL sample) and two times above the upper limit measured in the site groundwater.

Following loading, the ZHE is sealed immediately and tumbled for 24-hours at 20±4°C, to equilibrate COIs between the solid and aqueous phases. The samples of solid and aqueous fractions are then collected and analyzed following procedures identical to those described above for collection of ZHE samples in the field.

The laboratory K_d experiments will include a total of eight (8) equilibrium reaction, and the aqueous and solid fractions will be analyzed in each equilibration. One (1) reaction will measure COI partitioning on an unspiked sample of the composite soil, and four (4) reactions will be spiked with COIs at varying levels to obtain the desired aqueous concentration range. Finally, three (3) splits of the soil retrieved from the equilibration reaction that received the highest COI spike concentration will then be re-equilibrated with clean groundwater to measure COI desorption from the soil. In these desorption experiments, the ratio of soil to groundwater will be varied, so that the COI concentrations in the groundwater and soil fractions are at least five times above the analytical detection limit (e.g., for lindane, detection requires approximately 0.025 µg lindane in the sample; thus the soil/water ratio should be chosen such that the water and the soil fractions each contain at least 0.125 µg of lindane). Final ratios will be selected from the theoretical COI K_d determined from the organic carbon content of the composite sample.

6.1.4.1 Laboratory Degradation Determinations

Due to the dependence of the required experimental and analytical methods on the particular COIs identified, the scope of the biodegradation experiments has been written assuming that lindane will be the primary COI. The laboratory microcosm study will start with multiple containers (either aerobic or anaerobic, depending on conditions determined in the aquifer) that contain accurately measured amounts of aquifer material, groundwater, and lindane. Each reaction bottle containing mixtures of aquifer material and water will then be spiked with lindane, to achieve a lindane concentration approximately equal to the average

concentration measured in the groundwater at the site. In the event that anoxic conditions exist in the aquifer, sample handling and experimental setup will be conducted in a sterile, nitrogen-atmosphere glove box, to avoid contamination by either oxygen or extraneous microorganisms. However, if oxygenated conditions are appropriate, the sample handling and experimental setup will be performed in a laboratory hood that has been rendered abiotic by ultraviolet irradiation. The laboratory degradation will yield the rate of lindane degradation, both biotic and abiotic.

On receipt at PTI's Boulder laboratory, a sample of the groundwater will be analyzed for sulfate, nitrate, phosphate, pH, and total organic carbon, to quantify the nutrients that are present initially in the groundwater. Unopened groundwater bottles and aquifer material samples will be placed in the sterile glove box or hood, where the stainless-steel tubes will be opened, and a representative sample of each solid material collected in a pre-cleaned glass sample bottle, and analyzed for nitrate, phosphate, total organic carbon, and bulk density to determine biological nutrients present in the aquifer material.

Twenty (20) sterilized 1-L glass bottles will be weighed empty (including cap), and 100 g of wet aquifer material (4 bottles of 3 aquifer materials, and 8 bottles of 1 aquifer material) will be added to each. Each microcosm will be filled with groundwater (approximately 900 mL) and sealed with impermeable caps (unless the redox measurement of the aquifer indicates oxygenated conditions, in which case, oxygen-permeable lids will be used). The microcosm vessels will be weighed to determine the mass of water and aquifer material in each container, and the percent moisture of the aquifer material will be determined (percent weight loss on drying at 105°C for 24 hours). Two additional microcosm vessels (abiotic) will be treated as above, but sodium azide (2,000 mg/L) will be added to inhibit any microbial activity and allow determination of abiotic degradation. Two final microcosm vessels (controls) will be filled with 1 L of type 2 deionized water. These procedures will provide 24 microcosm vessels with the following contents: 1) 4 bottles each of 4 aquifer materials for determination of lindane biodegradation at 4 time points (16 bottles total), 2) 1 aquifer material for triplicate analyses at two time points (4 total bottles), 3) 2 bottles sterilized with sodium azide for determination of abiotic degradation at two time points (2 total bottles), 4) 1 travel blank, 5) 1 rinsate blank, and 6) 1 bottle with deionized water spiked with known concentration of lindane (laboratory control samples, LCS).

After sealing, the microcosm reactors will be spiked with equivalent volumes of lindane to achieve fluid lindane concentrations approximately equal to average concentrations in the groundwater plume. The vessels will be rotated end-over-end for 24 hours to establish lindane equilibrium between the fluid and solid phases. After establishing equilibrium, samples will be collected on the first day of the experiment by emptying the contents of one bottle of each aquifer material into a zero-headspace extractor (ZHE) and separating the fluid from the solid fraction. The fluid fractions of the Day 1 samples will be placed in precleaned glass bottles under zero-headspace conditions and sent to PACE laboratories for lindane analysis by EPA Method 8080 to establish initial condition. The vessels will be stored in the dark at approximately 25° C, and one bottle from

each aquifer material type will be opened at 10, 50, and 100 days. The fluid and solid fractions will be separated using the ZHE, and the fluid fraction analyzed for lindane by EPA Method 8080.

The time points in the lindane degradation study were chosen based on published studies of lindane biodegradation in sewage sludges, which indicated half-lives on the order of 25–30 days (Jacobson, et al., 1991; McTernan and Pereira 1991). The samples collected after 50 and 100 days should thus indicate quantifiable degradation losses.

Concentrations of known daughter products formed during biodegradation, which include 1,2,4-trichlorobenzene, 1,2,3,5- and/or 1,2,4,5-tetrachlorobenzene, 1,2,3,4-tetrachlorobenzene, γ-2,3,4,5,6-pentachlorocyclohex-1-ene, and γ-3,4,5,6-tetrachlorohexene (Howard 1991), will be determined by EPA Method 8270, using the SIM, for all four of the aquifer material types at 1 and 100 days. For two of the aquifer materials at 100 days, the EPA Method 8270 SIM runs will be performed in triplicate. One (1) sterile sample will be analyzed for lindane and its daughter products at 1 and 100 days to determine the abiotic component of degradation. Finally, one groundwater spiked with lindane, without aquifer material, will be analyzed for lindane at 1 and 100 days to measure the fluid degradation rate in the absence of aquifer material. These experiments will result in 32 Method 8080 analyses for lindane, and 10 Method 8270 analyses for biodegradation daughter products.

Biodegradation will be assessed by comparing the disappearance of lindane in the biodegradation vessels versus the abiotic controls and spiked method blanks over time. The determination of lindane daughter products will provide verification of any biodegradation occurring in the vessels, and may indicate the degradation pathway, providing valuable information regarding selection of appropriate remedial alternatives.

6.2 SAMPLING EQUIPMENT

Sampling equipment must be correctly chosen to preserve the integrity of the sample while assuring representativeness. Sampling equipment will be selected from the list of equipment and supplies listed in Section 6.2 of the QAP (BCC, 1991).

6.3 CLEANING PROCEDURES

Field sampling equipment and supplies will be cleaned in accordance with the procedures outlined in Section 6.3 of the QAP (BCC, 1991). A centrifugal pump (used to purge the wells) will be cleaned by pumping alconox and water through the pump and discharge hose, followed by a deionized water rinse.

6.4 SAMPLE CONTAINERS, PRESERVATION METHODS, AND HOLDING TIMES

The proper sample containers, preservation methods, and holding times are established by 40 CFR Part 136, and are summarized in Table 6-1 of the QAP (BCC, 1991).

6.4.1 Sample Bottle Filling Procedures

Sample containers will be filled following the procedures specified in Section 6.4.1 of the QAP (BCC, 1991).

6.4.2 Sample Packing for Shipment

Samples will be packed and shipped in accordance with the procedures specified in Section 6.4.2 of the QAP (BCC, 1991).

6.5 FIELD RECORDS

Field records will be prepared and maintained in accordance with Section 6.5 of the QAP (BCC, 1991).

7.0 SAMPLE CUSTODY

Standard procedures, including sample identification, maintenance of field record, and chain-of-custody documentation, will be used to maintain sample custody and control. The sample custody procedures are defined in Section 7.0 of the QAP (BCC, 1991).

8.0 CALIBRATION PROCEDURES AND FREQUENCY

Procedures for calibration of field equipment are provided in Section 8.0 of the QAP (BCC, 1991). Procedures for calibration of laboratory equipment are provided in Appendix B of the QAP (BCC, 1991).

9.0 ANALYTICAL PROCEDURES

The field and laboratory sampling and analysis will be conducted in accordance with the methods specified in Section 9.0 of the QAP (BCC, 1991), with project-specific deviation summarized below.

9.1 ANALYTICAL PARAMETERS

Groundwater samples collected during the Phase 1 sampling event will be analyzed for purgeable halocarbons and purgeable aromatics (EPA Methods 601/602); semi-volatile organic compounds (EPA Method 625); chlorinated pesticides (EPA Method 608); organophosphate pesticides (EPA Method 614); arsenic (EPA Method 206.2); chromium (EPA Method 200.7); and lead (EPA Method 239.2). Additional groundwater samples will be collected for in-field characterization of the oxidation potential, and will be analyzed at the well head for pH, Eh, ferrous iron [Fe(II)], sulfide, dissolved oxygen, specific electrical conductivity, and temperature. Although the field analyses are classified as level I, all measurements will be quantitative, and instrument response will be verified during field analysis with calibration standards and, where appropriate, spikes.

During the Phase 2 monitor well construction, aquifer matrix and groundwater samples will be collected and analyzed to provide site-specific geochemical data. Each field and laboratory sample of aquifer material collected to determine K_d will generate a solid and aqueous fraction. These will both be analyzed for organochlorine pesticides (EPA SW-846 Method 8080), and for the metals arsenic and chromium (EPA SW-846 Methods 7060 and 6010, respectively). The K_d is determined from the ratio of the concentration in the solid and aqueous fractions.

The samples generated during the laboratory degradation study will be analyzed for organochlorine pesticides (EPA SW-846 Method 8080) at 1, 10, 50, and 100 days to determine the rate at which these constituents decay under site conditions. The later sampling times may be adjusted based on results of the initial sampling. In addition, ten (10) of the samples from the laboratory degradation experiment and two (2) of the field groundwater samples will be analyzed for lindane degradation products (e.g., 1,2,4-trichlorobenzene, 1,2,3,5- and/or 1,2,4,5-tetrachlorobenzene, 1,2,3,4-tetrachlorobenzene, γ-2,3,4,5,6-pentachlorocyclohex-1-ene, and γ-3,4,5,6-tetrachlorohexene) by EPA SW-846 Method 8270, with the mass spectrometer in selective ion monitoring (SIM) mode.

The Phase 2 monitor wells and existing monitor wells will be sampled and samples analyzed for the COIs. The analytical methods and parameters will be consistent with the Phase 1 methods and parameters. The Phase 2 methods and parameters may be modified, with EPA approval, based on the Phase 1 results.

The Phase 2 soil samples will be analyzed for purgeable hydrocarbons (EPA Method 8260); semi-volatile organic compounds (EPA Method 8270); chlorinated

pesticides (EPA Method 8080); arsenic (EPA Method 206.2); chromium (EPA Method 200.7); and lead (EPA Method 239.2).

9.2 ANALYTICAL METHOD SUMMARIES

The analytical methods to be used for the Phase 1 groundwater analysis and the Phase 2 soil sample analysis are summarized in Section 9.0 of the QAP (BCC, 1991), except for purgeable hydrocarbons and the metals. Purgeable hydrocarbon analysis by EPA Method 8260 is a purge and trap technique for the determination of a number of purgeable organic compounds that are partitioned and analyzed by gas chromatography/mass spectrometry (GC/MS). The chemical analysis for arsenic and lead will be accomplished by atomic absorption spectrophotometry. Chromium will be analyzed by Inductively Coupled Plasma (ICP). In addition, the EPA Method 601 and 602 analyses of groundwater samples will include second column confirmation.

Temperature, pH, Eh, specific electrical conductivity, and dissolved oxygen will be measured with the appropriate electrodes in a flow-through cell apparatus to prevent contact with the atmosphere. The field methods are described in detail in PTI's Standard Operating Procedures [Appendix A of the Sampling and Analysis Plan Amendment, (TASK/PTI, 1993)], and are summarized below.

- Redox potential, or Eh, will be measured electrometrically at the well head with a platinum electrode and a Ag/AgCl reference electrode, calibrated against ZoBell's solution (Nordstrom 1977).

- Dissolved ferrous iron, Fe(II), will be determined colorimetrically with a Hach DR-2000 spectrophotometer at the well head on a filtered sample of groundwater.

- Dissolved sulfide will be determined at the well head on unfiltered samples of groundwater using a sulfide-specific electrode.

- Dissolved oxygen (DO) will be determined with an oxygen-permeable membrane electrode in the flow-through cell at the well head.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

The procedures to be followed for data reduction, validation, and reporting of field data are contained in Appendix D of the Standard Operating Procedures and Quality Assurance Manual U.S. EPA Region IV, 1991, and are included as Appendix C of the QAP (BCC, 1991).

The procedures for laboratory data reduction, validation, and reporting are provided in the laboratory quality assurance plan, which is included as Appendix B of the QAP (BCC, 1991).

11.0 FIELD AND LABORATORY QUALITY CONTROL CHECKS

11.1 FIELD QUALITY ASSURANCE PROCEDURES

Field quality assurance procedures are designed to ensure that the samples collected during field operations provide accurate and representative data. Quality assurance samples for the project will include replicate samples, spike samples, and field quality control blanks.

A summary of the estimated number of quality assurance samples is presented in Table 11.1. A description of the types of quality assurance samples is provided in Section 11.1 of the QAP (BCC, 1991). TASK will also collect and analyze material blank samples. The material blanks will include a sample each of the drilling fluid, sand pack, and bentonite used to construct the new monitor wells, along with a rinsate sample from the well casing and screen. The material blanks will be collected during the Phase 2 monitor well construction, and analyzed for the contaminants of interest (COIs).

TABLE 11.1 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

SAMPLE TYPE	SAMPLES PER SAMPLING ACTIVITY			
	Phase 1 GW	Phase 2 Well Construction	Phase 2 GW	Phase 2 Soil
Duplicate	1	0	3	2
Equipment Blank	1	0	3	2
Field Blank	1	0	1	1
Trip Blank	4	1	10	4
Material Blanks				
Drilling Fluid	0	1	0	0
Sand Pack	0	1	0	0
Bentonite	0	1	0	0
Casing/Screen Rinsate	0	1	0	0
EPA Spikes and Blanks	3	0	6	3
TOTAL QA/QC SAMPLES PER EVENT	**10**	**5**	**23**	**12**

12.0 PERFORMANCE AND SYSTEM AUDITS

Quality assurance audit address the technical and procedural accuracy of work efforts. The general requirements for performance and system audits are provided in Section 12.0 of the QAP (BCC, 1993).

13.0 PREVENTATIVE MAINTENANCE

Preventative maintenance procedures for field and laboratory equipment are provided in Section 13.0 and Appendix B of the QAP (BCC, 1993), respectively.

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Procedures used for field and laboratory assessment of data pecision, accuracy, and completeness are provided in Section 14.0 and Appendix B of the QAP (BCC, 1993), respectively.

15.0 CORRECTIVE ACTIONS

Corrective actions become necessary when measurement systems fail to follow the QAP (BCC, 1991) and this QAPPA. Corrective actions which may be needed during the course of the project for field and laboratory activities are described in Section 15.0 and Appendix B of the QAP (BCC, 1993), respectively.

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality assurance reports to management are described in Section 16.0 of the QAP (BCC, 1991).

17.0 REFERENCES

1. Brown and Caldwell Consultants, 1991. Quality Assurance Project Plan for the Chevron Orlando Site.

2. Brown and Caldwell Consultants, 1991. Sampling and Analysis Plan for the Chevron Orlando Site.

3. TASK Environmental, Inc. and PTI Environmental Services, Inc., 1993. Sampling and Analysis Plan Amendment for the Chevron Orlando Site Remedial Investigation and Feasibility Study.

4. USEPA, 1986. Test Methods for Evaluating Solid Waste (SW-846).

5. USEPA, Region IV, 1991. Standard Operating Procedures and Quality Assurance Manual.

6. Zobell, 1946. Studies of Redox Potential of Marine Sediments. Bul. Am. Assoc. Petro. Geol. v. 30, pp 477-513.