WORK PLAN

COKE OVEN AREA SPECIAL STUDY AREA DUAL PHASE INTERIM MEASURES: SVE, AIR SPARGING, AND GROUNDWATER PUMPING PHASE I (PILOT TESTING)

SEVERSTAL SPARROWS POINT, LLC
SPARROWS POINT, MARYLAND

Prepared for:

Severstal Sparrows Point, LLC
Sparrows Point, Maryland

In accordance with:

United States of America and State of Maryland Department of the Environment v. Bethlehem Steel Corporation; Docket No. JFM-97-558 & JFM-97-559

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URS

1.0 INTRODUCTION

This document is the revised work plan to implement Phase 1 (P1) of interim measures (IM) intended to recover former Coke Oven Area (COA) byproducts in groundwater and the vadose zone at the Coke Oven Area (COA) of the Severstal Sparrows Point Facility (Severstal). This P1 IM WP describes the planned procedures to implement a pilot scale Soil Vapor Extraction/Air Sparging/Groundwater Pumping (Dual-Phase) system at the COA, intended to recover COA groundwater and vadose zone contamination and provide design information for a larger scale Dual-Phase system. Figure 1 illustrates the location of the COA.

This P1 IM WP complies with the requirement specified in the United States Environmental Protection Agency (USEPA) letters (dated February 19 and June 17, 2009) requesting Severstal to submit to USEPA a work plan to implement interim measures to recover hydrocarbon product in the COA. The June 17, 2009 USEPA letter offered comments on Severstal's April 20, 2009 Work Plan, and required Severstal to add a groundwater pumping component (i.e., Dual-Phase) to the IM pilot-scale testing at both the Former Benzene Processing Plant Area and the Former Coal Tar Storage Area, which are addressed in this revised P1 IM WP.

1.1 OBJECTIVES

The overall objective of this P1 IM WP is to assess the site-specific applicability of the subject technologies to reduce contamination at the subject sites, to provide design information for subsequent IM Phase(s), and to remove contamination to encourage protection of human health and the environment. Specifically, this P1 IM WP describes a Pilot Test that is intended to:

1. Evaluate the potential effectiveness of Dual-Phase technologies for removing and destroying benzene and naphthalene mass from the unsaturated zone and shallow groundwater,
2. Conduct groundwater pumping to test the effects that groundwater extraction has on: a) optimizing heavy fraction hydrocarbon removal, b) mitigating groundwater

elevation increases at the SVE extraction well to optimize extraction well efficiency (e.g., maintain/increase the vadose zone thickness to enhance vapor recovery), and c) lowering the groundwater table elevation at the pilot test area, thus influencing shallow groundwater migration,

3. Develop criteria for expanded-scale IM application of the technology(ies) that demonstrate the most potential effectiveness.

In addition, other technologies, including thermal enhanced recovery and enhanced microbial degradation via introduction of co-metabolites and enhancing redox conditions will be evaluated by desktop analysis to determine their potential application for Interim Measures in the impacted area.

1.2 DESCRIPTION OF SITE AND P1 IM DUAL-PHASE PILOT TEST AREAS

The COA is located at the southwestern portion of the Sparrows Point peninsula. This area is made land comprised of slag placed over the natural sediments comprised of: 1) recent fluvial sediments deposited by Bear Creek/Patapsco River, and 2) the underlying Talbot Formation.

The the uppermost hydrostratigraphic unit occurs within slag fill (Slag-Fill Unit) at the COA An unconfined water table zone occurs within the Slag-Fill Unit at a depth on the order of 10 feet below ground surface. In some COA areas, the Slag-Fill Unit is directly underlain by and connected to the coarser grained beds or lenses within the Talbot Formation that comprise the Upper Talbot Channel Unit. In these areas, the Slag-Fill and Upper Talbot Channel Units form a single groundwater flow system. Throughout much of the COA, the Slag-Fill unit is underlain by finer-grained silts and clays that minimize downward flow of groundwater from the Slag-Fill Unit. In these areas, groundwater flow in the Slag-Fill Unit is separated from groundwater flow in any underlying coarse-grained beds or lenses. Shallow groundwater movement at the COA generally is radial toward surrounding surface water bodies.

COA groundwater analytical results indicate that VOCs and SVOCs (predominately benzene and naphthalene) have impacted groundwater. The areal extent of the VOCs and SVOCs is confined to the southwestern fill portion of the Sparrows Point peninsula and have not migrated to the area north of the COA. The maximum VOC concentrations (predominately benzene) are located at the northwest portion of the COA. Groundwater with elevated VOCs has migrated toward the southwest and northwest of the Coke Oven Special Study Area (SSA) and is present at the shoreline. The SVOC concentrations (predominately naphthalene) are more evenly distributed, and the maximum concentrations are located on the eastern half of the Coke Oven SSA near the Former Coal Tar Storage Area. VOC and SVOC concentrations decrease to below their respective reporting limits or exhibit a significant decreasing trend toward the laboratory reporting limits in all samples collected from piezometers completed in groundwater zones at depths of approximately 80 to 100 feet in depth.

Figure 2 shows the general planned location of the P1 Dual Phase Pilot System test areas within the COA. These locations and the basis for their selection are described below.

1.2.1 Northwest Corner of COA – Former Benzene Processing Plant Area

As shown on Figure 2**,** shallow groundwater benzene and naphthalene concentrations are elevated in this area (i.e., 1,300 mg/L benzene and 0.19 mg/l naphthalene in well CO18). These data suggest that the P1 Dual-Phase pilot system could recover benzene and naphthalene vapor mass from the unsaturated zone and groundwater, and provide sufficient information to design the future larger scale system.

1.2.1 Northeast Corner of COA – Former Coal Tar Storage Area

Figure 2 shows an elevated shallow groundwater naphthalene concentration (22 mg/L) and lesser benzene concentration (<1 mg/L) in well CO-13. Accordingly, the area around well CO-13 was selected for evaluation of the Dual-Phase technology's capability to recover naphthalene mass in both the groundwater and soil gas.

2.0 P1 IM DUAL PHASE PILOT TEST INVESTIGATION PROGRAM

This section describes activities to collect and evaluate further site-specific information pertaining to IM Dual-Phase Pilot Test technologies. The discussion focuses on benzene in the Former Benzene/Litol Processing Plant Area because the benzene concentrations greatly exceed the naphthalene concentrations. Conversely, the technology discussion focuses on naphthalene in the Former Coal Tar Storage Area because the naphthalene concentration in groundwater exceeds the benzene concentration in this area.

Equipment mobilized to the Site for implementing the Phase 1 IM Pilot Tests will include:

- Trailer-mounted ICE unit (see Appendix A for typical specifications),
- Portable gasoline or diesel-powered air compressor to supply sparge air,
- Two portable “Frac” tanks (21,000 gallon capacity each, typ.),
- Propane tank for ICE supplemental fuel, and
- Various ancillary equipment necessary to support the Phase 1 IM Pilot Tests, including soil gas sampling equipment, gasoline-powered generator and submersible pump/hoses/valves/flow meters, field instruments (PID, FID, water level meter, etc.), PPE necessary for compliance with project health and safety plan (Appendix B) requirements, and other miscellaneous equipment.

2.1 Phase 1 IM Pilot Test Procedures (common to both Pilot Tests)

P1 IM Pilot Test procedures are described in the following paragraphs. Field conditions may dictate variations in these anticipated procedures, but in general, these procedures will be followed:

- Field-check all equipment for proper operation including the ICE unit, AS air compressor, generator and submersible pumps, field instruments for measuring total volatile organic constituents (VOCs) in air, and communication connections, as appropriate,
- Install the submersible pump and electronic water level indicator in well EXT-1 (see Figure 3) or well EXT-2 (see Figure 5), connect piping, flow meter, hoses, etc. to route pumped groundwater to the Frac tanks,

- Connect the trailer-mounted ICE unit to extract soil gas from EXT-1 and EXT-2 for a period of up to four days, operating the ICE 24-hours per day. While the ICE unit is equipped with automatic data logging of critical operating parameters, selected readings (e.g., soil gas flow rate, inlet vacuum pressure, etc.) will be recorded manually in the project log book,
- Operate the submersible pump as necessary to maintain the water level in the extraction well (proposed well EXT-1: Figure 3 or well EXT-2: Figure 5) at or below the original static water level before the test start. A maximum pumping rate of 10 gallons per minute (gpm) is planned because of limitations on water storage/transfer/treatment capacity. Groundwater flow rates will be observed and recorded in the project log book. Two groundwater samples will be collected; one shortly after Pilot Test startup and one near the end of the Pilot Test. Each sample will be submitted for laboratory analysis for TCL VOCs and TCL SVOCs. The vapor chemistry results will be compared to the groundwater chemistry results to assess achievable rates of light and heavy hydrocarbon fraction removal by vapor extraction versus groundwater extaction, with the intent of assessing the effectiveness of dual phase extraction versus SVE.
- Measure vacuum pressure and water level in the extraction well and in all six observations wells at intervals frequent enough to establish a vacuum pressure radius of influence (ROI). The observation wells will be vented to atmosphere when collecting water level readings,
- Collect samples of untreated soil gas (up to six for each Pilot Test plus one ICE exhaust gas sample) for laboratory analysis by EPA Method TO-15 + methane and EPA Method TO-13A for naphthalene to evaluate soil gas composition and confirm ICE/catalyst benzene destruction performance. Because of the high benzene concentrations anticipated in the untreated Former Benzene Processing Plant soil gas, samples must be collected in Tedlar bags for the TO-15 + methane analyses. Method TO-13A requires the sample be collected using a polyurethane foam (PUF) cartridge. ICE exhaust gas samples will be collected in Summa cans for the TO-15 analysis, which should be able to quantify naphthalene at the anticipated low concentrations,

- Measure soil gas flow rate through the ICE, which will be used to calculate benzene and naphthalene removal rate (expressed in pounds per day),
- Condensate production during SVE operation will depend on ambient temperature conditions at the time the test is performed; the colder the air temperature, the more condensate may be produced. As shown on Figure 4, condensate will be transferred to the Frac tanks for treatment/disposal along with the groundwater,
- The AS component of the Pilot Test will be initiated depending on field-measured responses to vacuum pressures, soil gas concentrations, and other performance factors. Typically, the AS component would be activated when soil gas total VOC concentrations (field instrument measurement) decrease to a steady-state or asymptotic level. However, if no significant decrease in soil gas total VOC concentration is observed after two full days of SVE operation, the AS system will be activated, regardless of the potential lack of asymptotic VOC concentrations, to observe possible changes in soil gas total VOC concentration. If an increase in total soil gas VOC concentration is observed after AS startup, the AS system will be operated until a decrease in soil gas total VOC concentration is observed or for one full day, whichever occurs first. The AS operation will be terminated before the end of each Pilot Test (typically on the fourth day of operation) to observe any effects on soil gas total VOC concentration,
- Connect the air compressor to well AS-1 (Figure 3) or well AS-2 (Figure 5) and operate as necessary to provide the desired subsurface response (as described above) for the AS component of the Pilot Tests. Compressed air flow rates and pressures will be increased slowly until the “breakout” pressure and flow is achieved (that at which flow is initiated into the formation) and will be increased gradually until a maximum practical flow is achieved,
- Measure and record sparge air injection pressure and flow rate at the AS well and observe vacuum pressure responses in the observation wells and total VOC concentrations in the extracted soil gas (via field instruments and ICE response to possible changes in VOC concentrations) while continuously operating the SVE unit,

- Collect samples as necessary for characterization of Pilot Test waste materials (soil and water) and ship the samples to the appropriate laboratories for analysis,
- Upon completion of the Pilot Tests, demobilize all equipment and secure the Pilot Test wells by installing caps/plugs.

2.2 Procedures at Former Benzene/Litol Processing Area

2.2.1 General Considerations

Based on the 1,300 mg/L groundwater benzene concentration at well CO18 (Figure 2), an equilibrium soil gas benzene vapor concentration of 8.9% (89,000 ppmv) is estimated. Percentage concentrations of benzene in soil gas are unsafe to treat with granular activated carbon (GAC) prior to discharge to atmosphere because of excessive heat generated during the exothermic GAC adsorption reactions. Several methods for extracting and treating the benzene-laden soil gas are possible:

1. Thermal oxidizer (propane-fired) with integral regenerative blower for soil gas extraction,
2. Catalytic oxidizer (either electrically heated or propane-fired) with integral regenerative blower for soil gas extraction, or
3. Specially equipped, propane-fueled internal combustion engine (ICE) equipped with catalytic converter.

Of these methods, the ICE applies best for pilot testing of the Site-specific conditions because:

- No electric power is required, as it is for both thermal and catalytic oxidizers (methods 1 and 2 above).
- The ICE system utilizes engine intake vacuum (up to 20 inches Hg) to extract soil gas from the well, whereas the oxidizers are normally equipped with regenerative blowers that can typically develop less than 10 inches Hg vacuum pressure. The higher vacuum pressure developed by the ICE allows for vapor extraction from “tighter” formations,

- The benzene concentrations anticipated may be too great for catalytic oxidizers to treat without excessive dilution air to prevent overheating (typical maximum operating temperature around 600° C).

Therefore, a propane-fueled ICE specifically designed for such applications and equipped with an exhaust catalytic converter will be used for off-gas treatment.

The static water level (SWL) is approximately 2 ft above msl (i.e., 10 ft below grade) in the Former Benzene Processing Plant Pilot Test area. Based on well CO18 construction information, approximately 2 ft of screen in well CO18 is open above the SWL; suggesting well CO18 (2-in. diameter) can be used as a vacuum pressure and water level observation well during the Pilot Test.

URS will submit a letter of determination request to the Maryland Department of the Environment (MDE) to request an exemption for an air discharge permit for the Phase 1 IM Pilot Tests using an ICE system.

2.2.2 Preparation for Former Benzene/Litol Processing Plant Area Pilot Test

Preparation includes installing additional test wells and mobilizing the necessary equipment to perform the Pilot Test.

Additional test wells are necessary to evaluate the Dual-Phase effectiveness and at least one AS well is necessary to evaluate the AS technology. Seven test wells (one SVE/groundwater-recovery well, five SVE/water level observation wells, and one AS well) will be installed in the area of existing well CO18 generally configured as shown on Figure 3. Well CO18 will be utilized as an observation well for measuring vacuum pressure/water level/AS response from extraction at proposed well EXT-1 and /or AS-1 (Figure 3).

Although free LNAPL has not been observed in monitoring wells specifically in the Benzene/Litol Processing Area, the groundwater benzene concentrations suggest its possible presence. Possibly NAPL may occur as non-recoverable free benzene bound within the formation matrix. In order to evaluate whether NAPL is present in the formation materials, the following actions are planned:

- Perform continuous split-spoon sampling during installation of the AS well (AS-1 on Figure 3) and collect an estimated thirteen soil samples for subsequent analysis,
- Submit each soil sample for analysis to a qualified laboratory for benzene by Method SW846-8260 and free benzene liquid.

Soil (slag) cuttings resulting from test well installation will be containerized in appropriate drums, characterized as necessary for offsite disposal. Similarly, any water produced by the drilling operations and well development, will be containerized and sampled/characterized for offsite disposal. Condensate from SVE operation and groundwater withdrawn from the SVE/groundwater recovery well (EXT-1 on Figure 3) will be transferred to portable "Frac" tanks and subsequently transported offsite for proper treatment and disposal.

The additional test wells will be installed using drilling techniques appropriate for the slag fill material present in the Pilot Test area. Test wells will be installed with screened intervals located at or just above the slag-marsh deposit interface (i.e., typically 20-25 ft total depth bgs). The AS test well will be installed within the saturated slag fill zone and equipped with a short (i.e., 2-ft) screen interval approximately 20-25 ft bgs. Figure 4 depicts a typical schematic sectional diagram of the Phase 1 IM Pilot Test wells and equipment layout.

2.3 Former Coal Tar Storage Area Pilot Test

2.3.1 General Considerations

Considerations for the Former Coal Tar Storage Area Pilot Test are essentially identical to those for the Former Benzene Processing Area Plant, as described in Section 2.2

above. Based on the 22 mg/L groundwater naphthalene concentration at well CO13 (Figure 2), an equilibrium soil gas naphthalene concentration of 80 ppmv is estimated (based on the groundwater concentration only, not including any naphthalene present in the unsaturated slag zone. This soil gas naphthalene concentration could result in removal of between 2 and 4 pounds of naphthalene per day in the soil gas stream, depending on the soil gas flow rate through the ICE. By comparison, pumping the groundwater containing 22 mg/L naphthalene at an assumed rate of 10 gallons per minute (gpm) would remove approximately 2 to 3 pounds per day.

2.3.1 Preparation

Seven test wells (one SVE/groundwater-recovery well, five SVE/water level observation wells, and one AS well) will be installed in the area of existing well CO13 generally configured as shown on Figure 5. Well CO13 will be utilized as an observation well for measuring vacuum pressure/water level/AS response from extraction at proposed well EXT-2 and /or AS-2 (Figure 5).

DNAPL has been observed in well CO-13 and the groundwater naphthalene concentrations suggest its presence. Possibly DNAPL may occur as non-recoverable free coal tar bound within the formation matrix. In order to evaluate whether DNAPL is present in the formation materials, the following actions are planned:

- Perform continuous split-spoon sampling during installation of the AS well (AS-2 on Figure 5) and collect an estimated thirteen soil samples for subsequent analysis,
- Submit each soil sample for analysis to a qualified laboratory for total semi-volatiles by Method SW846-8270 and free coal tar residual.

Equipment will be relocated to the Former Coal Tar Storage Area upon completion of the Former Benzene/Litol Processing Plant Area Pilot Test.

2.4 Data Evaluation and Reporting

Data collected from the Phase 1 IM Pilot Tests will be evaluated using commonly accepted procedures in the industry. A written report summarizing the Pilot Test results will be prepared that will contain sufficient text, tables, and figures to:

- Describe the Phase 1 IM Pilot Test procedures and results,
- Estimate a radius of influence (ROI) for the SVE, AS, and groundwater pumping components,
- Estimate the benzene and naphthalene removal rate, expressed in pounds per 24-hour day,
- If warranted by the Pilot Test results, provide a conceptual design to expand and operate a full-scale SVE/AS or dual phase system as part of the IM effort.

3.0 PROJECT SCHEDULE

The Phase 1 IM SVE/AS Pilot Test project implementation schedule is summarized as follows:

Receive Work Plan Approval:	
Contractor Selection and award	4-6 weeks
Phase 1 Work Plan Field Work	4 weeks
Evaluate Data and Prepare Report	10 weeks

The implementation schedule will depend on Severstal scheduling requirements, driller availability for well installation, and determination of air permitting requirements.

Figure 1

Locations of Wells
Coke Oven Area/Coke Point Landfill
Sparrows Point, MD

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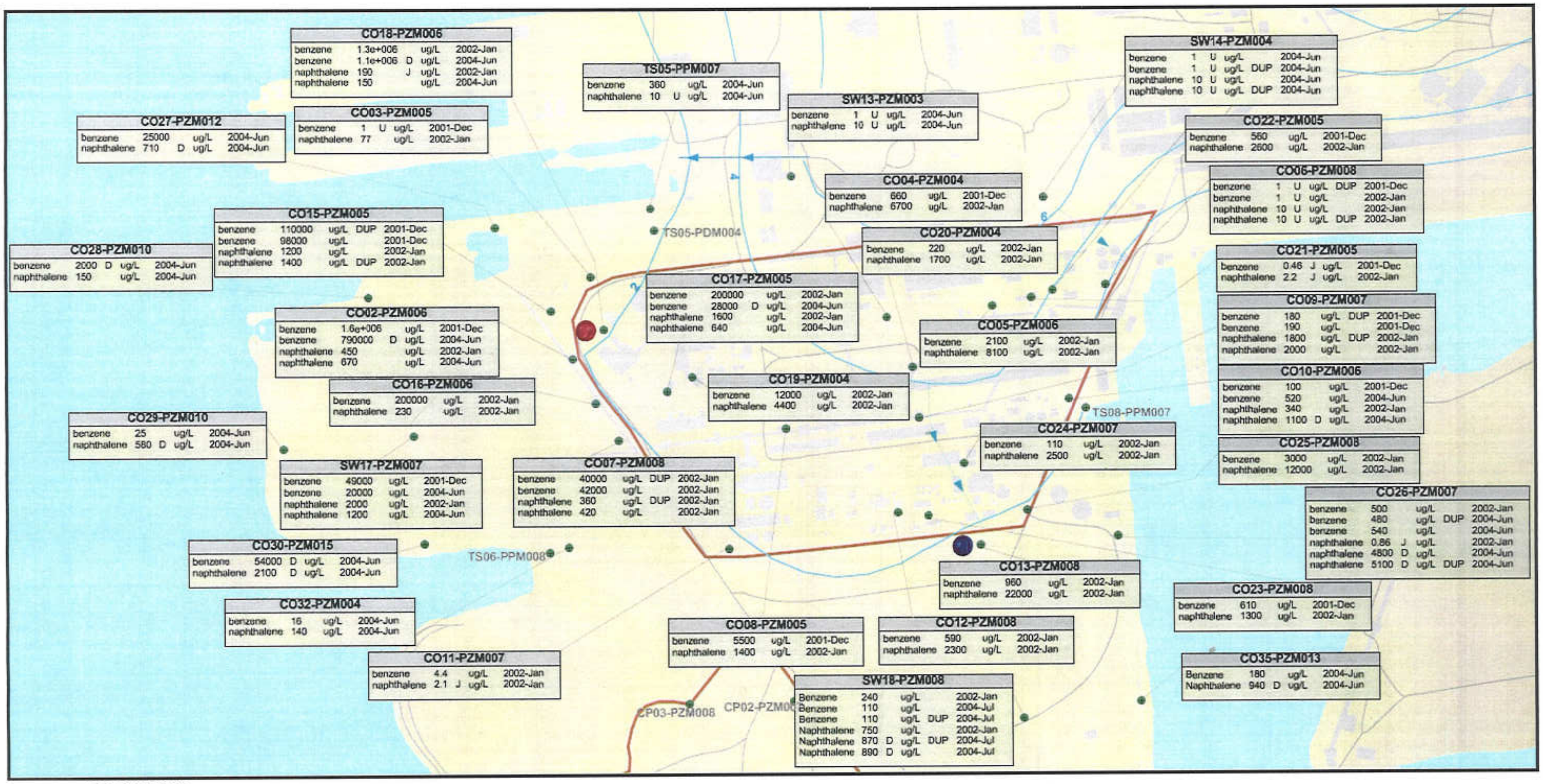
Figure 2

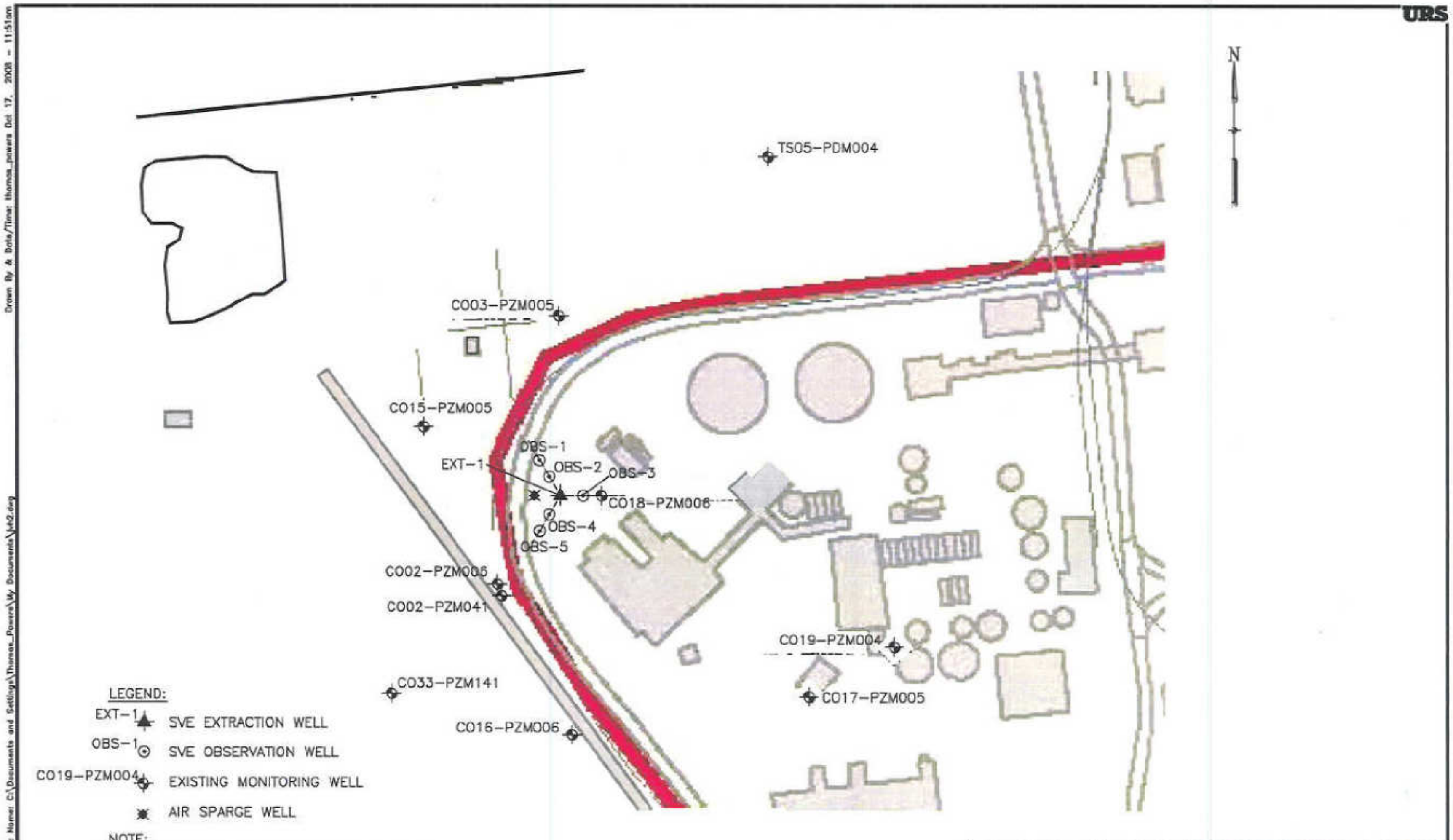
Planned Dual Phase Pilot Test System Locations
Sparrows Point Former Coke Oven Area



LEGEND

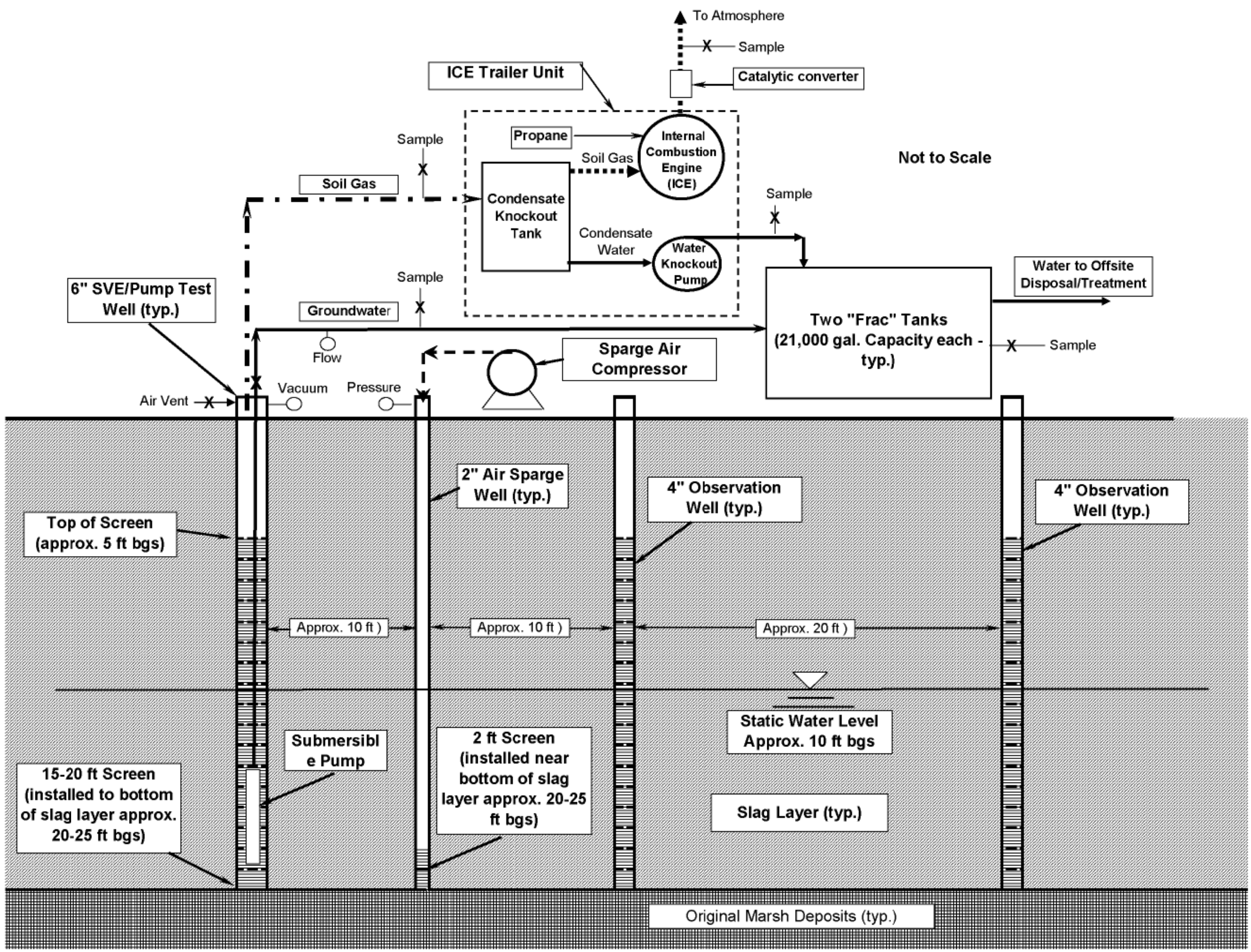
1st System Focused on the Benzene Area:

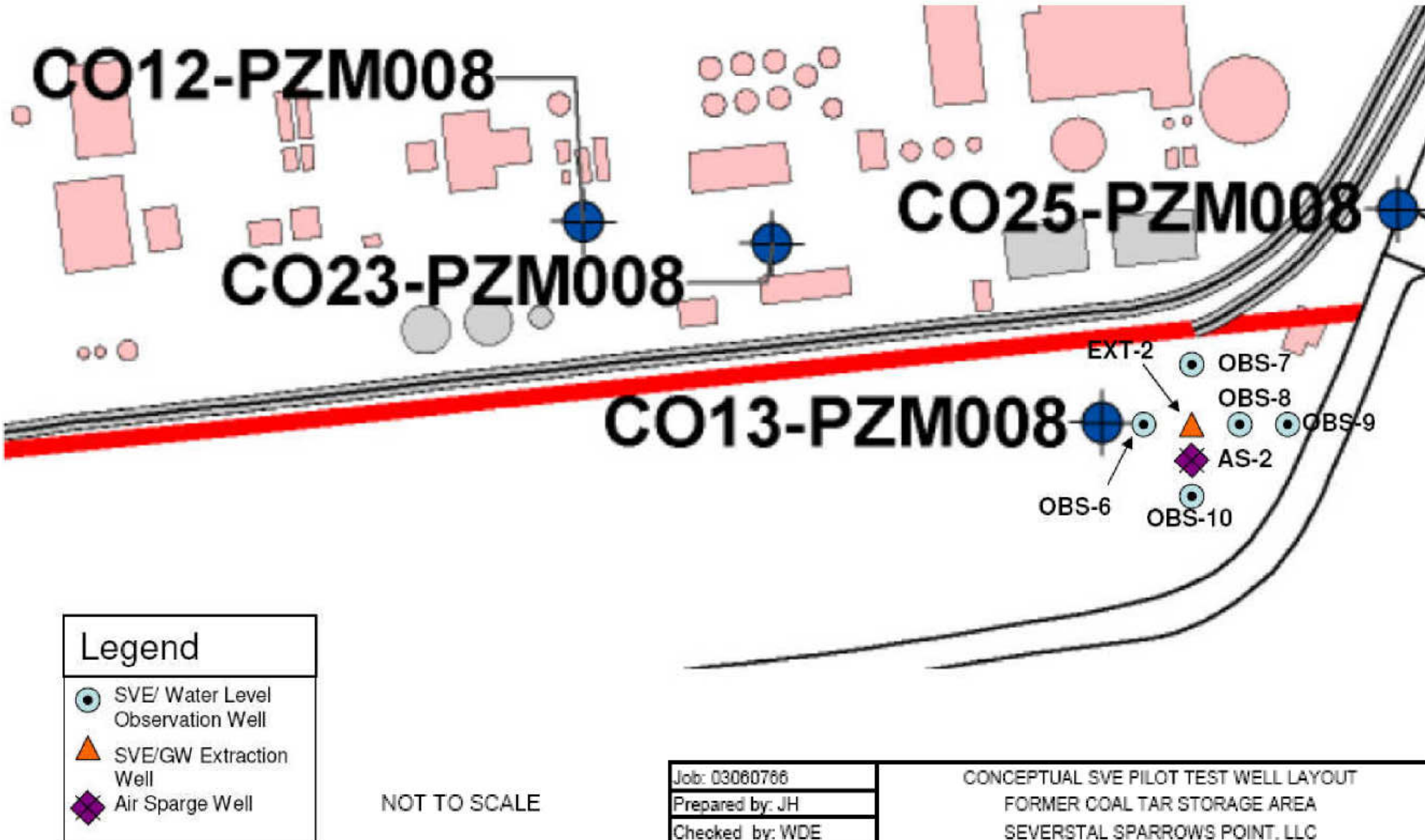
2nd System Focused on the Naphthalene Area:



Job: 03060766	CONCEPTUAL SVE PILOT TEST WELL LAYOUT COKE OVEN AREA SEVERSTAL SPARROWS POINT, LLC
Prepared by: TFP	
Checked by:	Figure 3
Date: 10/17/2008	

Figure 4
Schematic of Pilot Test Systems
Former Coke Oven Area
Severstal Sparrows Point, LLC





NOT TO SCALE

Job: 03060766	CONCEPTUAL SVE PILOT TEST WELL LAYOUT
Prepared by: JH	FORMER COAL TAR STORAGE AREA
Checked by: WDE	SEVERSTAL SPARROWS POINT, LLC
Date 6/7/2009	FIGURE 5

APPENDIX A

RSI Model V3 Base Unit

REMEDIATION SERVICE, INT'L
"Technology in Support of the Envrionment"

Remediation Service, Int'l (RSI)
4835 Colt. St., Unit D · Ventura, CA 93003 · USA
Tel +1 805 644 8382 · Fax +1 805 644 8378
E-mail: info@rsi-save.com Web: http://www.rsi-save.com

Model V3 Base Unit

Model V3 Base Unit

System Specifications

- Up to 30 lbs/hr hydrocarbon destruction rate
- Engine - power source/compressive thermal oxidizer
- Catalytic converter
- Miscellaneous engine gauges with safety shutdown
- Moisture knockout tank with air particulate filter (one gallon capacity)
- Oil reservoir system
- Automatic Fire Suppression System
- Hot Air Ducts/additional noise reduction
- Natural gas control solenoid valve and propane regulator
- Noise abatement housing/cabinetery
- Single or dual Axle Trailer Optional

APPENDIX B

Health & Safety Plan
(presented as a separate document)

COKE OVEN AREA SPECIAL STUDY AREA INTERIM MEASURES WORK PLAN

HEALTH AND SAFETY PLAN

SEVERSTAL SPARROWS POINT, LLC
SPARROWS POINT, MARYLAND

Prepared for:

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