APPENDIX A

FIELD SAMPLING AND ANALYSIS PLAN

FOR CONDUCTING AN ENGINEERING EVALUATION/COST ANALYSIS

NORTH POTATO CREEK WATERSHED

DUCKTOWN, TENNESSEE

In Response to
Administrative Order on Consent
For Removal Action at Davis Mill Creek Watershed
U.S. EPA Region 4
CERCLA Docket No. 01-12-C

Glenn Springs Holdings, Inc.
A subsidiary of Occidental Petroleum

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1.0 INTRODUCTION

Barge, Waggoner, Sumner & Cannon, Inc. (BWSC) has been retained by Glenn Springs Holdings, Inc. (GSH), a subsidiary of OXY USA, Inc., to conduct an Engineering Evaluation/Cost Analysis (EE/CA) required by the United States Environmental Protection Agency under VI.2 of the Administrative Order of Consent dated January 11, 2001.

The Field Sampling and Analysis Plan (FSAP) has been prepared as an appendix to the Work Plan for Conducting an Engineering Evaluation/Cost Analysis for North Potato Creek Watershed prepared by Shepherd Miller, Inc. and Barge Waggoner Sumner & Cannon, Inc (BWSC) in 2001. In addition to the FSAP, the Work Plan includes the Health and Safety Plan for the field activities.

2.0 SITE BACKGROUND

Information on the project background, site description, and previous removal actions at the site are included in the Work Plan (Section 2.0).

3.0 GENERAL FIELD OPERATIONS

3.1 General Sequence of Field Operations

The Work Plan covers 1) Phase 1 – Site Characterization including data collection, dynamic system modeling, and limnological modeling and 2) Phase II – Treatability Alternative Analysis and Streamlined Risk Assessment. This Field Sampling and Analysis Plan is focused on the collection of field data necessary to develop an understanding of the hydrologic and chemical mass balance of the South Mine Pit system as well as to evaluate changes, if any, in the flow and/or water quality in the reach of the North Potato Creek below the South Mine Pit.

The anticipated sequence of field activities under this Sampling and Analysis Plan is as follows:

- Periodic Water-Quality Monitoring
- Continuous Flow, Conductivity, pH, and Temperature Monitoring
- South Mine Pit Water-Level Measurements
- Pit Wall-rock Analysis
- Site-Specific Weather Measurements
- Water-Level Measurements and Water-Quality Determination in Monitoring Wells and Shafts around the South Mine Pit

3.2 Field Team Personnel and Responsibilities

The overall project management approach and organizational structure is presented in the Work Plan (Section 4.0). Day-to-day field activities will be directed by BWSC's field manager.

3.3 Personal Protection

Information regarding required levels of protection and personal decontamination procedures is provided in the Health and Safety Plan (Appendix C of the Work Plan).

3.4 Field Technical Guidance

The primary source of technical guidance for field activities will be the EPA Region 4 *Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual* (EPA, 1996, revised 1997). Selected Standard Operating Procedures (SOPs) are attached. The attached SOPs are based on the EPA Region 4 SOPs. In some cases, minor modifications may be necessary to meet site conditions. This Sampling and Analysis Plan also provides technical guidance for specific tasks not included in the EPA Region 4 document. Copies of the Sampling and Analysis Plan and the *Compliance Branch Standard Operating Procedures and Quality Assurance Manual* will be maintained by the field manager and reviewed with the field team before initiation of field activities.

3.5 Decontamination Procedures

An area of the former Tennessee Mine will be designated for use in the decontamination operations. This area will be used for equipment decontamination as well as for BWSC personnel entering and leaving the work areas on the site. A decontamination pad will be constructed in this area to collect fluids produced during decontamination activities.

Due to the nature of the contamination associated with the water within the South Mine Pit, hazardous wastes are not expected to be encountered. Decontamination liquids will be transported to the London Mill WasteWater Treatment Plant for disposal. Other investigation-derived wastes (shipping materials, disposable sampling equipment, and used personal protection equipment) will be properly disposed as solid waste.

The standard operating procedures for field decontamination are presented in Attachment 1.

3.6 Survey

A base map has been prepared for the South Mine Pit. The locations of the surface-water flow monitoring stations will be located with an accuracy of 0.1 foot or more precise. The datum elevations will be will be surveyed using the National Geodetic Vertical Datum (NGVD) to the nearest 0.01 feet.

4.0 FIELD INVESTIGATION OBJECTIVES

The objective of the EE/CA is to provide the necessary data to evaluate temporary response action alternatives to reduce the contaminant loading from North Potato Creek to the Ocoee River. Information gathered as a result of the EE/CA Work Plan will be utilized, when possible, to aid in the determination of long-term solutions; however, the EE/CA Work Plan specifically addresses the interim remedial action.

An objective of the EE/CA field activities is to collect data to develop a hydrologic and chemical mass balance of the South Mine Pit system. Flow and chemistry characteristics of North Potato Creek from its inflow into the South Mine Pit to the mouth of the Ocoee will be included in this evaluation. The hydrologic and chemical data will then be entered into a Dynamic Systems Model (DSM) of the South Mine Pit System and contributions from inputs and outputs of the system will be evaluated. The hydrologic and chemical data collected in the South Mine Pit will also be used to evaluate the chemical stratification in the South Mine Pit and hydrodynamic limnologic modeling will be conducted using CEQUAL-W2 to evaluate potential for pit-turnover. Once conditions in North Potato Creek and the South Mine Pit system are understood, potential treatment alternatives for the system will be evaluated.

This Work Plan presents the EE/CA process as a phased approach. Phase I includes the data collection, development of the dynamic system and limnologic models. Results from Phase I will then be used in Phase II to evaluate treatment alternatives.

5.0 SAMPLE LOCATIONS AND FREQUENCY

The FSAP has been developed to present sampling and analysis actions that will be executed during the EE/CA. The sampling and analysis program is described in the following sections and presented on Table 5.1.

5.1 North Potato Creek

Typically, two types of water-quality monitoring will be conducted at three primary stations (SW-8, SW-9 and NPC1) in North Potato Creek: (1) periodic water-quality sample collection; and (2) continuous temperature, pH, and conductivity measurement.

<u>Periodic Water-Quality Monitoring</u>

Water-quality samples will be collected twice a month from SW-8, SW-9, and NPC1. The water-quality samples will be analyzed for the field parameters of pH, conductivity, Eh, temperature, ferrous iron, and dissolved oxygen (DO). The analytical suite for the initial two sampling events will include:

Analyte	EPA Test Method
Acidity	305.1
Alkalinity	310.1
Chloride	325.2
Dissolved inorganic carbon (DIC)	415.1
Hardness	130.2
Nitrate	9056
Phosphate (PO4)	365.2
Sulfate (SO4)	375.4
Total suspended solids (TSS)	160.2
TAL Metals (filtered and unfiltered)	200/600 Series
TCL volatile organic compounds (VOCs)	8260
TCL semi-volatile organic compounds (SVOCs)	8270
Polychlorinated biphenols (PCBs)	8082

The lower detection limits required by the Tennessee Water Quality Criteria will be used, where technically possible, for the initial (expanded) sampling event. Following the collection and analysis of the initial two sampling events, the constituents of interest will be identified based on detected constituent concentrations and potential environmental impacts of the constituents. After the identification of the constituents of interest, the analytical suite for the twice a month sampling events will reflect the constituents of interest. The minimum analytical suite will include acidity, alkalinity, aluminum, calcium, copper, chloride, DIC, hardness, iron, magnesium, manganese, nitrate, phosphate, potassium, sodium, sulfate, TSS, and zinc. Continuous pH, temperature, and conductivity measurements will be made at SW-8 and SW-9 which will collect data during storm flow events, including potential "first flushes". Additionally, during the low-flow season (October/November 2001) and during the high-flow season (March/April 2002) the full suite of constituents will be analyzed.

"First Flush" storm-water quality characteristics will be evaluated from the set of data collected during the routine sampling events (assuming at least two of the routine events can be scheduled during storm events). The storm-water inflow data evaluated will include data from SW-8, SMP-RO1 and SMP-RO2.

As data is developed and the understanding of the dynamics of the system is improved, the number of sampling locations and/or the extent of the analytical suite may be added to, or dropped from the list of analyses. Revisions to the analytical suite will be reviewed and approved by the EPA and the TDEC prior to implementation.

Continuous Monitoring

The principal flow of water into the South Mine Pit is surface water discharge from North Potato Creek at the upstream limit of the site boundary. This location, SW-8, is one of the three primary monitoring locations to be monitored and sampled. Using constant flow measurement devices at the weir and continuous measurements of temperature, pH, and conductivity, a continuous record of flow and these indicator parameters will be obtained. The installation and operation of the weirs and monitoring equipment is presented in a separate work plan.

The principal flow of water from the South Mine Pit to the lowest reach of North Potato Creek is at location SW-9**,** which will be designed to measure similar parameters as discussed above for SW-8. Flow monitoring at SW-8 and SW-9 will be performed continuously.

The third location, NPC1, to be monitored in North Potato Creek is near the confluence with the Ocoee River and located at the recently installed EPA monitoring station. Surface water sampling will be conducted at the same frequency as stations SW-8 and SW-9. If water quality is found to degrade below the South Mine Pit then the source of contamination will be investigated, quantified and identified. Also, a corresponding evaluation of flow measurement options at NPC1 will then be conducted.

Direct measurement of flow at NPC1 will be conducted on a schedule compatible with the storm-water flow monitoring being proposed for the Lower North Potato Creek . Following the survey of the cross section of the stream channel and the installation of a stream gauge the collection of the direct flow measurements will include:

- Measurement of water depth in the stream channel using the stream gauge
- Measurement of the estimated flow velocity using a Marsh-McBirney Flo-Mate

The sampling effort at SW-8 and SW-9 will be coordinated with the operation of the London Mill Water Treatment Plant (LMWTP) to identify the operations of the plant during sampling activities.

5.2 South Mine Pit Sampling

Twice a month a Hydrolab will be used to measure conductivity, dissolved oxygen, temperature, pH, and Eh at various locations and depths within the South Mine Pit. The laboratory analyses to be utilized for the South Mine Pit sampling is presented above in Section 5.1, Periodic Water-Quality Monitoring, and on Table 5.1. The primary sample locations, SMP1 through SMP4, are shown on Figure 4.1. For a minimum of three expanded events, the initial time, once during October/November 2001 and once during March/April of 2002; a total of 12 locations will be monitored using the Hydrolab. The 12 locations will consist of the four primary locations plus an additional two locations on the perpendicular transect for each location near the NW and SE walls of the Pit. Hydrolab monitoring will continue through March of 2002 at which time the monitoring schedule will be modified by agreement with EPA and TDEC.

At times other than the expanded sampling events described above, a minimum of three locations will be monitored (likely; SMP1, SMP4 and SMP2 or SMP3;). If the data indicates dynamic behavior in the pit, the number of sampling locations to be monitored and/or the monitoring frequency will be increased.

Field measurements will be collected at 2-meter intervals down to a depth of approximately 20 meters. Thereafter, from 20 meters to the bottom of the pit, measurements will be made every 5 meters. The interface(s) between the high and low conductivity water (chemocline) and higher and lower temperature water (thermocline) will be monitored more extensively (i.e., 1 meter increments). The sampling frequency with depth will be adjusted based on variability of measurements; i.e. sampling may be less frequent if parameters are found to vary less than 5 %.

Based upon the parameter profiles obtained by the Hydrolab, water-quality samples will be collected at various depths (approximately 4 or 6 depths per sampling location) and at a minimum of 3 sampling locations. Specific depths and sampling locations will be determined based on evaluating the results of the initial physical/chemical Hydrolab measurements and the locations of the chemocline and thermocline. The intent is to collect samples above and below each water layer. This intensity of water quality sampling will be performed a total of four times; twice during the initial two sampling events, once during October/November 2001 and once during March/April of 2002. Ferrous iron will be measured at one sampling location at multiple depths (4 or 6 depths).

At other twice per month monitoring events, water quality sampling will include 4 or 6 samples from one location and 2 samples (one near the surface and one at depth) from the other 2 sampling locations. Ferrous iron concentrations will be measured in the field at the sampling location with the 4 or 6 depth samples.

The Hydrolab results will also be used to evaluate the mixing of North Potato Creek with the South Mine Pit at its the influent and effluent and across its surface. At locations SMP1 and SMP4, particular attention will be paid to the upper 15 meters of depth. Hydrolab measurements will be made in the presumed mixing zone, as close to the Pit inlet and outlet as practical.

GSH has identified four locations within the South Mine Pit where boreholes or underground mine works were intercepted by the open pit mining. The Hydrolab will be used to make measurements as close possible to these locations (SMP13 though SMP16) on three occasions; during the initial sampling event, once during October/November 2001 and once during March/ April of 2002.

Water samples will be collected at locations SMP-13 through SMP-16 if the Hydrolab measurements indicate inflow or other anomalies. These water samples will be analysed for the full suite constituents , as described in the section, Periodic Water Quality Sampling.

Estimation of run-on quantity and quality into the pit from the diversion ditches will be made at two locations, SMP-R01 and SMP-R02 (Figure 4.1 of the Work Plan). If these two locations have measurable flow during routine sampling events performed twice a month, grab water-quality samples will be collected and flows will be estimated using the bucket and stopwatch method. Field parameters to be measured include pH, conductivity, Eh, dissolved oxygen, temperature, and ferrous iron. The laboratory analyses to be utilized for the sampling of SMP-RO1 and SMP-RO2 is presented above in Section 5.1, Periodic Water-Quality Monitoring, and on Table 5.1.

5.3 South Mine Pit Water Level Measurement Using Calibrated Benchmarks

Elevation control will be established around the perimeter of the South Mine Pit by the installation of three staff gauges (SMP-SG1 through SMP-SG3) in the water near the pit rim. The elevation of these staffs will be measured to an accuracy of ± 0.01 feet (Figure 4.2 of the Work Plan). All three will be tied to a common benchmark. Concurrent measurements of water levels at these three staffs will be made twice a month under varying conditions of wind speed and direction while other field activities are being conducted.

5.4 Pit Wall-rock Analysis

Exposed pit wall-rock will be characterized by rock type and evaluated using Acid Base Accounting analysis (ABA) (Sobek et al., 1978) and Synthetic Precipitation Leaching Procedure (SPLP) (EPA Method 1312) for chloride, zinc, phosphate (PO_4), sulfate (SO_4) and TAL metals. The number of samples to be analyzed will depend on the variability of the rock type in the pit walls. Approximately five samples will be collected for ABA and SPLP analysis .

5.5 Site-Specific Weather Measurements

Site-specific pan evaporation rates will be determined using an evaporation pan installed at the LMWTP. This equipment will be monitored daily by the water treatment plant operators.

Daily rainfall measurement is occurring at the LMWTP and measurement began in 1998. A meteorological station will be installed near the Copper Basin High School. This rain gauge will be measured on the same schedule already established for the London Mill Wastewater Treatment Plant. Wind speed and direction measurements will be obtained from the meteorological station to be installed at the Copper Basin High School.

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5.6 Water Level Measurement and Water Quality Determination in Wells and Shafts around the South Mine Pit

During this South Mine Pit investigation, GSH will measure mine-water and ground-water levels in boreholes and/or shafts around the South Mine Pit. Preliminary site reconnaissance identified four to six locations where water levels may be available (Figure 4.2 of the Work Plan). To the north-east of the South Mine Pit are the Cherokee and Tennessee mine shafts and N14, to the south-west are S-16 (gravel hole), S-16 (vent), S-17 (waste pass), S-19 (vent raise), and S-21 (vent borehole). A drill hole has been tentatively identified west of the South Mine Pit, its location will be field verified during the sampling activities.

These shafts, vents and bore-holes will be investigated and reopened, if possible, to allow sampling using a water level monitoring probe and water sampling equipment. If field measurements of conductivity are found to vary by greater than 10% between the top and bottom of the accessible water column, two water samples will be collected, one near the surface and a second at lower depth. If a water sample can not be readily obtained, the feature will not be sampled.

A ground-water sample will be obtained from the well at the residence of Mr. Emil Watson. Mine-water samples will also be collected from the selected vents, shafts, and/or drill holes during the initial sampling event, the wet (March 2002) and dry season (October 2001). The laboratory analyses to be utilized for the mine-water samples to be collected is presented above in Section 5.1, Periodic Water-Quality Monitoring, and on Table 5.1.

There is likely stratification in the mine workings and therefore water quality results will only be used for general characteristics and comparison purposes.

Water levels will be measured (± 0.1 feet) quarterly for one year. During the water-level measurement activities, field measurements of pH, conductivity and temperature will also be collected.

6.0 SAMPLING EQUIPMENT AND PROCEDURES

This section provides information relative the sampling activities to be performed. The media to be sampled includes shallow surface water (depths less than three feet), deep surface water (depths greater than three feet, and wall rock.

6.1 Staging, Sampling Devices, and Jars

Prior to any sampling event, the following steps will be taken by personnel responsible for sampling:

- Review sampling locations
- Assemble and inspect field equipment necessary for sample collection, verify that equipment is clean and in proper working order

- Note and replace items that are in short supply or that are showing indications of wear, maintain an adequate supple of spare parts for the sampling equipment

- Calibrate equipment to manufacturer's specifications

- Examine sample shuttles, bottles, and preservatives, contact laboratory immediately if any problems are found

- Confirm sample delivery time and method of sample shipment with the laboratory

- Establish a sampling team consisting of enough trained people to perform the planned sampling event efficiently and without undue haste

- Establish a sampling schedule for the activities of the day

The laboratory shall provide the necessary sample containers. Furthermore, it is also the responsibility of the laboratory for preparing the sample containers so that they comply with applicable container-preparation methods and quality assurance procedures.

It will be the responsibility of the field sampler to properly identify the location of the collection of the sample, the date upon which it was obtained, the type of sample, type of preservative, the name of the sampler, and the appropriate project number. This same information will be placed on the sample identification label, which in turn will be affixed to the sample container. Sample labels will be filled out with indelible ink. If the field sampler determines that additional information is pertinent to the sample being taken, such data will be recorded in the field-sampling log. Likewise, if photographs are taken of the sample location, all relevant information about the photograph will be documented as required in the QAPP.

6.2 Field Measurement Collection

The field measurements, including chemical characteristics, will be collected from shallow surface water and from deep surface water. The collection of field measurements from shallow surface water will be performed in conformance with Standard Operating Procedure – Field Measurable Physical/Chemical Characteristics (Attachment SOP 2).

The collection of field measurements from deep surface water will be collected using a Hydrolab. The standard operating procedures for the Hydrolab are presented in Attachment SOP 3.

6.3 Surface-Water Sample Collection

Surface-water sampling will be conducted in accordance with the Standard Operating Procedure – Surface Water Sampling presented in Attachment 4. The surface-water sampling will include the collection of shallow surface-water samples and deep surface-water samples.

6.3.1 Shallow Surface-Water Sample Collection

The preferred method of shallow surface-water sample collection is direct dipping of the sample container. The sample containers are opened just beneath the surface of the water body and allowed to fill. The surface-water film, if present, should not be included in the sample as it is not representative of the water body. Care will be taken to avoid dilution of the preservatives present in the sampling containers during the sampling process. If the water is too shallow for direct dipping a ziploc bag will be used.

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6.3.2 Deep Surface-Water Sample Collection

Deep surface-water samples will be collected from the South Mine Pit. The deep surface-water samples will be collected with a decontaminated Van Dorn-style sampler or Kemmerer sampler. The samplers are designed to allow the collection of water from discrete sample intervals of a water column. The sample collection shall follow the sequence set forth below:

Sequence	Parameter
1	Volatile Organic Compounds
2	Acid Extractable Organics
3	Base/Neutral Extractable Organics
4	PCBs
5	Metals

6.3.3 Surface-Water Sample Shipping

Immediately after collection, each surface-water sample will be preserved according to the EPA Region 4 protocol. The QAPP provides the sample volume and preservative requirements. The VOA sample bottles will be filled to capacity to prevent any headspace for volatilization. The sample will be placed in a cooler with "freezer-packs" or bags of ice in order to maintain sample integrity. The shipment to the laboratory will be performed using an overnight courier.

6.4 Mine-Water Sampling

Mine-water sampling will be conducted in accordance with the Standard Operating Procedure – Ground Water Sampling presented in Attachment 5. The mine-water sampling will include the collection of water samples from boreholes and/or mine shafts. Due to the volume of the boreholes and shafts, the sample locations will not be purged prior to sampling. Based on the site conditions and the number of samples to be collected from each location, the mine-water samples will be collected with either a discrete sampler or a bailer.

The sample collection shall follow the sequence set forth below:

Sequence	Parameter
1	Volatile Organic Compounds
2	Acid Extractable Organics
3	Base/Neutral Extractable Organics
4	PCBs
5	Metals

Immediately after collection, each water sample will be preserved according to the EPA Region 4 protocol. The QAPP provides the sample volume and preservative requirements. The VOA sample bottles will be filled to capacity to prevent any headspace for volatilization. The sample will be placed in a cooler with "freezer-packs" or bags of ice in order to maintain sample integrity. The shipment to the laboratory will be performed using an overnight courier.

6.5 Wall-Rock Sampling

Wall rock samples will be collected from approximately five locations from within the South Mine Pit. Initially, the rock walls above the water surface of the South Mine Pit will be evaluated, and five wall rock samples will be collected from representative sample locations. The wall rock samples will be collected using hand tools. Care will be exercised not to collect samples in areas with overhanging rock or apparent unstable wall conditions.

Immediately after collection, each wall-rock sample will be placed in a cooler with "freezer-packs" or bags of ice in order to maintain sample integrity. The shipment to the laboratory will be performed using an overnight courier.