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Work Plan

In Situ Thermal Remediation
(Electrical Resistance Heating)
Pemaco Superfund Site
Maywood, California 90270

Prepared by

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Abbreviations and Acronyms

AST	Above Ground Storage Tank
bgs	Below Ground Surface
BTU	British Thermal Unit
COC	Contaminant of Concern
CPVC	Chlorinated Polyvinyl Chloride
°C	Degrees Celsius
°F	Degrees Fahrenheit
EC/WMP	Environmental Compliance/Waste Management Plan
ERH	Electrical Resistance Heating
FTO	Flameless Thermal Oxidizer
gpm	Gallons per Minute
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
In. Hg.	Inches of Mercury
kW	Kilowatt
kW-hr	Kilowatt Hour
MPE	Multi-Phase Extraction
OSHA	Occupational Safety and Health Administration
PCU	Power Control Unit
psi	Pounds per Square Inch
QAQCP	Quality Assurance/Quality Control Plan
SAP	Sampling and Analysis Plan
scfm	Standard Cubic Feet per Minute
SVE	Soil Vapor Extraction
TCE	Trichloroethene
TMP	Temperature Monitoring Point
TN&A	TN & Associates, Inc.
TRS	Thermal Remediation Services
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
V	Volts
VMP	Vacuum Monitoring Point
VOCs	Volatile Organic Compounds
VR	Vapor Recovery

1.0 INTRODUCTION

This Work Plan describes the technical approach Thermal Remediation Services, Inc. (TRS) and the project team members will implement for the Electrical Resistance Heating (ERH) portion of subsurface source area remediation at the Pemaco Superfund Site in Maywood, California. Subsurface source area remediation using ERH will focus on the removal of Volatile Organic Compounds (VOCs) from the depth interval of 35 to 95 feet below grade surface (bgs).

This remediation work is being conducted for the United States Environmental Protection Agency (USEPA) under Contract Number DACW45-01-D-0007-0002: Subcontract Number SC-2002191-4035. The ERH project at the Pemaco Superfund Site is being conducted under the specifications of a performance-based contract and, as such, this Work Plan provides the necessary plans to construct, install, operate, and monitor all aspects of the ERH system for this project. The plan will also be used to help determine if performance criteria have been met in accordance with the specifications outlined in Subcontract SC-2002191-4035.

ERH will be the main component of the thermal remediation system for the VOC source area at the Pemaco Superfund Site. The ERH portion of the project will be a complex and dynamic process. As such, this Work Plan and all of the supporting plans are viable documents that have been written to provide a basis for the construction, operation, and monitoring of the remediation system.

This Work Plan addresses heating and contaminant removal from the subsurface VOC source area at the Pemaco Superfund Site. The project team will work together to implement changes in project protocol as the ERH remediation effort progresses. It is quite possible that sampling and monitoring procedures and locations will change over the course of the project.

Project performance information will be collected daily, weekly and monthly. TRS and TN & Associates, Inc. (TN&A) will use this information to determine if the project is meeting contract specifications, and as a platform to determine if changes to the protocols provided in the Work Plan could maximize the efficiency of field operations and remediation system monitoring.

2.0 PROJECT DESCRIPTION

2.1 Site Description

The Pemaco Superfund Site is located at 5050 East Slauson Boulevard in the City of Maywood, Los Angeles County, California. The site occupies approximately 1.7 acres of land located in a mixed industrial and residential neighborhood. The Pemaco Superfund Site property is currently owned by the City of Maywood where the City plans to build a 7.3-acre public recreational park. Figure 1, provides an overview of the project site in relationship to the surrounding community.

The ERH portion of the VOC source area at the Pemaco Superfund Site is comprised of the following lithology:

- Near surface soil consisting of non-native silty and clayey sand.
- The upper vadose zone extends from beneath the site fill to approximately to 40 feet bgs. From 2 to 30 feet bgs it consists of clay and silt lenses. A laterally continuous clay interval that ranges from 1 to 10 feet thick is found between 30 to 40 feet bgs. Where it is thick, this perching clay interval has local saturated silty sand intervals within it. The bottom of the upper vadose zone is at the base of this perching clay lens.
- An upper vadose perched zone occurs in lenses of poorly graded sand, silty sand, and sandy silt, which lie on top of the perching clay and are locally overlain by finer-grained units. These saturated lenses are located at different depths ranging from 20 and 40 feet bgs and range from 5 inches to 5 feet thick. Measurements of depths to groundwater in the perched zone range from 18.48 to 39.31 feet bgs. Groundwater fluctuations of greater than 5 ft have been observed since groundwater monitoring began.
- The lower vadose zone extends from approximately 35 to 65 feet bgs and consists of interbedded clayey silts, silty clays, silty sands and sands. An unsaturated sand interval is encountered between 40 and 50 feet bgs. This lower vadose zone sand varies from 1 to 14 feet thick and is consists predominantly of fine to medium grained sands and gravelly sands. The sand appears to be continuous throughout. The interval between 50 and 65 feet bgs is generally fine grained (silts/clays) with thin local silty sand lenses.
- The ‘A’ groundwater zone is found between 65 and 80 feet bgs and is comprised of fine silty sand and poorly graded sands locally interbedded with well-graded sands.
- The ‘B’ groundwater zone is typically found between 80 and 90 feet bgs and is comprised of fine silty sands, poorly graded sands and poorly graded sands with silt ranging from 1.5 to 10 feet thick.

2.2 General Site History

From 1950 to 1991, the site was operated as a custom chemical blender. A wide variety of chemicals were used on site including chlorinated and aromatic solvents, flammable liquids, oils, and specially chemicals. These chemicals were stored in drums, above ground storage tanks (ASTs), and underground storage tanks (USTs). The previous owner abandoned the site in 1991. Between 1992 and 1998 the stored chemicals, drums, ASTs, and USTs that remained on site were removed by the USEPA.

Several environmental investigations performed between 1990 and 1999 concluded that contaminants fond in soil and impacts to groundwater quality were the result of the blending and storage of chemicals at the site. A soil vapor extraction (SVE) system was installed at the site as an interim remediation measure in 1998 and was operated until 1999, when it was shut down due to community concerns with emissions from the thermal oxidation unit used to treat the extracted vapors. The USEPA enlisted the site into the Superfund Program in 1999.

2.3 Project Overview

The *in-situ* thermal remediation portion of the Pemaco Superfund Site remediation project will employ ERH. The project will be completed by a multidisciplinary team of remediation experts from two companies, TN&A as the prime contractor and TRS serving as the ERH application subcontractor. The construction and installation process for the project is slated to begin in late 2005. Once operational, reports regarding sample and process monitoring data information collected from sampling and process monitoring will be used to modify and optimize the efficiency of the ERH remediation process.

The ERH portion of the Pemaco Superfund Site remediation is being designed and implemented to achieve the specification requirements set forth in TN&A Contract No. SC-2002191-4035:

1. Establish, maintain, and verify subsurface temperatures of 90ºC throughout 90% or more of the remediation area and from 35 ft. to 95 ft. bgs for a minimum of 60 days.

2. Comply with local, State, and federal regulatory requirements,

3. Minimize the time to implement the remedy,

4. Provide the required level of performance monitoring, compliance monitoring, and reporting.

2.4 Treatment Area

The ERH remediation area covers approximately 13,000 square feet at the surface and extends vertically from 35 feet to approximately 95 ft. bgs. The approximate total ERH treatment volume is 29,000 cubic yards.

2.5 Technical Approach

Based on the information presented in Section 2.3, the Project Team developed a design remedy employing ERH integrated with a high vacuum multi-phase extraction (MPE) system, a SVE system, and a groundwater extraction system, a groundwater treatment system, and an air treatment system. The ERH system will be installed and operated by TRS, while all components of the MPE, SVE, groundwater extraction, water treatment, and vapor treatment systems will be installed and operated by TN&A.

In order to successfully complete the ERH portion of the project, those systems installed and operated by TN&A must meet the minimum requirements presented in this Work Plan. In addition, downtime of the TN&A installed and operated system will have a direct impact on schedule, efficiency, and power input of the ERH system.

The ERH design was developed by TRS to provide sufficient remedy criteria for the VOC source area. Table 1 provides the general ERH design parameters for the area of concern at the Pemaco Superfund Site to be treated by subsurface heating.

Table 1: General ERH Design Parameters

Criterion	Treatment Area
ERH Treatment Area	13,000 square feet
Shallow Extent of ERH	35 feet
Deep Extent of ERH	95 feet
Average Depth to Groundwater	60 feet
Approximate Treatment Volume	29,000 cubic yards
Soil Organic Carbon Content	<1%
Number of Electrodes	55
Distance Between Electrodes	17 feet
Total Depth of Electrodes	100 feet
Depth to Top of Electrodes	37 feet
Number of Temperature Monitoring Points Total Number of Subsurface Thermocouples	30 450
Number of Vapor Recovery Wells	73
Piping and Well Installation	Above grade
Vapor Recovery Air Flow Rate	540 scfm
Vapor Extraction Blower	Installed and Operated by TN&A
Vapor Treatment Method	Flameless Thermal Oxidizer (FTO) Installed and Operated by TN&A
Controlling Contaminant	Trichloroethene (TCE)
Maximum Expected Temperature	100°C
Estimated Electrical Heating Power Input	1400 kilowatt (kW)
Estimated Days to Heat-Up Treatment Volume	73
Estimated Heat-Up Energy	2,439,000 kilowatt-hour (kW-hr)
Estimated 30 Day Boiling Energy	1,003,000 kW-hr

2.6 Conceptual Site Model

Site geology at the Pemaco Superfund Site consists of non-native silty and clayey sand fill to a depth of 2 feet bgs, an upper vadose zone of clay and silt lenses extending from 2 to 30 or 40 ft. bgs, and a lower vadose zone of interbedded clayey silts, silty clays, silty sands and sands located at 35 to 65 ft. bgs. A perched zone occurs in lenses of poorly graded sand, silty sand, and sandy silt, which lie on top of a perching clay lens marking the bottom of the upper vadose zone. and are locally overlain by finer-grained units. These saturated lenses are located at different depths ranging from 20 and 40 feet bgs and range from 5 inches to 5 feet thick.

The ‘A’ groundwater zone is found between 65 and 75 feet bgs and is comprised of fine silty sand and poorly graded sands locally interbedded with well-graded sands. The ‘B’ groundwater zone is typically found between 80 and 90 feet bgs and is comprised of fine silty sands, poorly graded sands and poorly graded sands with silt ranging from 1.5 to 10 feet thick.

Groundwater is encountered at approximately 60 feet bgs. Contaminants of concern (COCs) are known to exist in both vadose zone soil and the groundwater zones.

Detailed descriptions of the regional and site geology, as well as a conceptual site model for the Pemaco Superfund Site are provided in the Final Feasibility Study Report prepared by TN&A dated June 10, 2004.

2.7 Regulatory Requirements

During construction, installation, and operations of the ERH system components and the supporting extraction and treatment systems, Occupational Safety and Health Administration (OSHA) regulations will be implemented to provide guidelines and protocols for a safe working environment. Special protocols have been developed to address safety issues pertaining to the electricity and steam present during the ERH project. The safety protocols and guidelines are provided in the Health and Safety Plan (HASP) for this project. The HASP, due to its size, is presented as a separate document.

Additionally, the TN&A installed and operated supporting extraction and treatment systems will have to meet the substantive requirements of local, state, and federal regulations for noise and contaminant discharge.

3.0 TREATMENT TECHNOLOGY DESCRIPTION AND SYSTEM DESIGN

3.1 Electrical Resistance Heating

ERH is an electrical technology that uses *in-situ* resistance heating and steam stripping to accomplish subsurface remediation. The technology has proven capable of remediating COCs from both the vadose and saturated zones, regardless of soil permeability or heterogeneity.

The ERH power control unit (PCU) uses conventional 60-hertz transformers to direct three-phase electricity from a municipal power line into the subsurface treatment region. The electricity is delivered throughout the subsurface treatment volume by electrodes installed using standard drilling techniques.

Electrodes are connected to the PCU so that adjacent electrodes are in electrical contact, but out of phase, with each other. Because each electrode is electrically out of phase with the electrodes surrounding it, current flows between it and all adjacent electrodes. In this manner, a volume of subsurface surrounded by ERH electrodes is saturated by the electrical current moving between the electrodes. It is the resistance of the subsurface to this current movement that causes heating.

While all soils in the targeted treatment volume are heated, electricity prefers to take pathways of lower resistance when moving between electrodes and these pathways are heated slightly faster. Examples of low resistance pathways in the subsurface include silt or clay lenses and areas of higher free ion content.

As chlorinated compounds sink through the lithology, they tend to become trapped on these same silt and clay lenses. Over time, trapped solvents undergo natural dehalogenation processes that produce daughter compounds and free chloride ions. Thus, at chlorinated hydrocarbon sites, the most impacted portions of the subsurface are also the low resistance electrical pathways that are preferentially treated by ERH. Subsequently, low permeability soils and solvent hot spots heat, and clean up, slightly faster than other soils during ERH remediation.

By increasing subsurface temperatures, ERH speeds the removal of contaminants by two primary mechanisms: increased volatilization and steam stripping. As subsurface temperatures increase, contaminant vapor pressure and the corresponding rate of contaminant extraction increases by a factor of about 30.

However, the ability of ERH to produce steam *in-situ* represents its most significant advantage over other subsurface heating techniques. Through preferential heating, ERH creates steam from within silt and clay stringers and lenses. The physical action of steam escaping these tight soil lenses drives contaminants out of those portions of the soil matrix that tend to lock in contamination via low permeability or capillary forces. Released steam then acts as a carrier gas, sweeping contaminants to the MPE, vapor recovery (VR), or SVE wells.

As the subsurface is heated by ERH, COCs trapped in the subsurface will mobilize due to changes in their physical properties (volatilization). If the COCs are volatilized within the vadose zone, the resulting vapors will be collected by the TN&A installed and operated SVE or VR system. If the COCs are volatilized beneath the groundwater table, the resulting vapors will begin to move to the top of the groundwater table. Movement of COC vapors to the top of the groundwater table will be the result of two primary forces that are very complementary. As the COCs located below the groundwater table are volatilized the resulting vapors move towards the top of the groundwater table where they will be recovered with steam by the VR systems.

4.0 PROJECT OBJECTIVES

4.1 Remediation Objectives

The objectives for the ERH portion of the Pemaco Superfund Site include:

- Design and implement an *in-situ* thermal treatment system that will allow enhanced source term removal of VOC's at the Pemaco Superfund site

- Instrumentation and control systems that allow timely data acquisition, reporting, interpretation, and decision making to verify that operational requirements are being met, to optimize each component of the remediation system

- Operate the ERH system in a safe and effective manner protecting the site workers, local population and the environment from the hazards of site environmental restoration

4.2 Performance Requirements

The *in situ* thermal system design will maximize COC recovery, minimize time to implement, and meet the required temperatures and treatment duration for the project. These requirements are that the system will provide energy sufficient to increase the soil and groundwater temperature in the ERH treatment area as follows:

- 90° C from 35 to 95 feet bgs at 90% of the Temperature Monitoring Points (TMPs).

This temperature will be maintained in the treatment area for a minimum of 30 days. The decision to extend the treatment time may be made by the EPA project team based on criteria such as COC concentrations in vapor extraction wells, vapor recovery wells, or groundwater within the ERH treatment zone.

Additionally, the *in situ* thermal remediation system design shall accomplish the following:

- Control *in-situ* pressure to prevent the migration of steam, vapors, or water to the ground surface,
- Capture vapors to remove, recover, or destroy COCs,
- Manage process waste generated from drilling the ERH electrodes.

The remediation design will include instrumentation and control systems that allow timely data acquisition, reporting, interpretation, and decision making to verify that operational requirements are being met, and to optimize each component of the *in situ* thermal remediation system. These instrumentation and control systems will also ensure that the treatment progress is accurately tracked, that the rate and volumes of COCs removal are measured, and that regulatory standards are being complied with.

5.0 SYSTEM DESIGN

5.1 General Site Preparation

General site preparation will include grading and preparing the ground surface for the placement of equipment components, the installation of the electrodes, and the placement of security fencing. A temporary power supply will be installed to operate the *in situ* thermal remediation equipment. Several subsurface utilities have been identified in the immediate vicinity and within the ERH treatment area. It is not anticipated that these underground utilities will interfere with the operations of the ERH system. However, installation of the electrodes and ERH equipment will be performed in a manner to minimize the possibility of damage to subsurface utilities. A site plot plan depicting the location of underground utilities is shown as Figure 2.

5.2 Electrical Power Source

During the Pemaco Superfund ERH remediation, the PCU will require up to 2,000 kW of power. Electrical power will be obtained from the nearest available 12,000 to 14,000 volt utility lines. The PCU will reduce the supply voltage from the utility lines to the appropriate level to apply to the subsurface.

The ERH subsurface heating load is pure electrical resistance. There is no “starting surge” with ERH as is typically found upon starting large electrical motors. During ERH, the load is quite stable, changing slowly over a period of days. Because the PCU operates at greater than a 99% power factor, it produces no harmonic distortion and no electrical or radio frequency noise.

5.3 Process Flow

During ERH, standard three-phase electrical power is taken from the utility grid by the PCU for controlled delivery to the subsurface. As the subsurface resists the movement of the electrical current between electrodes, it is heated to the required temperature.

For remediation of the Pemaco Superfund Site ERH treatment area, three phases of electrical energy will be applied to the electrode field over the depth interval of 35 to 95 feet bgs. Because current has a tendency to fan out slightly in the vertical plane as it travels between the electrodes in a uniformly contaminated region, strong heating will extend about 3 feet above and below the electrode conductive zone. The tendency for current to spread slightly is often counterbalanced by the contaminant distribution at the site; more contaminated regions are more electrically conductive and thus “attract” additional current for stronger heating.

As this subsurface interval is heated, COCs will be volatilized and steam-stripped from the soil matrix. Volatilized COCs and steam will be collected at the electrode wells and associated VR wells located within the ERH area. Screened from 50 to 62.5 feet bgs, the electrode wells are designed to allow the recovery of soil vapors, volatilized COCs, and steam from the subsurface. The vacuum blowers installed and operated by TN&A provide the vacuum necessary to recover these media from the subsurface and to move them through the VR system. A process and instrumentation diagram for the ERH remediation system is presented as Figure 3.

Once collected at the VR wells, vapors and steam are transported through the VR piping system to an ERH condenser. The ERH condenser includes an integral inlet vapor liquid separator. At the ERH condenser, steam is condensed to water, while vapors pass through to the VR blowers. Condensate collected in the condenser is pumped to the TN&A installed and operated water treatment system. Soil vapors and volatilized VOCs pass through the condenser and are transported to the TN&A installed and operated vapor treatment system, which will utilize an on-site FTO.

5.4 ERH Power Control Unit

The electrical energy delivery system consists of the PCU, the cables from the PCU to the electrodes, and the electrodes. The PCU adjusts the voltage applied to the subsurface for optimum heating. For remediation of the Pemaco Superfund Site, a single PCU rated for 2,000 kW (7 Million British Thermal Units (BTUs)/hour) will be mobilized to the site, placed on level ground, and connected to the temporary power supply. The PCU is designed to allow local utility power to be connected directly to the PCU input disconnect and is equipped with energy, voltage and current metering instruments for monitoring operations.

Manufactured specifically for use in ERH applications, the PCU is designed for 100% duty cycle. Over the course of the remediation, the average output from the PCU is assumed to average approximately 65% of the rated capacity, based upon an estimated 80% uptime factor at operations of 80% of rated capacity.

The 2,000 kW PCU is capable of adjustable voltage outputs from 0 to 800 volts (V) while maintaining a near constant power output. During the remediation, the applied electrode voltage is anticipated to vary between 130 and 250 V. Electrical requirements for the operation of the 2,000 kW PCU are 100 ampere service at between 12 and 14kV. This service will be sufficient to not only power the PCU, but also the ERH condenser.

ERH power control and data acquisition is performed on a dedicated computer. Remote data acquisition software is used to collect and store temperature reading at selected locations throughout the ERH system. The application of ERH is monitored continuously. Operations personnel can access the power control and data acquisition system and download data or monitor and control the heating process either locally or remotely by telephone modem.

The voltage and current applied at the electrodes is measured by field personnel and used to calculate the power-input rates at the individual electrodes. During remediation of the Pemaco Superfund Site, it is anticipated that the PCU will operate at an average output of about 1,400 kW.

Cables used to connect the PCU to the electrodes will be Type W extra hard usage cords. These cables are often referred to as “mining cable” and are rated for outdoor use under routine foot traffic and occasional vehicle traffic.

5.5 Electrode Design

A total of 55 electrodes, placed on 17-foot spacing, will be used to heat the treatment area. A treatment area plot plan with electrode locations is shown on Figure 2.

The electrode design consists of ERH heating elements and VR system components co-located in 12-inch diameter boreholes. Electrode elements are constructed of 3-inch diameter steel pipe extending to about 62.5 feet bgs and coupled copper plates from 66 to 100 ft. bgs. Active electrical resistance heating will span the subsurface interval from 34 to 100 feet bgs.

To assist with VR operations, the pipe interval from 50 to 62.5-feet bgs is slotted (0.040 inches). The borehole annulus from 34 to 100 ft. bgs is filled with high permeability graphite and steel shot to expand the effective diameter of the electrode. Each borehole is then filled from 34 ft. bgs to surface grade with high temperature Class G grout (neat silica cement). Design details for electrode wells are shown on Figure 4.

The electrode elements are isolated electrically at the surface by an 8-inch diameter chlorinated polyvinyl chloride (CPVC) over-sleeve and non-conductive vapor recovery pipe connections, to prevent personnel exposure to hazardous voltages. High temperature Class G grout is used to seal the CPVC over-sleeve and electrode elements at the ground surface. High temperature Class G grout has shown the capability to allow thermal expansion of the electrode elements without failure, and is an efficient barrier to steam flow upward along the outside of the casings.

Materials of construction are steel, carbon backfill, temperature rated plastics, and neat cement grout. These materials have been proven to withstand a combination of elevated temperature, pressure, and chemical attack.

The spacing of the electrodes was designed to provide sufficient power delivery to the subsurface and electrodes have been located to provide active electrical resistance heating slightly beyond the established boundaries of the treatment area. The electrode elements extend the entire depth of the treatment volume to ensure that subsurface heating is applied evenly and uniformly.

5.6 Vapor Recovery Well Design

A total of 18 additional vapor recovery wells will be installed throughout the ERH treatment area. Nine of the 18 VR wells will recover vapors from approximately 40 to 50 feet bgs (single screened VR wells) and nine co-located VR wells will recover vapors from both 20 to 35 feet bgs and from 40 to 50 feet bgs (dual screened VR wells). The locations of the additional VR wells are shown on Figure 2.

The single screened VR wells are constructed of 2-inch diameter CPVC pipe extending to approximately 50 feet bgs. These VR wells are screened from 40 to 50 feet bgs using 0.020-inch slotted CPVC pipe. A 2-inch diameter CPVC riser pipe will be installed and extend to approximately 6 inches above grade. The borehole annulus in the screened interval is filled with high permeability sand to maximize air flow from the soil. Each borehole is then sealed from approximately 38 feet bgs to surface grade with high temperature Class G grout. Design details for the single screened VR wells are shown on Figure 5.

In order to minimize installation costs, nine of the 18 VR wells incorporate shallow TN&A operated VR wells. Constructed to a depth of approximately 50 feet bgs, these dual screened VR wells each contain two, 2-inch diameter CPVC casings. The deep

VR casing is screened from 40 to 50 feet bgs using 0.020-inch slots. The shallow TN&A operated VR casing is screened from 20 to 35 feet bgs using 0.020-inchslots. A separate 2-inch diameter CPVC riser pipe is installed to each VR screen interval and each extends to approximately 6 inches above grade.

The deep VR well borehole annulus is filled with high permeability sand from approximately 39 to 50 feet bgs to maximize air-flow from the soil. To separate the shallow and deep VR wells the borehole is sealed from approximately 35 to 39 feet bgs with high temperature Class G grout (neat silica cement). The shallow VR well borehole annulus is filled with high permeability sand from approximately 19 to 35 feet bgs to maximize air flow from the soil. Each borehole is then sealed from approximately 19 feet bgs to surface grade with high temperature Class G grout (neat silica cement). Design details for the dual screened VR wells are shown on Figure 5.

Each of the 18 additional VR wells will be equipped with an isolation valve and is piped to the ERH VR piping headers. The anticipated vacuum at the wellhead for each VR well is approximately 8 inches of Mercury (in. Hg.).

5.7 TMP and Vacuum Monitoring Point Design

In order to measure subsurface temperatures, a total of 20 TMP locations will be installed inside the ERH treatment area and 10 TMP locations will be installed adjacent to the ERH treatment area. The locations of the TMPs are shown on Figure 2. The TMPs are constructed of 1.25-inch diameter CPVC pipe extending to approximately 100 feet bgs. All of the TMPs will have 15 dedicated thermocouples installed at five-foot intervals from 25 to 100 feet bgs.

In order to measure subsurface vacuum influence, each TMP will also have a co-located vacuum monitoring point (VMP). The VMPs will be constructed using ½” CPVC pipe, extend to a depth of 46 feet bgs, and will be screened from approximately 44 to 46 feet bgs. This configuration will allow measurement of vacuum influence in the depth interval of 40 to 50 feet bgs.

The TMP borehole annulus is filled from 100 feet bgs to 50 feet bgs with high temperature Class G grout (neat silica cement), then from 50 feet bgs to 40 feet bgs with high permeability sand, and completed with high temperature Class G grout (neat silica cement) from 40 feet bgs to the ground surface. Design details for the TMPs are shown on Figure 6.

Each of the 30 vacuum monitoring points will be equipped with a quick connect fitting at the surface to facilitate the collection of vacuum measurements.

5.8 Electrode Wetting System

To prevent electrode “dry out” conditions, an electrode wetting system will be installed to each electrode. The depths of water injection in the electrodes are shown on Figure 4. In order to minimize the risk of water migration from the site, the injection system will be designed and operated in a manner that ensures less water is injected into the subsurface than is extracted from the subsurface in the form of steam. Water totalizers will be installed to measure the quantity of water injected to the subsurface as well as volume of water extracted during vapor recovery.

5.9 ERH Condenser

Once any portion of the subsurface reaches the boiling point of water, steam generation will begin. As steam rises into the vadose zone, it is collected at the electrodes and VR wells and routed to the ERH condenser. The skid-mounted ERH condenser is sized and manufactured to accommodate the PCU used in the remediation effort. The condenser package will be mobilized to the site by TRS and placed on level ground near the PCU. Operation of the ERH condenser is the responsibility of TN&A.

The condenser performs as a vapor-liquid separator, separates soil vapors from steam condensate, provides automated condensate pumping functions and cools the soil vapors to ambient temperatures. The vapor outlet of the condenser contains a mist eliminator that is 99% efficient in removing droplets to a size of 10 microns. When connected to the TN&A installed and operated vacuum blower, the pressure drop across the condenser is typically less than 0.5 pounds per square inch (psi), which is equivalent to approximately 1 in. Hg vacuum.

The expected volumes of steam, soil vapors, and condensate passing through the condenser during the remediation process are summarized in Table 4. Once the treatment volume is completely heated, the VR system will capture approximately 1,610 standard cubic feet per minute (scfm) of steam and soil vapors from the subsurface. This combined flow will be composed of 900 scfm of steam and 710 scfm of soil vapors.

Steam extraction will remove water from the subsurface at a rate of approximately 8 to 10 gallons per minute (gpm). Some of the steam will condense within the recovery piping and join with the extracted liquids to be captured by the vapor-liquid separator and pumped directly to the TN&A installed and operated water treatment system.

Table 2: Estimated Condenser Operating Parameters

Process Stream	Maximum Flow Rate [a] or Volume (gal)
Combined steam and vapor flow	1,600 scfm
Steam from the subsurface	900 scfm
Air and vapors from the subsurface	710 scfm
Inlet Vacuum	10 in. Hg
Outlet Vacuum	12 in. Hg
Inlet Temperature	160 to 180^{o}C
Outlet Temperature	Near Ambient
Water recovered from the subsurface as steam	8 to 10 gpm
Total Volume Over the Entire Remediation Period	1,811,000 gal

Notes:
[a] Estimated flow rates when the heated region is at design temperatures.

The conditions within the condenser are a good application of Henry's Law. Based on Henry's Law, and borne out by experience at previous ERH sites, 99.6% of the TCE vapor will remain in the vapor phase as it passes through the condenser. Only 0.4% of the TCE will become dissolved in the steam condensate for treatment. Condensate exiting the condenser will not be cooled prior to delivery to the TN&A installed and operated treatment system.

The condenser utilizes a non-contact water-cooled heat exchanger. The heat that is removed from the steam in condensation is reflected in a temperature rise of the recirculation cooling water. The heat is then removed from the recirculation water using a cooling tower in which a portion of the recirculation water evaporates with each pass.

5.10 System Controls

System diagnostics, controls, and alarms are accessed and set through the computer in the PCU and the control panels of the condenser. Emergency shut downs and automatic notification alarms are routed through these same system components.

On-site and remote operators can turn the PCU on or off, change the voltages applied to the electrodes, reset some PCU alarms, and monitor temperatures throughout the ERH system. Voltage changes can be made immediately or by ramping up or down over set time intervals. Alarms are provided for transformer over-temperature, current trips and faults, and excessive current levels. Closing the main contactor on the PCU is the only way to energize the electrode field. Only authorized operations personnel using the PCU control computer can close the main contactor.

Remote and on-site operators can determine if system faults or unwanted operating conditions exist inside the PCU or the electrode field. Most faults and undesired operating conditions can be corrected remotely by altering operating parameters or can be tolerated until field staff can make adjustment to the PCU or the electrode field. More severe system faults may require portions of the electrode field, or the entire PCU, to be shut down for repairs or adjustments. Transformer alarms instigate immediate shut down of the PCU and must be cleared on-site before the PCU can be reenergized.

Because steam collection and vapor treatment are vital operations functions, system alarms that do not originate in the PCU are routed through the control panel of the ERH condenser. If the VR system faults for any reason, the PCU is automatically shut down discontinuing power to the electrode field and an auto-dialer contacts operations personnel. On-site action is then required to correct the alarm condition and restart the VR treatment system before the PCU can be reenergized.

If the ERH condenser is unable to process steam or condensate, it will fault. This condenser fault immediately stops the VR blowers and halts steam and vapor recovery. Stopping steam recovery also halts condensate production. Stopping the VR blower triggers a shut down of the PCU and initiates the automatic notification auto-dialer.

If the FTO is unable to process vapors for any reason, it will fault and shutdown the PCU and trigger the automatic notification auto-dialer. If there are no operating faults within the condenser, it will continue to operate under this scenario until shut down manually.

The faults and alarms associated with ERH remediation system components, along with the actions caused by each condition are identified in the Operations and Maintenance Manual.

5.11 Power and Mechanical Failures

In case of a site-wide power failure, all system equipment will shut down and the auto-dialer will contact operations staff using an emergency battery pack for power. When power is restored, the ERH components must be restarted locally.

When the PCU is shut down, the creation of steam in the subsurface stops quickly. Residual steam, however, remains in the subsurface and that steam continues to rise toward the surface. If the VR system is operating, residual steam is collected at the bottom of the vadose zone. If the VR system is not operating, a small flux of residual steam will enter the non-heated portion of the vadose zone and condense. The condensate will be remediated by the system once operations are restarted.

6.0 MOBILIZATION AND INSTALLATION

6.1 General Information

Prior to the mobilization of equipment to the site, there will be a preconstruction meeting to discuss the general plan and schedule for construction, installation, and operations. In addition, the project-wide health and safety issues will be presented and discussed (regular, daily health and safety tailgate meeting will occur throughout the duration of the project any time TRS is on-site).

The ERH portion of the project will occur in several phases. These general phases are presented below.

<u>Phase I</u>

The initial phase will concern the following:

- Surveying
- Site grading

<u>Phase II</u>

- Electrode Installation
- TMP Installation
- VR Well Installation
- Vapor Recovery Piping Installation
- Cabling of Electrodes
- Installation of the PCU and Condenser

<u>Phase III</u>

- Startup/Shakedown of the ERH system

<u>Phase IV</u>

- Operations

- Sample collection and process monitoring
- Reporting

Phase V

- Demobilization
- Final Reporting

The schedule for the construction and operation of the ERH system is presented as Figure 8 of this Workplan.

6.1.1 Construction and Installation Hours of Operation

All drilling activities will be performed during daylight hours (approximately 7:00 a.m. to 5:00 p.m.). All work activities will be conducted in accordance with approval from TN&A and any rules and regulations according to the City of Maywood.

6.2 Underground Utilities

The treatment area will be surveyed for the presence of underground utilities by TN&A prior to conducting subsurface work. Utility locations will be determined using existing utility maps and communication and local utility companies. The utility survey will be completed prior to construction activities associated with the site operations. Drilling permits will be obtained by TRS prior to commencing drilling.

6.3 Equipment Decontamination

The Environmental Compliance/Waste Management Plan (EC/WMP) and the Sampling and Analysis Plan (SAP) detail all decontamination activities associated with site work.

6.4 Electrical Utility Infrastructure

In order to support the remediation effort, a 100 amp electrical service at 13.8kV will be routed to the site. The electrical energy meter will be located near the TN&A treatment system area site entrance off 60th Street.

The TRS team will extend the electrical service to the equipment compound. The equipment will be located adjacent to the treatment area remediation as shown on Figure 2. The electrical one-line diagram for the ERH system is provided on Figure 7.

6.5 Equipment and Material Storage Area

Hardware and support components associated with the *in-situ* thermal treatment system will be staged and operated within an ERH equipment area, adjacent to the treatment area. The equipment pad area is expected to be approximately 4,000 square feet and located at the southern end of the treatment area.

6.6 Drilling Procedures

6.6.1 Drilling Oversight

The ERH project will employ the use of hollow-stem auger drilling. This method was selected for the ability to expedite the installation without the concern for refusal and offset due to the subsurface lithology.

All ERH site personnel will be supervised by the TRS Site Manager, who will have overall responsibility for the installation and construction of the subsurface materials necessary for the ERH application.

TRS personnel will oversee and supervise the drill rig(s) for the construction and installation of the electrodes, TMPs, and VR wells. Logging requirements will be kept to a minimum: dimensions of borehole, noticeable changes in subsurface lithology, time started and completed, and electrode and TMP construction details (as-builts).

Wells, electrodes, and TMPs will be constructed according to the specifications and requirements in the following subsections. All drilling activities will conform to federal, state, and local regulations. TRS will obtain all permits, applications, and other documents required by state and local authorities for drilling and ERH construction activities.

6.6.2 Drilling Log

A log of drilling activities will be kept in a bound field notebook. Information in the log book will include, at a minimum, location, time on site, personnel and equipment present, down time, materials used, and activities conducted. The subcontracted drilling firm will complete a Daily Drilling Log at the end of each day of drilling for approval and signature by the rig supervisor.

6.6.3 Field Screening

If requested by the USEPA, all field screening and monitoring will be performed by TN&A.

6.6.4 Drilling Derived Waste

Soil cuttings, including the soil core, will be stored on site in DOT approved roll-off bins for later transported to an approved facility. Please refer to the Environmental Compliance/Waste Management Plan (EC/WMP) for additional details.

6.7 Sampling and Logging

Sampling and logging of boreholes during the installation of the electrodes, TMPs, and VR wells is not planned.

6.7.1 Borehole, Casing, Grout, Filter Pack, and Seal Requirements

The table below provides the construction details for the subsurface components of the ERH system.

Table 3: ERH Subsurface Components and Surface Completion Details

Location and Type	Specifications
Electrodes	
Number of Electrodes	55
Borehole	Minimum 12-inch diameter; 100 ft bgs
Casing	3-inch diameter steel pipe
Screen Interval	50 to 62.5 ft bgs
Well Boxes	None. Complete above grade
Grout Seal	Class G grout
Filter Pack	Graphite and steel shot
Temperature and Vacuum Monitoring Points (TMPs & VMPs)	
Number of TMPs	30
Borehole Dimensions	Minimum 4-inch diameter;100 ft. bgs
Casing	1 1/4-inch diameter CPVC casing
Screen Interval	Not applicable
Well Boxes:	None. Complete above grade
Grout Seal	Class G grout
Filter Pack	Not applicable
Number of VMPs	30
Casing	½" CPVC
Screen Interval	44 to 46 feet bgs
Filter Pack Interval	40 to 50 feet bgs
Filter Pack Material	Sand
VR Wells	
Number of VR Wells	18
Borehole	Minimum 8-inch diameter
Casing	2-inch CPVC
Screen Interval	40 to 50 feet bgs; 40 to 50 feet bgs and 20 to 35 feet bgs
Well Boxes	None. Complete above grade
Grout Seal	Class G grout
Filter Pack	Sand

6.8 Electrode Installation

The electrode design is detailed in Section 5.5. The electrodes will be constructed in the field by the drill crew under TRS supervision. Borehole depths will be sounded and recorded on as-built drawings for each location. A treatment area plot plan with electrode locations is shown on Figure 2. The electrode is comprised of two discrete elements. The upper element is constructed of 3-inch diameter steel pipe extending to 62.5-feet bgs. The lower element is composed of a copper plate from 66 feet bgs to 100 feet bgs.

The borehole annulus from 34 to 100-feet bgs is filled with high permeability graphite and steel shot to expand the effective diameter of the electrode. The rig supervisor will record sounding depths that are taken by the drill crew with a weighted tape, as well as document the volume of graphite and steel shot that is used at each location. As indicated in Section 5.5, borehole will be sealed from 34 feet bgs to surface grade with Class G cement grout.

As shown on the electrode details, the electrode elements will have a surface/subsurface completion that consists of an 8-inch diameter CPVC over-sleeve and non-conductive VR piping connection, to prevent personnel exposure to hazardous voltages.

Class G cement grout is used to seal the CPVC over-sleeve and electrode elements to the ground surface. The grout seal is important to eliminate steam from leaking to the surface, therefore, great care must be taken to ensure that the over-sleeve installation has not created any air pockets.

6.9 Temperature Monitoring Points

The ERH heating process is directly monitored by thermocouple instrumented TMPs. A total of 20 TMPs are located in TMP borings inside the treatment area and a total of 10 TMPs are located in TMP borings adjacent to the ERH treatment area, as shown in the plot plan (Figure 2).

Construction details for the TMP borings are shown on Figure 6. These borings will extend to 100-feet bgs and will contain a 1 1/4-inch CPVC casing instrumented with 15 thermocouples spaced at 5-foot depth intervals beginning at 35 feet bgs. In addition, each TMP boring will contain a vacuum monitoring piezometer placed to measure subsurface vacuums at the depth interval of 40 to 50 feet bgs. The vacuum piezometers are constructed of ½" CPVC piping surrounded by a silica sand filter pack, which extends to the surface where pressure readings can be made.

7.0 EQUIPMENT AND MATERIALS

The ERH system will use a wide variety of equipment and materials during construction, installation, and operations. General field equipment will include an assortment of hand and power tools such as circular saws and drills. The information presented below presents the basic equipment to be utilized during construction and ERH operations.

7.1 Electrical Resistance Heating Equipment

Item	Description	Quantity
PCU	2000 KW Power Control Unit	1
Condenser	plate and frame heat exchanger, non-contact water cooled	1

8.0 SAMPLING AND ANALYSIS PLAN

Details regarding the sampling strategies, requirements and schedules are presented in the SAP. The schedule, location and rationale for all sampling and monitoring activities are provided in the SAP.

9.0 SITE HEALTH AND SAFETY HEALTH PLAN

Due to size and complexity of the ERH remediation system at the Pemaco Superfund Site, the HASP is presented as a separate document for this Workplan. All site personnel will be required to read and sign an acknowledgment form located within the HASP. Copies of the HASP will be available to all site personnel including subcontracting vendors such as drilling service providers.

A kick-off health and safety meeting will be held prior to the commencement of field activities. In addition, daily tailgate meetings will also include health safety briefings. A daily sign-off sheet will be kept on file at the site.

All personnel working on the ERH project at the Pemaco Superfund Site will have completed a 40-hour OSHA HAZWOPER course, and will also have a current medical testing report. Copies of the certifications will be maintained in the project files.

10.0 ENVIRONMENTAL COMPLIANCE/WASTE MANAGEMENT PLAN

A detailed EC/WMP is presented as a separate document.

Details regarding the handling of all construction and remediation operations waste and measures taken to ensure a safe work environment as well as the protection of the surrounding environment are detailed within the EC/WMP. Contact and emergency numbers are also presented within the EC/WMP.

11.0 QUALITY ASSURANCE/QUALITYCONTROL PLAN

A detailed Quality Assurance/Quality Control Plan (QAQCP) is presented as a separate document.

Details regarding the quality control, approvals, and oversight for all phases of the construction, installation, and operation of the ERH remediation system are provided in the QAQCP. The plan also provides details regarding the titles and qualifications of all key personnel.

12.0 REPORTING

Once installation of the ERH system is complete, "As-Built" drawings will be generated and submitted to TN&A.

Per the contract specifications for the ERH remediation project at the Pemaco Superfund Site, weekly reporting will be generated and submitted to TN&A.

A final report for the ERH remediation area is scheduled to be provided.

13.0 PROJECT MANAGEMENT AND SCHEDULE

The ERH remediation is a joint effort by the TN&A and TRS project team, which includes the USACE and USEPA. Efficient and accurate communication is a critical element to the success of this project. The purpose of this section is to outline the management structure and areas of responsibility.

Table 4 provides details on the primary points of contact within each organization.

13.1 Project Team Responsibilities

General details regarding the responsibilities of the TRS project team are provided below.

TRS:

- Design of an ERH system necessary to meet the specifications outlined in Section 2.3 of this document.
- Mobilize, install, and operate the PCU and condenser for the ERH system.
- Install the necessary electrodes, TMPs, and VR wells shown in Figure 2 of this document.

- Install the necessary cabling, piping, and communication wiring from the electrodes, TMPs, drip system, and VR wells to the PCU and condenser.

- Operate the ERH system to meet the specifications in Section 2.3 of this document.

TN&A:

- Perform all site preparation and grading services.

- Install all necessary connections between the ERH equipment and the TN&A equipment shed.

- Install and operate the MPE and SVE systems not associated with the ERH system.

- Install and operate the necessary equipment to provide vacuum to the MPE, VR, SVE, and ERH system.

- Install and operate the necessary systems to treat the extracted vapors and liquids.

- Perform all functions associated with soil, water, and vapor sampling and monitoring.

United States Army Corps of Engineers (USACE):

- Provide technical assistance and over site to the project team.

USEPA:

- Set overall project goals.

- Provide management, technical assistance, and oversight to the project team.

13.2 Project Schedule

A general construction, installation and operations schedule is provided as Figure 8. This schedule is subject to change.

Table 4: Contact Information

Name	Title	Organization	Phone	E-Mail
Timothy Garvey	Senior Scientist/Associate	TN&A	805-585-6386	tgarvey@tnainc.com
John Wingate		TN&A	805-585-6389	jwingate@tnainc.com
Jacques Marcillac	Project Geologist	TN&A	805-585-6382	jmarcillac@tnainc.com
Sam Serpa III	Remedial Construction Manager	TN&A	323-771-0414	sserpa@tnainc.com
Rose Marie Caraway		USEPA	415-972-3158	caraway.rosemarie@epa.gov
James Cummings		USEPA	703-603-7197	cummings.james@epa.gov
Eva Davis		USEPA	580-436-8548	davis.eva@epa.gov
John Hartley		USACE	402-293-2523	john.r.hartley@usace.army.mil
Kira Lynch	Environmental Scientist	USACE	206-764-6918	kira.p.lynch@usace.army.mil
Paul Bianco	Project Manager	TRS	541-318-7079	pbianco@thermalrs.com
Gregory Sandberg	Site Operations Manager	TRS	406-863-9528	gsandberg@thermalrs.com
Doug Seiler	Project Engineer	TRS	360-560-4858	gbeyke@thermalrs.com
Jerry Wolf	Vice President of Operations	TRS	817-379-0536	jwolf@thermalrs.com
Tom Powell	Operations Group Manager	TRS	360-263-3615	tpowell@thermalrs.com

FIGURES

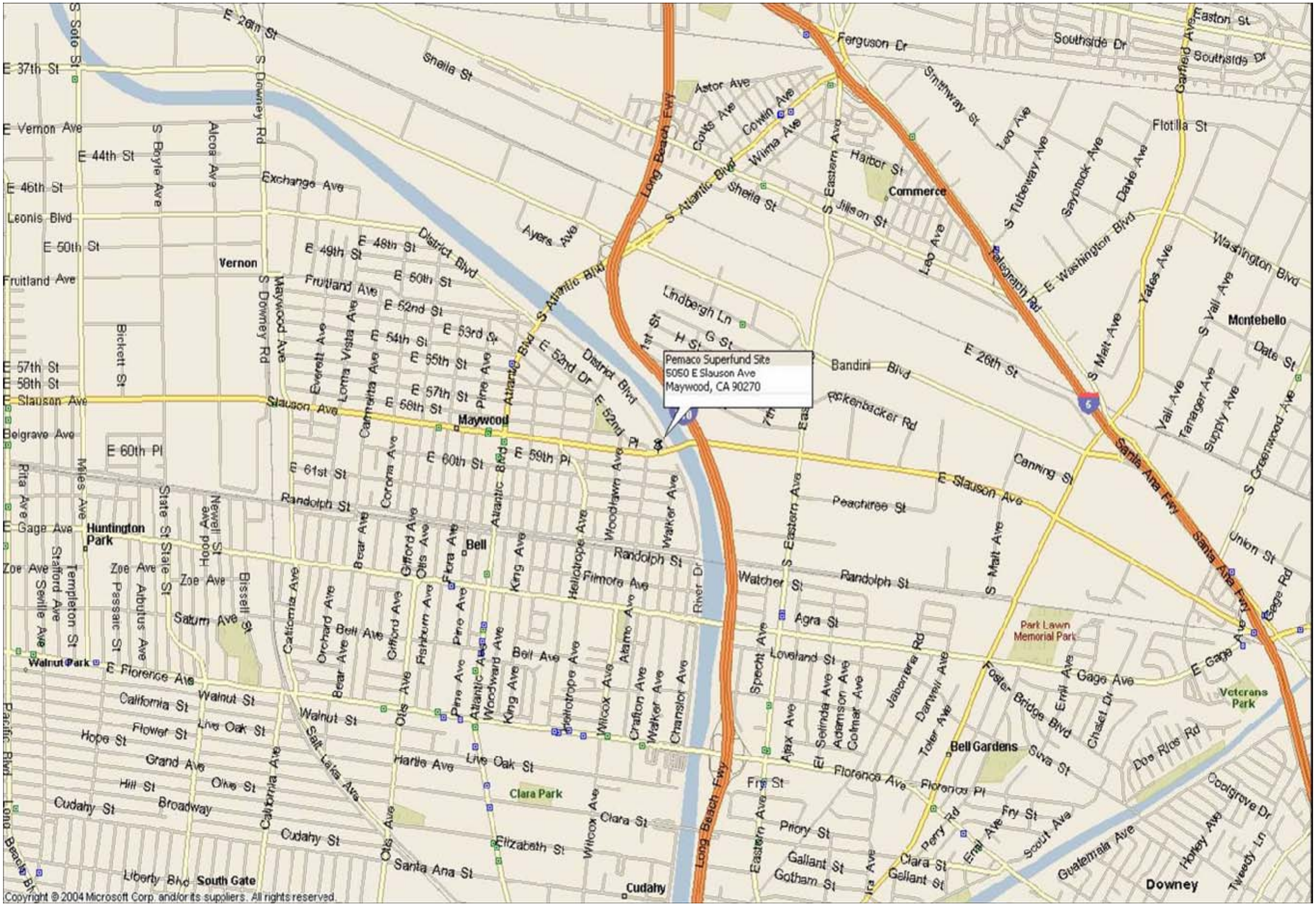


FIGURE 1: Pemaco Superfund Site Location Map

ELECTRICAL RESISTANCE HEATING
80% REMEDIATION DESIGN

FOR THE
PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE
MAYWOOD, CA 90270

THERMAL REMEDIATION SERVICES, INC.

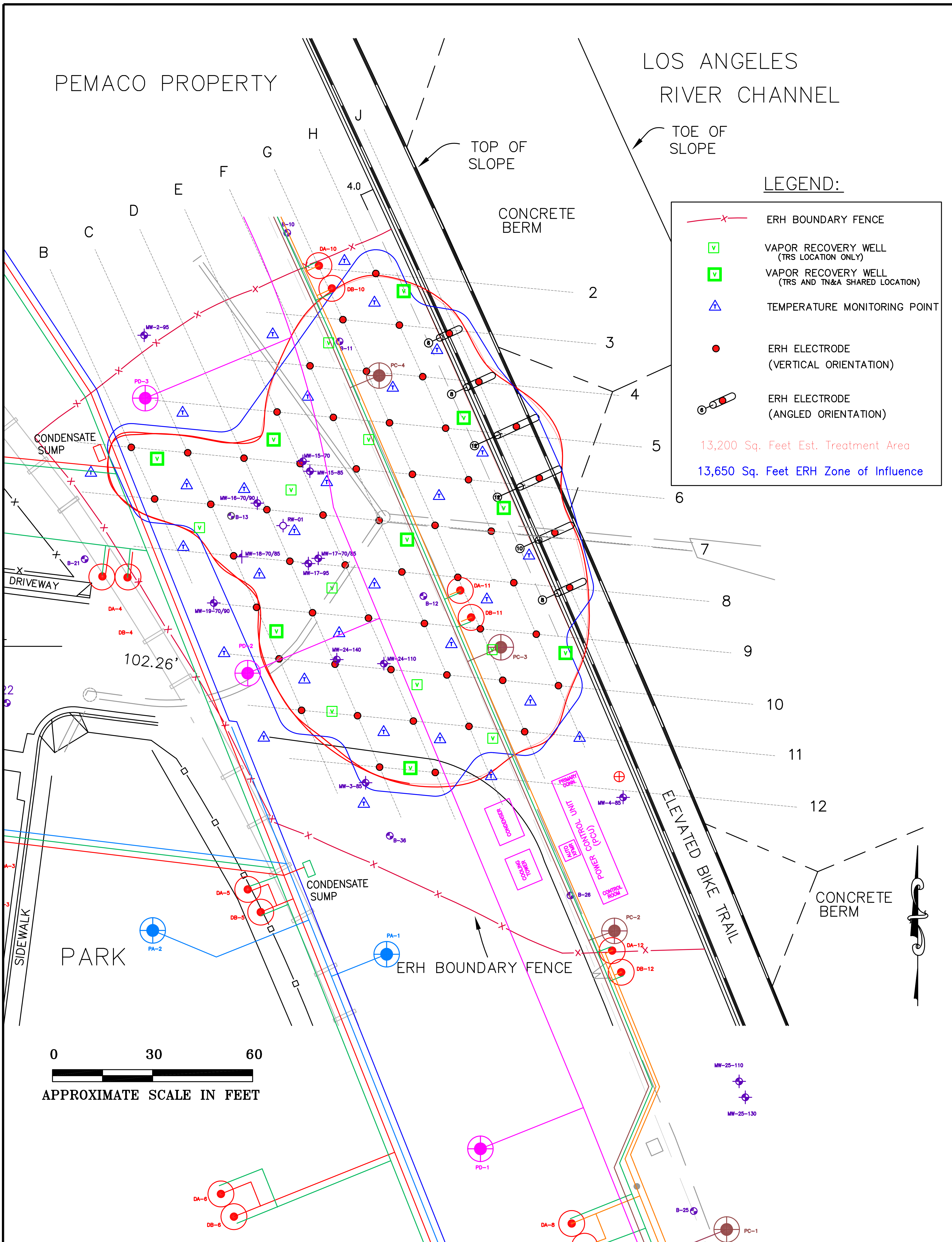
PREPARED BY:

THERMAL REMEDIATION SERVICES
2325 HUDSON STREET, LONGVIEW, WA 98632

PREPARED FOR:

TN & ASSOCIATES, INC.
317 EAST MAIN STREET, VENTURA, CA 93001

INDEX OF DRAWINGS



NOTES:
1. USE OF INFORMATION AND DATA FROM THIS DRAWING IS RESTRICTED TO PARTICIPANTS IN THE PEMACO SUPERFUND SITE. INFORMATION AND DATA FROM THIS DRAWING MAY NOT BE TRANSMITTED TO OTHERS WITHOUT THE EXPRESS WRITTEN CONSENT OF TRS.
2. MAXIMUM SLOPE OF GROUND SURFACE IN ERH AREA SHALL NOT BE GREATER THAN 2%.

CONFIDENTIAL

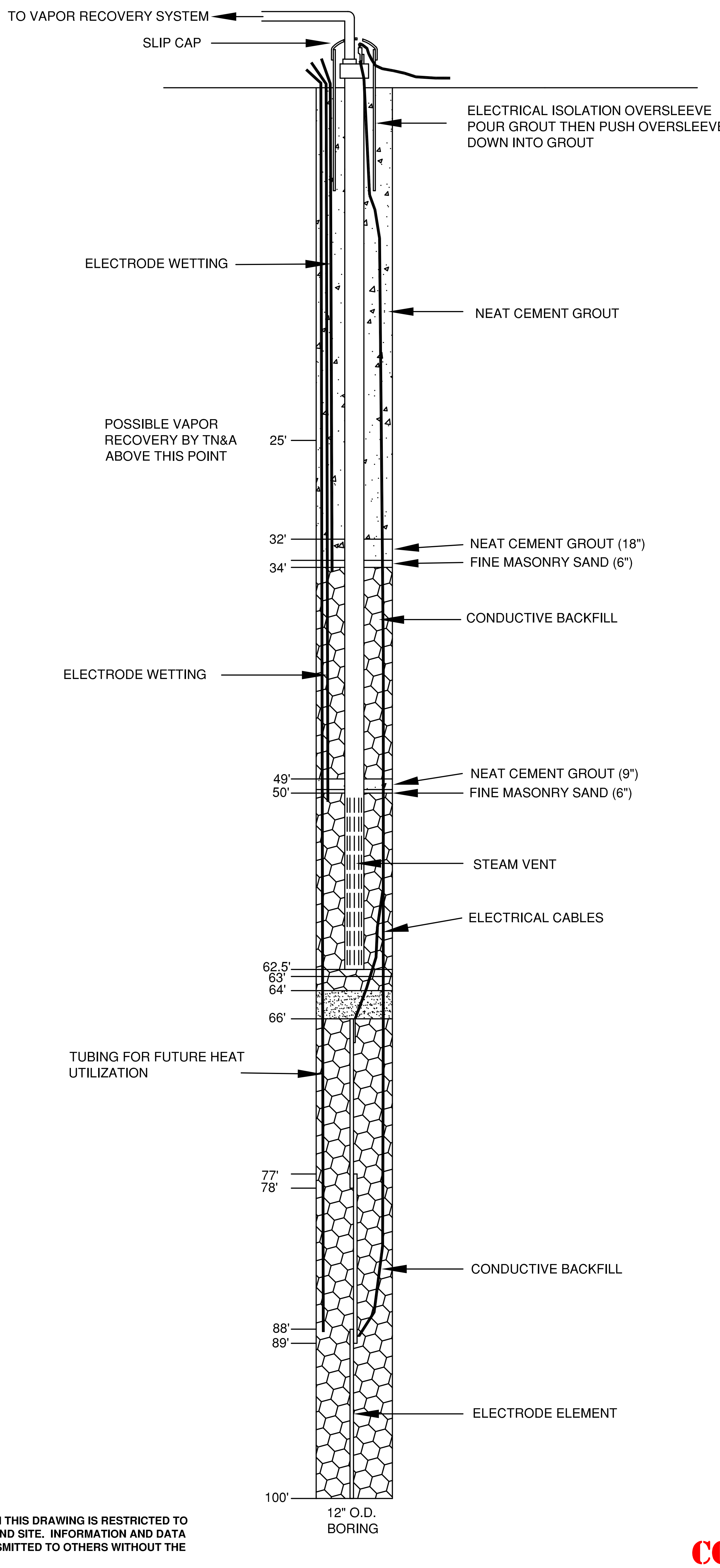
NO.	DATE	BY	REVISIONS

DESIGN BY:	DS
DRAWN BY:	DS
CHECKED BY:	GB
PROJECT MANAGER:	PB
DATE:	8-29-05
SCALE:	AS SHOWN
FIGURE NUMBER:	DRAFT
PROJECT NUMBER:	MAY-05
FILE NAME:	MAY05 PP 082905.eid

ERH PLOT PLAN
80% DESIGN

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE, MAYWOOD, CA 90270

THERMAL REMEDIATION SERVICES, INC.



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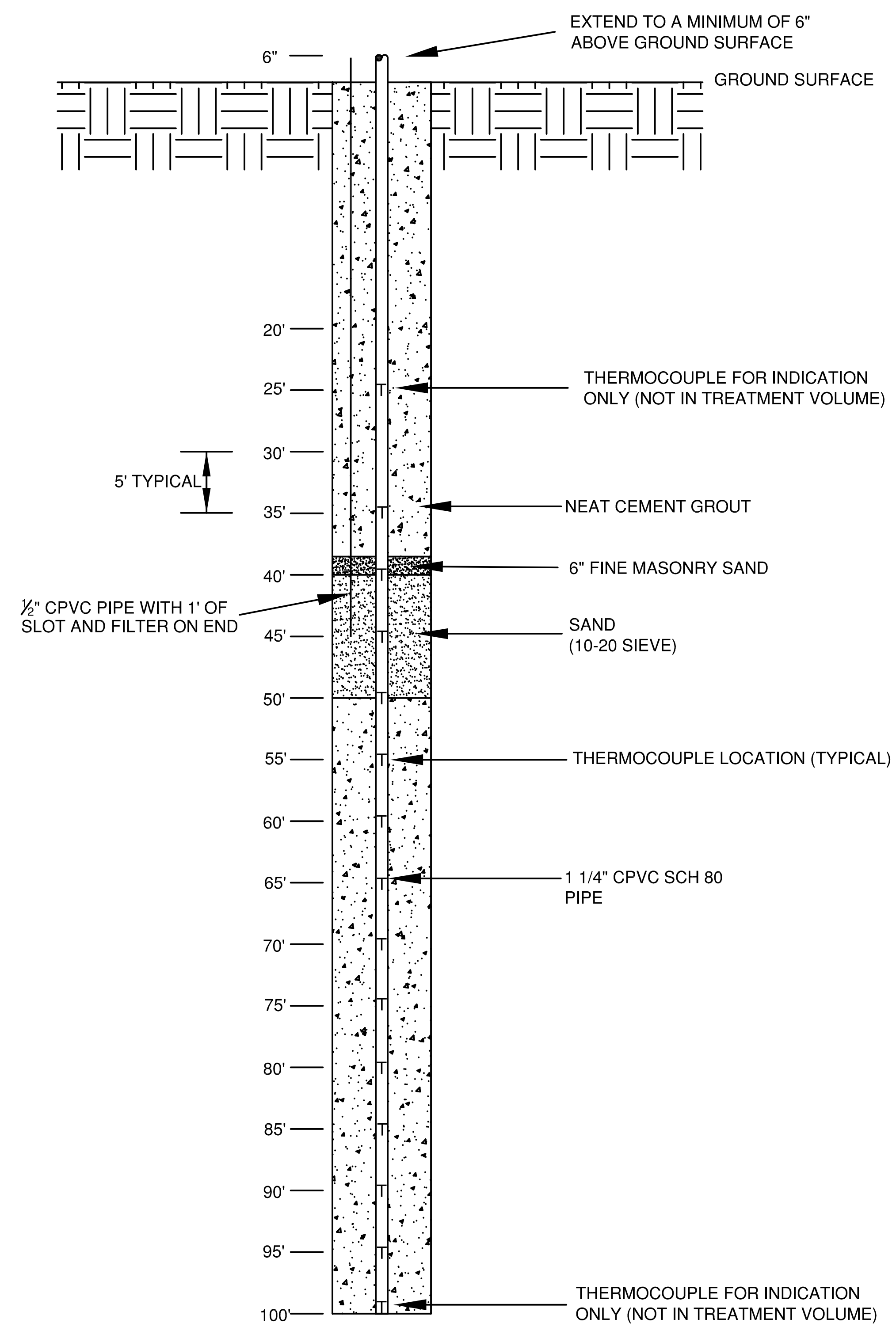
CHECKED BY:	GB
PROJECT MANAGER:	PB
DATE:	09-06-05
SCALE:	AS SHOWN
FIGURE NUMBER:	DRAFT
PROJECT NUMBER:	MAY-05

ELECTRODE DETAIL
80% DESIGN

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE, MAYWOOD, CA

THERMAL REMEDIATION SERVICES, INC.



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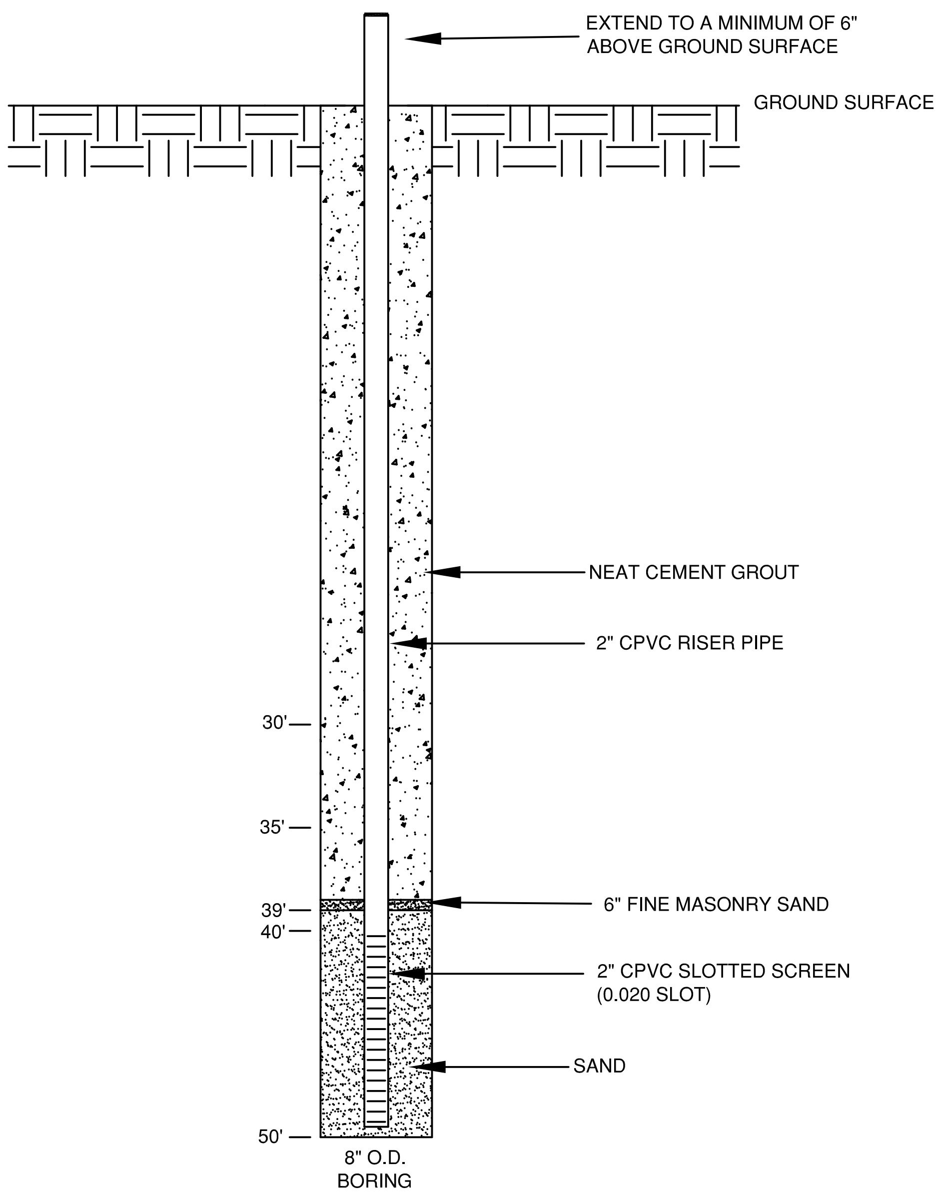
CHECKED BY:	GB
PROJECT MANAGER:	PB
DATE:	09-02-05
SCALE:	AS SHOWN
FIGURE NUMBER:	DRAFT
PROJECT NUMBER:	MAY-05

ERH TMP WELL DETAIL
80% DESIGN

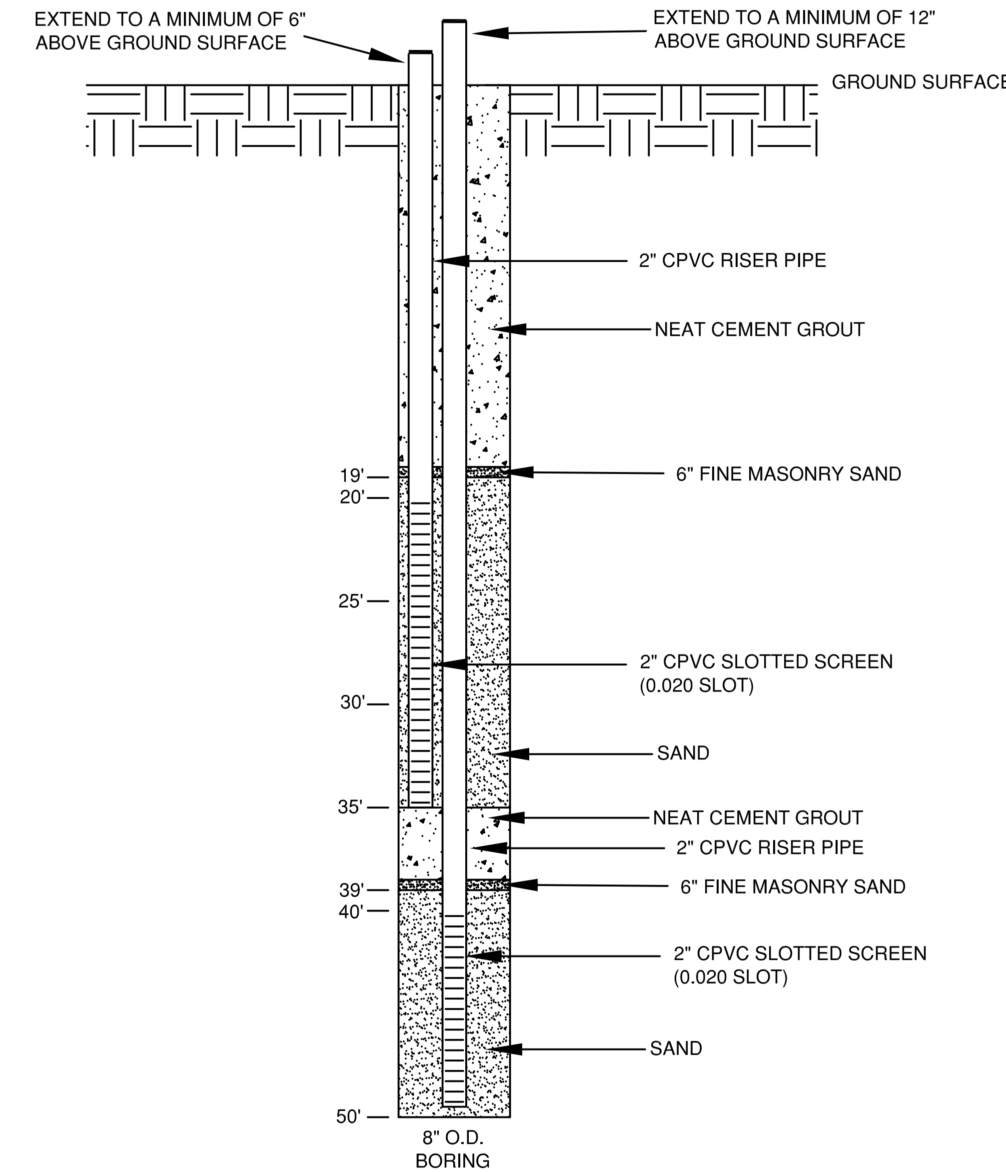
PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE, MAYWOOD, CA 90270

THERMAL REMEDIATION SERVICES, INC.

TRS VR WELLS (TYPICAL 9 LOCATIONS)



CO-LOCATED TRS AND TN&A VR WELLS (TYPICAL 9 LOCATIONS)



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ENGINEER'S SEAL

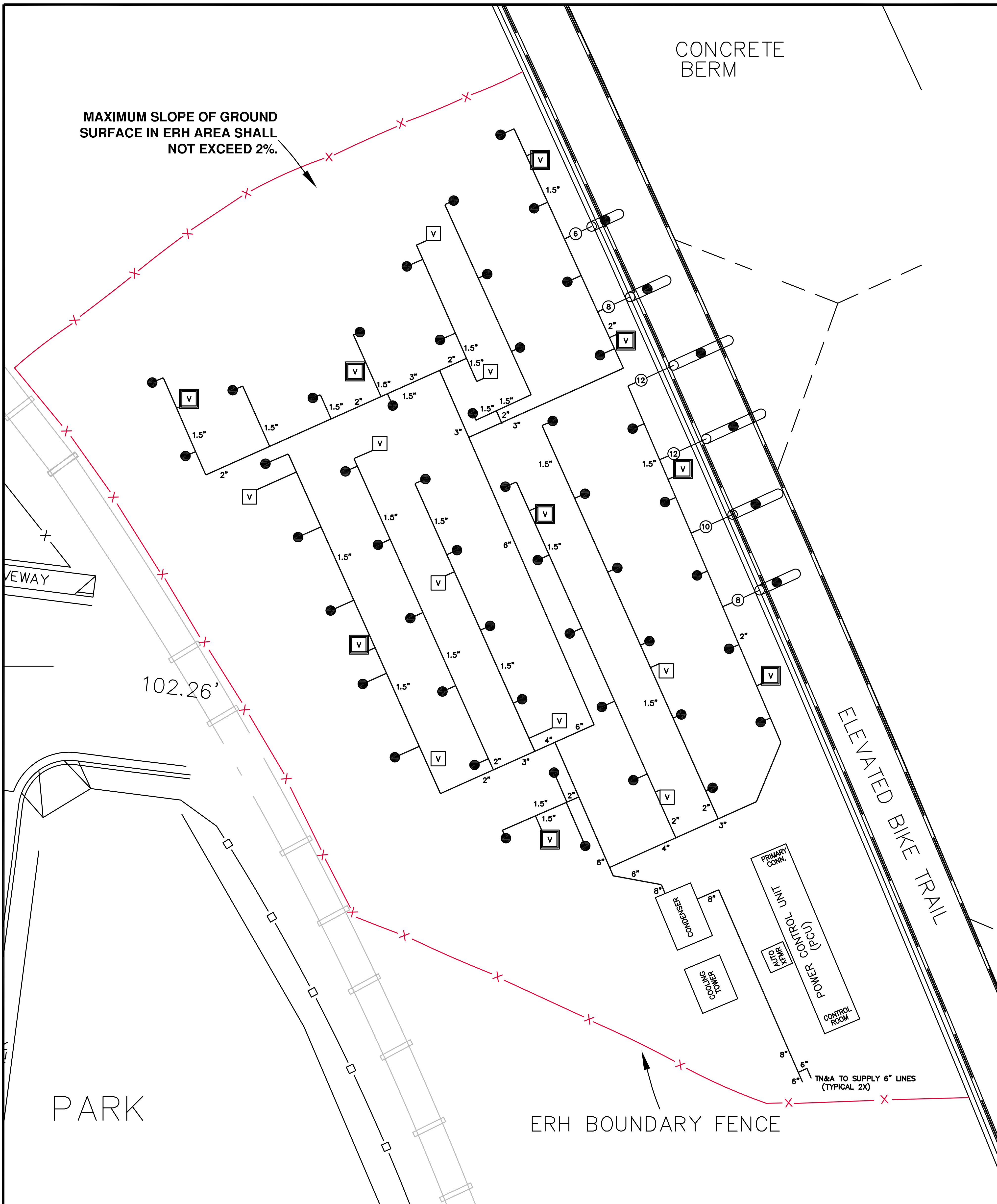
NO.	DATE	BY	REVISIONS

DESIGN BY:	DS
DRAWN BY:	DS
CHECKED BY:	GB
PROJECT MANAGER:	PB
DATE:	09-02-05
SCALE:	AS SHOWN
FIGURE NUMBER:	DRAFT
PROJECT NUMBER:	MAY-05

ERH VAPOR RECOVERY WELL DETAIL
80% DESIGN

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE, MAYWOOD, CA 90270

THERMAL REMEDIATION SERVICES, INC.



0 20 40

APPROXIMATE SCALE IN FEET

NOTES:
1. USE OF INFORMATION AND DATA FROM THIS DRAWING IS RESTRICTED TO PARTICIPANTS IN THE PEMACO SUPERFUND SITE. INFORMATION AND DATA FROM THIS DRAWING MAY NOT BE TRANSMITTED TO OTHERS WITHOUT THE EXPRESS WRITTEN CONSENT OF TRS.

CONFIDENTIAL

NO.	DATE	BY	REVISIONS

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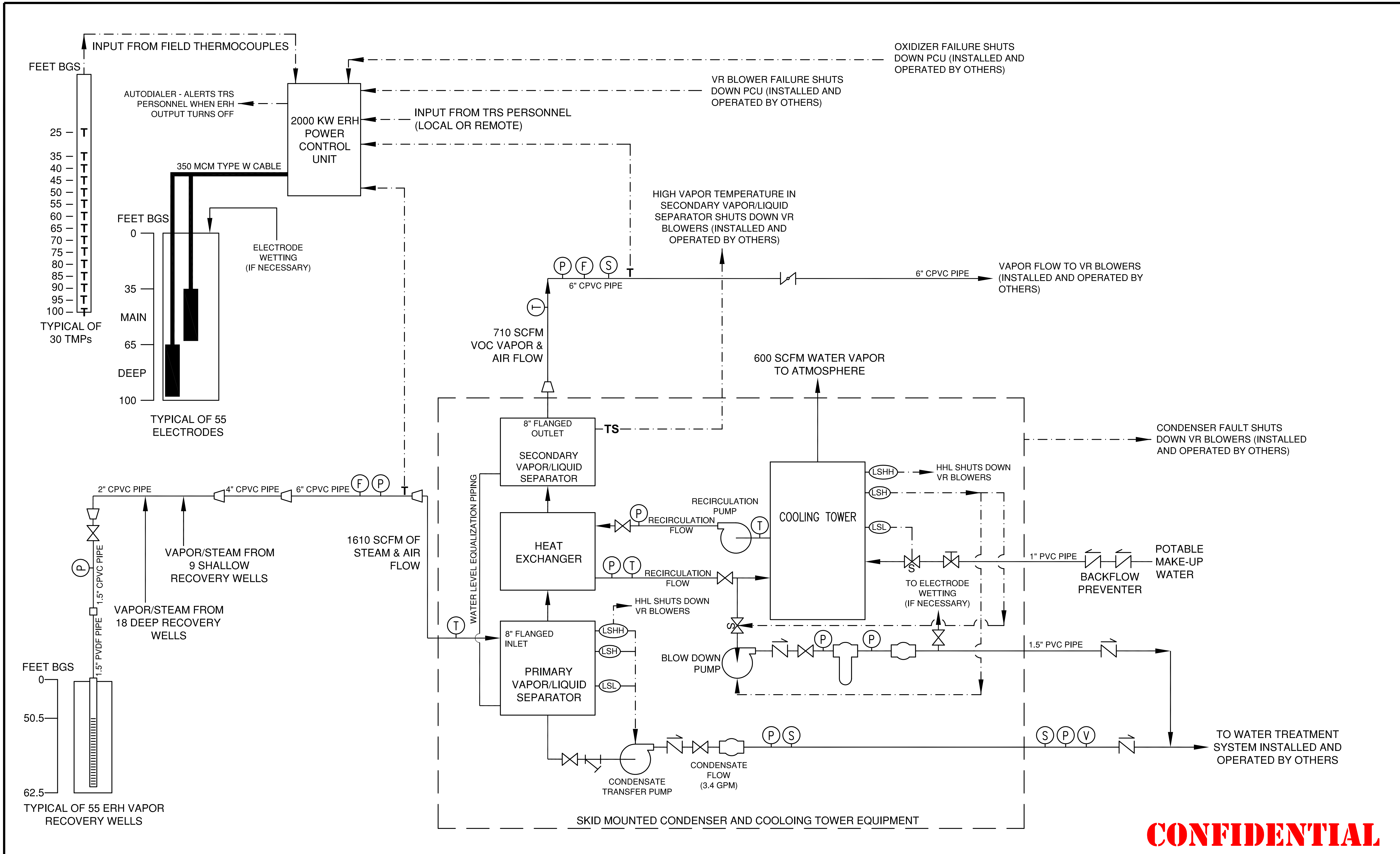
CHECKED BY:	GB
PROJECT MANAGER:	PB
DATE:	8-29-05
SCALE:	AS SHOWN
FIGURE NUMBER:	DRAFT
PROJECT NUMBER:	MAY-05
FILE NAME:	MAY05 PP 082905.eid

ERH VAPOR RECOVERY PIPING LAYOUT
80% DESIGN

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE, MAYWOOD, CA 90270

THERMAL REMEDIATION SERVICES, INC.



(P) PRESSURE INDICATOR	SOLENOID VALVE	PRESSURE REGULATOR	COUPLE
(T) TEMPERATURE INDICATOR	BALL VALVE	BUTTERFLY VALVE	(V) VACUUM BREAK
(S) SAMPLE PORT	CHECK VALVE	CARTRIDGE FILTER	TS TEMP. SWITCH
(F) FLOW METER/TOTALIZER	(LSHH) LEVEL SWITCH HIGH-HIGH	Y-STRAINER	
T THERMOCOUPLE	(LSH) LEVEL SWITCH HIGH	REDUCER BUSHING	
TOTALIZING FLOW METER	(LSL) LEVEL SWITCH LOW		

NOTES:

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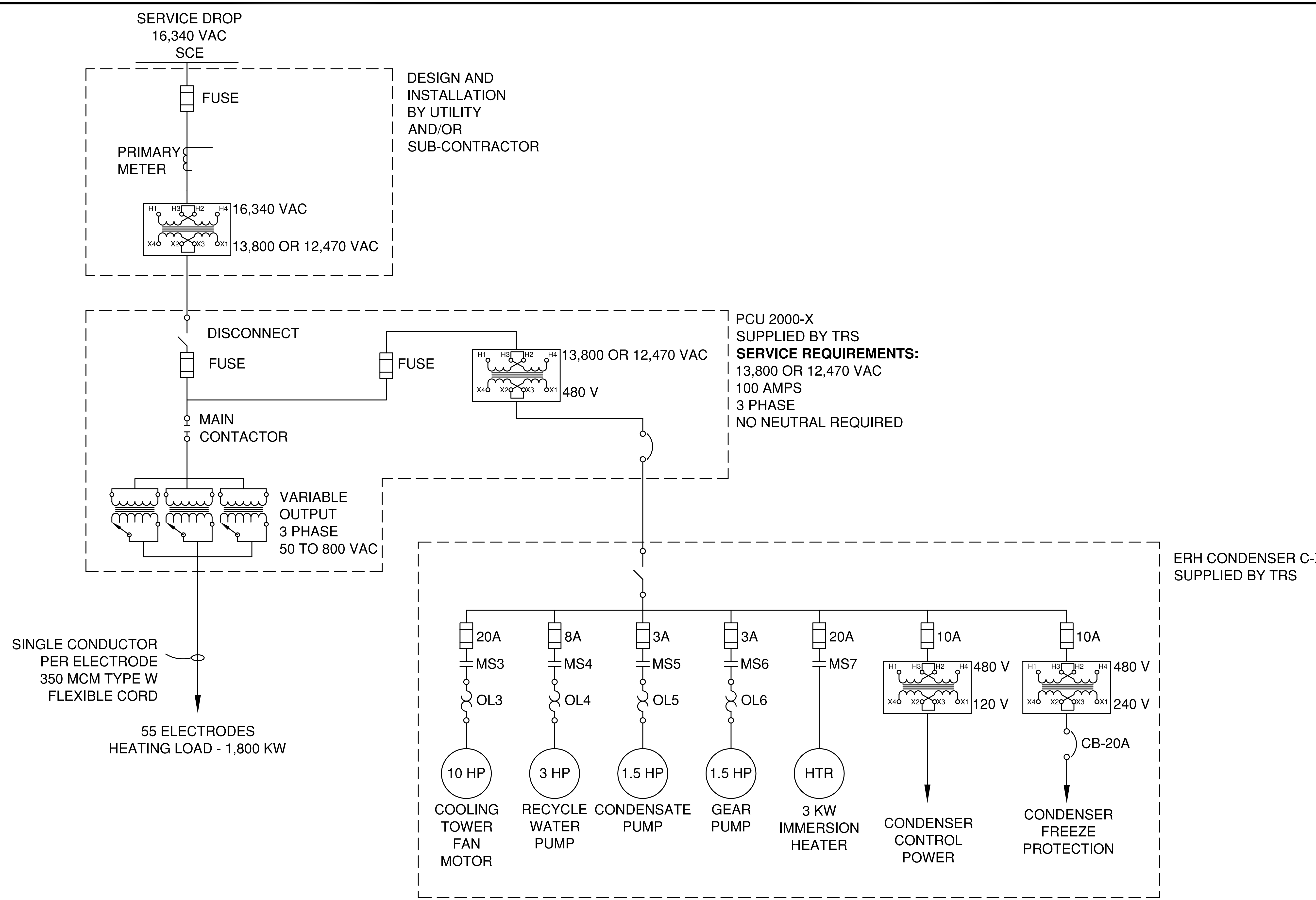
PROJECT MANAGER:	PB
DATE:	08-18-05
SCALE:	NTS
FIGURE NUMBER:	DRAFT
PROJECT NUMBER:	MAY-05
ENGINEERING APPROVAL:	XX

PROCESS & INSTRUMENTATION DIAGRAM
80% DESIGN

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE,MAYWOOD, CA 90270

THERMAL REMEDIATION SERVICES, INC.



NO.	DATE	BY	REVISIONS
dcf	10-07-05	DKS	CHANGED SERVICE DROP TO SITE CONDITIONS AND ADDED DETAIL TO PCU

DESIGN BY:	DKS
DRAWN BY:	DKS
CHECKED BY:	TP
PROJECT MANAGER:	PB
DATE:	10-07-05
SCALE:	NTS
FIGURE NUMBER:	80% DESIGN
PROJECT NUMBER:	MAY-05
ENGINEERING APPROVAL	DKS

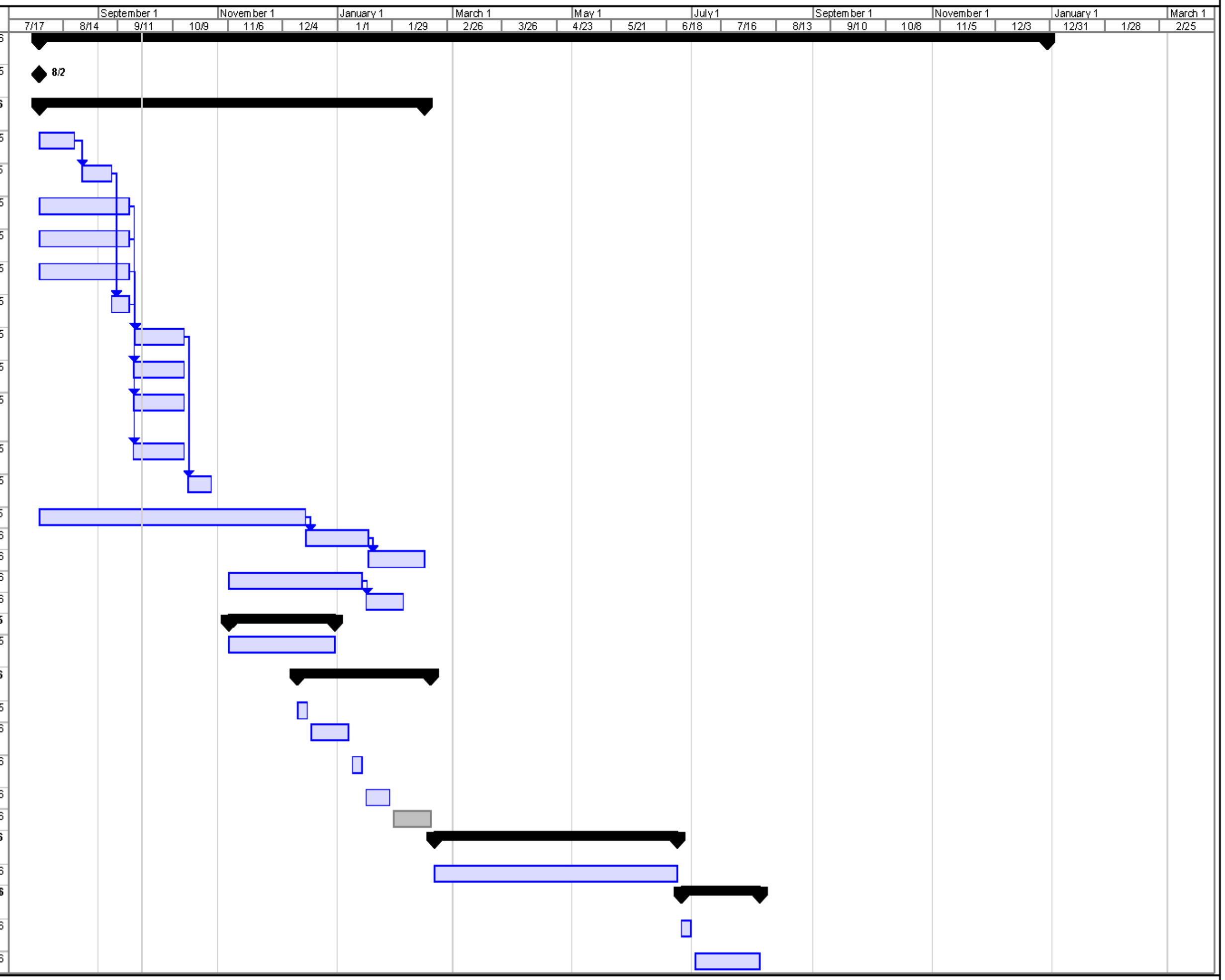
ERH ONE-LINE DIAGRAM
80% DESIGN

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE, MAYWOOD, CA 90270

THERMAL REMEDIATION SERVICES, INC.

Thermal Remediation Services
Project Schedule
Pemaco Superfund Site, Maywood, California

ID	Task Name	Duration	Start	Finish
1	**Project**	369 days	Tue 8/2/05	Fri 12/29/06
2	**Notice to Proceed**	1 day	Tue 8/2/05	Tue 8/2/05
3	**Design, Work Plans, & Permits**	**141 days**	**Tue 8/2/05**	**Tue 2/14/06**
4	*Conceptual Design Submittal*	14 days	Tue 8/2/05	Fri 8/19/05
5	*60% Design Submittal (Drawings and Report)*	11 days	Wed 8/24/05	Wed 9/7/05
6	*Draft Sampling/Monitoring and Analysis Plan*	34 days	Tue 8/2/05	Fri 9/16/05
7	*Draft Health & Safety Plan*	34 days	Tue 8/2/05	Fri 9/16/05
8	*Draft Remedial Action Work Plan*	34 days	Tue 8/2/05	Fri 9/16/05
9	*90% Design Submittal (Drawings & Report)*	7 days	Thu 9/8/05	Fri 9/16/05
10	*Draft Final Remedial Action Work Plan*	19 days	Tue 9/20/05	Fri 10/14/05
11	*Final Design Submittal(Drawings & Report)*	20 days	Mon 9/19/05	Fri 10/14/05
12	*Draft Final Sampling/Monitoring and Analysis Plan*	20 days	Mon 9/19/05	Fri 10/14/05
13	*Draft Final Health & Safety Plan*	20 days	Mon 9/19/05	Fri 10/14/05
14	*Final Remedial Action Work Plan*	10 days	Mon 10/17/05	Fri 10/28/05
15	*Draft O & M Plan*	98 days	Tue 8/2/05	Thu 12/15/05
16	*Draft Final O & M Plan*	22 days	Fri 12/16/05	Mon 1/16/06
17	*Final O & M Plan*	21 days	Tue 1/17/06	Tue 2/14/06
18	*Field As-Built Drawings*	50 days	Mon 11/7/05	Fri 1/13/06
19	*Final As-Built Drawings*	15 days	Mon 1/16/06	Fri 2/3/06
20	**Subsurface Installation**	**40 days**	**Mon 11/7/05**	**Fri 12/30/05**
21	*Drilling and Electrode Installation*	40 days	Mon 11/7/05	Fri 12/30/05
22	**Surface Installation and Start-Up**	**50 days**	**Mon 12/12/05**	**Fri 2/17/06**
23	*Mobilization*	5 days	Mon 12/12/05	Fri 12/16/05
24	*ERH Construction and Set-Up*	15 days	Mon 12/19/05	Fri 1/6/06
25	*VR System Construction and Set-Up*	5 days	Mon 1/9/06	Fri 1/13/06
26	*Start-Up*	10 days	Mon 1/16/06	Fri 1/27/06
27	*Readiness Review*	15 days	Mon 1/30/06	Fri 2/17/06
28	**ERH and VR System and Operation**	**90 days**	**Mon 2/20/06**	**Fri 6/23/06**
29	*Daily ERH Operations*	90 days	Mon 2/20/06	Fri 6/23/06
30	**Demobilization and Final Report**	**30 days**	**Mon 6/26/06**	**Fri 8/4/06**
31	*Soil Sampling and Demobilization*	5 days	Mon 6/26/06	Fri 6/30/06
32	*Final Report*	25 days	Mon 7/3/06	Fri 8/4/06



Project: Pemaco P271
Date: Fri 9/23/05

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

FIGURE 8: Project Schedule