SRSNE Site Group

Remedial Design Work Plan Attachment C

Thermal Treatment Performance Criteria

Solvents Recovery Service of New England, Inc.
(SRSNE) Superfund Site
Southington, Connecticut

November 2010

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Southington, Connecticut

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Date:
November 2010

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Executive Summary

The Thermal Treatment Performance Criteria Work Plan has been prepared to describe the scope and approach for performance monitoring of the In-Situ Thermal Desorption (ISTD), to determine the progress of the ISTD system, to demonstrate compliance with the applicable permit equivalency requirements, and to monitor the quality of any air or water discharges from the system.

Performance Criteria

Concentrations of volatile organic compounds (VOCs) within the Thermal Treatment Zone (TTZ) will be reduced to levels that are not indicative of the presence of pooled non-aqueous phase liquid (NAPL) from the ground surface to the top of bedrock. NAPL cleanup levels are shown in the document as Table C-1.

Well Field and Subsurface Monitoring

To monitor subsurface conditions, the centroid of 50 heater triangles will be monitored for temperature. Twenty-five additional pressure/vacuum and groundwater levels will be distributed evenly throughout the TTZ. Additional monitoring points will be located outside the TTZ.

Vacuum, temperature, flow and total VOCs will be monitored from the conveyance piping system during system operation. Data collected will be evaluated and used to determine modifications, if any, are required to optimize the treatment system.

Pressure, temperature, and VOCs will be monitored from select wells periodically during treatment operations to determine the variability of mass removal rates from different portions of the treatment zone. It will be of special interest to monitor conditions at selected wellheads during later phases of the remediation in order to identify areas that may not have been sufficiently remediated and to determine when to proceed with interim and performance soil sampling.

ISTD and Process System Monitoring

Various system components throughout the treatment system, including the effluent treatment system, will be continuously monitored through a Programmable Logic Controller (PLC) during thermal treatment to ensure the system is fully optimized and is operating within design safety limits. Additional measurements will be recorded daily by the TerraTherm field operator. Inlet and outlet vapor samples will be collected approximately every two weeks and analyzed for VOCs via United Stated Environmental Protection Agency (USEPA) method TO-15. Samples of condensate and NAPL may also be collected periodically and submitted for laboratory analyses.

Energy Balance Calculations

An energy balance will be periodically calculated for the TTZ to verify that the thermocouples are providing accurate representation of conditions throughout the thermal treatment zone and to assess the progress of heating.

Soil Sampling

Two interim sampling events will be conducted to evaluate VOC concentrations in soil when concentrations in the inlet vapor stream to the off-gas treatment system have decreased and temperatures within the TTZ have reached or exceeded the eutectic boiling point of NAPL. Approximately 30 soil samples will be collected after approximately 50-60 days of operation. Approximately 70 soil samples will be collected after approximately 90-110 days of operation. Estimates of mass removal will be based on screening-level sampling at several locations in the conveyance pipe system, at the treatment system, and to some degree by sampling individual extraction wells in critical areas of the TTZ. At this point, the USEPA may decide to continue thermal treatment within the TTZ.

Once the data from the interim soil sampling events indicate that VOC concentrations are sufficiently reduced, temperatures within the well field have achieved design temperatures, and well-field vapor samples verify that individual site segments are almost depleted, thermal treatment verification sampling will be conducted. The planned approach for verifying that ISTD has achieved the Interim NAPL Cleanup Levels involves collection of 100 soil samples from approximately 50 locations within the thermal treatment area.

This program may be modified based on the final delineation of the treatment area and spacing of the heater wells.

<u>Permit "Equivalency" Compliance Monitoring</u>

Although Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) on-site response actions are exempted by law from the requirement to obtain Federal, State, and/or local permits, as described above, samples will be collected to verify performance of the process treatment equipment and to document compliance with substantive provisions of Federal, State, and/or local permitting regulations that are Applicable or Relevant and Appropriate Requirements (ARARs).

1. Overview of Performance Criteria and Monitoring

1.1 Introduction

This document has been prepared on behalf of the SRSNE Site Group, an unincorporated association of Settling Defendants to a Consent Decree (CD) and Statement of Work (SOW) for the Remedial Design/Remedial Action (RD/RA) at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut (Site). The CD was lodged on October 30, 2008 with the United States District Court for the District of Connecticut in connection with Civil Actions No. 3:08cv1509 (SRU) and No. 3:08cv1504 (WWE). The CD was entered by the Court on March 26, 2009.

Section V.C.1 of the SOW states that the Remedial Design Work Plan describes in detail certain pre-design activities to be undertaken during the design of the thermal treatment remedy for the Site. Specifically, Section V.C.1.c of the SOW states that “a comprehensive set of criteria shall be developed to evaluate the performance of the in situ thermal technology during and after implementation.” This *Thermal Treatment Performance Criteria Work Plan* has been prepared to describe the scope and approach for performance monitoring of the In-Situ Thermal Desorption (ISTD) to determine the progress of the ISTD system, to demonstrate compliance with the applicable permit equivalency requirements, and monitor the quality of any air or water discharges from the system.

Specific objectives of the monitoring during treatment are:

- *Evaluate the performance of the below ground and surface components of the ISTD system.*

- *Provide data to document that Interim Non Aqueous Phase Liquid (NAPL) Cleanup Levels are attained in the thermal treatment zone.*

- *Provide data to evaluate the rate of mass removal from different segments of the treatment zone.*

- *Provide data to determine when appreciable recovery of NAPL contamination ceases.*

- *Demonstrate that the process discharge criteria have been maintained during operation of the ISTD system.*

- *Ensure that health and safety related parameters are observed during treatment*

To achieve these project objectives, the following activities will be implemented:

- Subsurface monitoring, including monitoring of temperature, vacuum/pressure and water level

- Well-field sampling and monitoring of flow rates and contaminant concentrations in individual segments of the conveyance pipes and at selected well heads

- Overall NAPL removal and vapor recovery loadings to the vapor treatment system

- System monitoring, including ISTD system progress and effluent treatment system monitoring

- Energy balance calculations

- Soil sampling, including baseline, interim and post-treatment sampling events

- Permit equivalency compliance monitoring

- Monitoring of health and safety related parameters

Each of the above mentioned activities are further described in this document.

1.2 Performance Standards Definition

The Performance Standards (provided in SOW Section IV.A.4) established for the Overburden NAPL Area at the SRSNE Site require that volatile organic compound (VOC) concentrations be reduced to levels that are not indicative of the presence of pooled or residual NAPL. The Interim NAPL cleanup levels shall be met from the ground surface to the top of bedrock throughout the thermal treatment zone (TTZ)[1], or as modified with United States Environmental Protection Agency (USEPA) approval during Remedial Design.

To achieve the Performance Standards, Interim NAPL Cleanup Levels must be achieved. These soil cleanup concentrations are presented in Table C-1.

Table C-1. Interim NAPL Cleanup levels in the TTZ

Contaminant	Interim NAPL Cleanup Level	Unit
Trichloroethylene	222	mg/kg
Tetrachloroethylene	46	mg/kg
1,1,1 - Trichloroethane	221	mg/kg
Ethylbenzene	59	mg/kg
Toluene	48	mg/kg
p/m-Xylene	70	mg/kg
o-Xylene	42	mg/kg

The objective of the thermal remediation at the SRSNE Site is to remediate the TTZ to levels at or below the values shown in Table C-1. The cleanup levels have to be obtained in every sample collected in the TTZ before the Performance Standards are considered fulfilled.

1.3 Criteria Triggering Soil Sampling to Determine if Performance Standards are Met

Two interim soil sampling events will be performed to evaluate reductions in soil concentrations as heating progresses. These sampling events will be initiated when concentrations of Contaminants of Concern (COCs) in the inlet vapor stream to the off-gas treatment system have reached consistently low

[1] Appendix B, RD/RA Statement Of Work, Solvents Recovery Service of New England, Inc

concentrations and temperatures within the TTZ have reached or exceeded the eutectic boiling point of the NAPL.

For DNAPL in an aqueous environment, boiling at the interface between the DNAPL and water occurs at a temperature significantly below the boiling point of either the DNAPL or pure water. The lowered boiling point is referred to as the eutectic boiling point. Where the two liquid phases are present together (i.e., share a common interface), the vapor pressure of each liquid contributes to the total system pressure. This results in boiling at the interface and creation of a gas phase that is composed of both DNAPL vapor and water vapor at temperatures below 100 °C (e.g., 73 °C for TCE and 87 °C for PCE when these NAPLs are in contact with water[2 3 4]).

Performance soil sampling will be initiated when the interim soil sampling events indicate that COC concentrations are sufficiently reduced, temperatures within the well field have achieved design temperatures, and well-field vapor samples verify that individual site segments are almost depleted in extractable COCs. The approximate mass removal will be estimated based on screening-level sampling at several locations in the conveyance pipe system, at the treatment system, and to some degree by sampling individual extraction wells in critical areas of the TTZ. At the time performance soil sampling is initiated, mass removal rates are expected to have diminished to an asymptotic level.

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[2] Davis, E. L. (1997): How Heat Can Accelerate In-situ Soil and Aquifer Remediation: Important Chemical Properties and Guidance on Choosing the Appropriate Technique. *US EPA Issue paper,* EPA/540/S-97/502.

[3] Heron, G., T. H. Christensen, T. Heron and T. H. Larsen (1998): *Thermally enhanced remediation at DNAPL Sites: The Competition between Downward Mobilization and Upward Volatilization,* Paper presented at the 1st International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 18-21.

[4] DeVoe, C., and K.S. Udell (1998). Thermodynamic and Hydrodynamic behavior of water and DNAPLs during heating, In *Proceedings from the First Conference on Remediation of Chlorinated and Recalcitrant Compounds*, May 18-21, Monterey CA, Battelle Press 1 (2): 61-66.

The SRSNE Site Group will make the final recommendation for Performance Sampling when a holistic view of all the available data indicates that the Interim NAPL Cleanup Levels have been met in all or the majority of the TTZ. More detail is provided in Section 8.2.

1.4 Evaluation of Appreciable Recovery of NAPL

The objective of the Interim NAPL Cleanup Levels established for the Overburden NAPL Area are to reduce soil concentrations to levels that are not indicative of the presence of pooled or residual NAPL. At the time the Interim NAPL Cleanup Levels are attained in the TTZ, an evaluation will be conducted to determine whether appreciable amounts of NAPL contamination continue to be recovered from portions of the treatment zone within the Overburden NAPL Area. The data and procedures that will be used to determine this are discussed in detail in Section 9.3. This evaluation and its findings will provide the basis for the USEPA to determine whether there is a need for continued operation of portions of the thermal remedy where recovery of appreciable NAPL is determined to be occurring. Per Section IV.A.4 of the SOW, the USEPA has discretion to require continued operation of the ISTD system beyond the point that interim NAPL cleanup goals are achieved if it determines that appreciable NAPL recovery continues to occur. The maximum duration of extended operation is equal to the amount of time required to achieve the interim NAPL cleanup levels.

2. Web Based Project Portal

During the thermal operation a significant quantity of data will be automatically collected by the data acquisition system to monitor the subsurface heating progress and performance of the vapor recovery and effluent treatment systems. Furthermore, daily field reports and status reports will be generated by the TerraTherm operators on-site. Data extracted from these will be included, as appropriate, in Monthly Progress Reports.

The SRSNE project will utilize a secure web-based application created and hosted by de maximis Data Management Solutions (ddms) called Project Portal™. Project Portal is an online resource sharing platform which the team can utilize to view, download or upload project documents and data. Project Portal was specifically designed for use on large environmental projects involving a multitude of stakeholders. The system contains specialized modules for use by the team including Document Management, Project Calendar, queryable Environmental Database, GIS (for mapping) and Project Tables.

During operation, TerraTherm and ddms will continually post important documents and data to Project Portal throughout the project for access by other team members thereby precluding the need for email distributions. TerraTherm will post field data forms and reporting documents to the Document Management Module and ddms will be responsible for populating the Environmental Database with field and system measurement and analytical data. Team members will be able to utilize the Environmental Database to query and retrieve recently collected environmental and system data. These data can then be trended temporally via an integrated graphing package or mapped utilizing the integrated GIS Module. Data may also be exported and downloaded in common file formats (e.g., Excel, CSV, Shapefile, Google Earth KML) for post processing and analysis outside of the Project Portal system.

The data that will be made available on the Project Portal web site is expected to include:

- Subsurface temperatures:
  - Average temperature by depth

- Graphs of temperature trends over time

- Subsurface pressure and water levels
  - Charts of data from 15 individual pressure/vacuum and water level monitoring wells

- Energy and water balances
  - Energy balance showing energy injected by the ISTD system and estimated energy extracted with effluent fluids
  - Mass balance showing estimated water extracted from the thermal treatment zone

- CVOC mass removal
  - Rate of CVOC removal based on available analytical samples, PID screenings, NAPL readings, and other data.
  - Cumulative mass removed.

- Daily field reports and status reports (available for download).

- Site pictures showing construction progress and operational features (available for download).

These data and interpretations will be posted at a minimum on a weekly basis. The data will be checked for quality prior to posting on the web-site.

3. Well-Field and Subsurface Monitoring

Separate temperature monitoring points and combined vacuum/pressure and water level monitoring points will be installed within the thermal well-field to monitor the effects of the heater and vacuum extraction wells on subsurface conditions including:

- Temperature,
- Vacuum/Pressure, and
- Potentiometric Surface (i.e., depth to the water table).

In situ temperature monitoring will be focused on locations within the TTZ that are expected to heat-up the slowest. These locations are the centroids of the triangles formed by the heater well array which represent locations farthest from any heater. Vacuum/pressures and water levels will be monitored to document pneumatic control and drawdown for hydraulic control.

In addition, some temperature and pressure monitoring points will be located outside the TTZ, documenting control of heat and fluids on the outer boundary of the TTZ.

3.1 Subsurface Temperature Monitoring

A total of 50 temperature monitoring points (approximately 1 for every 12 heater wells) will be installed. Each temperature monitoring point will include a string of between 4 and 7 thermocouples that will provide temperature data from the ground surface to the top of bedrock, with varying depths and number of sensors depending on the overburden thickness. These monitoring points will be distributed evenly throughout the entire well-field on the following basis:

- 60% (30) at centroid locations (i.e., center of triangle formed by three heater wells);
- 20% (10) located 3 feet (ft) from heater wells, and
- 20% (10) located 1 ft from heater wells.

The centroid temperature monitoring points will provide information on the progress of heating the regions of the TTZ that are located farthest from the heaters. The monitoring points located 1 and 3 ft from the heater wells will provide important information on the temperature gradients adjacent to the heaters.

This distribution of temperature monitoring points will provide the data necessary to monitor:

- The progress of the ISTD system in heating the subsurface;
- The uniformity of the heating; and,
- The impact, if any, of groundwater flow through the TTZ.

The subsurface temperatures will automatically be measured daily, and the data will be transmitted and stored in a central database and subsequently made available for viewing and analysis on the project portal on a weekly basis.

3.2 Subsurface Vacuum/Pressure and Water Level Monitoring

A total of 25 combined vacuum/pressure and water level monitoring points will be distributed evenly throughout the thermal wellfield in order to provide information on the vacuum/pressure of the vadose zone and the potentiometric surface within the TTZ. These wells will be screened across the water table from 2 to 8 ft bgs and be equipped with dual-port well heads that will allow measurement of both the vacuum/pressure and water level at each location.

The vacuum/pressure measurements will be used to assess and adjust the vapor extraction system to maintain capture of steam and contaminant vapors. The water level measurements will be combined with data from existing overburden and bedrock monitoring wells around the TTZ to assess horizontal and vertical groundwater gradients within and around the treatment area. This assessment will be used to evaluate the degree of hydraulic capture of the ISTD system.

Monitoring of pressure and water levels will be performed at a minimum of once per week. These data will be posted on the Project Portal ©.

3.3 Conveyance Pipe Sampling and Monitoring

The conveyance piping sampling and monitoring will be done at specified locations in the vapor piping system that runs from the well field to the treatment system.

3.3.1 Pressure

The vacuum in the conveyance piping system will be monitored at selected locations to balance and distribute the overall capacity of the treatment system as needed throughout the entire well field. Vacuum monitoring points will be placed at the end of the vapor collection manifold laterals, where they join the main trunk of the manifold system, and at the inlet to the effluent treatment system.

3.3.2 Temperature

Temperatures will be monitored in the conveyance pipe system at the same locations where vacuum monitoring points are located. In connection with vacuum monitoring data, the observed temperatures during treatment will be used to optimize the extraction strategy for each site segment. Temperatures in the pipe system will be measured either a manual thermometer gauge or by a transmitting thermometer connected to an automated data logging system.

3.3.3 Flow

Vapor flow rates will also be monitored in the conveyance pipe system and used to optimize the extraction of vapors from the treatment zone. The collected flow data will be used with PID screening results of vapor samples from selected locations to estimate the mass removal rate from the entire well field and portions thereof.

3.3.4 PID screening

The purpose of PID screening is to determine the origin of the overall mass load treated by the treatment system and to identify parts of the well field that require special focus.

The PID conveyance pipe sampling and monitoring will be a special focus at the end of the thermal operation and will be used in combination with all available data to decide when the remediation goals have been met and when to proceed with collection of interim and final performance soil samples.

The PID screening of vapor samples from the vapor collection piping will also be used to evaluate if appreciable NAPL is being recovered from portions of the treatment zone following attainment of the Interim NAPL Cleanup Levels.

Vapor samples will be collected at selected monitoring points in Tedlar bags using a pump and allowed to cool to a temperature less than 25 °C. The vapor in the Tedlar bag will then be analyzed using a handheld Photo-Ionization Detector (PID) (MiniRae 2000 or similar) equipped with either a 10.6 or 11.7 eV lamp and calibrated to 100 ppm isobutylene and reported as total VOCs. The PID readings will be converted to actual total VOC concentrations and concentrations of specific VOCs based on site specific correction factors. The site specific correction factors will be developed based on the correlation between PID readings and analytical laboratory results (e.g., TO 15) of the vapor samples.

3.4 Well-Head Monitoring

The following will be periodically monitored at selected vapor extraction well-heads during operation of the thermal remediation system: pressure, temperature, and VOC concentrations (by PID-screening of a vapor sample). Well-head monitoring will be performed periodically during operations to determine the variability of mass removal rates from different portions of the treatment zone. It will be of special interest to monitor conditions at selected well-heads during later phases of the remediation in order to identify areas that may not have been sufficiently remediated and to determine when to proceed with interim and performance soil sampling. Well-head monitoring will also be used to evaluate if and where appreciable NAPL is being recovered following attainment of the Interim NAPL Cleanup Levels.

3.4.1 Pressure

The pressure at selected well-heads will be monitored to determine what vacuum is applied to each well and to ensure sufficient vapor extraction at each extraction well.

3.4.2 Temperature

Temperatures will be monitored at selected well-heads and used together with pressure monitoring data to optimize the extraction of vapors from each well. Since every vapor extraction point is located close to an ISTD heater, temperatures will be used to indicate the heat distribution from the matching heater well.

3.4.3 PID screening

Vapor samples will be collected at selected well-heads for PID screening during the latter half of the heating phase, if vapor sampling of the manifold laterals indicate that some portions of the TTZ are removing substantially more mass than others. The results of the well-head vapor sampling will be used to optimize the recovery of mass from the high-mass portions of the TTZ. Well-head samples may also be collected as part of the evaluation of recovery of appreciable NAPL in order to pinpoint where the mass is coming from and to focus any additional treatment.

The vapor samples will be collected and screened following the same procedures outlined in Section 3.3.4 describing collection and screening of vapor samples from the conveyance piping.

3.5 Procedures

Procedures associated with implementing the Well Field and Subsurface Monitoring program described above will be developed and presented as part of the design of the ISTD approach and the associated Remedial Action Work Plan and Project Operations Plan. This will include specification of the locations and frequency of sample collection and/or measurement, and the field and analytical methods.

3.6 Reporting

Data generated as part of the Well field and Subsurface Monitoring program will be posted to the Project Portal© web site, and included, as appropriate in Monthly Progress Reports. These data will also be presented in the Completion Report documenting the ISTD activities.

4. ISTD and Process System Monitoring

The ISTD effluent treatment system will generally include the following inputs, treatment components, and discharges:

1) Inlet vapor stream from ISTD well field (steam, air, and COC vapors).

2) Separation of steam from air and COC vapors (heat exchanger cooled by a cooling tower, and moisture knockout).

3) Removal of COCs from vapor stream and destruction. Based on preliminary analyses, the initial concept for removal and destruction of the COCs is thermal oxidation. The exact method used to remove COCs from the vapor stream will be further evaluated in the Vapor Treatment Needs Evaluation Work Plan.

4) Removal of HCl formed due to thermal decomposition of COCs (wet scrubber).

5) Discharge of treated vapor stream to atmosphere.

6) Condensate from moisture knockout will be passed through a phase separator to recover any NAPL from the water.

7) NAPL will be removed from the separator and stored separately for off-site disposal.

8) Aqueous portion of condensate will be sent to an air stripper to remove COCs

9) Treated condensate will be sent to the Hydraulic Containment and Treatment System (HCTS) for further treatment and discharge to the Quinnipiac River.

10) Blow down from the scrubber and the cooling tower (high salinity) will be discharged to a sewer connection and sent to the POTW.

11) COC vapors removed by the air stripper will be fed back into the inlet side of the thermal oxidizer for treatment.

The system will be designed so the following process parameters can be measured:

- Energy delivered to the subsurface by the ISTD heaters, and removed in the form of steam, hot air, and hot water.

- Mass of COCs removed from the treatment zone:

- NAPL volume recovered as a liquid by the treatment system (collected at the gravity separator).

- COC mass present in the condensate stream based on aqueous samples collected prior to the air stripper.

- COC mass in the non-condensable vapor stream based on vapor samples at the inlet to the thermal oxidizer (after the heat exchanger and moisture knockout but before addition of off-gas from the air stripper).

- Water removed from the treatment zone as steam (percentage of pore water present in the treatment zone removed during remediation). Measurement will be based on condensate produced from moisture knock out.

- Operating condition of each component of the treatment system (e.g., temperature, pressure, flow, pH, salinity).

- Other monitoring parameters as required by the water and vapor system discharge permits.

Furthermore, a Programmable Logic Controller (PLC) will log selected system operating data including relevant temperatures, pressures and flows, as well as the position of safety sensors and controls such as pressure switches, level switches, and motor operated valves. The PLC will be accessible remotely through an internet connection, allowing engineering staff to access the PLC and observe the same operating information available to the field staff. Alarms and shut-down conditions will lead to notification of the lead operator and project manager, so that they can respond, correct the issue, and restart the system.

4.1 ISTD System Progress Monitoring

In addition to the data automatically collected by the PLC, the TerraTherm Operator will manually collect the following data on a daily basis:

- ISTD system power usage;
- ISTD energy delivered to each site segment;
- Heater temperatures and set points.

These data will be used to optimize energy delivery, and to establish mass- and energy-balance calculations for the project.

4.2 Effluent Treatment System Monitoring

The effluent treatment system will be monitored closely during operation in order to optimize the treatment and run the system properly. Furthermore, some of the recorded parameters are used to notify the TerraTherm operator in case operating conditions exceed certain safety levels.

All recorded data will be transmitted to TerraTherm's main office on a daily basis for review by TerraTherm's Project Manager and Project Engineer. Through this daily review, TerraTherm will be able to make adjustments to system components to optimize treatment progress.

The monitoring and data collection for the effluent treatment system is described below.

4.2.1 Process System Temperatures

Process system temperatures will be monitored in selected key vapor and liquid streams. The monitoring will include recording of temperatures of extracted liquids and vapors from the well field at different places through the treatment system, recording of cooling water temperatures in the heat exchanger, temperatures in the thermal oxidizers and temperatures of discharged liquids and vapors.

The inlet temperature of extracted fluids from the well field will be used in the energy balance to estimate the amount of energy extracted from the treatment zone.

4.2.2 Process System and Manifold Vacuums/Pressures

Vacuum and pressure will be monitored throughout the treatment system (on both sides of the blowers), and used to document proper function of the units, and to indicate if partial blockage or leaks occur. The pressure is also used for the energy balance calculations related to the vapor streams.

4.2.3 Process System Flow Measurements

Flows in both vapor and liquid streams will be measured at certain locations throughout the process system. Flow measurements are used as input for the energy balance and to calculate removal rates for COC's in the vapor and liquid phase. Furthermore, relevant flow data will be collected to document proper function of the treatment units and for permit reporting requirements.

4.2.4 Vapor PID Readings (inlet and outlet)

Daily PID readings will be conducted on the vapors coming into the treatment system and the vapors discharged to the atmosphere.

The vapor samples will be collected and screened following the same procedures outlined in Section 3.3.4 describing collection and screening of vapor samples from the conveyance piping.

The samples for laboratory analysis will be periodically collected (e.g., once every two weeks) concurrently with the daily PID sampling to allow direct comparison of the results.

4.2.5 Power and Gas Usage

Power and gas usage is recorded to keep track of energy used by the treatment system. A separate meter will be used to record the ISTD power input to the site. The amount of gas used by the oxidizers will indicate how close to their maximum capacity they are running, and to estimate the fuel value of the extracted contaminants. This, in turn, will be used as a check on other indicators of mass removal rate, such as incoming vapor concentrations and the consumption of caustic for scrubbing acid gases.

4.2.6 Wet Scrubber Operating Parameters

Important wet scrubber operating parameters like caustic usage, pH, temperatures and pressures are monitored in order to optimize the running of the scrubber system. The usage of caustics indicates how the thermal oxidizers are running, and how much COC is being recovered and destroyed in the oxidizers.

4.2.7 Sampling for Laboratory Analysis

As described above, inlet and outlet vapor samples will be periodically collected for laboratory analysis (e.g., TO-15). These samples will provide the basis for evaluating the efficiency of the Air Quality Control System (AQC) and estimating the mass of COCs removed. Furthermore, these data, together with the daily PID screening of the inlet and outlet vapor streams will be used to establish the correlation between the laboratory data and the PID readings. The correlation will be used to develop site-specific correction factors for the PID readings so that the concentrations of COCs in the inlet and outlet vapor streams can be estimated from the PID data.

The exact sampling locations will be determined once the Process and Instrumentation Diagram is developed for the AQC. Sampling locations, methods, and intervals will be described in the Remedial Action Work Plan and the Sampling and Analysis Plan.

In addition to the process vapor samples, samples of condensate and any NAPL that is produced will be periodically collected and submitted for laboratory analysis. These data will be used to determine the total amount of mass removed from the treatment zone. Samples of condensate before and after treatment will also provide information on the removal efficiency of the liquid treatment system and the characteristics of the water discharged to the sanitary sewer. The NAPL samples will be collected from the NAPL collection tank and submitted for compositional analysis (e.g., VOCs, SVOCs, PCBs, GRO/DRO, etc. as needed to characterize the material for offsite disposal). Condensate and NAPL sampling locations, methods (field and analytical), and intervals will be described in the Remedial Action Work Plan and the Sampling and Analysis Plan.

4.3 Procedures

Procedures associated with implementing the ISTD and Process System Monitoring program described above will be developed and presented as part of the design of the ISTD approach and the associated Remedial Action Work Plan and Project Operations Plan. This will include specification of the locations and frequency of sample collection and/or measurement, and the field and analytical methods.

4.4 Reporting

Data generated as part of ISTD and Process System Monitoring will be posted to the Project Portal web site, and provided, as appropriate, in the Monthly Progress Reports. These data will also be presented in the Completion Report documenting the ISTD activities.

5. Energy Balance Calculations

During operations an energy balance is kept for the treatment area using the following data:

- Energy delivered to the ISTD heaters (from meter readings and power loads on the heater circuits);
- Energy removed in the form of entrained liquid from the well field (estimated based on liquid rates and liquid line temperatures);
- Energy removed in the form of steam (estimated based on the vapor extraction manifold temperature and estimated flow-rate based on pitot tube flow readings in the manifold lines);
- Energy removed in non-condensable air (estimated from total treatment system vapor flow rate); and
- Estimated heat losses.

The energy balance returns an average heating rate (in degrees per day) and a calculated average treatment zone temperature. These numbers are compared to the design numbers (energy delivery, average temperature) and the observed subsurface temperatures (thermocouple measurements from the 50 temperature monitoring wells). An energy balance will be periodically calculated for the TTZ to verify that the thermocouples are providing accurate representation of conditions throughout the thermal treatment zone and to assess the progress of heating.

During operation TerraTherm and ddms will post the results of the energy balance calculations on the SRSNE Project Portal on a weekly basis.

5.1 Power Injected

The total power delivered to the site using the ISTD heater wells will be determined from readings of electric meters.

5.2 Energy Stored

The thermocouple data will provide detailed information on the heat-up of the subsurface. These data will be used to determine the amount of energy stored in the subsurface. Energy stored in soil is equal to the product of soil temperature increase times heat capacity of soil times mass of soil. Assumptions of porosity and water saturation will be used to estimate the heat capacity of the TTZ.

5.3 Energy Removed

Energy will be removed from the TTZ in the form of vapor and hot water entrained with the extracted vapor. The hot vapor from the extraction wells will consist of steam, air and VOCs. For air and water, the energy fluxes are determined by multiplying the flow rate times a heat capacity times the fluid temperature. For steam, it is determined as a flow rate times the specific enthalpy of the steam (heat of condensation). The flow is determined as the sum of the condensate volume and the water moisture carried to the oxidizers. The condensate volume is expected to make up more than 95% of the water extracted as steam from the subsurface.

Energy removed with the VOCs cannot be separated from the energy removed in the steam and air, but the total energy removal will include energy removed with the VOCs. The fraction removed with the VOCs will be relatively small compared to the energy removed as steam.

Energy balance calculations will be posted to the Project Portal web site. Results of the energy balance evaluations will also be presented in the Completion Report documenting the ISTD activities.

6. Soil sampling

In order to determine the effectiveness of the ISTD treatment within the footprint of the treatment area, soil sampling will be performed. Soil samples will be collected during operation of the ISTD system to evaluate the progress of the soil treatment, and following completion of the treatment, to verify attainment of the Interim NAPL Cleanup Levels.

6.1 Interim Soil Sampling Events

Interim drilling and sampling events will be used to document remedial progress and to identify potential areas that may require additional treatment or modifications to the heater well network. Hot sampling techniques will be used to sample zones that have achieved target temperatures and are expected to have been depleted in mobile DNAPL, and zones that resist heating and may need additional focus.

Two (2) interim sampling events have been scheduled during operation. The time for implementing the interim sampling events will be determined during operation based on review of operational parameters. The interim sampling will be implemented when available data such as temperatures in the target treatment, contaminant recovery rates, and PID screening results indicate that important information can be obtained by collecting interim samples. Target temperatures are not expected to be achieved fully in the thermal treatment zone at the first sampling event and areas lagging behind in heating and boiling are still expected at the second sampling event.

Procedures associated with implementing the interim sampling efforts described below will be developed and presented as part of the design of the ISTD approach and the associated Remedial Action Work Plan and Project Operations Plan. This will include descriptions of the drilling method and soil handling procedures.

In general, the sampling procedures will involve the following:

1. Soil borings will be advanced at the selected locations, and soil sample(s) will be collected from the pre-determined depths. Soil sample coring devices will be chilled to room temperature prior to opening by placing the sample core devices in ice trays. Specific procedures for drilling, sampling,

and processing of high-temperature soil samples will be further developed and provided as part of the detailed design of the ISTD approach.

2. Soil samples will be obtained in approximately 6-inch lengths (sufficient for obtaining 3 Encore™ samplers for VOC analysis) centered at the pre-determined sample depths. The use of pre-calculated sample depths will minimize sample collection time and VOC loss. However, if visible staining, sheen or NAPL is readily observed in the sampler, such visibly impacted material will be targeted for sampling in lieu of the pre-determined sample.

Analytical data generated as part of the ISTD verification sampling will be posted to the Project Portal web site. Results of the interim sampling will also be presented in the Completion Report documenting the ISTD activities.

6.1.1 Interim Soil Sampling Event 1

Approximately 30 soil samples will be collected at selected locations and depths (expected 15 locations with two depths each) near existing temperature monitoring locations, where the temperatures are known. These samples will represent spots suspected of hosting DNAPL at the start of the project, and will represent locations that have been heated to the eutectic point, above it, and to boiling temperatures. Some locations will represent areas that have seen less than average heating, in order to decide whether intervention is necessary.

Sampling event 1 is expected to take place after approximately 50 - 60 days of operation. The time for implementing the interim sampling events will be determined by TerraTherm, in consultation with the Project Coordinator, during operation based on available operational data.

6.1.2 Interim Soil Sampling Event 2

Approximately 70 soil samples will be collected, at selected and random locations and depths. The selected locations will include repeat sampling of some of the same spots sampled in sampling event 1 to evaluate progress. Other samples will represent random locations concentrated around the centroids between the heaters as used for the final performance sampling later, to illustrate progress towards the remedial goals.

Sampling event 2 is expected to be conducted after approximately 90 - 110 days of operation. The time for implementing the interim sampling events will be determined by TerraTherm, in consultation with the Project Coordinator, during operation based on available operational data.

6.2 Thermal Treatment Verification Sampling

As described in preceding sections, various operational parameters will be monitored in the course of ISTD operations to assess the progression of the treatment. Once a determination is made that the treatment goals have very likely been met based on monitoring of these parameters, including the results of the interim sampling events, a soil sampling program will be performed to verify that the thermal treatment has resulted in achievement of the applicable Performance Standards. This section identifies a preliminary approach for soil sampling to confirm that the ISTD activities have achieved the Interim NAPL Cleanup Levels, which are specified in Section IV.A.4 of the SOW. These levels were calculated using site-specific data, where available, and conservative literature values, and apply from the ground surface to the top of bedrock throughout the thermal treatment zone. These levels represent the point at which soil concentrations are not indicative of the presence of pooled or residual NAPL. Accordingly, the goal of the ISTD is to achieve soil concentrations within the overburden NAPL area that equal to or lower than the following:

- Trichloroethylene (TCE) – 222 parts per million (ppm)
- Tetrachloroethylene (PCE) – 46 ppm
- 1,1,1-Trichloroethane – 221 ppm
- Ethylbenzene – 59 ppm
- Toluene – 48 ppm
- p/m-Xylene – 70 ppm
- o-Xylene – 42 ppm

The planned approach for verifying that ISTD has achieved the Interim NAPL Cleanup Levels involves collection of soil samples from approximately 50 locations within the thermal treatment area. The approach described below is preliminary based on two primary factors:

1. The target limits to which ISTD will be applied in the northwest portion of the former Operations Area are subject to further assessment as described in the *Overburden NAPL Delineation Plan*, which is provided as an attachment to the RDWP.

2. The specific ISTD well spacing/location array is subject to further assessment as part of the detailed design of the ISTD component of the remedy.

The approach specified herein reflects the presumed ISTD application area shown in Figure C-1. The approach also reflects the anticipated use of a 14-foot spacing for thermal heating wells. To the extent that these factors are modified during the pre-design and design processes, the verification approach will be modified and presented as part of the design of the ISTD component.

6.2.1 Scope

The preliminary approach for verifying that soils within the TTZ have met Performance Standards is as follows:

1. A grid will be created to produce approximately 50 boring locations covering the overburden NAPL area. The boring locations will be distributed uniformly throughout the treatment zone (see Figure C-1).

2. During implementation, the surface of the ISTD area will be partially covered with various equipment and controls, including electric cables, well heads, and piping and headers associated with the vapor collection system. Given the presence of this equipment, it may not be possible for a drill rig to access and drill at the precise centroids among the thermal wells. Accordingly, target sample locations may be modified based on field conditions to an accessible location that is nearest the target centroid location and at least 4 feet from any thermal well.

3. At each planned soil boring location, the overburden thickness will be estimated based on existing boring data. The overburden thickness in the overburden NAPL area ranges from approximately 5 to 29 feet, with an average thickness of approximately 16 feet. The elevation contours for the bedrock surface have been interpreted based on existing boring data and

are shown on attached Figure C-2. This data, in combination with additional depth-to-bedrock data generated during the thermal well installation program, will be used to estimate the depth to bedrock at each location on the verification sampling grid. The target number of samples to be obtained from each boring will be determined based on the estimated overburden thickness as follows:

a. 5-10 feet – 1 sample
b. >10 to 20 feet – 2 samples
c. >20 feet – 3 samples

4. The average number of samples per boring is expected to be approximately 2, producing a total of approximately 100 compliance soil samples.

5. For each boring, the total estimated boring depth (depth to rock) will be divided into equal length increments, one per required soil sample, and a random depth for sampling within each depth increment will be calculated. For example, if the bedrock is expected to be 13 feet deep at a boring, the two equal increments will be from ground surface to 6.5 feet deep, and from 6.5 to 13 feet deep. Within each 6.5-ft long increment, random depths for sampling will be calculated. Figure C-3 shows cross section locations, and Figure C-4 shows an example of random-depth samples determined as described above and plotted on two intersecting cross sections.

6. Soil borings will be advanced at the grid locations, and soil sample(s) will be collected from the pre-calculated depth(s). Soil sample coring devices will be chilled to room temperature prior to opening by placing the sample core devices in ice trays. Specific procedures for drilling, sampling, and processing of high-temperature soil samples will be further developed and provided as part of the detailed design of the ISTD approach.

7. Soil samples will be obtained in approximately 6-inch lengths (sufficient for obtaining 3 Encore™ samplers for VOC analysis) centered at the pre-determined sample depths, within each of the 50 borings. The use of pre-calculated sample depths will minimize sample collection time and VOC loss. However, if visible staining, sheen or NAPL is readily observed in the

sampler, such visibly impacted material will be targeted for sampling in lieu of the pre-determined sample.

8. A total of approximately 100 samples will be obtained for analysis of the selected VOCs for which Interim Cleanup Levels have been established, as indicated above.

9. If any verification soil sample exceeds the cleanup level, thermal treatment will be continued in the area of the sample(s) with exceedance(s).

10. After further thermal treatment, the same locations and depths of prior non-attainment of the Interim Cleanup Levels will be re-sampled. If any exceedances of Interim Cleanup Levels are identified, Steps 5 through 9 will be repeated. Otherwise, Interim Cleanup Levels will be deemed to have been attained at of the date collection of the final verification sample.

6.2.2 Procedures

Procedures associated with implementing the verification sampling approach specified above will be developed and presented as part of the design of the ISTD approach and the associated Remedial Action Work Plan and Project Operations Plan. This will include descriptions of the drilling method and soil handling procedures.

6.2.3 Reporting

Analytical data generated as part of the ISTD verification sampling will be posted to the Project Portal web site, and discussed with USEPA and CTDEP as results become available. Results of the post-thermal remediation sampling will also be presented in the Completion Report documenting the ISTD activities.

7. Permit "Equivalency" Compliance Monitoring

Although CERCLA on-site response actions are exempted by law from the requirement to obtain Federal, State, and or local permits, as described above, samples will be collected to verify performance of the process treatment equipment and to document compliance with substantive provisions of Federal, State, and or local permitting regulations that are applicable or relevant and appropriate requirements (ARARs). For example, monitoring, sampling and reporting programs will be developed to demonstrate compliance with permitting equivalency requirements for treatment and discharge of the vapor and aqueous waste streams.

Procedures associated with implementing the discharge permit equivalency programs will be developed and presented as part of the design of the ISTD approach and the associated Remedial Action Work Plan and Project Operations Plan. This will include specification of the locations and frequency of sample collection and/or measurement, and the field and analytical methods.

Data generated as part of discharge permit equivalency programs will be posted to the Project Portal web site. These data will also be presented in the Completion Report documenting the ISTD activities.

8. Data Usage, System Adjustments and ISTD Completion

This section describes how the operations team will use the collected data to make operational decisions, determine the progress towards successful site remediation and determine when to proceed with verification sampling.

8.1 Adjustment of Operations Strategy Based on Collected Data

8.1.1 ISTD energy delivery

The ISTD power distribution system is equipped with automatic controls and data acquisition which allows the operators to evaluate the load and energy delivery to each circuit or group of ISTD heater borings. If the delivery of energy to certain circuits lags behind the design numbers, an investigation into the cause will be made. Adjustments may include:

1. Raising the set-point of the heaters to create larger temperature gradients

2. Modifying the extraction approach to reduce influx of water

3. Addition of heater borings to the problematic areas.

8.1.2 Hydraulic Control Issues

If the groundwater level monitoring or the temperature monitoring indicates that inward gradients and flow is not maintained in one or more locations, and the groundwater flow is deemed unacceptable, the extraction strategy may be modified. The options include:

1. Application of higher vacuum at select locations to increase the rate of liquid entrainment and steam extraction

2. Changes to the heating strategy if it is believed that steam may be pushing water away, or

3. Addition of groundwater extraction either to existing wells or by installation of new wells.

8.1.3 Areas Lagging behind in Heating

If the heat-up of certain areas lag behind the design numbers, an investigation into the cause will be made. The most probably cause will be movement of cold or cool water into the treatment zone, either from perimeter locations or upward from the bedrock. Adjustments may include:

1. Raising the set-point of the heaters in those areas to create larger temperature gradients and increase the energy input

2. Modifying the extraction approach to reduce influx of water, or

3. Addition of heater borings to the problematic areas.

8.1.4 Areas with Extreme CVOC Concentrations

If the PID screening indicates that some areas release extreme concentrations of CVOCs in the vapor stream, it is an indication that large amount of NAPL mass is present. The remediation of such areas may be stimulated by:

1. Increasing the energy input to speed up the vaporization process

2. Increase the extraction vacuum and rate to pull the COCs out more rapidly, or

3. By extraction of liquids from existing wells or from new wells installed for the purpose of extracting DNAPL

These adjustments will be subject to the capacity of the vapor treatment system as discussed in the following section.

8.1.5 Effluent Treatment System Capacity Exceeded

If the system is overloaded with contaminant mass, two options exists:

1. Add treatment capacity to the system by cooling more aggressively, compressing the cooled vapors, or by increasing the vapor flow capacity by adding additional equipment, such as an extra thermal oxidizer.

2. Slowing the heating and ISTD process to spread out the mass loading over a longer treatment time.

These issues are further described and discussed in the document "Vapor Treatment Needs and Options Evaluation".

8.1.6 CVOC Load not Declining as Expected

If the mass removal remains high, even after the TTZ has been heated to the target temperatures and treated as designed, the most plausible explanation will be that contaminants mass is entering from outside the thermal treatment zone at a substantial rate. Such mass flux would have to be in the form of NAPL, in order to make a substantial contribution. NAPL could hypothetically enter either horizontally around the perimeter of the treated area, or upward from the bedrock.

If this problem exists, the first step is to investigate the source. A well-field survey would be used to identify the areas where the mass is coming from. Select boreholes would then be advanced to determine if NAPL is present in substantial quantities, and whether this is the case in locations outside the perimeter, or below the treatment zone.

Such initiatives would be proposed to USEPA by TerraTherm, in consultation with the Project Coordinator and the SRSNE Site Group after a careful review of all available data.

8.2 Triggers for Performance Soil Sampling

In order to minimize unnecessary operation and cost, the performance soil sampling will be triggered as soon as the operational parameters indicate that the goals have been met. The critical data for this evaluation are:

- Achievement of temperatures above the eutectic point for DNAPL at most of the 50 temperature monitoring locations within the treatment volume.

- A trend in the mass removal indicating diminishing returns. For instance, for a treatment area the size of that contemplated for the SRSNE Site, our experience is that a mass removal of less than 100 lbs/day of COCs will be seen as an indication that very little, if any, DNAPL exists in the treatment volume, and that the performance standards likely are met.

- Soil sampling results from interim soil sampling event 1 and 2, when some areas are expected to have met the remediation goals.
- Well-field samples measured in the conveyance pipe system, at the treatment system and to some degree by sampling individual critical extraction wells in critical areas of the thermal treatment zone verify that individual site segments are depleted in extractable COCs.
- Miscellaneous operational observations such as mass and energy balance interpretations, caustic usage, etc.

The actual vapor phase concentrations and mass-flux that triggers the performance sampling will be discussed with the Project Coordinator and based on all available data collected during treatment.

8.3 Determining Appreciable NAPL Recovery

The objective of the Interim NAPL Cleanup Levels established for the Overburden NAPL Area are to reduce soil concentrations to levels that are not indicative of the presence of pooled or residual NAPL. At the time the Interim NAPL Cleanup Levels are attained in the TTZ, an evaluation will be conducted to determine whether appreciable amounts of NAPL continue to be recovered from portions of the treatment zone within the Overburden NAPL Area. The data and procedures that will be used to determine this are discussed below. This evaluation and its findings will provide the basis for the USEPA to determine whether there is a need (i.e., recovery of appreciable NAPL) for continued operation of portions of the thermal remedy.

A mass removal balance will be established for the TTZ based on process vapor samples and PID readings at sample locations in the influent to the vapor treatment system, samples of the entrained water from the well-field, and samples of the NAPL separated from the condensate stream. The mass balance will be updated as results from the laboratory analyses become available.

The mass removal in every phase will be recorded in the mass balance, and results from the calculations will be posted on the SRSNE project portal.

8.3.1 Mass Removal Rate

Figure C-5 and Table C-2 below show the relation between the weekly mass removal and the associated reduction in average soil concentrations near the end of thermal treatment, where VOC removal rates decline to asymptotic levels. These calculations were made based on a total TTZ weight (soil and groundwater) of 59.5 million kg.

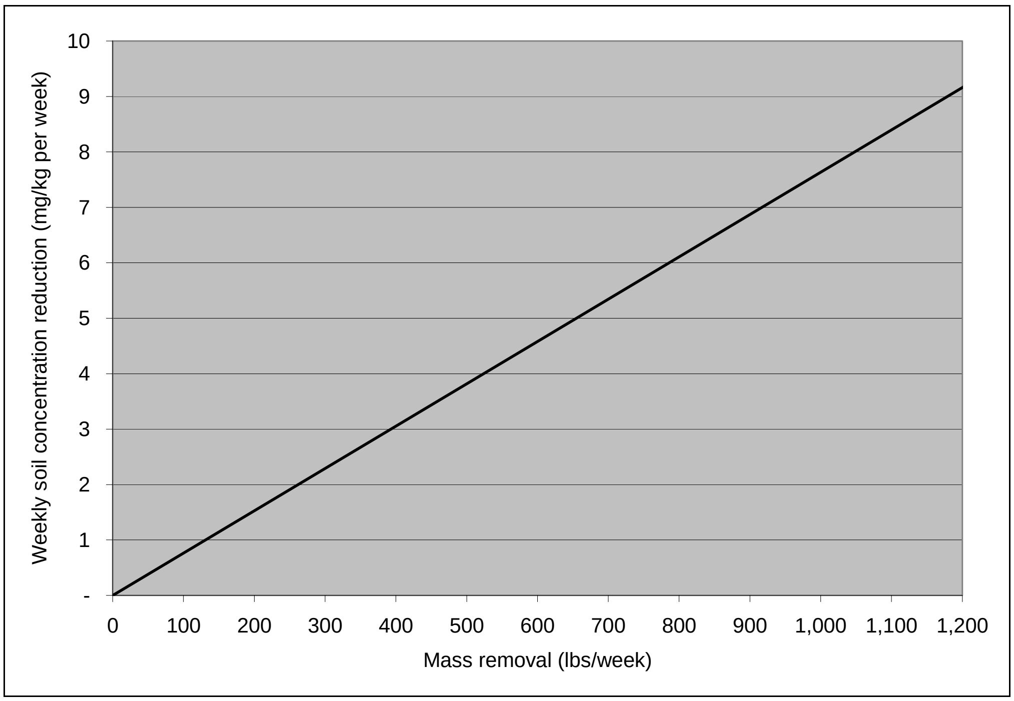


Figure C-5. Relation between weekly VOC mass removal and reduction in average soil concentration.

Table C-2. Weekly Mass Removal Needed for Reduction of Average Total VOC Soil Concentrations.

Weekly reduction (mg/kg)	Mass removal (lbs/week)
1	133
5	658
10	1,309
20	2,618
50	6,552

The NAPL Cleanup Levels, when summed up, are 708 mg/kg total for the COCs listed in Table C-1. Since all COCs have to meet the criteria, it is expected that most samples will have a total VOC concentration of less than 250 mg/kg at the time the NAPL Cleanup Levels are met. An average site-wide concentration is expected to be in the range of 100 mg/kg or lower of total VOCs.

These calculations show that when the recovery rate drops to the range of 100 lbs/day, the concentrations on average will be reduced by about 5-6 mg/kg for each week of operation, which is only about 5% of the mass leftover at the time the NAPL Cleanup Levels are met. Therefore, it is suggested that the definition of “Appreciable NAPL Recovery” and the criteria for stopping the thermal treatment be defined as when the mass removal rate has declined to below 100 lbs per day, or 4.2 lbs/hr.

8.3.2 Estimation of Mass Left in Ground

Data from interim soil samples collected at each site segment will be used together with monitored mass recovery rates in the conveyance pipe system to determine how much mass is expected to be left in each site segment.

In summary, the data used for determining the rate of recovery of NAPL constituents is:

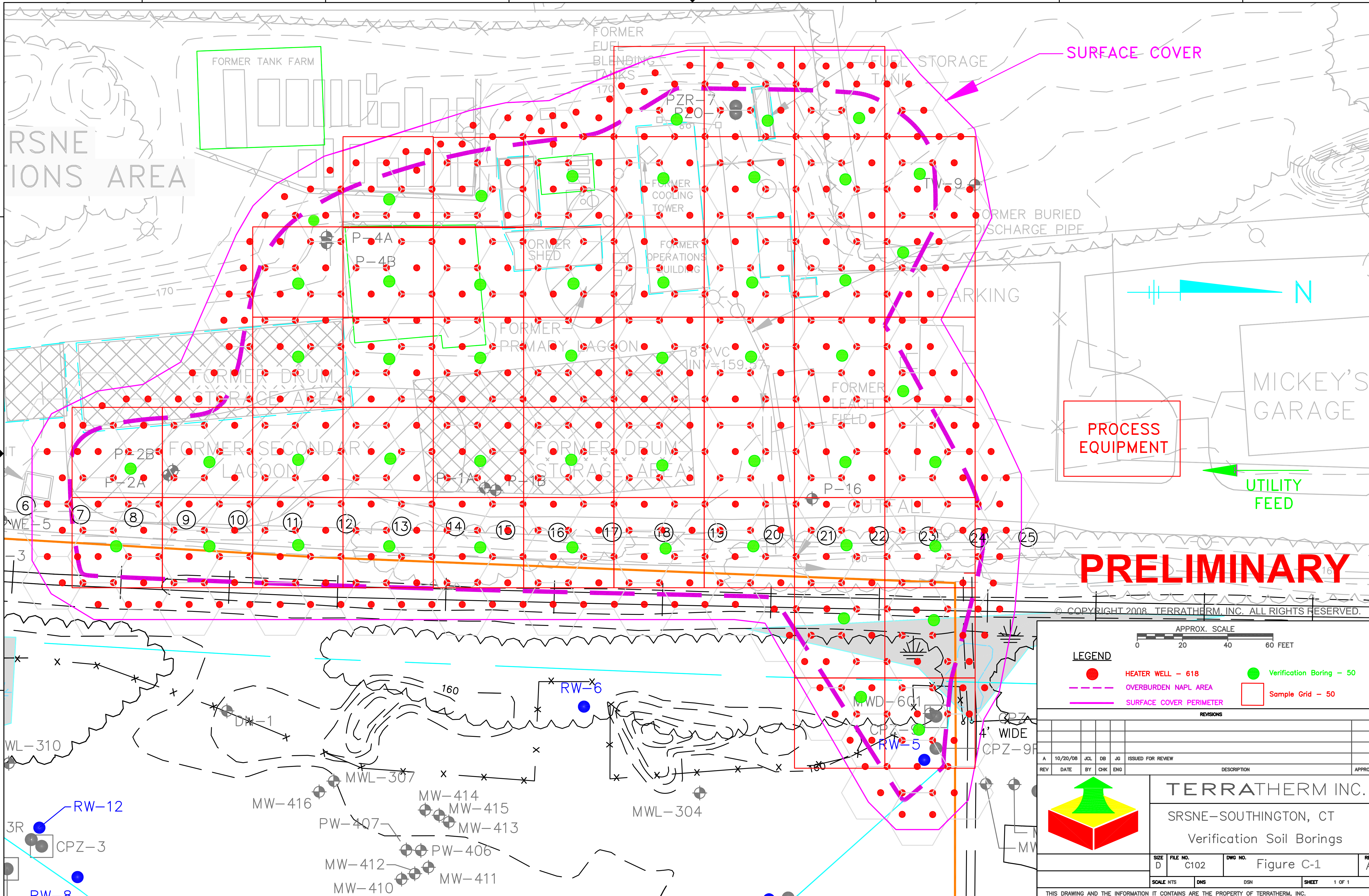
- Mass removal rate determined by sampling the influent to the treatment system. This will yield an estimate of the mass removal in the unit of lbs/day. A threshold of 100 lbs/day of CVOC removal from the TTZ is proposed as the trigger for a final evaluation of whether heating can be stopped.

- PID or FID screening of individual site segments. This data can be used to determine whether the mass is coming from a small segment of the site, or from a larger area. The mass removal criteria for each segment should be seen in relation to its fraction of the total treatment volume. For instance, if a segment representing 15% of the site volume is recalcitrant to remediation, the treatment should be continued until the mass removal rate drops to approximately 15 lbs/day.

The SRSNE Site Group expects to be able to stop heating in site segments that have both met the NAPL Cleanup Levels, and where the mass removal rate is small compared to historic high numbers and compared to other segments of the site. Such decisions will be made after discussion and consensus with the USEPA.

TERRATHERM

Figures



REVISIONS

REV	DATE	BY	CHK	ENG	DESCRIPTION	APPROVED
A	10/20/08	JCL	DB	JG	ISSUED FOR REVIEW	

TERRATHERM INC.

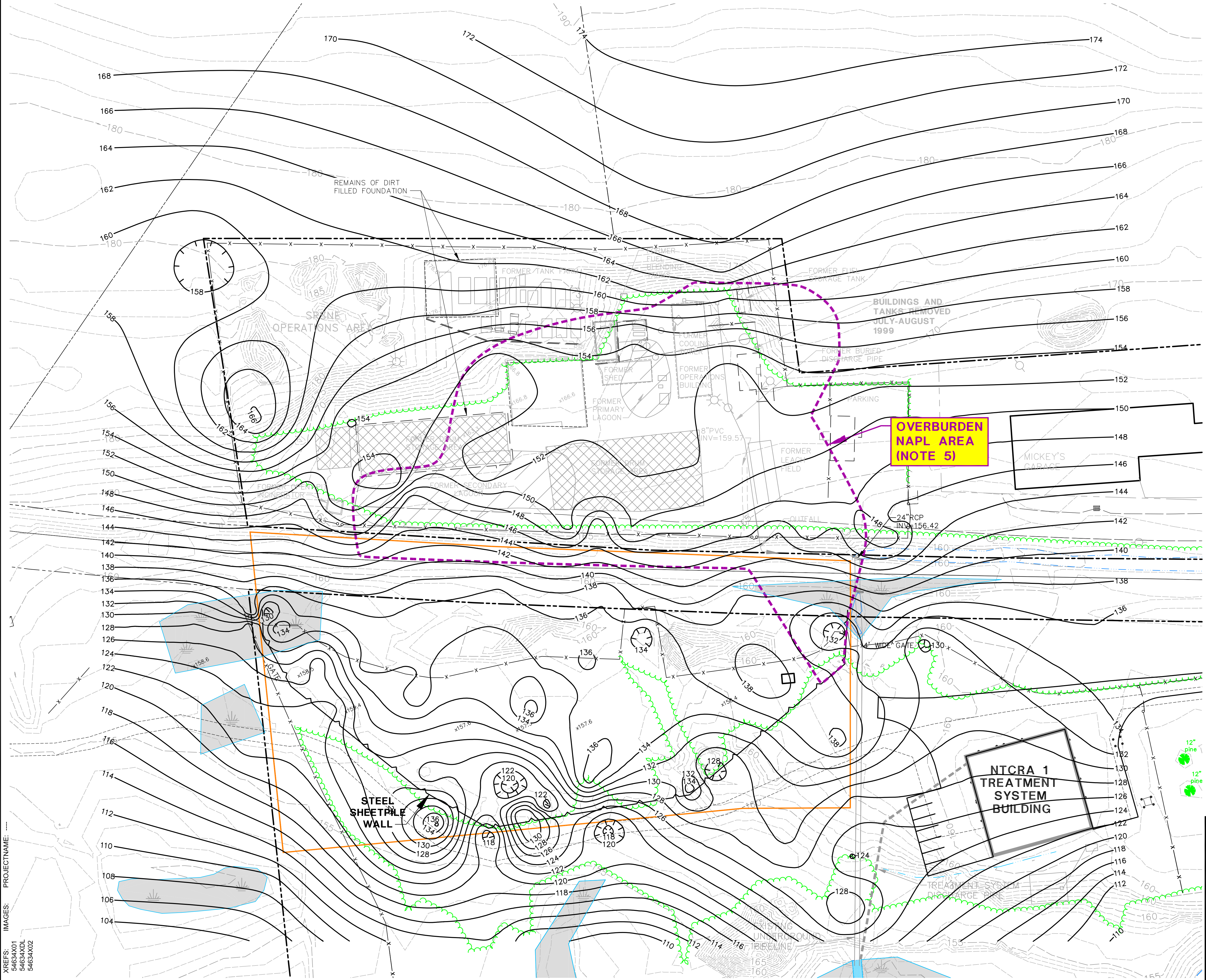
SRSNE–SOUTHINGTON, CT

Verification Soil Borings

SIZE	FILE NO.	DWG NO.	REV
D	C102	Figure C-1	A

SCALE NTS | DNS | DSN | SHEET 1 OF 1

4/2/09



LEGEND:

- PROPERTY LINE
- EXISTING CONCRETE PAD
- WETLAND
- NTCRA 1 CONTAINMENT AREA
- FENCE
- VEGETATION
- 160 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- 147–12 LOT NUMBER
- ABOVE-GROUND TANK
- 170 APPROXIMATE TOP OF BEDROCK ELEVATION CONTOURS

NOTES:

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. APPROXIMATE TOP OF BEDROCK ELEVATION CONTOURS INTERPRETED FROM SOIL BORING DATA.
3. BEDROCK AND GROUND SURFACE ELEVATION CONTOUR INTERVAL IS 2 FEET.
4. ELEVATIONS ARE BASED ON NGVD 29.
5. OVERBURDEN NAPL AREA LIMITS SHOWN WERE OBTAINED FROM THE TREATMENT LIMITS PRESENTED IN THE USEPA RECORD OF DECISION (ROD) DATED SEPTEMBER 2005. THE OVERBURDEN NAPL AREA LIMITS ARE PRELIMINARY AND SUBJECT TO MODIFICATION AS A RESULT OF PLANNED ADDITIONAL DELINEATION ACTIVITIES.

0 40' 80'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
THERMAL TREATMENT PERFORMANCE CRITERIA

INTERPRETED TOP OF BEDROCK ELEVATION CONTOURS

ARCADIS

FIGURE
C-2

CITY:SYRACUSE GROUP: ENV-141 DB: KMD NES PGL KEW PIC: G. CAMERON PM: J. HOLDEN TM: C. ALBUNIO LYR:ON=*;OFF=REF (FRZ)
G:\ENVCAD\SYRACUSE\ACT\B0054634\0000\10001\DWG\TTPC54634B04.DWG LAYOUT: C-2 SAVED: 4/7/2009 3:49 PM ACADVER: 17.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/7/2009 3:49 PM BY: WOOD, KATE
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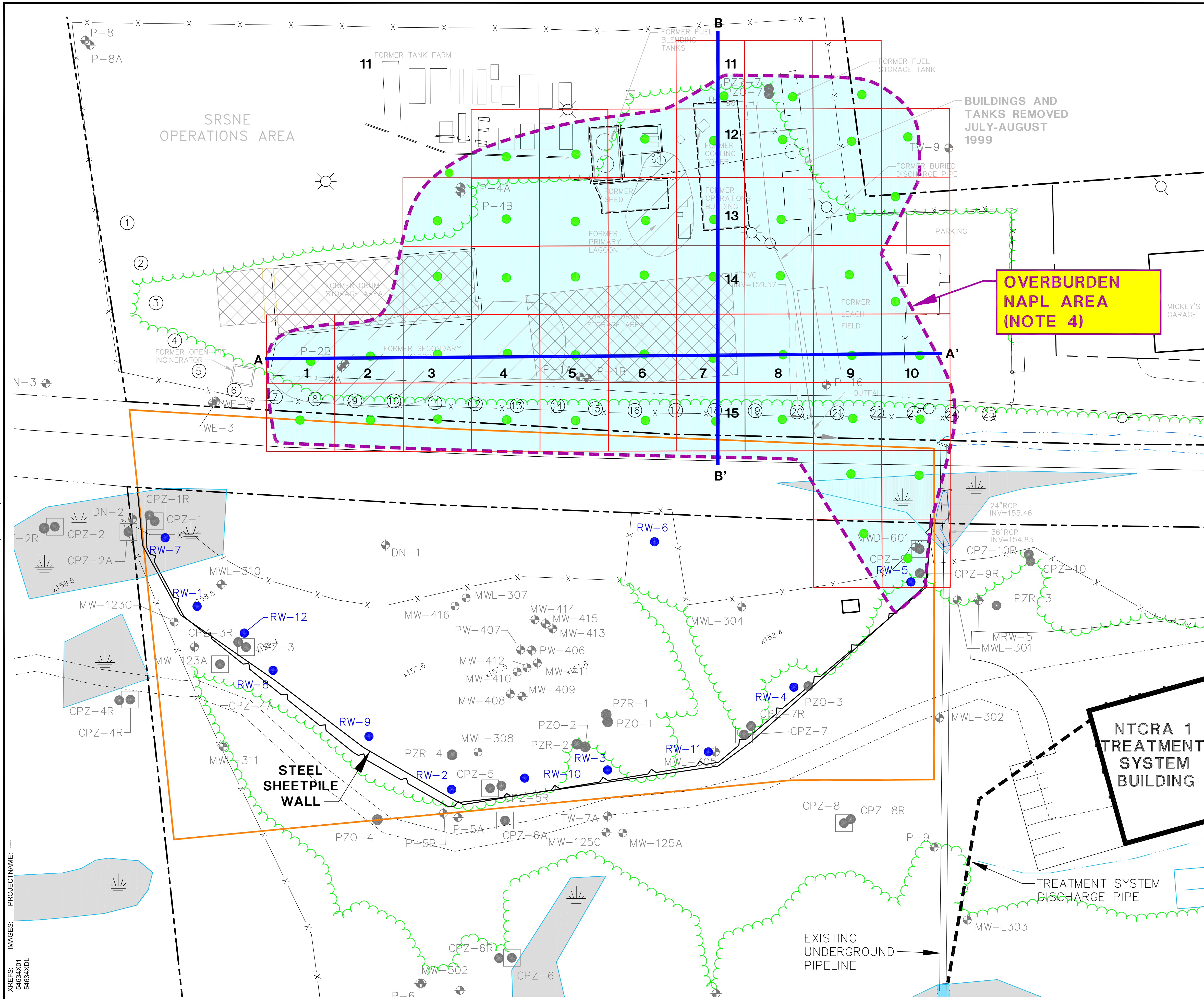


LEGEND:

- PROPERTY LINE
- WETLAND
- NTCRA 1 CONTAINMENT AREA
- EXISTING STRUCTURE
- FENCE
- P-10 MONITORING WELL
- PZR-1 NTCRA 1 PIEZOMETER
- CPZ-10 NTCRA 1 COMPLIANCE PIEZOMETER
- RW-1 NTCRA 1 OVERBURDEN EXTRACTION WELL
- (12) FORMER ON-SITE INTERCEPTOR SYSTEM EXTRACTION WELL
- LIGHT POLE
- POWER POLE
- VERIFICATION BORING – 50
- SAMPLE GRID – 50

NOTES:

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPHY MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978. SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BENCHMARK #1 IS AT ELEVATION 164.03. PK NAIL; S'LY SIDE; POLE #9049.
3. THE LOCATIONS OF EXISTING DRIVE POINTS WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.
4. OVERBURDEN NAPL AREA LIMITS SHOWN WERE OBTAINED FROM THE TREATMENT LIMITS PRESENTED IN THE USEPA RECORD OF DECISION (ROD) DATED SEPTEMBER 2005. THE OVERBURDEN NAPL AREA LIMITS ARE PRELIMINARY AND SUBJECT TO MODIFICATION AS A RESULT OF PLANNED ADDITIONAL DELINEATION ACTIVITIES.

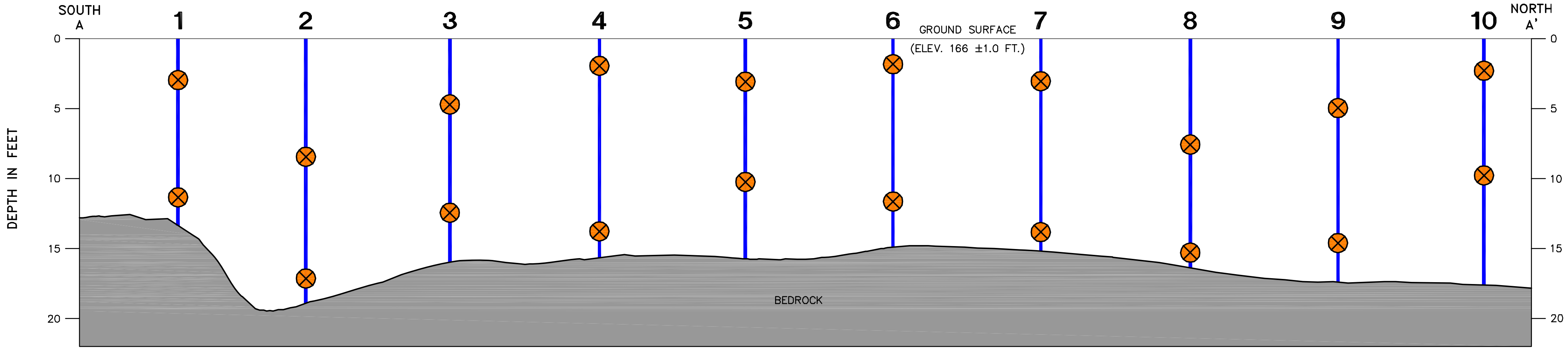
0 30' 60'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
THERMAL TREATMENT PERFORMANCE CRITERIA

CROSS SECTION LOCATIONS

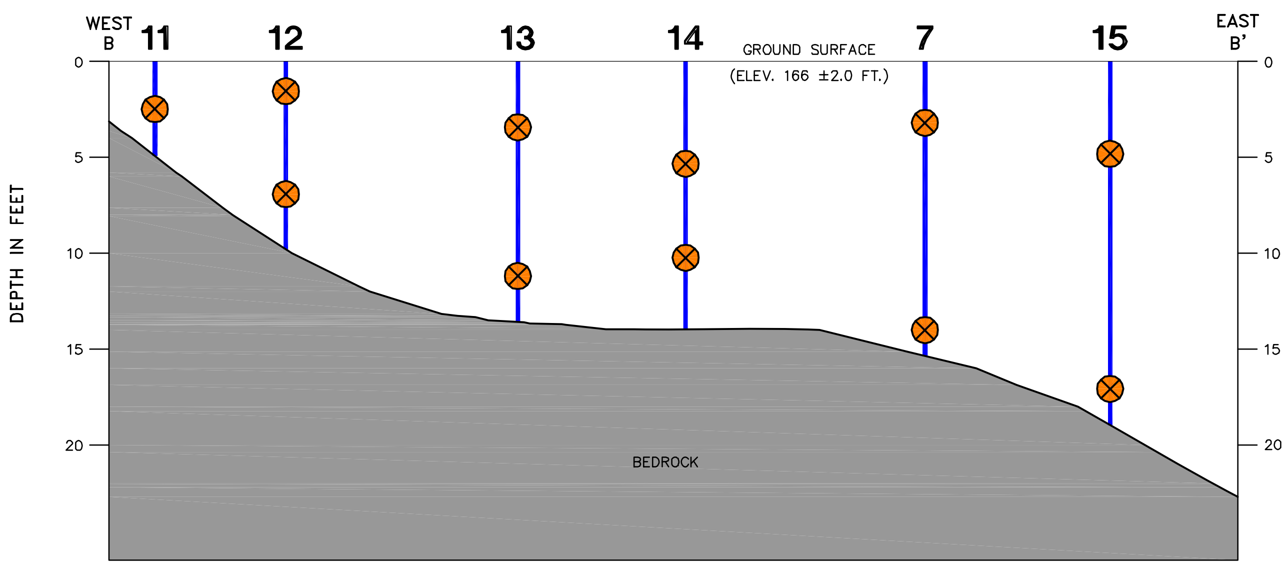
ARCADIS

FIGURE
C-3



SECTION A-A'

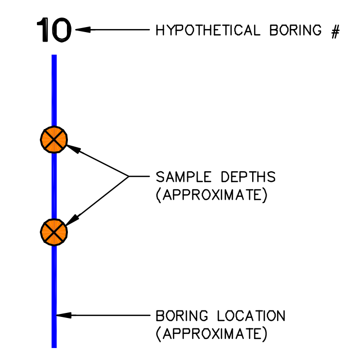
HORIZONTAL: NOT TO SCALE
VERTICAL: 1"=10'



SECTION B-B'

HORIZONTAL: NOT TO SCALE
VERTICAL: 1"=10'

KEY



NOTE:

LOCATIONS AND DEPTHS ARE APPROXIMATE.

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EXAMPLE OF RANDOM SAMPLE DEPTHS

ARCADIS

FIGURE
C-4