Engineering Design Report

Yakima Valley Spray (U-Haul) Site
Yakima, Washington

Prepared by:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, Washington 98134

RETEC Project Number: DWT40-16457-300

Prepared for:

Yakima Valley Spray Steering Committee

October 16, 2003

Engineering Design Report

Yakima Valley Spray (U-Haul) Site
Yakima, Washington

Prepared by:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, Washington 98134

RETEC Project Number: DWT40-16457-300

Prepared for:

Yakima Valley Spray Steering Committee

October 16, 2003

Engineering Design Report

Yakima Valley Spray (U-Haul) Site
Yakima, Washington

Prepared by:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, Washington 98134

RETEC Project Number: DWT40-16457-300

Prepared for:

Yakima Valley Spray Steering Committee

Prepared by:

Winston Chen

Winston Chen, P.E., Project Engineer

for Winston Chen

Sarah Albano, Staff Engineer

Reviewed by:

Michael Byers

Michael Byers, P.E., Project Manager

Michael Byers / FOR

Halah M. Voges, Program Manager

October 16, 2003

Table of Contents

Table of Contents

List of Tables

List of Figures

List of Appendices

1 Introduction

This document presents the Engineering Design Report (EDR) for the Yakima Valley Spray (U-Haul) site in Yakima, Washington, prepared by The RETEC Group, Inc. (RETEC; formerly ThermoRetec Consulting Corporation) for Davis Wright Tremaine, Ater Wynne Hewitt Dodson & Skerritt and Bryan Cave Law Firm (Yakima Valley Spray Steering Committee). The EDR is one in a series of documents required under the Model Toxics Control Act (MTCA; Revised Code of Washington 70.105D; Washington Administration Code 173-340) cleanup process. The Remedial Investigation (RI; RETEC, 1995) and the Draft Feasibility Study (Draft FS; ThermoRetec, 1995) presented the results of investigations of the nature and extent of contamination at the site. The Draft FS further evaluated the extent of impacts and the feasibility of remedial alternatives for the site. The Cleanup Action Plan (CAP; Washington State Department of Ecology, 2001) describes the cleanup action for the site.

1.1 Background and Site Conditions

The Yakima Valley Spray (U-Haul) site (site) is located in south central Yakima, Washington (Figure 1-1). The current U-Haul property consists of three parcels that were essentially undeveloped until the early 1900's. Yakima Rex Spray Company and subsequently Yakima Valley Spray operated a pesticide business on one parcel from 1909-1973. The pesticide businesses on the parcel formulated pesticides at the center of the parcel. A fire damaged the Yakima Valley Spray plant in 1973 and the plant was demolished thereafter. Washington Refining Company (1912-1955) and then the Shell Oil Company (1955-1971) operated a petroleum products distributing business on the second parcel. A large building (Shell building) occupies a portion of the second parcel. The third parcel was historically operated as a salvage yard and farm and heavy equipment sales and service business. A two-story building (Webb building) and the operations building for the U-Haul rental facility occupy the third parcel. The three parcels together comprise the current U-Haul property.

The U-Haul property along with adjacent narrow strips of land to the north and west comprise the site as defined in the CAP. The site boundaries are defined on the north by the centerline of an east-west rail spur, on the west by the centerline of the nearest north-south rail spur, and on the south and east by the current U-Haul property boundaries. The narrow strips of land within the site boundaries but outside of the U-Haul property boundaries are owned by the Burlington Northern and Santa Fe Railway Company (BNSF). For the purposes of the consent decree negotiations, the site is further divided into Operable Unit 1 (OU1) and Operable Unit 2 (OU2). OU1 is the portion of the site that is within the current U-Haul property boundaries. OU2 is the portion of the site that is owned by BNSF. OU1 and OU2 are shown on Figure 1-2.

Current U-Haul operations are confined to the south and east sides of the property and include the Retail/Office building shown on Figure 1-3.

The site contains a gentle north to south slope and ranges from an elevation of 1045.5 feet in the northwest corner to a low of about 1040.0 in the southeast corner. Approximately one half of the site is paved. The remainder of the site is occupied by buildings or contains light vegetation. South First Street is adjacent to the east end of the site and East Arlington Street is adjacent to the south side of the site. A City of Yakima (City) sanitary sewer pipeline and an irrigation pipeline (the New Schanno Pipeline) cross the site in a general north-south direction (Figure 1-3). Water lines run along the roads adjacent to the property. There is one utility pole on the site that supplies electricity to the Evergreen Kia dealership north of the site. The functional U-Haul building on the southeastern corner of the property receives its power from a utility pole off-site.

The Washington State Department of Ecology (Ecology) CAP indicates that there are sixty-two contaminants found at the site. The calculated carcinogenic risks from both the soil and the groundwater exceed the Model Toxic Control Act (MCTA) acceptable lifetime cancer risk. Ecology has selected nine indicator hazardous substances to represent and control cleanup of the site. They are DDT, aldrin, dieldrin, beta BHC, gamma BHC (Lindane), arsenic, PCE, total petroleum hydrocarbons from gas (TPH-G) and total petroleum hydrocarbons from diesel fractions (TPH-D).

1.2 Purpose

The purpose of this Engineering Design Report is to document the engineering concepts and design criteria used for the design of the cleanup action specified in the CAP. This document satisfies the requirements of WAC 173-340-400 4(a) and has been prepared under the direct supervision of a registered Professional Engineer. This document is prepared under the assumption that OU1 and OU2 will be remediated together. It does not, however, preclude remediating the operable units separately. Both the excavation and in-situ treatment systems can be designed and operated separately if required.

1.3 Overview of Cleanup Action

The cleanup action chosen by Ecology for the site is a combination of excavation and removal of site soils that exceed the cleanup levels (CULs) of the nine indicator substances, and bioventing or biosparging. The plan consists of the following actions:

- Excavation of soil in the disposal 'pit' area that exceed the CULs to the seasonal low groundwater level approximately 18-20 feet below ground surface

- For areas outside of the disposal pit (except for TPH contaminated areas), soil above the CULs will be excavated to a depth of five feet

- Areas with TPH concentrations above CULs will be excavated to a minimum depth of five feet or to the TPH remediation levels (RLs) before bioventing, whichever is deeper. The RLs are 15,675 mg/kg for TPH-G, 14,950 mg/kg for TPH-D, and 14,950 mg/kg for hydraulic or waste oils

- Soil screening of excavated soils. Excavated soils whose contamination exceed CULs and are less than 1.0 inch in diameter will be disposed of at an appropriate licensed facility. Gravel, cobbles and boulders (larger than 1 inch in diameter) remaining after the screening process will be used as backfill provided that they meet the backfill requirements

- Demolition and disposal of two site buildings, the Shell building and the Webb building

- Rerouting and reinstallation of the operating twelve-inch diameter sewer line

- Backfilling of excavated areas up to the current site grades after the results of confirmational sampling have been reviewed and analyzed by Ecology

- Bioventing or biosparging for TPH impacts that exceed the CULs but are less than the RLs in areas that are not fully excavated to the CULs

- Installation of three shallow down-gradient monitoring wells one of which will be nested with two deeper monitoring wells

- Replacement of any pre-existing monitoring wells which are destroyed during excavation

- Monitoring of site groundwater to demonstrate the effectiveness of the site cleanup

- Institutional controls to limit future site use to commercial uses and to restrict future use of site groundwater

Each component of the cleanup action is described in detail in Sections 3 and 4 of this report.

2 Regulatory Framework

This section provides a discussion of Ecology and other regulatory requirements that have been applied to this remedial design.

2.1 MTCA Design Requirements

This remedial design is being implemented in accordance with the Washington Administration Code (WAC) 173-340-400 Implementation of the Cleanup Action. This chapter is a part of WAC 173-340 also known as the MTCA Cleanup Regulations. CULs for site soil are listed in the CAP and presented in Table 3-1. These criteria define the extent of remediation required to prevent public exposure to impacted areas of the site.

2.2 Other Regulatory Requirements

2.2.1 Health and Safety

WAC 296 specifies Safety Standards for Construction. This code specifies health and safety standards for responding to releases or substantial threats of releases of hazardous substances at hazardous waste sites. The Occupational Safety and Health Administration (OSHA) specifies health and safety requirements for hazardous waste sites (29 CFR 1910.120). Details regarding the use of 40-hour trained contractor personnel and requirements for the contractor's health and safety plan are provided in Section 5.

2.2.2 Stormwater Management

Because the area to be disturbed during remedial activities is between 1 and 5 acres, remedial action and construction activities must adhere to substantive requirements of the General Permit to Discharge Storm Water Associated with Construction Activities; however, an Ecology permit is not required due to MTCA's procedural preemption. This preemption applies to cleanup activities only. A Stormwater Pollution Prevention Plan has been prepared (Appendix A) that includes Best Management Practices (BMPs) for managing stormwater during remedial activities. These BMPs are outlined in the Draft Stormwater Management Manual for Eastern Washington (Ecology, 2002).

2.2.3 Noise Control

The Washington Noise Control Act (RCW 70.107; WAC 173-60) provides maximum permissible decibel (dB) levels for all site activities, construction equipment and portable powered equipment in temporary locations. The Yakima Municipal Code (YMC, Title 6-04-180) prohibits any sound that is a public disturbance noise but exempts sounds created by construction equipment from six a.m. to ten p.m. weekdays. Site activities will comply with these regulations.

2.2.4 Waste Characterization

Waste generated during remediation will be characterized as dangerous (hazardous) or non-hazardous in accordance with WAC 173-303.

2.2.5 Hauling of Hazardous Waste

Transportation of dangerous waste from the site will comply with the requirements of WAC 173-303-240 through WAC 173-303-270. WAC 173-303-240 lists the requirements for transporters, while the other sections detail the requirements for the actual transport and record keeping. The transporter will have a current EPA/State identification number and abide by these codes.

WAC 173-303-190 provides the requirements necessary for preparing dangerous waste for transport. These requirements include specifics for packaging, labeling, marking and placarding.

Trucks will leave the site on E. Arlington St., which is a dead end road so no flagger is anticipated to be needed. The light at the corner of E. Arlington St. and S. 1st St. will meter traffic. If flagging and traffic control signs are needed they will be implemented.

2.2.6 Solid Waste Management

Requirements for solid waste management are applicable to the non-hazardous waste generated during remedial activities that is to be disposed of off-site. WAC 173-304 details the requirements that will be followed for the proper handling of all solid waste materials.

2.2.7 Excavation and Grading

The City requires a Building Permit be obtained for grading activities. The backfill placed in the excavated areas will be compacted to a density that is at least 90 percent of the ASTM D-1557 maximum density to satisfy Universal Building Code (UBC, Appendix, Chapter 33) and City requirements.

2.2.8 Sanitary Sewer

The City Procedures Manual for Construction of Public Improvements and the Specifications for Private Construction of Public Sewer Mains for City of Yakima (1998) provide requirements for the replacement of sewer lines. The design of the final sewer line will comply with the stated requirements and will contain City comments. During excavation a temporary sanitary sewer line will be constructed that will comply with city requirements as laid out by the City Engineering Division.

2.2.9 New Schanno Pipeline

The New Schanno Pipeline crosses the site as shown in Figure 1-2. The pipeline was located during field activities on March 11, 2003. The pipeline does not cross excavation areas so will remain undisturbed during excavation and backfilling.

2.2.10 Demolition

The Uniform Building Code (UBC, Section 3303) provides requirements for demolition activities. An inspection by a qualified and licensed expert to determine the quantities and types of asbestos materials, lead and other potentially hazardous materials will be conducted. Removal of these materials will be in accordance with the National Emission Standard for Hazardous Air Pollutants (NESHAPS, 40 CFR Part 61) and the Yakima Regional Clean Air Authority (YRCAA Regulation 1, Section 3.07).

2.2.11 Air Quality

The Yakima Regional Clean Air Authority (YRCAA) and Ecology (WAC 173-460) provide air emissions criteria for the site. Section 3.08 of Regulation 1 (YRCAA) discusses the requirements regarding visible emissions of fugitive dust. The YRCAA has indicated that a specific permit for this work will not be required since this is a MCTA cleanup. Substantive requirements for the YRCAA permit are required to be met by the design. In addition to YRCAA requirements, RETEC has developed acceptable levels of particulates in the air that are protective of site workers during remediation efforts. These levels were developed based on organics, pesticide and metal concentrations found in site soils and the potential for this material to become airborne. Measures will be provided to suppress any fugitive dust generated during site excavation and grading that exceeds these criteria. Dust monitoring and specific corrective actions are discussed in later sections.

The YRCAA considers the biosparging/venting equipment as a new source and requires a New Source Review be completed. The calculated weight of Volatile Organic Compounds using maximum detected concentrations was 0.04 tons, significantly below the 2 tons per year Exemption Threshold Level of the Yakima Regional Clean Air Authority. Accordingly, it is expected that the *in situ* remediation system will be exempted from any permit requirements.

3 Design Criteria

This section presents the design criteria and basis of design for the remedial action. Design criteria for each component of the remedy are described in the following sections.

3.1 Site Preparation

Site preparation includes performing a utility locate to adequately identify site utilities, installing temporary erosion and sediment control features around the site, and installing other temporary facilities. Temporary facilities include site entrances, security fencing, construction trailers, decontamination areas and parking areas.

3.2 Building Demolition

Two buildings on the site will be demolished as part of the cleanup work. Locations of the two buildings are shown on Figure 1-3. Prior to demolishing the buildings, an inspection for lead, asbestos and other potentially hazardous materials will be conducted by a qualified firm. The results of the inspection will be used to determine proper disposal of the demolished materials.

Drums containing investigation derived wastes (soil and monitoring well purge water) that are currently stored inside the Shell Building will be moved out of the building prior to the building demolition. The drums will be temporarily staged and secured within the site remediation areas until the remediation begins and will be disposed of off-site with other impacted materials at a permitted disposal facility. Drums with well purge water may be disposed of prior to overall site remediation.

3.3 Excavation

3.3.1 Soil Excavation

The goal of the remedial action is to remediate the site to meet the cleanup levels set forth by Ecology. In the CAP, Ecology selected nine (9) indicator hazardous substances to represent and control the cleanup of the site. The nine (9) indicator hazardous substances (IHS) and their corresponding soil cleanup levels (CULs) are summarized in Table 3-1. As an alternative for cleanup of the TPH-impacted soils, the CAP allows the use of biosparging/venting technology to remediate the soils with TPH levels below RL (Table 3-2). Excavation will be performed based on the following criteria:

- **Former Yakima Valley Spray Lime Sulfur Pit Area:** This area will be excavated to the seasonal low water table. Based on the historical groundwater data, the excavation depth is estimated to be approximately 18 to 20 feet bgs.

- **TPH-Impacted Areas:** The TPH-impacted areas above the CULs will be excavated to a minimum depth of 5 feet. If TPH concentrations below the upper 5 feet exceed the CULs but are below the RL (Table 3-2), excavation or treatment is required. There is an option to stop excavation and use a biosparging/venting system to remediate the soils until the TPH concentrations are reduced to the CULs. Excavation will continue below the upper 5 feet if the TPH concentrations in the soils exceed the RL. Excavation below a depth of 5 feet is not required for IHS other than TPH. The maximum depth of excavation is the seasonal low water, estimated at 18 to 20 feet bgs.

- **Pure Waste:** Pure pesticide product in bags, boxes or other containers may be encountered in the excavation, particularly in the old basement of the Yakima Valley Spray structure. If pure pesticide product is encountered at the site during excavation, the waste material will be isolated and disposed of at a RCRA facility in accordance with WAC 173-303. The Ecology site manager will be notified within 12 hours of encountering the product. There is also the potential to encounter an underground storage tank during activities. Should this occur, the nature and extent of the structure will be evaluated.

- **Other Contaminant Impacted Areas:** These areas are defined as the areas outside of the disposal pit that are impacted with one or more of the indicator hazardous substances (other than TPH) selected by Ecology (Table 3-1) at soil concentrations above the site CULs. The excavation depth in these areas will be a maximum depth of 5 feet.

Based on the historical analytical testing results, delineations of proposed excavation areas and depths are shown on Figure 3-1. Excavation will be performed during the low water table season to maximize the excavation depth. Previous groundwater monitoring results indicated that groundwater levels are depressed from mid-December until late-March.

3.3.2 Soil Screening

The soil that is excavated during the course of the work may be screened to remove oversized gravel, cobbles, boulders and large chunks of concrete. For the purposes of this discussion, oversized material includes soil and concrete particles that are retained on a one-inch sieve or mesh. The purpose of the screening operation is to separate the fine-grained fraction of the site soils (portion in which impacts are generally concentrated) from the oversized fraction that generally is less impacted. The final details of the screening operation will be determined based on site-specific conditions observed during excavation. Both the final and oversized fraction will be sampled and characterized to determine if off-site disposal is required.

The screening operation is expected to remove most of the finer-grained soil that may cling to oversized material, leaving the oversized fraction relatively free of impacts. Discussions with Ecology personnel about a nearby site (Cameron-Yakima) suggest that the screening operation will result in oversized material that will be below site CULs. Oversized material will be tested either by crushing or by using a wipe test on a representative fraction of the oversized material. Once the RETEC site engineer and the Ecology site manager determine that there is a relationship between visible impacts and laboratory testing results of the oversized material, visual observation will primarily be used to evaluate the oversized material end use or disposal.

3.3.3 Waste Characterization

Prior to off-site disposal of the excavated impacted materials, waste profiling of the impacted materials will be performed in accordance with the requirements of the licensed waste disposal facility for approval of the waste disposal. Representative samples of the impacted materials will be collected and delivered to the laboratory for analytical testing. Details of the sampling procedures are included in the Sampling and Analysis Plan included in Appendix B.

3.3.4 New Schanno Pipeline and Sanitary Sewer Pipeline

Two utility pipelines currently cross the site at the approximate locations shown on Figure 3-1. The New Schanno Pipeline crosses the eastern part of the site, while the sanitary sewer pipeline crosses the western portion of the site.

New Schanno Pipeline

The New Schanno Pipeline is an irrigation pipeline owned by the New Schanno Ditch Company. A portion of the New Schanno Pipeline is located near the two previously designated dry wells, DW-1 and DW-2. The previous site investigation data indicated impacted sediments in the dry wells. It was suspected that the extent of impact might have encroached onto soil that surrounds the New Schanno Pipeline. RETEC performed an additional field investigation at the site on March 10 and 11, 2003 to further characterize the impacted area and to locate the New Schanno Pipeline near DW-1 and DW-2. Results of the investigation and laboratory testing around DW-1 and DW-2 indicate that there are no impacts around DW-1 and DW-2 themselves, and that they are catch basins piped to other discharge points, and not dry wells at all. DW-1 and DW-2 will be referred to as CB-1 and CB-2 to better represent that they are catch basins.

The New Schanno Pipeline was found at the March 2003 test pit location to be a circular concrete pipe, located approximately 12 feet east of the former Webb Building. The outside diameter of the pipeline is approximately 48 inches. The depth to the crown of the pipeline is about 8 inches below existing ground surface at the test pit location. The pipeline was visibly in good shape with no cracks or leaks. The soils surrounding the pipeline appeared to be imported materials consisting of concrete and brick pieces, gravels, and fines. Laboratory testing of one sample obtained from the soils surrounding the pipeline resulted in an arsenic concentration of 34 mg/kg, which is above the arsenic CUL of 20 mg/kg. Based on a review of the historic arsenic concentration data at the site, with the exception of the sediment sample in CB-2, the arsenic concentrations in the vicinity of the Schanno Pipeline were all below the CUL. The arsenic concentration adjacent to the pipeline appears to be an isolated case. The data point will be included in the site-wide statistical evaluation to be used to demonstrate compliance with the CULs at the completion of excavation activities.

Sanitary Sewer Pipeline

The sanitary sewer pipeline owned by the City of Yakima is a 12-inch diameter, gravity flow line that crosses from north to south on the western half of the site. As shown on Figure 3-1, the sewer line is located within the planned deep excavation areas. A bypass and a new sewer will be designed and installed before and after construction, respectively. City sewer drawings show a manhole just south of the southern site boundary in East Arlington Street and a manhole north of the northern site boundary in the open area just south of the automobile dealership parking lot as shown on Figure 1-2. The manhole in East Arlington Street was visually located during previous site activities but the manhole north of the site boundary could not be located. The city was notified and is in the process of locating the manhole. The City Public Works department and sanitary sewer maintenance department will provide input into both the bypass design and the final new sewer design. All necessary permits required for the bypass and new sewer will be obtained from the City of Yakima.

3.3.5 Catch Basins (Formerly Thought To Be Dry Wells)

Previous site investigation identified TPH and metals impacts in the sediments of what were thought at the time to be two dry wells labeled as DW-1 and DW-2 on Figure 1-3. A dry well can be constructed in many ways, but the primary concept is that surface water that flows into the dry well is allowed to infiltrate into the natural surrounding soil deposit either through perforated sides of the dry well or through an open bottom. The dry well structure collects sediment that flows into the dry well, thereby allowing infiltration of the collected water. DW-1 and DW-2 were thought to be dry wells, and impacts identified in the dry well sediments were suspected to continue into the soil surrounding the dry wells. An additional characterization program was performed on March 10 and 11, 2003 to better define potential impacts in soils surrounding DW-1 and DW-2. The work plan (RETEC, 2003) describes the program in detail.

Test pits were excavated between DW-1 and DW-2 and at DW-1 to expose the structure itself. Observation of the test pit and sampling and testing performed on the exposed soils indicate no impacts in the surrounding soils and that the structures are, in fact, catch basins. A catch basin differs from a dry well in that a catch basin does not allow infiltration of collected water since it is an enclosed structure. Sediment collects in a deeper sediment trap and the water is allowed to drain out of the catch basin in a pipe. It is suspected that the two catch basins are connected to the city stormwater sewer on South First Street. However, verification of the connection needs to be conducted. Test pit logs and the lab report are attached in Appendix C.

It is apparent that sediment from ongoing operations of the U-Haul facility has been allowed to accumulate in CB-1 and CB-2 (designation changed from DW-1 and DW-2 to better reflect the actual condition). Measurements from about ten years ago indicate that sediment has continued to accumulate over the last ten years. It is apparent that the sediment is the result of day-to-day operation of the site as a rental facility and not the result of historical site operation. This being the case, the sediment will be dealt with as a maintenance item by U-Haul alone and will not be considered part of this cleanup.

3.4 Biosparging/Venting System

This subsection presents the design basis and describes criteria for selecting biosparging combined with bioventing system components. Biosparging and bioventing (biosparging/venting) are well-demonstrated technologies for the removal of relatively volatile and degradable organics (e.g., TPH and PCE). Subsurface conditions at the site are suitable for use of biosparging/venting as a remedial technology. The saturated zone soil is relatively permeable (sand, gravel and cobbles), and the organic constituents of concern are volatile and biodegradable.

Biosparging is an *in situ* bioremediation technology that promotes biodegradation of the contaminant constituents in the saturated zone by injecting air into the target zone. Generally, the biosparging process is similar to air sparging except that biosparging has lower air flow rates. Compressed air introduced to the saturated zone through vertical well points migrates vertically upward to the soil/water interface. Movement of air through the saturated soil formation oxygenates the groundwater. Oxygenation of the groundwater stimulates the biodegradation of dissolved hydrocarbons by native organisms present in the formation.

Bioventing is an *in situ* remediation technology that is used to remediate the biodegradable organic constituents in the unsaturated (vadose) zone by introducing airflow via extraction wells. A vacuum extraction system located in the vadose zone will be used to remove the hydrocarbons that exist above the seasonal high water table. While moving through the unsaturated zone to the vacuum collection network, hydrocarbons will undergo a complex process of adsorption, desorption, and biodegradation.

Based on the historic TPH-diesel data documented in the RI report and the 1999 test pit excavation (RETEC, 1999), three cross sections were generated (locations shown on Figure 3-2) for evaluating the vertical and horizontal extent of the TPH-diesel impact. Cross sections A-A', B-B' and C-C' are displayed on Figure 3-3. As shown on Figure 3-3, the majority of the TPH-impacted soils will be excavated and disposed of off-site. The areas that will require *in situ* bioremediation are located on the western portion of the site where TPH-diesel concentrations in excess of the CUL have been observed. In areas where the impacted soils extend into the saturated zone, the biosparging system will be used. For impacted soils existing in the vadose zone, the bioventing system will be used.

PCE is below detection limits in the soil in the biosparging area. No data for groundwater exist within the biosparging area. Should PCE migrate into the biosparging area, it will be volatilized due to its high vapor pressure and associated Henry's Law Constant.

The biosparging system will include a blower and vertical wellpoints to inject air. The bioventing system will consist of vapor extraction wells and a vacuum blower. Additionally, due to the relatively permeable materials at the site, asphalt concrete pavement will be installed in the bioventing zone to expedite removal of contaminants in the vadose zone. The air injection and extraction systems will operate continuously except for shutdowns required for maintenance. The proposed layout for the biosparging/venting system and the extent of excavation are shown on Figures 3-4 and 3-5. Figure 3-6 shows a typical cross section of the proposed system.

3.4.1 Biosparging System

The placement of air injection wells and the amount of air that must be injected into the groundwater are the most important physical parameters in the design of biosparging systems. The vertical placement of air injection wells is determined by subsurface conditions (e.g., vertical contaminant distribution, depth to groundwater, depth to aquitard, and subsurface stratigraphy). As a general rule, injection wells are screened between 10 and 15 feet below the low water table.

Air Injection Wells

The horizontal spacing of air injection wells depends on hydrogeologic characteristics of a site. The radius of influence (ROI) describes the areal extent of the formation that is effectively influenced by an air injection well.

Information published in the literature suggests that the ROI may be two to three times the depth of an injection well below the water table (Marley et al., 1992a; P. J. Ware, 1993; Marley et al., 1992b; Leonard and Brown, 1992; and Felten et al., 1992).

The empirical information presented above suggests a "rule of thumb" that the ROI of an injection well is approximately 1.5 times the distance between the water table and the top of the screened section of the well. The seasonal low water table encountered at the site ranged between 18 to 20 feet below ground surface. The target zone for air injection will be in the saturated zone. The top of the one foot screened interval of the air injection wells will be at approximately 10 feet below the seasonal low water table. The ROI is expected to be about 15 feet. Note that the ROI increases with the depth of the saturated zone depth. Therefore, when the water table rises above the seasonal low water table, the ROI increases.

The layout of the biosparging/venting system is presented on Figure 3-4. As shown, thirty-two air injection wells are proposed in areas where the highest concentrations of TPH-diesel have been detected in soil. The shaded areas within the biosparging areas indicate bioventing areas.

Air Injection Rate

Each injection well will have a maximum design airflow of 2 to 3 standard cubic feet per minute (scfm), for a total maximum flow of approximately 96 scfm. The amount of air to be injected into the groundwater was calculated based on previous experience designing and operating similar systems, biological oxygen demand, and air requirements for stripping volatiles. The minimum design air pressure at the well screen is 9 pounds per square inch gage (psig), sufficient to overcome the hydrostatic head and minor losses as the air enters the formation. Calculation of the minimum air injection rate is included in Appendix D.

Air Injection Piping

The main compressed air line will be 4-inch galvanized steel pipe; individual supply lines will be 1-inch HDPE.

3.4.2 Bioventing System

Vertical bioventing wells will be installed at the locations as shown on Figure 3-4 to supply oxygen for biodegradation of hydrocarbons in the vadose zone. The extraction line from each extraction well will be connected to a header line, which will be connected to an extraction blower. Additionally, flush-to-grade well monuments will be installed at the extraction wells to facilitate maintenance and performance checks. Due to the relatively high permeability of the subsurface soils at the site, an asphalt pavement will be installed in the bioventing area to improve the performance of the system by increasing the ROI of the bioventing wells.

Extraction Wells

The design of the bioventing extraction wells includes well screen depth, air flow rate and well spacing. The screened interval of a bioventing well is typically located above the groundwater table in the contaminated vadose zone. However, seasonal fluctuation of the water table must be considered to ensure that wells are designed such that oxygen is provided to the vadose zone during both low and high water table conditions. Based on the site-specific TPH data, the bottom of each bioventing well screen will be approximately 1 foot above the seasonal low water table, and the top of the screen will be at least 5 feet above the seasonal high water table.

The required airflow for the bioventing system is a function of the oxygen demand for biodegradation of contaminants. The oxygen demand (i.e., oxygen utilization rate) at the site is estimated using available published literature. Based on the field data presented in the bioventing research report sponsored by the U.S Air Force and the U.S. EPA (Leeson et al., 1996), the oxygen utilization rate of the site soils can be estimated by using the *in situ* respiration rates measured at sites with similar contaminants. Based on our calculations (Appendix D), the oxygen utilization rate at the site is estimated to be approximately 10 percent per day. Calculations of the oxygen utilization rate, required airflow rate and ROI are included in Appendix D. The design flow rate for the extraction blower is approximately 25 scfm. The ROI of each extraction well is calculated to be approximately 24 feet.

3.4.3 Performance Monitoring

Performance of the biosparging and bioventing systems will be monitored using several soil gas monitoring points that will be installed within the bioremediation area. The monitoring data collected will be used to evaluate the system performance during remediation and for the ultimate closure of the site. The soil gas monitoring points will be installed in contaminated soils with high TPH-diesel concentrations, which will provide critical data pertaining to the biodegradation rate of contaminants. The soil gas monitoring will include, at a minimum, air pressure, concentration of hydrocarbon, oxygen and carbon dioxide.

Respiration measurements are useful in estimating the mass of contaminants that are being biodegraded and removed from the soil during bioventing. *In situ* respiration rate is an important indicator of biodegradation of contaminants. The *in situ* respiration testing involves measuring the uptake of oxygen in the contaminated area, which in turn can be used to calculate the biodegradation rate of contaminants. The *in situ* respiration testing will be conducted periodically during the bioventing system operation to monitor the remediation progress.

Table 3-1 U-Haul Indicator Hazardous Substances With Soil Cleanup Levels

Contaminant	Cleanup Level (mg/kg)	MTCA Method	MCTA Method C Commercial Cleanup Levels (mg/kg)
DDT	2.94	B	118
Aldrin	0.0588	B	2.53
Dieldrin	0.0625	B	2.5
Beta BHC	0.556	B	22.1
Gamma BHC (Lindane)	0.769	B	30.8
Arsenic	20.0	A	66.7
PCE	0.02	Site-specific	NA
TPH (gas)	1500.0	Site-specific	NA
TPH (diesel)	3500.0	Site-specific	NA

NA: Not Applicable

Table 3-2 TPH Impacted Soils Remediation and Cleanup Levels

TPH Contaminant	Minimum TPH Levels Required Before Using Biosparging/Venting (mg/kg)	TPH Cleanup Level After Excavation/Biosparging/Venting (mg/kg)
Gasoline	15,675	1,500
Diesel	14,950	3,500
Hydraulic or Waste Oil	14,950	3,500

4 Scope of Work

This section presents a general scope of work for remedial activities at the site. Construction quality assurance and technical performance criteria in support of this work are provided in Section 5. A schedule detailing design and remediation at the site is provided as Figure 4-1. Remedial activities at the site include building demolition, excavation, sanitary sewer bypass and relocation, biosparging/venting and final site grading. Construction specifications and drawings will be prepared following Ecology review and approval of this EDR. The scope of work includes:

- Construction Specifications and Drawings
- Mobilization and Site Preparation
- Excavation
  - Air Monitoring
  - Screening and Stockpiling
  - Confirmation Sampling and Testing
  - Backfilling and Grading
- Sanitary Sewer Pipeline
- Biosparging/Venting System
  - Well Installation
  - Injection and Extraction Systems
- Groundwater Monitoring Wells
  - Replacement and New Wells Installation
  - Groundwater Monitoring
  - Vapor Monitoring

4.1 Construction Specifications and Drawings

RETEC will prepare a construction specification and drawing package for Ecology review and approval prior to commencing remedial activities. The specifications will consist of a detailed scope of work that provides the bidding contractors with the remedial action criteria. The scope of work will provide the contractor with performance criteria rather than specifying methods and means to perform the work. The specification will also include a bid form and a set of 5 to 10 drawings.

4.2 Mobilization and Site Preparation

The contractor will mobilize to the site all the necessary equipment, labor and materials to perform the work described in the following sections. Site preparation will include the following activities:

- **Utility Locate.** Prior to commencing any on-site activities, all underground public and private lines will be located and marked with paint. Figure 1-3 shows the approximate location of all known utility lines on the property.

- **Temporary Facilities and Access Controls.** The Contractor shall install all required temporary facilities, including worker facilities and staging areas such as stockpiles and storage areas. The Contractor shall establish work zones including perimeter work zone, security and barricades, exclusion zones, and contaminant reduction zones.

- **Erosion and Sedimentation Controls.** The Contractor shall install silt fencing along the perimeter of the work area prior to commencing site work. Other stormwater and erosion and sedimentation controls are discussed in the Stormwater Pollution Prevention Plan (Appendix A).

- **Health and Safety Plan.** The Contractor shall have a Health and Safety Plan that has been developed following guidelines put forth in the project specifications prior to commencing on-site activities.

- **Site Clearing.** The Contractor shall clear and grub the area to facilitate remediation activities.

- **Demolition.** Two buildings on-site will be demolished prior to commencing excavation. The demolition may be completed just prior to excavation, or it may be completed at an earlier date to allow the excavation timetable to be met. An inspection of the building structures will be conducted to determine disposal and permitting requirements. The Uniform Building Code (UBC, Section 3303) provides requirements for demolition activities. A permit application for the demolition of the two buildings will be submitted to Yakima County Public Works Engineering Division for review and approval.

- **Power Pole Relocation.** The power pole that is located within the area planned for excavation (Figure 1-3) will be relocated to the east so that it is outside of the excavation activities.

4.3 Excavation

The remedial action will remove an estimated 19,250 cubic yards (cy) from OU1 and 950 cy from OU2. It is estimated that on the order of 30 to 40 percent of this total volume will be oversized material that will be screened, resulting in 14,140 cy to 12,120 cy being removed from the site. The excavation areas are shown on Figure 3-1. The impacted areas were delineated based on the previous analytical and characterization results performed during site investigation. The extent of excavation may vary depending upon the results of the confirmation sampling conducted during excavation activities. Excavation sidewalls are expected to stand at a stable slope somewhere between 1.5H:1V (horizontal to vertical) to 2H:1V depending on soil conditions. Debris encountered during excavation will be run through the screening process if it is concrete, or be sampled and disposed of properly if it is wood. Other debris (such as glass, piping, drums) that is encountered will be disposed of as construction debris if it is found to be not impacted.

A portion of the site is located outside the U-Haul property boundaries, as shown on Figure 3-1. This portion of the site is designated as OU2 on Figure 2-1. The site boundaries on the west and north are the centerline of the closest rail spur track. However, excavation cannot be completed up to the site boundaries without impacting the integrity of the BNSF rail tracks. Excavations are limited to outside a zone that is defined by a sloping line (in cross section) that begins at the end of the tie, and extends downward at a slope of 2H:1V (2 Horizontal to 1 Vertical). These limits are shown on Figure 3-6.

The area within OU2 between the site boundary (track centerline) and the area where excavation is structurally viable is referred to as the Offset Zone in the CAP. Impacted soil that is within OU2 will be handled in a similar manner as the impacted soil in OU1 with the following two exceptions:

- TPH impacts within the offset zone will be treated using bioventing/sparging.
- PCE impacts that are above the PCE CUL will only be addressed if they are co-located with DDT that is also above the DDT CUL.

The OU2 excavation volume is estimated to be approximately 950 cubic yards.

4.3.1 Air Monitoring

An air-monitoring program will be implemented during construction to ensure the air quality meets the criteria established in the site-specific Health and Safety Plan (HASP) (Appendix F). Relevant wind information will be collected and evaluated to determine the appropriate locations for air monitoring stations along the perimeter of the work area. A certified industrial hygienist will be retained to prepare the air monitoring program for the project. The air monitoring program will be submitted under separate cover to Ecology for review and approval. Specific air monitoring equipment/device will be presented in the construction specifications and design drawings.

4.3.2 Screening and Stockpiling

The excavated materials will be screened prior to being stockpiled separately based on the size of the materials. Appropriate erosion and sedimentation controls will be put in place to prevent run-on and run-off. Samples will be collected from the stockpiles in accordance with the sampling and analysis plan (SAP) included in Appendix B. Results of the laboratory analytical testing will be used to determine the handling of the stockpiles. The material will be used as backfill on-site or hauled for off-site disposal. A site layout plan showing areas available for soil screening and stockpiling will be included in the construction drawings.

The stockpiles will be covered with plastic sheeting during periods of inactivity or precipitation. Due to the relatively flat topography and high infiltration rate of the on-site soils, no run-on and run-off control berms constructed around the perimeter of stockpile areas are expected to be required.

4.3.3 Transportation

Transportation of impacted material from the site to an approved disposal facility will be either by truck and trailer or by rail car. Rail car transportation may or may not be a viable alternative due to the ability to stage railcars on the spur that is adjacent to the site. Truck transportation, if used, will likely be by dump truck and trailer.

Assuming a reasonable unit weight for the on-site soils, and 34 tons per truck and trailer, a total of 750 loads will leave the site. Assuming 5 trucks per hour and 8 hours per day, this comes to about 19 days of hauling material from the site. It is expected that the hauling days will not be contiguous to any great degree. Trucks will leave the site on East Arlington Street (a one-way street that is a dead end just past the site) and turn at a light onto South First Street. Trucks arriving at the site and leaving the site will queue up off of City streets.

4.3.4 Confirmation Sampling and Testing

Once impacted soil is removed, confirmation sampling of the excavation sidewalls and bottoms will be performed to demonstrate that the site is in compliance with the CULs listed in the CAP in accordance with WAC 173-340-740(7). The confirmation sampling and testing program will include qualitative field-testing and quantitative analytical testing. If any of the confirmation samples indicate remaining soils exceed cleanup levels, additional excavation will be performed. If a specific sidewall sample exceeds cleanup levels, then additional sidewall soil will be removed until visual inspection and laboratory testing indicate that the CULs have been achieved, consistent with MTCA statistical guidance for demonstrating compliance with CULs (WAC 173-340-740(7)). Any additional excavated material will be handled similarly to impacted soil, i.e., screening and stockpiling prior to being used as backfill on-site or transported off-site for disposal.

Sidewall samples will be collected and analyzed for the nine indicator hazardous substances (Table 3-1) as applicable, based on location within the site and depth as described below. Excavation will continue as directed by the site construction engineer-in-charge in the direction where exceedance of the cleanup levels occurs or until the requirements of the CAP are achieved. TPH-impacted soils and areas outside of the disposal pit will be handled as described in Section 3.3.1. Sidewall samples will be collected according to the following method.

A sidewall sampling section will be located every 50 lineal feet around the exterior of the excavation. At each sidewall sampling section, the vertical axis of the excavation will be divided into 5-foot vertical depth sampling segments. One discrete soil sample will be collected from the center of each 5-foot segment. If there are obvious visible impacts within the 5-foot increment, the sample will be obtained from the visibly impacted depth rather than from the center of the segment. Samples from each segment will be collected by hand if the excavation sideslope is deemed safe for entry in accordance with OSHA 29 CFR 1926 Subpart P. Otherwise, the samples will be collected from a backhoe bucket. At a minimum, one sample will be collected from each excavation interval of 5 feet or less. For example, if the excavation depth is 19 feet, 4 samples will be collected, representing 0-5, 5-10, 10-15 and 10-19 feet intervals, respectively.

Discrete soil samples will be collected from excavation bottoms according to the following method. The excavation will be divided into 400-square foot grids. Each grid will be divided into four sub-quadrants. A sub-quadrant from each grid will be randomly selected for sampling. The soil samples will be collected from the surface of the excavation bottom, at the center of the selected quadrant.

Laboratory analyses will be conducted for all IHS (see Table 3-1) on OU1 within the lime/sulfur pit area and in the upper 5 feet of in other areas of the site. Laboratory analyses will be conducted for all IHS in the upper 5 feet on OU2 with the exception of PCE, which will be excluded from the analyses suite since PCE will only be addressed in OU2 is DDT is present (DDT is included in the analyses).

Once laboratory testing has confirmed that excavation has reached the limits of the lime/sulfur pit on both OU1 and OU2, laboratory analyses will consist of the following:

- **OU1** – All IHS (see Table 3-1) in the upper 5 feet and TPH only below a depth of 5 feet

- **OU2** – All IHS in the upper 5 feet with the exception of PCE. Testing will omit PCE on OU2 since PCE cleanup only occurs is DDT above site cleanup levels is detected. Below a depth of 5 feet and outside of the lime/sulfur out (as defined by confirmation sampling results), confirmation samples will be analyzed for TPH only.

The confirmation sampling soil samples will be collected in accordance with the SAP.

4.3.5 Backfilling and Grading

After the results of the confirmation sampling and analysis indicate compliance with WAC 173-340-740(7) and the results have been reviewed and analyzed by Ecology, the excavations will be backfilled. According to the CAP, backfill in the surface to 5-foot depth and below 12 feet in depth (or high groundwater table) will be analyzed to demonstrate it contains no hazardous substances exceeding MTCA method A or B cleanup levels. Backfill placed between 5 and 12 feet bgs may have contaminant concentrations between method B and method C Commercial cleanup levels. These levels are shown in Table 3-1. In TPH excavations, backfill will not contain hazardous substances that exceed MTCA method A or B cleanup levels. The imported backfill material will be clean, free-draining sandy and/or gravelly soils. Samples of the proposed import backfill will be approved by the site construction engineer-in-charge prior to use.

Backfill material for the excavation areas will include stockpiled clean native soil or approved additional imported soil. Backfill will be placed in maximum loose lifts of 1 foot and compacted to at least 90 percent maximum dry density as determined by ASTM D-1557. The ground surface of the backfilled excavation areas will be graded to the final elevations indicated on the design drawings. Any hard surfaces that are damaged as part of this remediation effort will be replaced in-kind when excavation and backfill is completed. For instance, if an existing asphalt area is damaged during construction, it will be patched with asphalt.

4.4 Sanitary Sewer Pipeline

The sanitary sewer line crossing the western portion of the site will be temporarily bypassed to facilitate the remedial excavation. A section of new sewer pipe will be installed upon completion of the construction. The bypass and final replacement sewer will be designed by a licensed professional engineer in accordance with city requirements. The bypass and new sewer design will be presented in the design drawings.

4.5 Biosparging/Venting System

4.5.1 Well Installation

Biosparging Wells

Figure 3-4 shows the biosparging air injection well locations. Construction details for the wells are shown on Figure 4-2. The top of air injection well screened interval will be installed about 10 feet below the seasonal low water table, approximately 28 to 31 feet below ground surface. Air injection wells will be installed using drilling techniques suitable for the soil conditions at the site. Each air injection well will be constructed of 2-inch diameter Schedule 40 PVC casing with 1 foot of 0.020-inch well screen surrounded by a sand or gravel pack. A 1-foot bentonite seal will be placed above the sand or gravel pack. The well annulus will then be grouted to approximately 2 feet below the ground surface. Once installed, wellheads will not be accessible at ground surface.

Bioventing Wells

The top of the bioventing extraction well screened interval will be installed 5 foot above the seasonal high water table, and the bottom of the screened interval will be about 1 foot above the seasonal low water table. Construction details for the wells are shown on Figure 4-3. Each extraction well shall be constructed of 4-inch diameter Schedule 40 PVC casing with about 12 feet of 0.020-inch well screen surrounded by a sand or gravel pack. A 1- to 2-foot bentonite seal will be placed above the sand or gravel pack. The well annulus will then be grouted to approximately 2 feet below the ground surface. Once installed, wellheads will not be accessible at ground surface.

Vapor Monitoring Wells

Vapor monitoring wells will be installed at several locations within the biosparging/venting areas, as shown on Figure 3-3. Construction details for the wells are shown on Figure 4-4. In the biosparging area, the vapor monitoring wells will be installed to a depth of approximately 18 feet bgs. The well bores will be drilled with a hollow-stem auger. The wells will be constructed using 3/8-inch aluminum tubing that will be hand-slotted between 16.5 and 17 feet bgs. In the bioventing area, a cluster of 3 monitoring wells will be installed at one location. The wells will be constructed using 3/8-inch aluminum tubing that will be hand-slotted 6.5-7.0, 11.5-12.0 and 17.5-18.0 feet bgs.

4.5.2 Injection and Extraction Systems

Air Injection Manifold

A 4-inch galvanized steel header line will deliver the air from the blower to the distribution manifold. Air injection wells will be controlled at distribution manifold housed in the equipment compound (Figure 4-6). The manifold will consist of a globe valve, a rotameter and a pressure gauge for each injection well (Figure 4-5). The air will be distributed to each well using 1-inch HDPE pipe. Supply lines will be buried at 12 inches below final grade, as shown on Figure 3-6.

Air Extraction Manifold

A 4-inch HDPE header line will connect the vertical extraction wells via a moisture separator to an extraction blower. The extraction wells will be controlled at distribution manifolds housed in the equipment compound. The manifold will consist of a butterfly valve, a rotameter and a pressure gauge for each extraction well (Figure 4-5). The vacuum line will be at a depth of 12 inches bgs. The air will be extracted from the screened interval of each 2-inch PVC well using a 2-inch HDPE pipe. Extraction lines shall be buried at 12 inches below final grade.

Asphalt Concrete Pavement

An asphalt concrete pavement will be installed over the bioventing area to enhance performance of the bioventing system by increasing the radius of the influence of the extraction wells. The pavement will act as an impermeable surface covering the bioventing area to prevent the suction induced by the extraction wells from short-circuiting the air flow near the extraction wells. The pavement will be constructed with a minimum of 1-1/2 inches thick asphalt concrete on top of a minimum of 3 inches thick crushed rock base course or other equivalent granular materials approved by the engineer. The finished pavement surface will have a minimum 2% slope from the center towards the edge of the pavement to allow surface drainage. As shown on Figure 3-6, the pavement will cover a total area of approximately 80 feet by 80 feet.

Biosparging and Bioventing Equipment

The air sparging equipment will be installed at the equipment pad location shown on Figure 3-5. The equipment pad layout is provided on Figure 4-5. The total design air injection rate is 96 scfm (total of 32 air injection wells, 3 scfm per air injection well). Compressed air will be supplied by one 9.5-horsepower (hp) Sutorbilt Legend 3M positive displacement blowers (or equivalent). The blower can provide a maximum of 112 scfm at 12 psig. Manufacturer's cut sheets are provided in Appendix E. Compressed air will be cooled to temperatures within the operating range of the HDPE pipe using heat exchangers. The air injection blowers will be housed in wire fence enclosure.

Bioventing extraction piping will be connected to one 1.5-hp regenerative blower (EG&G Rotron EN/CP 513, or equivalent). Each blower can provide a maximum flow rate of 78 scfm at a vacuum pressure of 75 inches of water. Manufacturer's cut sheets are included in Appendix E. A piping and instrumentation diagram for the sparging equipment is provided on Figure 4-5.

Utility Installation and Hookup

New electrical service will be provided to the blowers. Power requirements will be provided in the construction specifications. Electrical conduit will be buried or run aboveground from the service location to the equipment. Power will run to a control panel at the equipment pad. The control panel will be used to operate the compressor and blower and will conform to NEMA4 standards.

4.6 Groundwater and Vapor Monitoring Wells

4.6.1 Replacement and New Wells

All existing monitoring wells for the site will be flagged prior to commencing excavation. Any monitoring wells that are damaged or destroyed during construction will be repaired or replaced. The replacement monitoring wells will be installed as close to the original well location as possible. The replacement wells will be replaced within 30 days after final backfill.

Five new monitoring wells will be installed within 30 days after final backfill. These new wells will be installed downgradient from the excavation areas (Figure 4-7). Of the five (5) new monitoring wells, three (3) will be to 28 feet, one (1) to 60 feet and one (1) to 90 feet bgs. Shallow well screens will consist of a 20-foot section and will generally extend from 8 to 28 feet bgs to intercept the water table during seasonal high and low conditions. Historic gauging data will be used to determine the exact screen interval and well depth prior to mobilizing to the site. Screening for the shallow wells will be 0.020-inch slots. The deep wells will have 10-foot screens at the bottom of the wells with 0.020-inch slots. The clustered 30-, 60-, and 90-foot wells will be separated by at least 7 feet.

The new wells will be constructed of 2 inch Schedule 40 PVC casing and 0.020-inch screen, consistent with wells installed during the RI. The filter pack will consist of 10- to 20-grade sand that will be placed in the annular space around the screen. The sand will extend one foot below the base of the screen and one foot above the top of the screen. A bentonite seal will be placed above the filter. This seal will consist of bentonite chips or pellets and will be a minimum of two feet thick. The wells will be completed with a flush-mount waterproof monument. All wells will be fitted with lockable caps tamper proof covers. All completed wells will have identification numbers clearly painted on the caps.

Additional specifications for monitoring well installation are given in the Sampling and Analysis Plan (SAP, Appendix B). Well construction details are shown on Figure 4-8. Standard protocols shall be followed for developing the monitoring wells. Well depths are detailed in the Groundwater Compliance Monitoring Plan (Appendix G).

4.6.2 Groundwater Monitoring

The overall remedial objective of the YVS cleanup is to decrease the volume of contaminated soil and groundwater such that the remaining conditions are protective of human health and the environment. Compliance monitoring will be conducted during and after remediation to demonstrate that conditions remain protective. In accordance with WAC 173-340-410, monitoring will be completed in the following three phases as outlined in the Compliance Monitoring Plan:

- **Protection Monitoring** is intended to "confirm that human health and the environment are adequately protected during construction and the operation and maintenance period." Protection monitoring will therefore occur during excavation activities as well as during operation of the groundwater sparging system.

- **Performance Monitoring** will be conducted to "confirm that the.... cleanup action has attained cleanup standards." Groundwater samples will be collected and analyzed to confirm that compliance with cleanup levels is maintained after the groundwater sparging/ bioventing system is shut down.

- **Confirmational Monitoring** is performed after completion of performance monitoring to "confirm the long-term effectiveness of the.... cleanup action." Periodic sampling of groundwater from selected wells will be conducted.

4.6.3 Vapor Monitoring

The vapor monitoring wells will be used for routine measurements of air pressure and the concentrations of oxygen. Data will be collected before start-up of the system and periodically during operations. Equipment required to perform these measurements will include a magnahelic gauge, vacuum pump, photoionization detector, oxygen meter, and Tedlar™ bags.

5 Construction Quality Assurance

This section discusses construction quality assurance for the project, including the quality assurance structure, responsibilities and requirements. Quality assurance includes compliance with health and safety requirements and performance standards outlined herein and within the specifications.

5.1 Quality Assurance Monitoring Structure

All aspects of construction will be performed under the oversight of the professional engineer registered in the State of Washington or a qualified field technician under the direct supervision of a professional engineer registered in the State of Washington. An Engineer or qualified representative will be on-site throughout construction and will be responsible for ensuring compliance with the performance standards outlined in Section 5.2.2.

Upon completion of remedial activities, the Engineer will submit a final completion report. The report will include as-built drawings, work accomplished, materials used, inspections and tests conducted, results of inspections and tests, nature of defects found (if any), and corrective actions taken.

5.2 Construction Quality Requirements

5.2.1 Health and Safety

All Contractors and subcontractors are required to use workers trained for hazardous waste work. It is the remedial contractor's responsibility to meet all the requirements of WAC 296-155, Safety Standards for Construction, and the applicable provisions of the hazardous waste operations regulations, WAC 296-62, Part P and 29 CFR 1910.120. The Contractor shall also have a site health and safety (H&S) officer who will ensure that all contractor personnel adhere to H&S regulations. Prior to starting work, the Contractor shall submit an H&S plan to the Engineer for review. The plan shall include written documentation of employee training and medical certifications as required under WAC 296-62, Part P. Documentation of the following items is required for each site worker where work falls under the requirements of WAC 296-62, Part P:

- Initial 40-hour health and safety training and annual 8-hour refresher training;
- Eight-hour supervisory training, required for the field supervisor;
- Medical clearance from a licensed physician certifying that the worker is fit to participate in field activities and use personal protective equipment;

- Current respirator fit test certification;

- Current CPR and first aid certification for at least one member of each crew; and

- Provision of personal protective equipment for each worker at the highest level of protection for this site (Level D).

5.2.2 Performance Standards

Performance standards address environmental and public health issues such as emission control, and compliance with environmental regulations. Monitoring efforts of the Engineer will be conducted to demonstrate compliance with performance standards.

The following sections identify performance standards for activities at the site. Table 5-1 lists the construction performance standards and the contractor quality assurance testing requirements.

Emission Controls

Excavation, grading, and capping activities will be carried out in a manner that minimizes emissions of odors and dust (fugitive emissions). Dust and vapor monitoring will be carried out according to an Ecology approved monitoring plan (to be submitted under a separate cover). This plan will detail the location of site perimeter monitoring stations and present action levels that will result in protection of workers surrounding the site. The Contractor will provide measures to suppress fugitive dust generated during site grading that the Engineer deems excessive based on visual and other monitoring criteria.

5.2.3 Record Keeping and Reporting

The Engineer will maintain records to document the work performed. These records include, but are not limited to, the following:

- **Daily Activity Log.** A daily activity log will be completed to describe general site activity and personnel working on-site. The records may be used to substantiate invoices as related to measurement and payment of site work. Health and Safety levels will also be noted in the daily logs as well as field H&S monitoring.

- **Material Testing Results.** All material testing results will be maintained. Material testing logs will, at a minimum, include the date and time of testing, testing site and location, identification of tester and company, test results, and any relevant comments.

Table 5-1 Performance Standards

Standard	Parameter	Level of Performance	Testing Method or Specification	Frequency of Testing	Comments
Preconstruction Testing					
Backfill	Gradation	Granular or non-granular soil and/or aggregate that is free of deleterious material and is non-plastic. The material is considered non-plastic if 0-15% passes #200 sieve, or if the soil fraction passing the #40 sieve cannot be rolled, at any moisture content, into a thread.	ASTM D4318 ASTM D422	For each source	- Backfill for 0-5 ft & >12 ft bgs: not exceeding MTCA method A or B CUPs. - Backfill 5-12 ft bgs: may have contaminant concentrations between MCTA method B and method C Commercial CUPs. - Uncontaminated concrete debris will be broken into pieces no larger than 1 foot in diameter.
Construction Testing					
Grading	Grade	Within 1.5 inches	Field Surveying	Continuous	
Emission Controls	Dust	< 5 mg/m^3 OSHA PEL	MiniRam and Site Perimeter Monitoring	Continuous	Contractor shall provide dust suppression measures
Surface Water Quality	Turbidity	No excessive turbidity	Visual	Continuous	
Backfill Compaction	Density	Compacted to at least 90% ASTM D-1557 density.	ASTM D698 ASTM D1557 ASTM D2922	One test event per 750 CY of fill placed.	

6 References

Department of Ecology, 2002. *Draft Stormwater Management Manual for Eastern Washington.* September.

Department of Ecology, 2001. *Final Cleanup Action Plan.* Prepared by Richard Bassett. Yakima. August.

Felten, D.W., M. C. Leahy, L. J. Bealer, and B. A. Kline, 1992. "Case Study: Site Remediation Using Air Sparging and Soil Vapor Extraction." In: *Proceedings of the 1992 Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Restoration.* Sponsored by The American Petroleum Institute and The Association of Groundwater Scientists and Engineers. November 4-6, 1992, Houston, Texas. p. 395-411.

Leeson, A. and Hinchee R.E., 1996. *Principles and Practices of Bioventing.* Prepared for the Armstrong Laboratory Tyndall AFB Florida, the U.S. EPA, and the U.S. Air Force Center for Environmental Excellence Technology Transfer Division Brooks AFB Texas. September 26, 1996.

Leonard, W. C. and R. A. Brown, 1992. "Air Sparging: An Optimal Solution." In: *Proceedings of the 1992 Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Restoration.* Sponsored by The American Petroleum Institute and The Association of Groundwater Scientists and Engineers. November 4-6, 1992, Houston, Texas. p. 349-364.

Marley, M. C., D. J. Hazebrouk, and M. T. Walsh, 1992a. *The Application of In Situ Air Sparging as an Innovative Soils and Ground Water Remediation Technology.* Groundwater Monitoring Review. Spring. p. 137-145.

Marley, M.C., F. Li, and S. Magee, 1992b. "The Application of Models in the Design of Air Sparging Systems." In: *Proceedings of the 1992 Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Restoration.* Sponsored by The American Petroleum Institute and The Association of Groundwater Scientists and Engineers. November 4-6, 1992, Houston, Texas. p. 377-392.

The RETEC Group, Inc., 2003. *Additional Field Characterization Work Plan.*, Prepared for U-Haul of Inland Northwest. February.

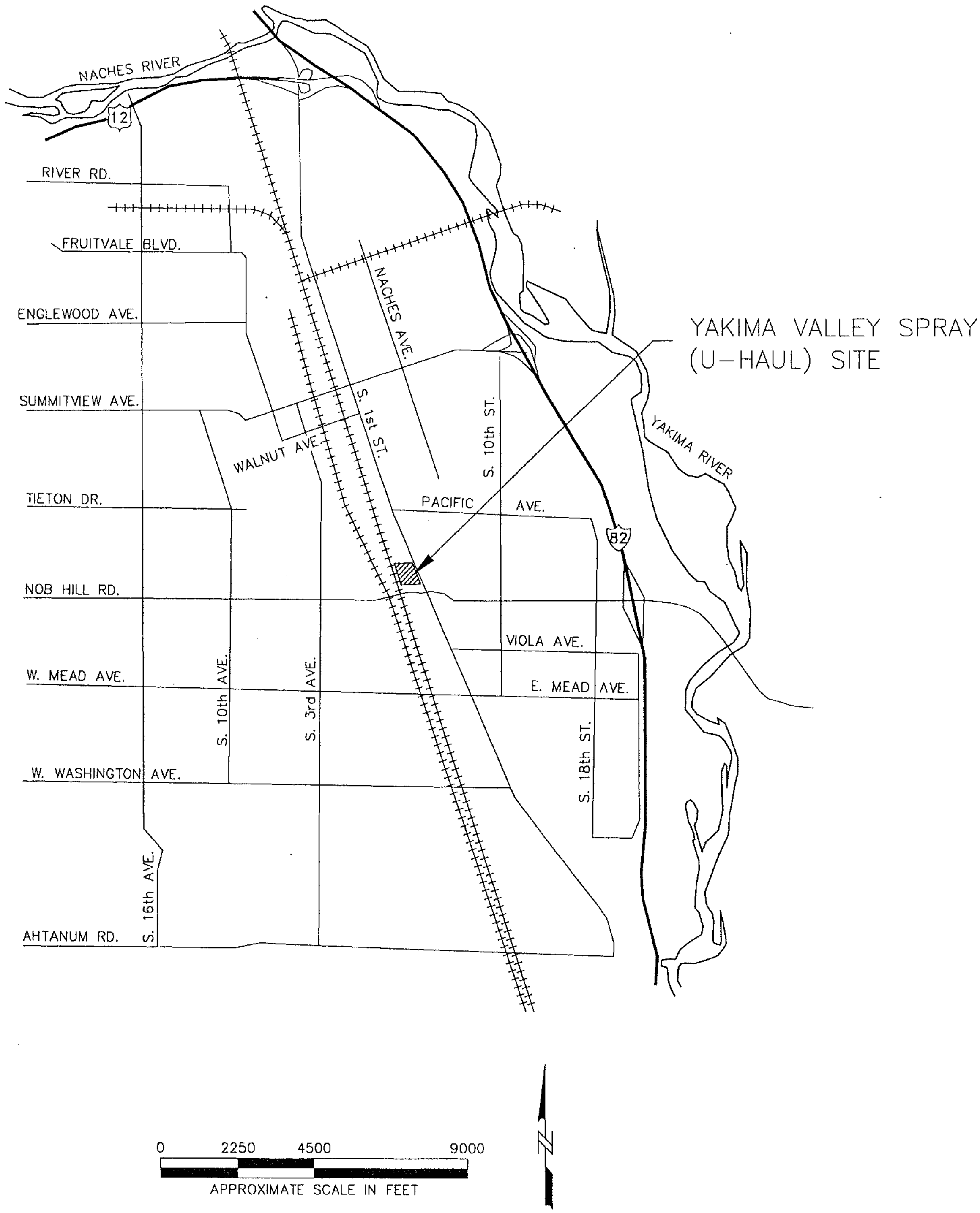
The RETEC Group, Inc., 1995. *Remedial Investigation Report for the Yakima Valley Spray Company (U-Haul) Facility, Yakima, Washington.* Prepared for U-Haul of Inland Northwest. March.

The RETEC Group, Inc. 1995. *Draft Feasibility Study for the Yakima Valley Spray (U-Haul) Facility, Yakima, Washington.* Prepared for U-Haul of Inland Northwest. March.

The RETEC Group, Inc. 1999. *Summary of May 1999 Test Pit Excavation, Pilot Sieve Test, and TPH Soil Sampling and Analysis for the Yakima Valley Spray Company (U-Haul) Facility, Yakima, Washington.* Prepared for Yakima Valley Spray (U-Haul) Site Steering Committee. July 6, 1999.

Ware, P. J., 1993. *Supplemental air to reduce remediation.* The National Environmental Journal. July/August. p. 18-20.

Figures



RETEC

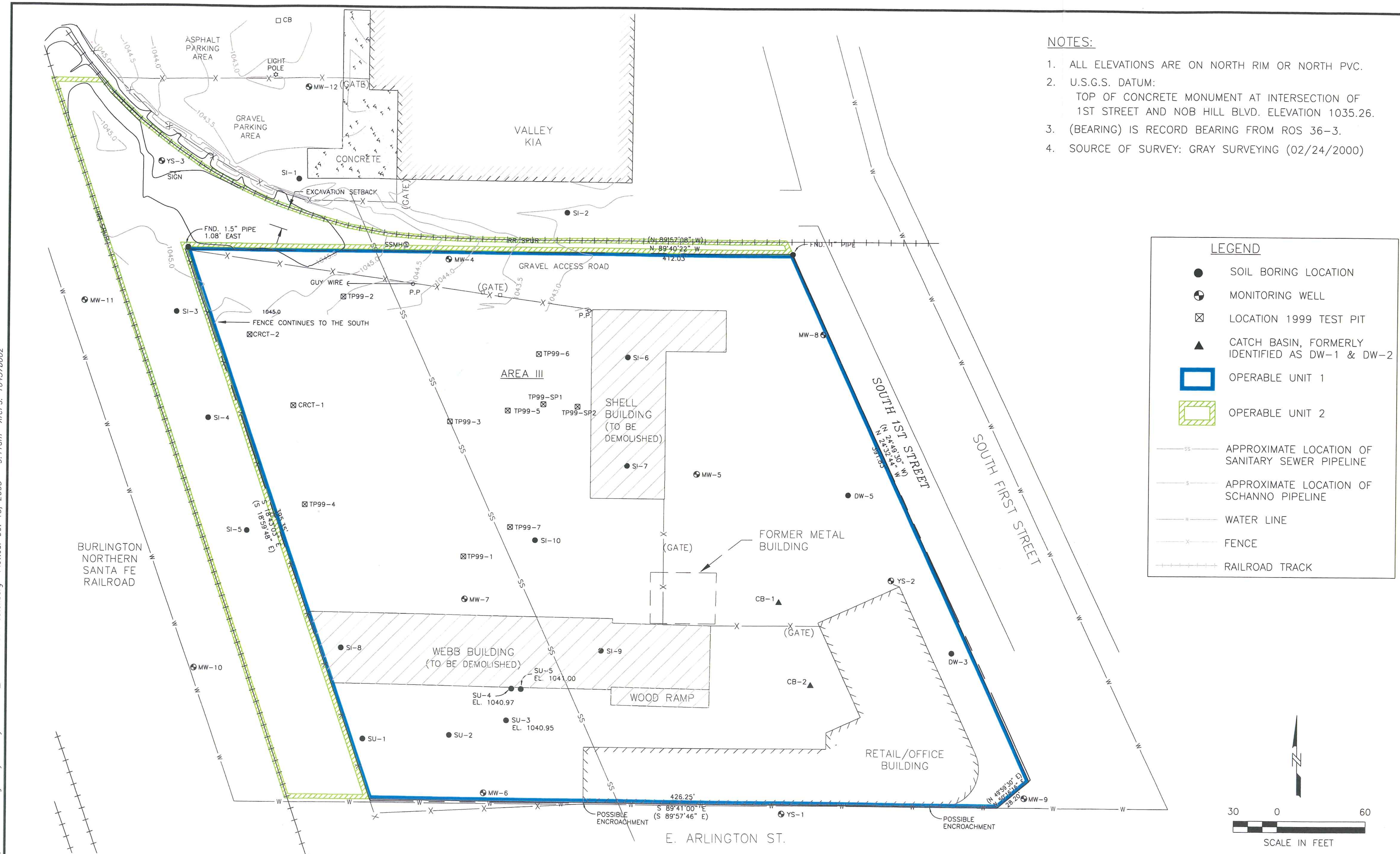
YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/04/03 DRWN: A.S./SEA

SITE LOCATION MAP

FIGURE 1-1

File: H:\16457\16457S004.dwg Layout: ANSI_AVI-LJ User: astenberg Plotted: Oct 15, 2003 - 9:42am Xref's:



File: H:\16457\16457S025.dwg Layout: Layout1-ANSI_BI-CP User: astenberg Plotted: Oct 15, 2003 - 9:41am Xref's: 16457b002

RETEC

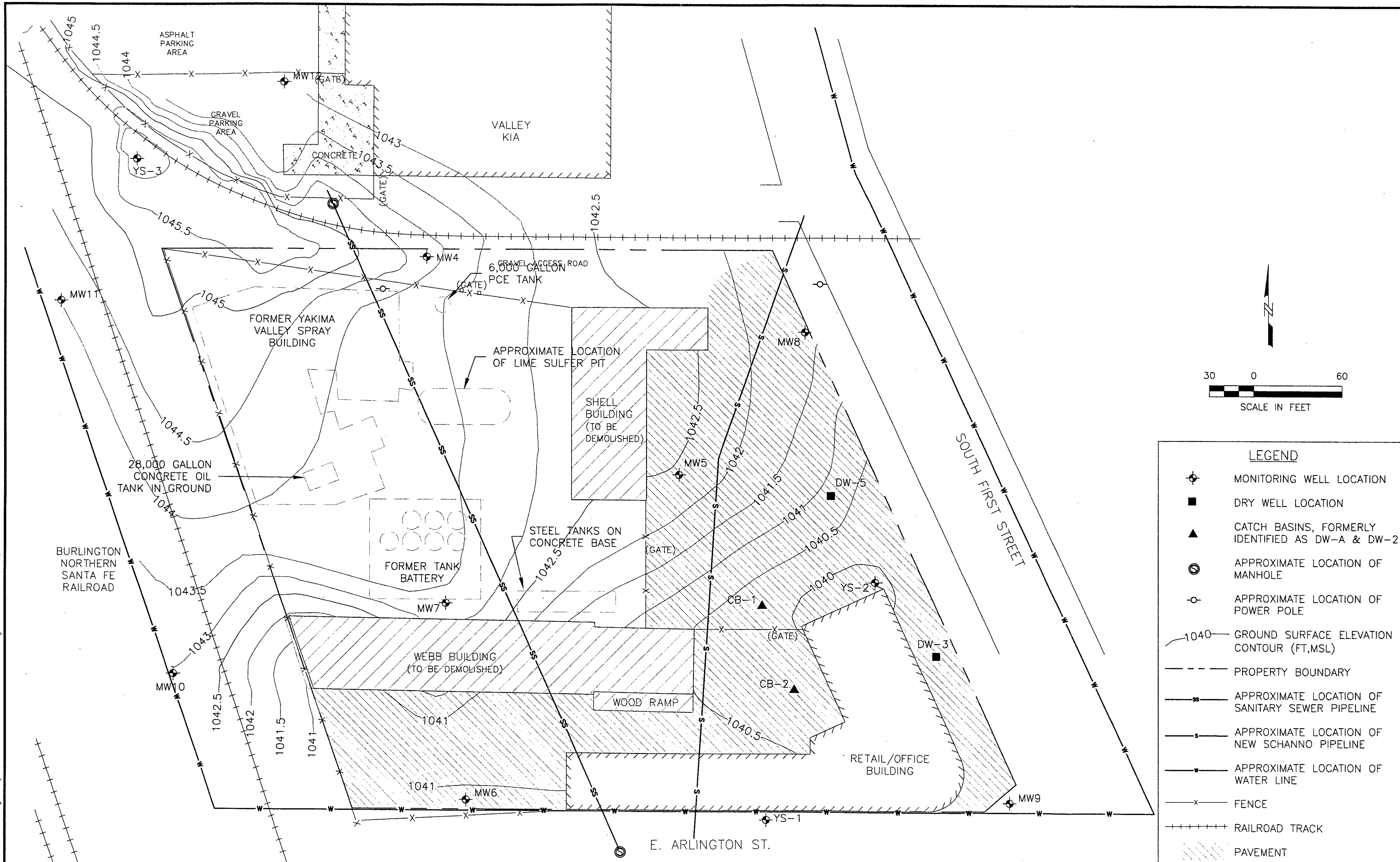
YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON

DWT40-16457-300

DATE: 04/03/03 | DRWN: A.S./SEA

OPERABLE UNIT DEFINITIONS

FIGURE 1-2



File: H:\16457\16457S012.dwg Layout: ANSI_BI-CP User: astenberg Plotted: Oct 15, 2003 - 9:42am Xref's: 16457b002

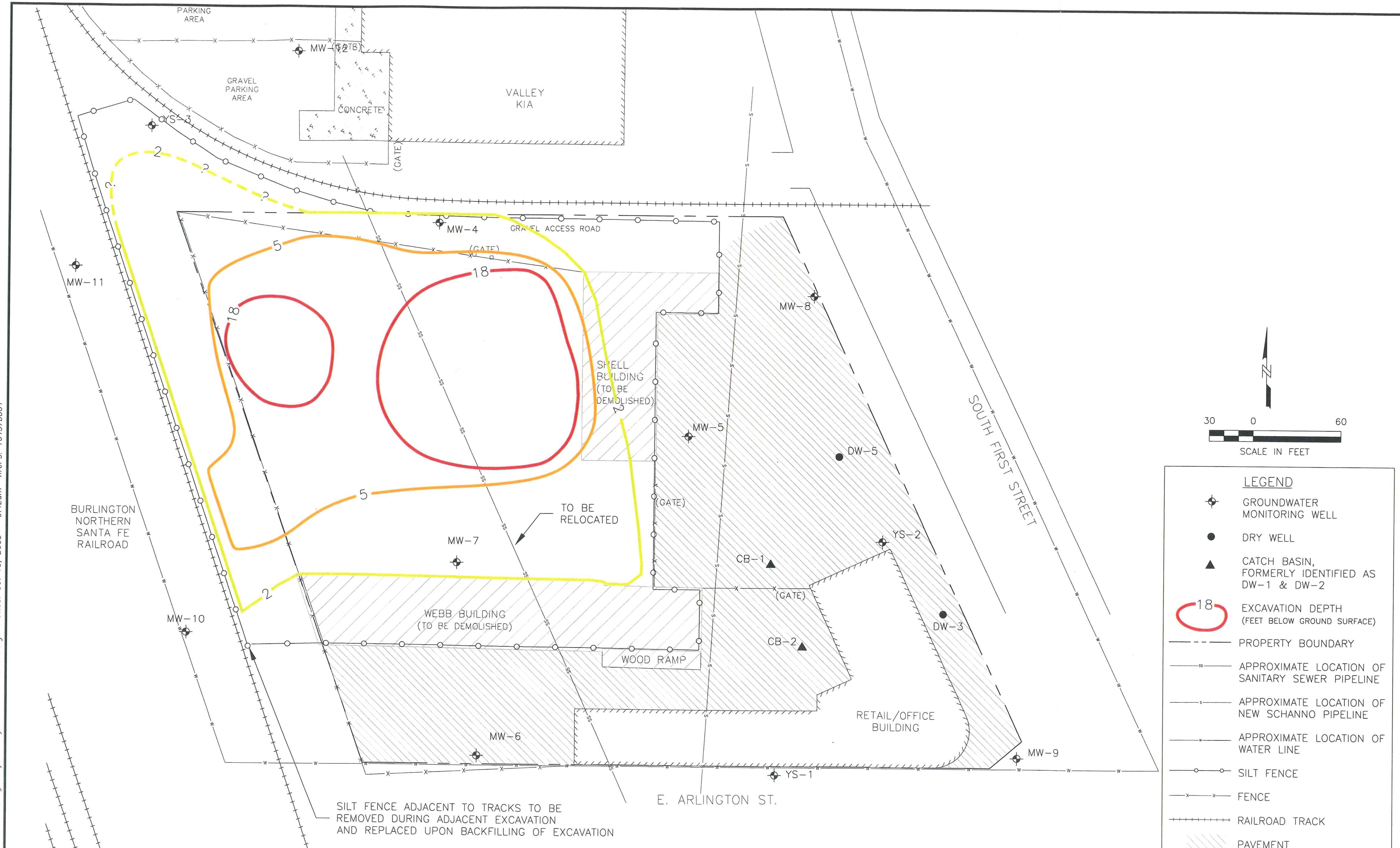
RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/03/03 DRWN: A.S./SEA

EXISTING SITE PLAN

FIGURE 1-3



File: H:\16457\16457S007.dwg Layout: Layout1 User: astenberg Plotted: Oct 15, 2003 - 9:42am Xref's: 16457b001

RETEC

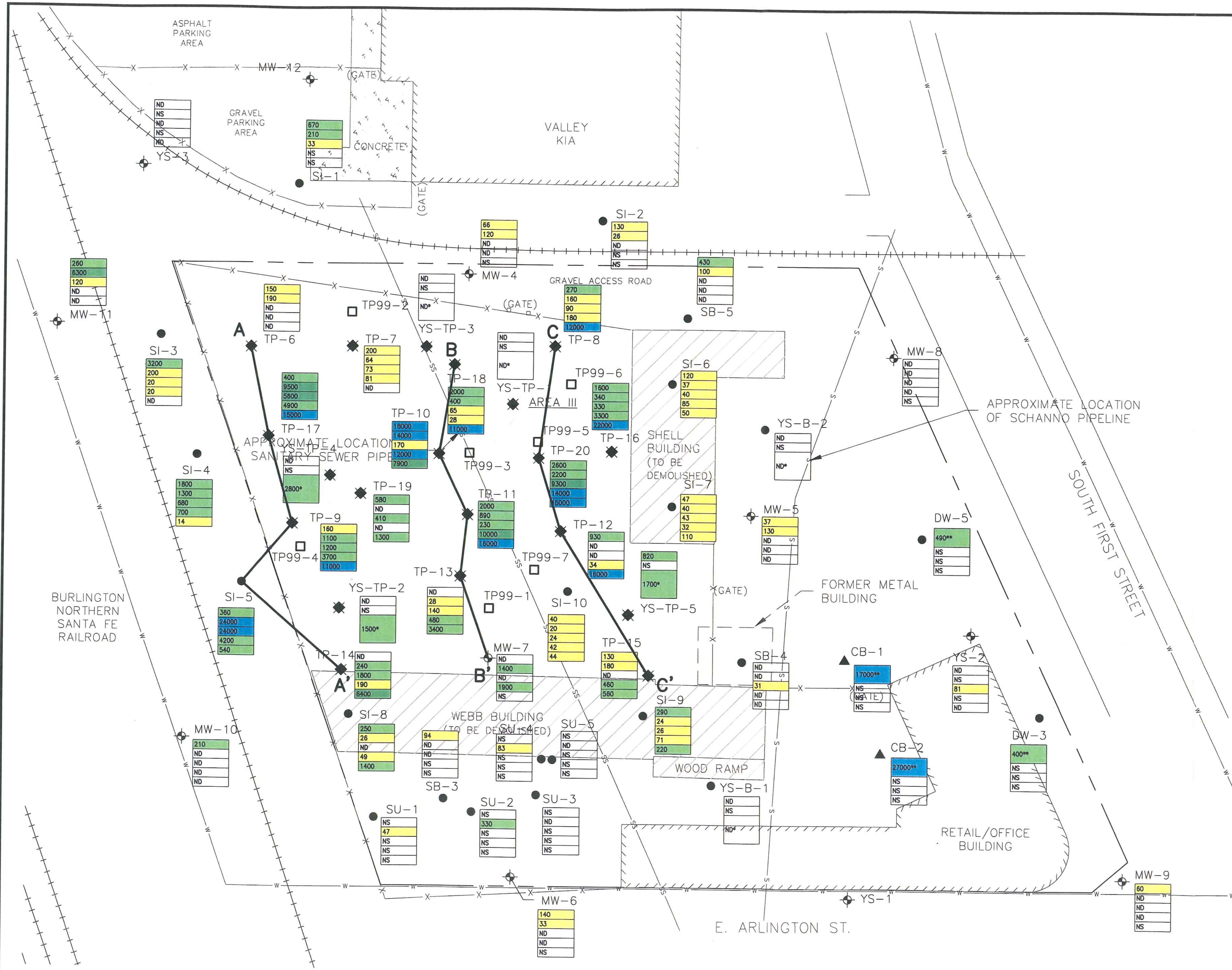
YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON

DWT40-16457-300

DATE: 04/04/03 | DRWN: A.S./SEA

EXCAVATION PLAN

FIGURE 3-1



LEGEND

SAMPLES TAKEN AT 0.3'
SAMPLES TAKEN AT 2'
SAMPLES TAKEN AT 5'
SAMPLES TAKEN AT 10'
SAMPLES TAKEN AT 17'

CONCENTRATIONS MIN–200 mg/kg
CONCENTRATIONS 200–5100 mg/kg
CONCENTRATIONS 5100–10000 mg/kg
CONCENTRATIONS >10000 mg/kg

NS NOT SAMPLED
ND NOT DETECTED
* COMPOSITE 5–15'
** COMPOSITE 0–2'

Test Pit	Depth (feet below ground surface)	Concentration (mg/kg)
TP99-1	5	<10
	14	4520
TP99-2	5	4010
	8	681
TP99-3	5	16100
TP99-4	16	9140
TP99-5	6	5540
TP99-6	5	<10
	15	13800
TP99-7	5	37.1
	15	3440

File: H:\16457\16457S020.dwg Layout: ANSL_BI-CP User: astenberg Plotted: Oct 15, 2003 - 9:41am Xref's: 16457b001

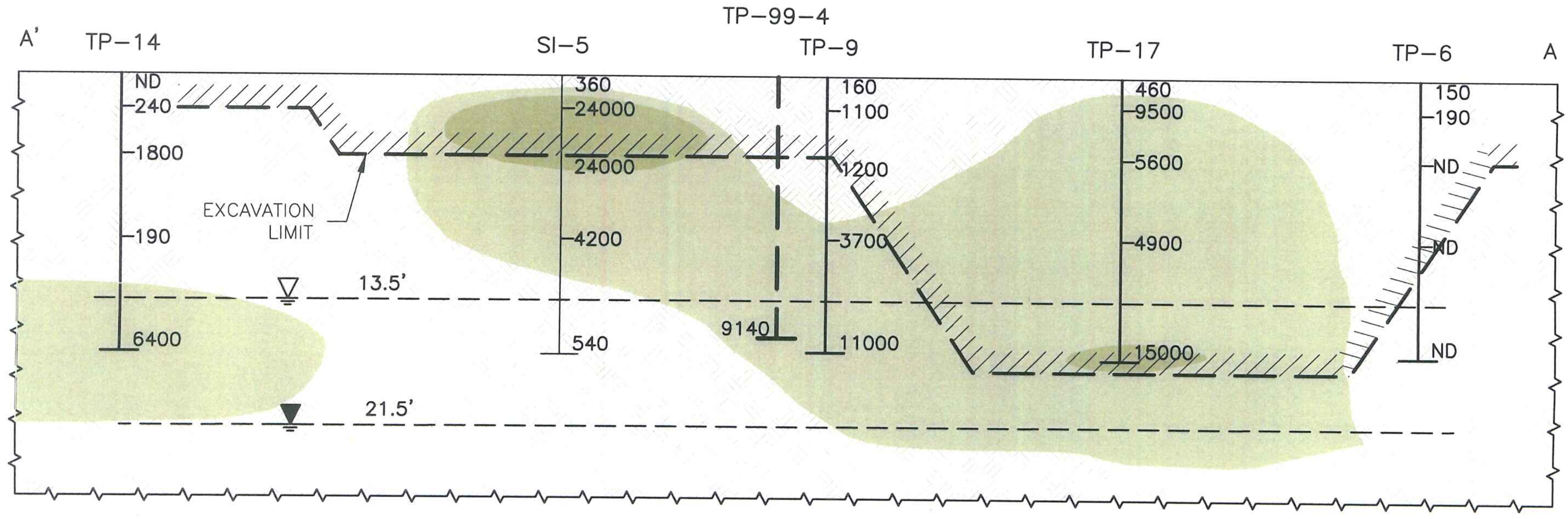
RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/03/03 DRWN: A.S./SEA

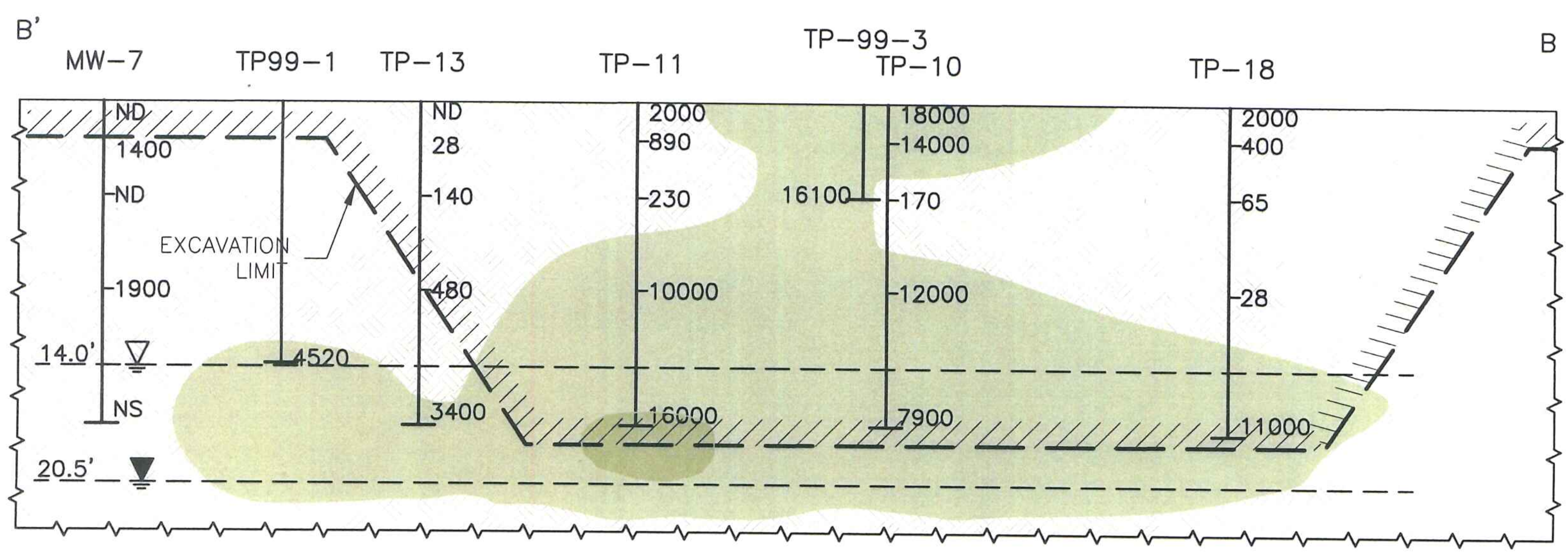
TPH DIESEL CONCENTRATIONS IN SOIL

FIGURE 3-2



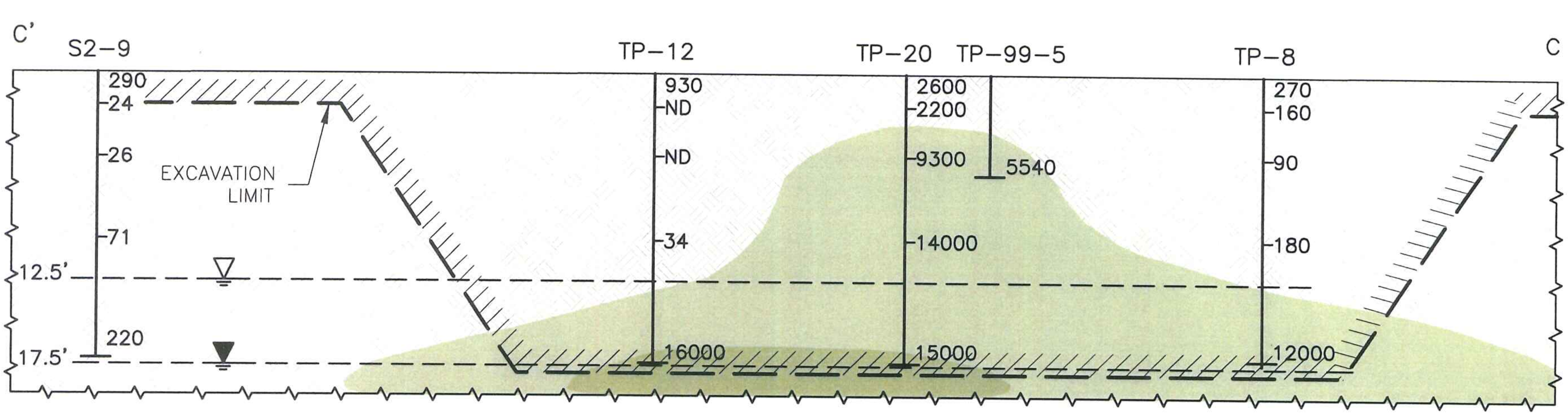
A-A'

PROFILE



B-B'

PROFILE



C-C'

PROFILE

LEGEND

(light shading)	CLEANUP LEVEL (3500 mg/kg OR GREATER)
(dark shading)	REMEDIATION LEVEL (14950 mg/kg OR GREATER)
– 71	TPH-DIESEL LEVEL mg/kg
▽	SEASONAL HIGH WATER TABLE
▼	SEASONAL LOW WATER TABLE
ND	NOT DETECTED
//////	EXCAVATION LIMITS

15 0 30

1"=30' HORIZONTAL
1"=10' VERTICAL

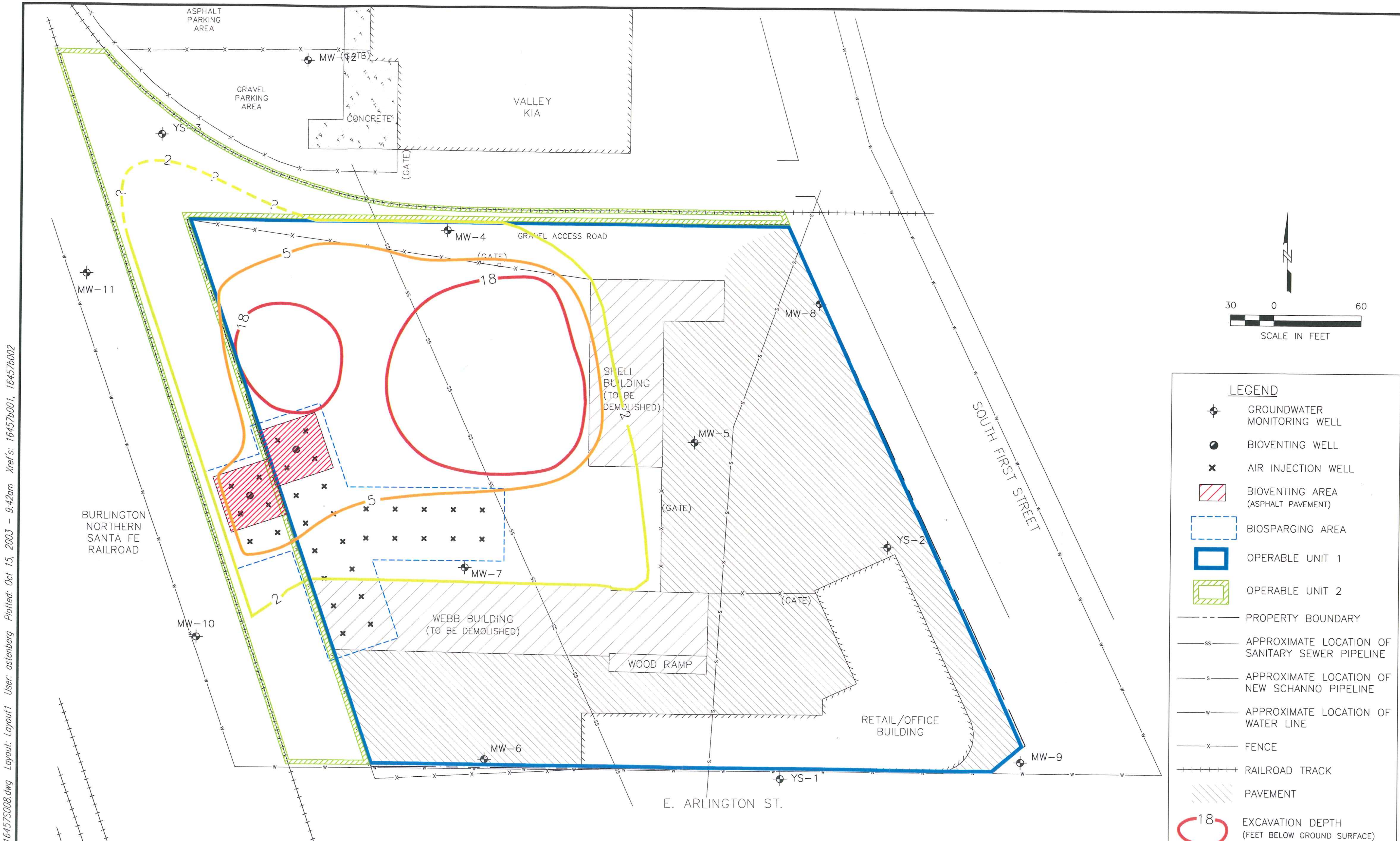
RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/03/03 DRWN: A.S./SEA

TPH-DIESEL CONCENTRATION PROFILES

FIGURE 3-3



File: H:\16457\16457S008.dwg Layout: Layout1 User: astenberg Plotted: Oct 15, 2003 - 9:42am Xref's: 16457b001, 16457b002

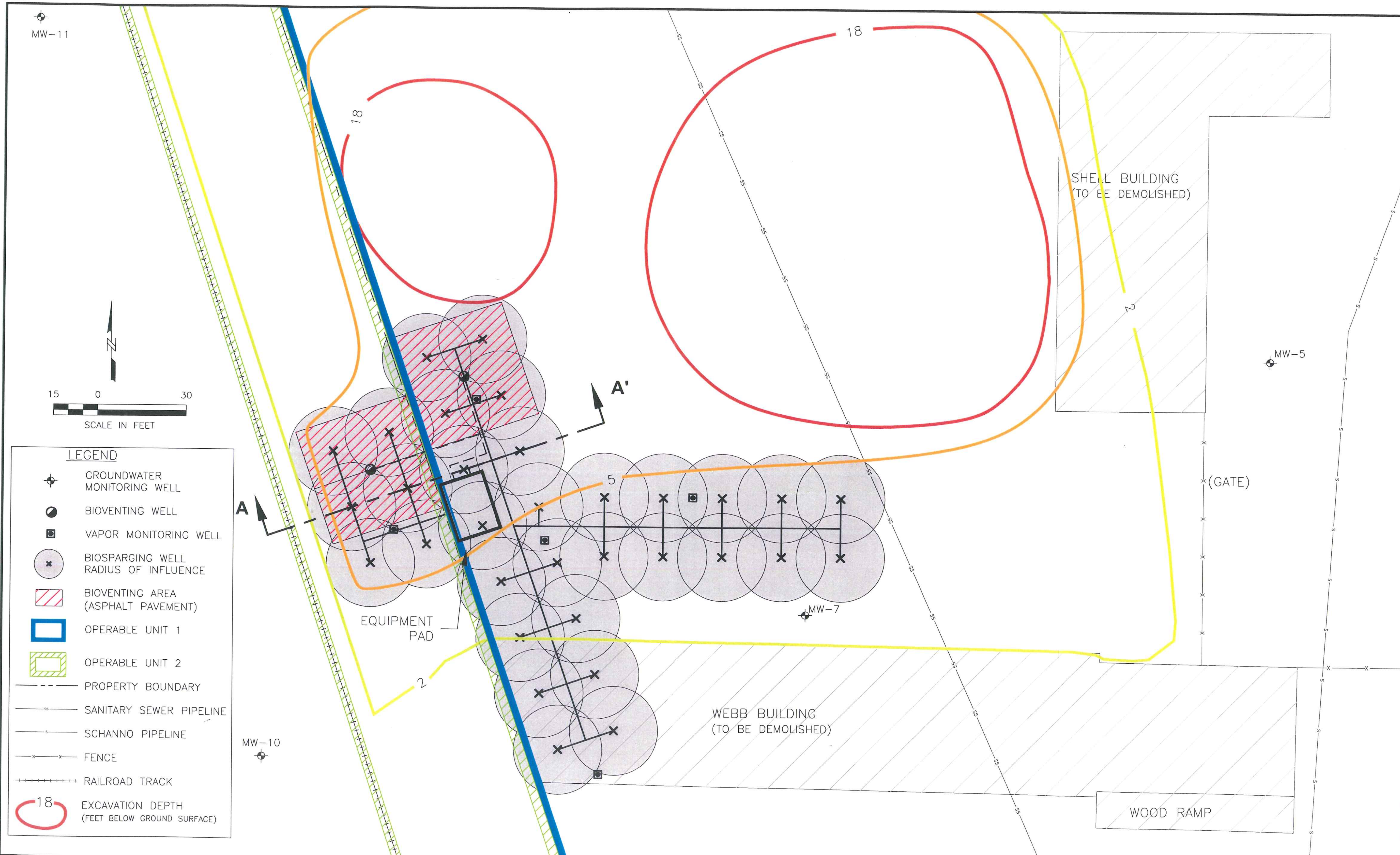
RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/04/03 | DRWN: A.S./SEA

BIOSPARGING/VENTING SYSTEM LAYOUT

FIGURE 3-4



File: H:\16457\16457S009.dwg Layout: Layout1 User: astenberg Plotted: Oct 15, 2003 - 9:42am Xref's: 16457b001, 16457b002

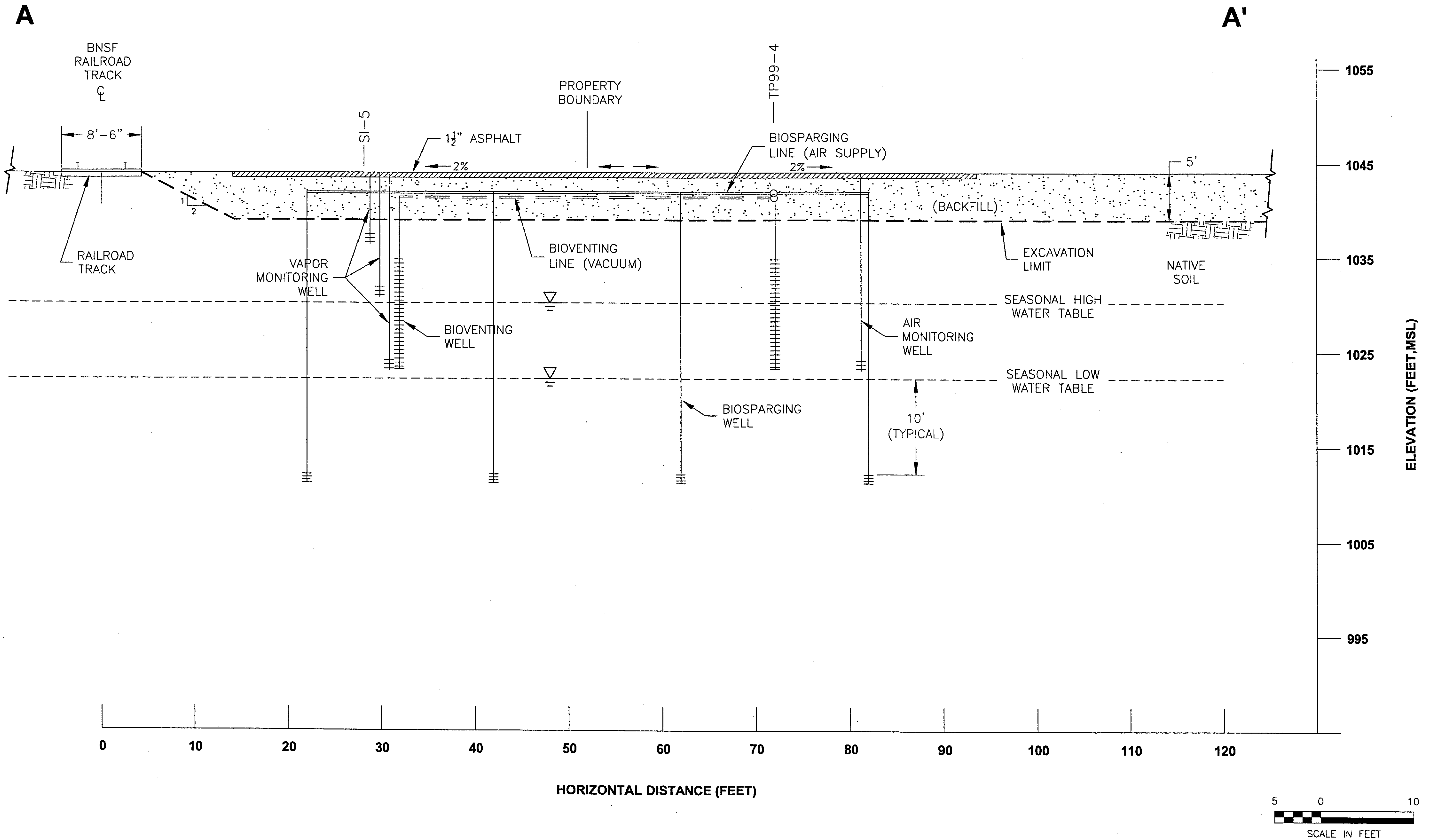
RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/04/03 | DRWN: A.S./SEA

BIOSPARGING/VENTING SYSTEM AREA OF COVERAGE

FIGURE 3-5



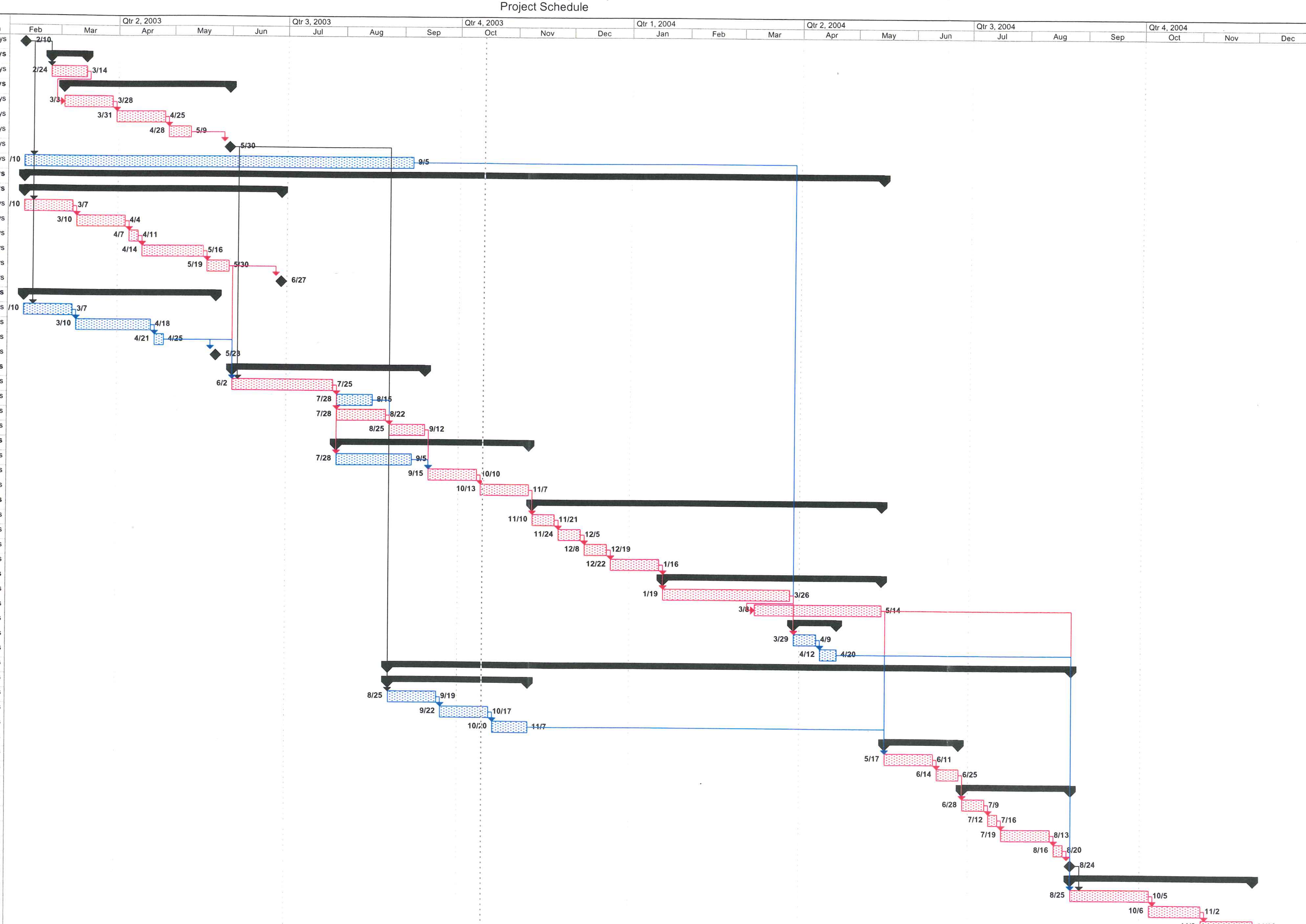
File: H:\16457\16457G001.dwg Layout: ANSI_BI-LJ User: astenberg Plotted: Oct 15, 2003 - 9:43am Xref's:

RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE YAKIMA, WASHINGTON DWT40-16457-300	CROSS-SECTION A-A'
DATE: 04/04/03 DRWN: A.S./SEA	FIGURE 3-6

Yakima Valley Spray (U-Haul) Site
Project Schedule

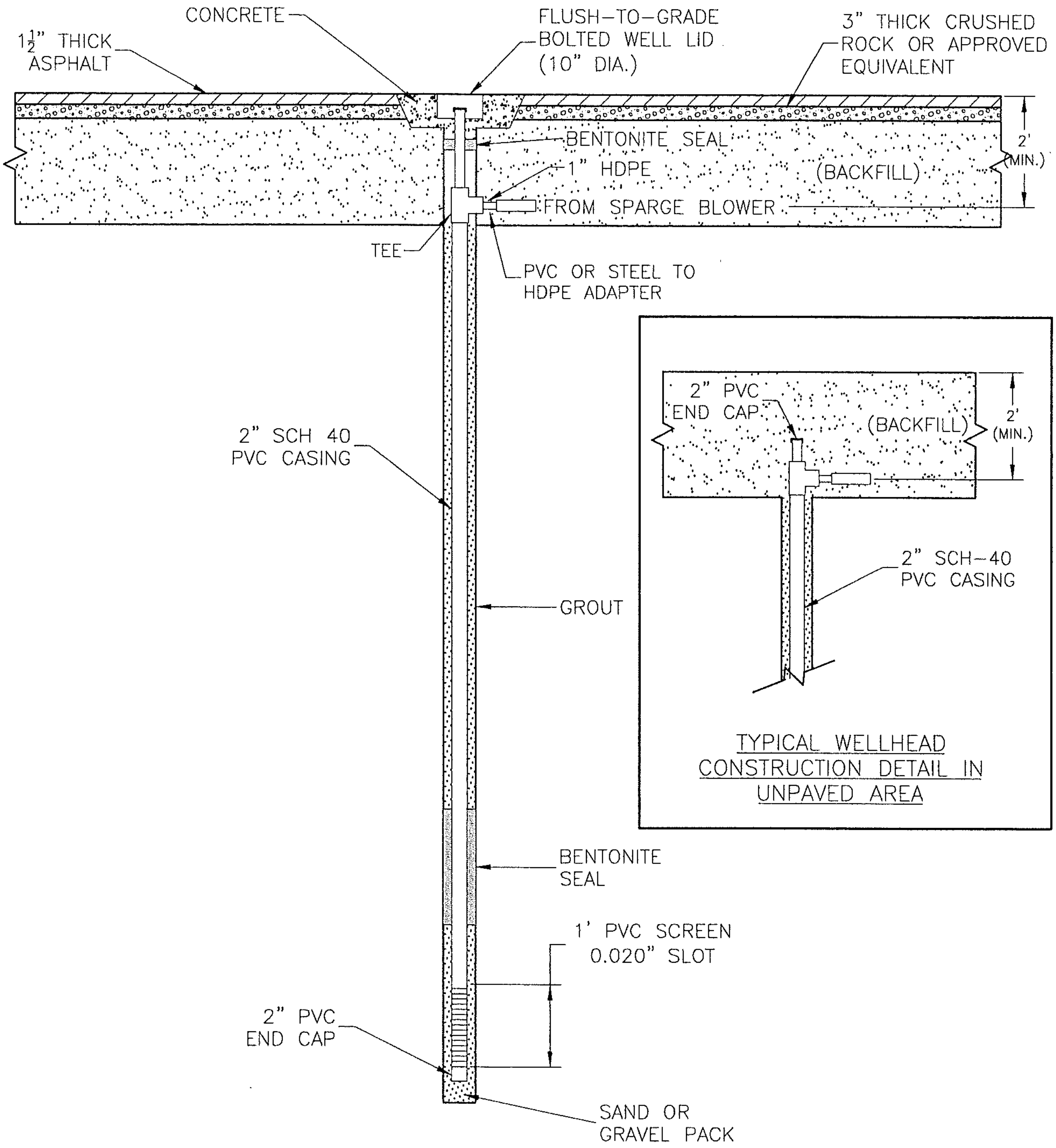
ID	Task Name	Duration
1	Notice to Proceed	0 days
2	**Additional Field Characterization**	**15 days**
3	Dry Well Investigation	15 days
4	**Engineering Design Report**	**65 days**
5	Draft EDR	20 days
6	Ecology Review	20 days
7	Final EDR	10 days
8	Ecology Approval	0 days
9	**Offsite Property agreement**	150 days
10	**Remediation - Excavation**	**330 days**
11	**Sanitary Sewer ByPass**	**100 days**
12	Subcontract	20 days
13	Design ByPass	20 days
14	Submit Permit Application	5 days
15	City Review	25 days
16	Finalize Design	10 days
17	Permit Issued	0 days
18	**Building Demolition**	**75 days**
19	Subcontract	20 days
20	Lead/Asbestos Assessment	30 days
21	Submit Permit Application	5 days
22	Permit Issued	0 days
23	**Plan and Specs**	**75 days**
24	95% Plans & Specs	40 days
25	Constructability Review	15 days
26	Ecology and City Review	20 days
27	Final Plans & Specs	15 days
28	**Bidding/Procurement**	**75 days**
29	Contractor Prequalification	30 days
30	Bid Period	20 days
31	Contracting	20 days
32	**Site Remediation**	**135 days**
33	Contractor Work Plans	10 days
34	Mobilization	10 days
35	Site Preparation	10 days
36	Demolition	20 days
37	**On-site**	**85 days**
38	Excavation/Disposal	50 days
39	Backfill & Grading	50 days
40	**Off-Site**	**17 days**
41	Excavation/Disposal	10 days
42	Backfill & Grading	7 days
43	**Remediation - Biosparging/venting**	**262 days**
44	**Plan and Specs**	**55 days**
45	95% Plans & Specs	20 days
46	Ecology Review	20 days
47	Final Plans & Specs	15 days
48	**Bidding/Procurement**	**30 days**
49	Bid Period	20 days
50	Contracting	10 days
51	**Site Remediation**	**42 days**
52	Contractor Work Plans	10 days
53	Mobilization	5 days
54	System Installation	20 days
55	System Testing/optimization	5 days
56	System Acceptance	0 days
57	**Completion Report/As-builts**	**70 days**
58	Draft Report	30 days
59	Ecology Review	20 days
60	Final Report	20 days



Project: Figure 4-1 Date: Tue 10/14/03	Task	Progress	Summary	Rolled Up Critical Task	Rolled Up Progress	External Tasks	Group By Summary
	Critical Task	Milestone	Rolled Up Task	Rolled Up Milestone	Split	Project Summary	

Tue 10/14/03 P:\DOCS\6457\DOC\Yakima Valley Spray Site\EDR\Figure4-1.mpp

Figure 4-1



NOTES:

1. ONLY THE WELLS IN THE ASPHALT PAVEMENT AREA WILL BE FLUSHMOUNTED TO GROUND SURFACE.

2. IN THE UNPAVED AREA THE PVC CASING WILL BE END CAPPED.

NOT TO SCALE

RETEC

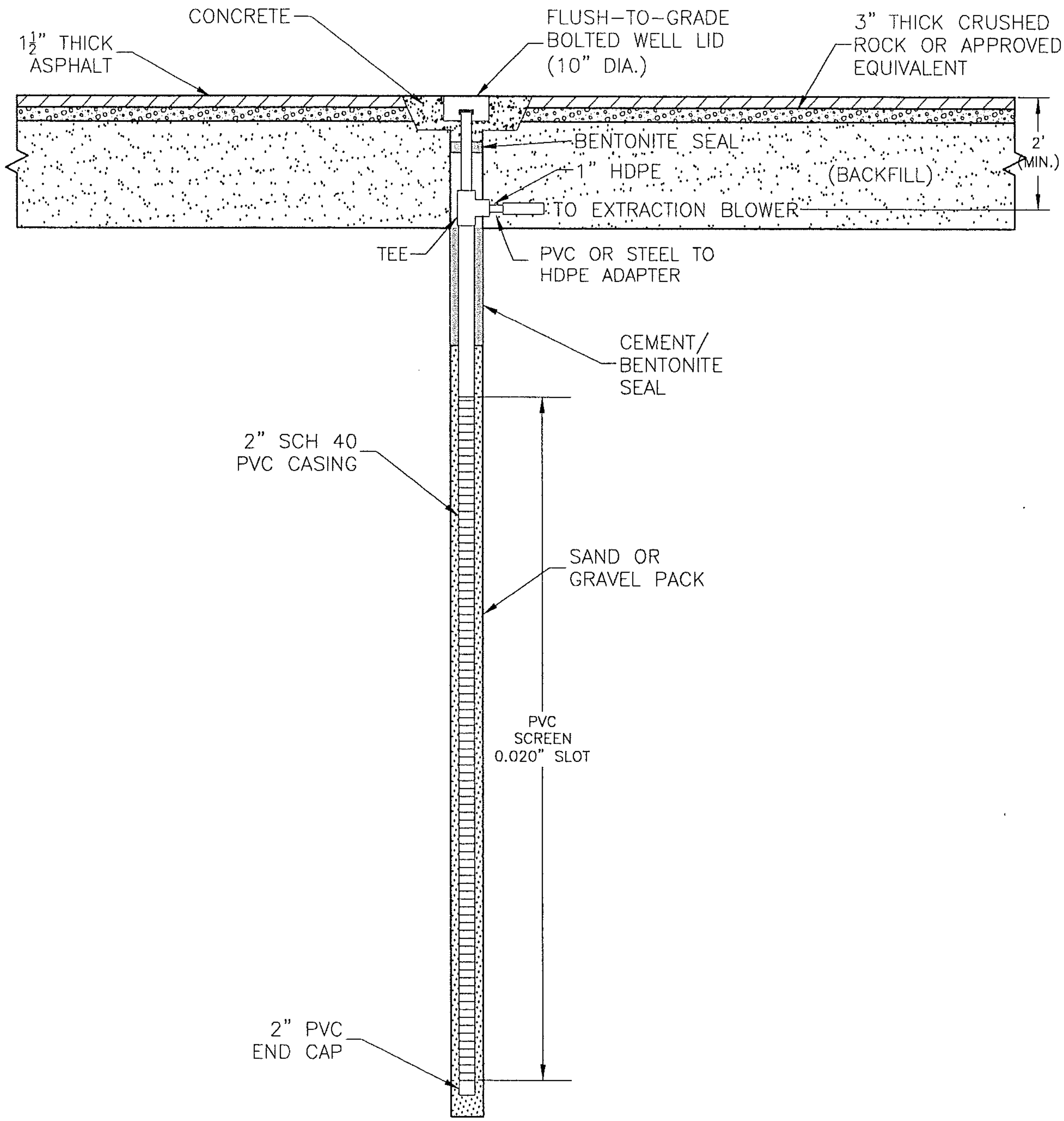
YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/04/03 DRWN: A.S./SEA

BIOSPARGING WELL CONSTRUCTION DETAIL

FIGURE 4-2

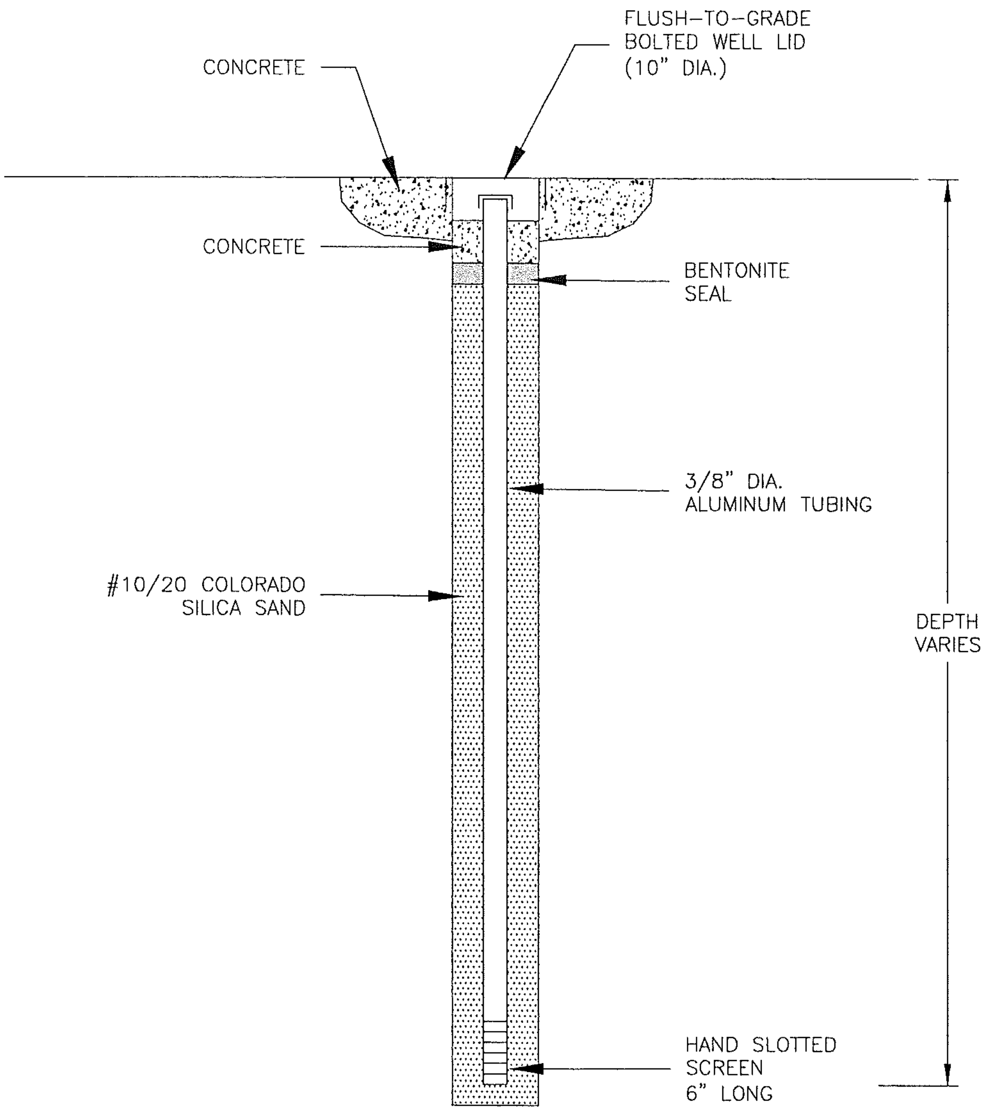
File: H:\16457\16457D003.dwg Layout: Layout1 User: astenberg Plotted: Oct 15, 2003 - 9:43am Xref's:



File: H:\16457\16457D005.dwg Layout: Layout1 User: astenberg Plotted: Oct 15, 2003 - 9:43am Xref's:

RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE YAKIMA, WASHINGTON DWT40-16457-300	**BIOVENTING WELL CONSTRUCTION DETAIL**
DATE: 04/04/03 DRWN: A.S./SEA	**FIGURE 4-3**

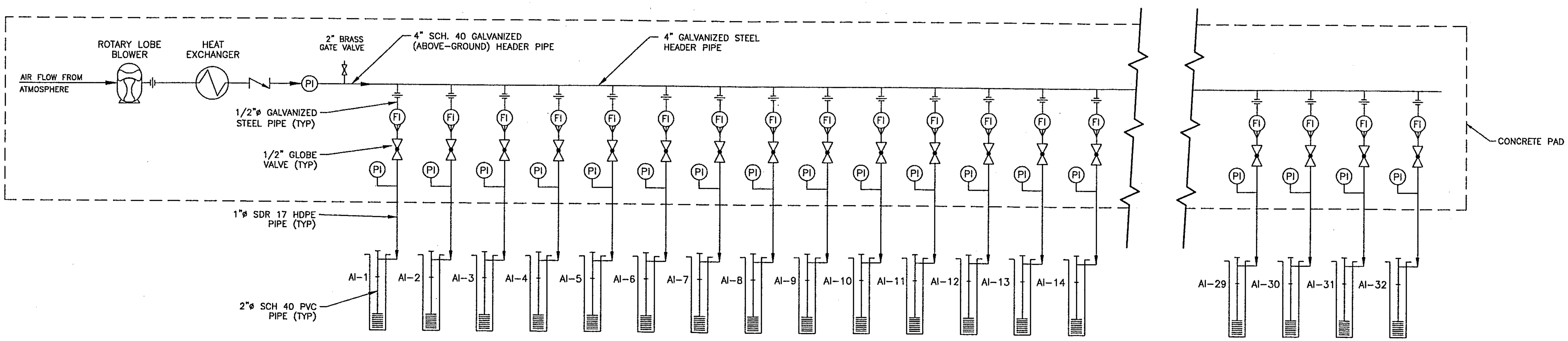


NOTES:
1. DRAWING IS NOT TO SCALE.

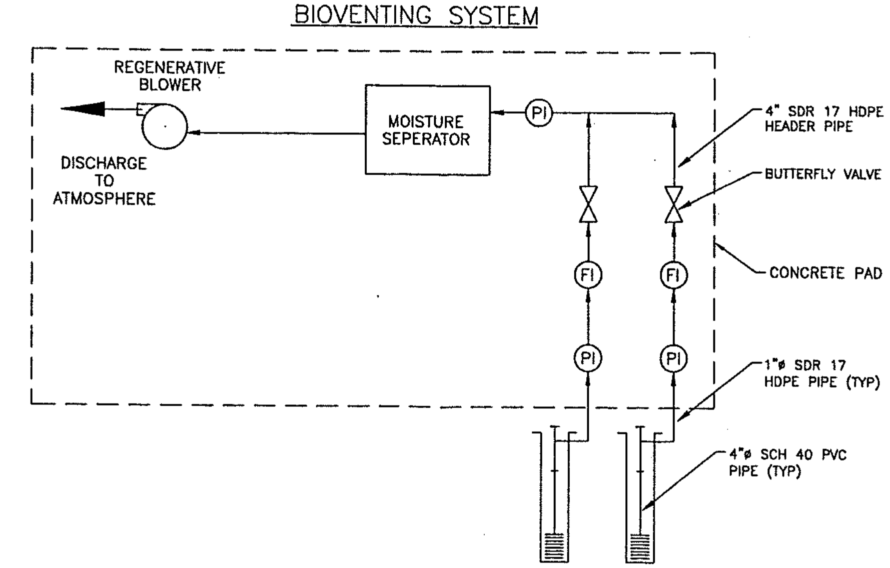
File: H:\16457\16457D006.dwg Layout: Layout1 User: astenberg Plotted: Oct 15, 2003 - 9:43am Xref's:

RETEC	YAKIMA VALLEY SPRAY (U-HAUL) SITE YAKIMA, WASHINGTON DWT40-16457-300	**VAPOR MONITORING WELL CONSTRUCTION DETAIL (TYPICAL)**
	DATE: 04/02/03 DRWN: A.S./SEA	**FIGURE 4-4**

AIR INJECTION SYSTEM



BIOVENTING SYSTEM



LEGEND

- (PI) PRESSURE INDICATOR
- (FI) FLOW INDICATOR
- AI-1 AIR INJECTION WELL
- CHECK VALVE
- GLOBE VALVE
- HEAT EXCHANGER
- ROTARY LOBE BLOWER (WITH SOUND ENCLOSURE)
- UNION
- REGENERATIVE BLOWER

File: H:\16457\16457D002.dwg Layout: Layout1 User: astenberg Plotted: Oct 15, 2003 - 9:44am Xref's:

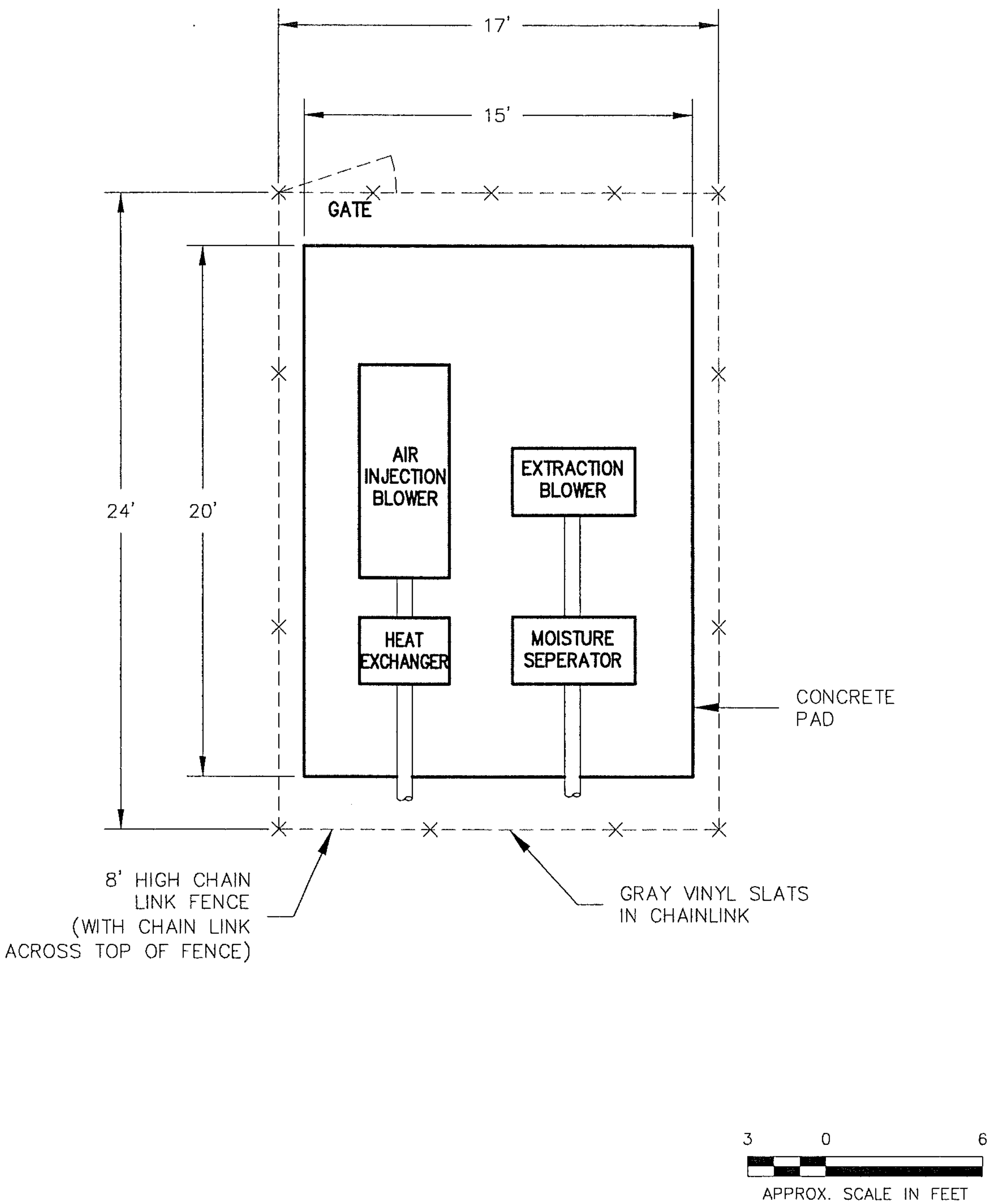
RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/03/03 | DRWN: A.S./SEA

PIPING AND INTRUMENTATION DIAGRAM

FIGURE 4-5



File: H:\16457\16457D001.dwg Layout: Layout1 User: astenberg Plotted: Oct 15, 2003 - 9:43am Xref's:

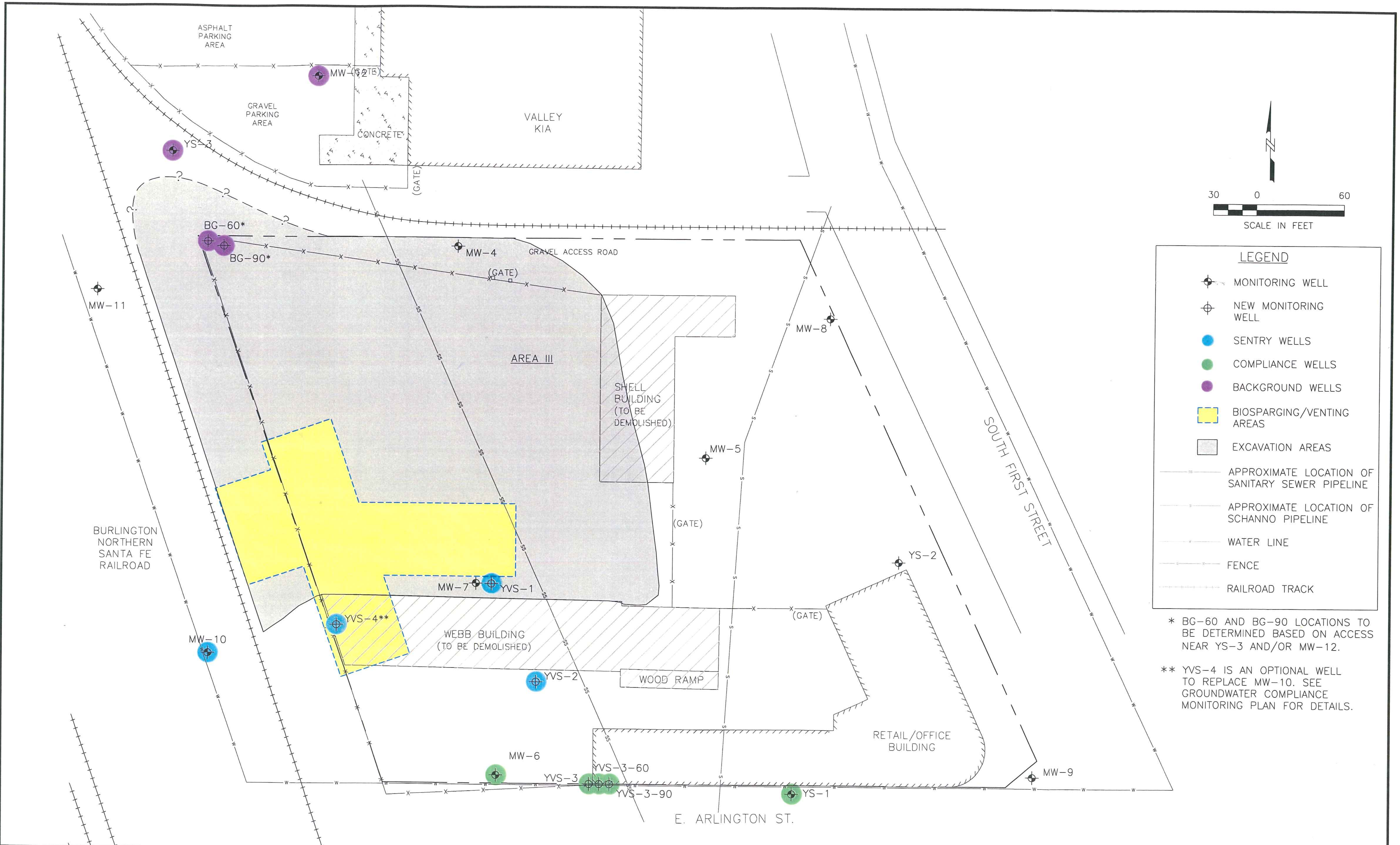
RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/04/03 | DRWN: A.S./SEA

BIOSPARGING/VENTING EQUIPMENT PAD LAYOUT

FIGURE 4-6



RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON

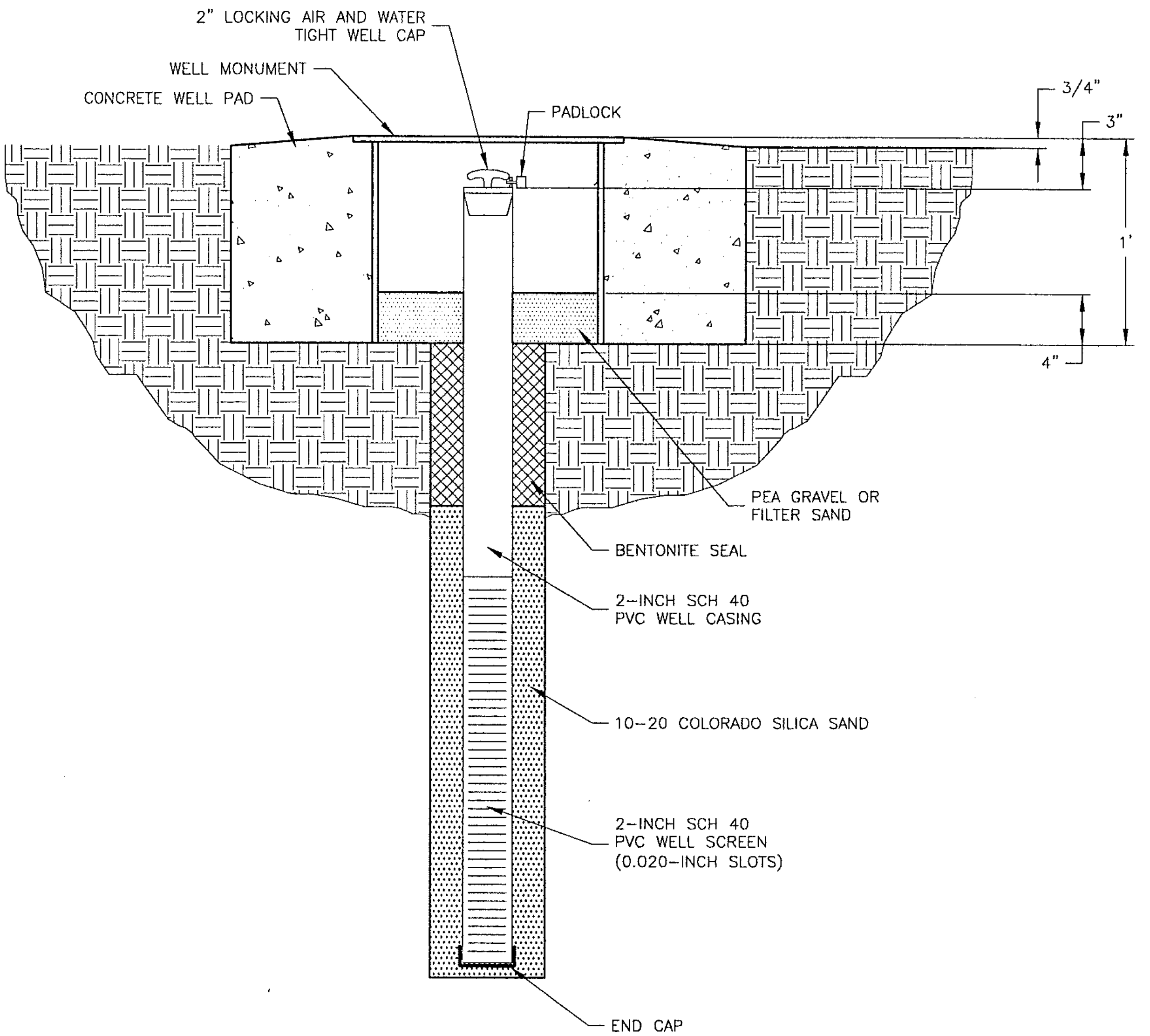
DWT40-16457-300

DATE: 07/21/03 | DRWN: A.S./SEA

LONG TERM GROUNDWATER MONITORING WELLS

FIGURE 4-7

File: H:\16457\16457S035.dwg Layout: Layout1 User: astenberg Plotted: Oct 14, 2003 - 5:00pm Xref's: 16457b002, 16457b001



NOTES:

1. DRAWING IS NOT TO SCALE.
2. FILTER PACK SAND IS A WELL ROUNDED, SILICEOUS KILN DRIED, FRESH WATER WASHED SAND.

File: H:\16457\16457D004.dwg Layout: Layout1 User: astenberg Plotted: Oct 15, 2003 - 9:44am Xref's:

RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON

DWT40-16457-300

DATE: 04/04/03 DRWN: A.S./SEA

GROUNDWATER MONITORING WELL CONSTRUCTION DETAIL

FIGURE 4-8

5 References

Department of Ecology, 2002. *Draft Stormwater Management Manual for Eastern Washington*. September.

United States Department of Agriculture, 1985. *Soil Survey of Yakima County Area Washington*. May.

Appendix A

Stormwater Pollution Prevention Plan

Stormwater Pollution Prevention Plan and Temporary Erosion and Sediment Control Measures

Yakima Valley Spray (U-Haul) Site
Yakima, Washington

Prepared by:

The RETEC Group, Inc.
1011 S.W. Klickitat Way, Suite 207
Seattle, Washington 98134

RETEC Project Number: DWT40-16457-300

Prepared for:

Yakima Valley Spray Steering Committee

April 4, 2003

Table of Contents

List of Figures

List of Attachments

1 Project Overview

The Yakima Valley Spray (U-Haul) Site (Site) is located in south central Yakima, Washington (Figure 1). The property consists of three parcels that were essentially undeveloped until the early 1900's. Property histories indicate that perchloroethylene (PCE) was used in manufacturing pesticides on one parcel. Waste from the pesticide formulation process was dumped into a waste disposal pit at the center of the parcel. Petroleum products distributors operated on the second parcel. A salvage yard as well as a farm and a heavy equipment sales and service company occupied the third parcel.

1.1 SWPPP Scope

This Stormwater Pollution Prevention Plan (SWPPP) covers construction associated only with the remediation efforts listed below. Future redevelopment of the site will have to be performed under a separate Stormwater Permit, and will require a separate SWPPP.

This SWPPP will be maintained on site or within reasonable access to the site, and does not require Ecology approval prior to commencement of construction activities.

1.2 Construction Activities

The remediation activities to be completed under this SWPPP all take place on YVS site and consist of the following actions:

- Excavation of soil in the disposal 'pit' area that exceed the Ecology cleanup levels (CULs) of the nine indicator substances to the seasonal low groundwater level approximately 18-20 feet below ground surface;

- Excavation of soil on the remainder of the Site that is above the CUL except in areas of high Total Petroleum Hydrocarbon (TPH) concentrations where excavation will be to a minimum depth of five feet or to the minimum TPH concentrations before bioventing, whichever is deeper (remediation levels [RL]). The RL are 15,675 mg/kg for TPH-G, 14,950 mg/kg for TPH-D, and 14,950 mg/kg for hydraulic or waste oils;

- Demolition of two site buildings, the Shell Oil building and the Webb building;

- Rerouting and reinstallation of the operating eight-inch sanitary sewer line;

- Backfilling of excavated areas up to the current site grades after the results of confirmational sampling have been reviewed and analyzed by Ecology;
- Bioventing or biosparging for TPH impacts that exceed the CUL but are less than the RL in areas that were not fully excavated to the CUL;
- Installation of five new down-gradient monitoring wells and replacement of any pre-existing monitoring wells which are destroyed during excavation; and
- Capping of residual soil impacts during development to prevent direct contact by humans.

1.3 Pre-Construction/Post-Construction Site Conditions

The site conditions will remain largely unchanged following remediation/construction activities described in Section 1.2 of this SWPPP, with the exception of the demolition of the two buildings. The total impervious area of the site will decrease due to the demolition of two buildings, which occupy approximately 0.46 acres. Figure 2 shows the existing conditions for this site.

Summary of Existing Conditions

This section describes the existing site conditions, including topography, runoff, soils, ground cover, critical areas such as stormwater facilities and utilities, areas with high erosion potential, and sensitive areas such as wetlands or vegetated buffers. Figure 2 shows site topography, the drainage sub-basin and flow path.

The site contains a gentle north to south slope and ranges from an elevation of 1045.5 feet above mean sea level (MSL) in the northwest corner to a low of about 1040.0 (MSL) in the southeast corner. Approximately one half of the site is paved, i.e., in the current U-Haul facility operational area (Figure 2). The remainder of the site is occupied by two buildings or contains light vegetation. The slopes of the existing land surface are typically below 1 percent. The existing ground cover at the site is mostly bare ground with spare grass and scattered bushes and small trees.

The surficial soil at the site consists of mostly alluvial gravels gravelly fine sandy loam to very gravelly sand within the upper 5 feet of the surface. According to the Yakima County Soil Survey, published by the Soil Conservation Services (U.S. Department of Agriculture, 1985), the site soils consist of Weirman gravelly fine sandy loam (Soil Map Unit No. 183). The permeability of this Weirman soil is rapid, with low available water capacity, slow runoff, and slight water erosion potential. The high water table depth is greater than 6 feet below ground surface.

The stormwater runoff in the paved area is collected by the catch basins located within the paved area, as shown on Figure 2. In the non-paved open area, little surface runoff occurs due to the high permeability of the soils. Surface runoff that does not immediately infiltrate into the site soils is generally retained on site due to the relatively flat land surface. The Santa Barbara Urban Hydrograph (SBUH) method was used to calculate runoff hydrographs (Hydrologic Analysis, Attachment A). After a 24-hour 10-year rainfall event, 311 cubic feet of surface runoff will be generated. There will be approximately 0.02" of water across the sub-basin that does not readily infiltrate. This water will be retained on site because the slope of the sub-basin is less than 1 percent.

Permanent Stormwater Control Plan

A permanent stormwater control plan describes the stormwater controls that will be implemented when the project is in its developed state. For this project, which covers only environmental remedy implementation, no development will be performed, and the project site stormwater drainage will not be impacted following construction. No permanent stormwater control plan is necessary at this time.

2 Installation, Operations and Maintenance of Control Measures

This section presents detailed soil erosion and sediment control measures. The purpose of the control measures is to control erosion of soil by wind and water, and to minimize the migration of sediments due to construction operations. The control measures will be implemented by the contractor to ensure protection of all construction areas from soil erosion and sediment transport.

Erosion and sediment control Best Management Practices (BMPs) are to be implemented at all construction affected areas and will consist of, at a minimum, the placement of control structures as shown on Figure 3. In general, methods used to control soil erosion and sediment migration may include:

- Construction sequencing;
- Control of vehicular tracking;
- Interception of stormwater runoff and delivery to a stable area;
- Slope stabilization;
- Sediment filtration;
- Control of soil loss from driveway entrances and exits, streams, natural and man-made drainage ways, and large cleared areas subject to wind and water erosion;
- Limiting disturbed areas of soils;
- Temporary stabilization of disturbed areas; and
- Dust suppression.

Control features may include, but are not limited to, silt fences, berms, temporary drainage facilities, vegetative cover and dust monitoring and control as needed. Specific measures for control of soil losses and diversion of stormwater run-off in areas of planned construction activity are described below.

Control features will be maintained in a functional condition and adjusted as necessary for the duration of the construction activities to ensure that applicable standards are met.

2.1 Pre-Construction

Prior to the start of construction, the following controls will be put in place to control soil erosion, sediment migration, and stormwater runoff:

- Installation of silt fence or straw bale dikes (see Figure 3).

2.1.1 Silt Fence Details

Specifications for the silt fence are taken from the *Draft Stormwater Management Manual for Eastern Washington* (Ecology, 2002). Standard strength and extra strength fence fabric will have a minimum grab tensile strength (ASTM D4751) of 100 pounds and 180 pounds, respectively. The filter fabric will have a maximum grab elongation (ASTM D4632) of 30% and an AOS (ASTM D4751) equal to a 30-100 sieve size for slit film and 50-100 sieve size for other fabrics. The fabric will have a minimum of 70% UV resistance (ASTM D4355), and a minimum permittivity (ASTM D4491) of 0.02 sec^{-1}. The welded wire will be 12.5 gauge galvanized with 2 x 4 inch openings. The posts will be 48-inch steel t-posts placed at 8-foot centers.

Wire backing will be used for standard strength fabric to increase the strength of the fence.

Where silt fences will be installed, it will be placed such that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

Silt fences will have a minimum height of 18 inches and a maximum height of 36 inches above natural ground. When joints in the silt fences are necessary, the adjoining sections will overlap a minimum of 6 inches and seal securely.

Sediment will be removed from behind the silt fences and/or straw bale dikes when it becomes approximately 6 inches high. Sediment deposits disposed at the designated spoil site for the project and/or spread evenly throughout the site, compacted and stabilized. Sediment will not be allowed to flush into any drainage way. If sediment has been contaminated, it will be disposed of in accordance with existing federal, state, and local rules and regulations.

If any signs of damage or ultraviolet breakdown of the silt fence are observed, the silt fence fabric will be repaired or replaced immediately.

2.2 During Construction

The construction activities associated with the current project are limited to excavation, backfill, and bioventing/sparging.

The current conditions of the site are such that stormwater naturally ponds and infiltrates through the ground surface without causing erosion and very limited overland stormwater flow. A hydrologic analysis of site conditions is attached to this SWPPP as Attachment A. Construction activities at the site are not expected to alter this condition significantly.

Inspections will be performed during construction to ensure that all applicable operational controls as described in the plan and shown on Figure 3 are in place prior to closeout of each day's work activities.

2.2.1 Construction Practices

Construction practices that will be used to limit erosion and stormwater impacts will include, but are not limited to, the following:

- Staging excavation activities to limit the volume of stockpiled impacted soil at any given time, and to limit the volume of any open excavations which may collect water;

- Staging of construction equipment to limit the areas where equipment will be driven, and development of a construction equipment roadway (gravel or equivalent) on site to limit erosion of soil caused by traffic.

2.2.2 Equipment Controls

Prior to use on site, all equipment and machinery will be inspected for leaks and tested to ensure proper operational conditions are met. While on site, equipment will be parked, serviced and fueled within designated areas. Equipment and vehicles will be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems will be repaired immediately by the Contractor.

Periodic inspections of equipment and control procedures will be implemented. All on-site vehicles will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Selected equipment may be fueled in place using fuel trucks.

When necessary, equipment and machinery will be decontaminated at an on-site decontamination area, if required, prior to removal from the construction area. Special areas will be designated for washing vehicles where the runoff can be collected in a temporary lined holding basin. The collected water will be pumped to an onsite water storage unit and disposed of offsite at an approved disposal facility.

2.2.3 Dust Control

Activities which create large amounts of dust will use dust control techniques to limit transport of airborne pollutants. However, water or slurry used to control dust will be filtered to prevent sediment from entering the water courses or stormwater conveyance systems.

Blowing dust will be controlled by using one or more of the following methods:

1. Irrigation by water sprinkling.
2. Barriers using solid board fences, snow fences, burlap fences, crate walls, bales of hay, or similar materials.

Dust control methods will be implemented immediately whenever dust can be observed blowing on the project site.

2.2.4 Street Cleaning

Streets will be kept clean of construction debris and mud carried by construction vehicles and equipment. If necessary to keep the streets clean, stabilized construction exits will be installed at construction, staging, storage, and disposal areas.

In lieu of or in addition to stabilized construction exits, the pavement will be shoveled or swept to the extent necessary to keep the street clean. Shoveled or swept debris will be collected and disposed of appropriately. Water hosing or moving of debris and mud off of the street into adjacent areas is not allowed.

2.2.5 Waste Disposal

The Contractor will be responsible for collecting, storing, hauling, and disposing of spoil, silt, and waste materials in compliance with applicable federal, state, and local rules and regulations. Areas will be provided with adequate waste disposal receptacles for liquid as well as solid waste.

2.2.6 Sanitary Waste

The contractor will provide portable units. Sanitary waste will be regularly collected by a licensed sanitary waste management contractor and disposed of in an approved manner.

2.2.7 Inventory for Pollution Prevention Plan

Fuels, lubricants, Portland cement and bentonite are the substances expected to be present on site during construction. MSDS sheets and containment and handling of these materials will be maintained, as required, with the operational site records.

2.2.8 Good Housekeeping

The good housekeeping practices listed below will be followed on-site during construction:

- An effort will be made to store only enough product required for task completion.
- All materials stored on site will be stored in a neat and orderly manner in appropriate containers and, where possible, under a roof or other enclosure.
- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.
- Whenever possible, all of the product will be used before disposing of the container.
- Manufacturer's recommendations for proper use and disposal will be followed.
- The Contractor superintendent will inspect the area daily to ensure proper use and disposal of materials.

2.2.9 Hazardous Products

These practices will be used to reduce the risks associated with hazardous materials, if hazardous materials are used:

- Products will be kept in original containers unless they are not resealable.
- Original labels and material safety data sheets will be retained.
- If surplus product must be disposed of, disposal will be in accordance with applicable regulations and procedures.

2.2.10 Spill Prevention Practices

In addition to the good housekeeping and material management practices that will be used to reduce the risk of spills or other accidental exposure of the materials and substances, the following practices will be followed for spill prevention and cleanup:

- Manufacturers' recommended methods for spill cleanup will be clearly posted and site personnel will be trained in the procedures and the location of the information and cleanup supplies.

- Materials and equipment necessary for spill cleanup will be kept in the material storage area on site. Equipment and materials will include but not be limited to brooms, dust pans, mops, rags, gloves, goggles, and plastic absorbent materials and metal trash containers specifically for this purpose.

- All spills will be cleaned up immediately after discovery.

- The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

- Spills of toxic or hazardous material will be reported to the appropriate State or local government agency, in accordance with appropriate regulations.

- The spill prevention plan will be adjusted to include measures to prevent this type of spill from recurring and how to clean up the spill if there is another one. A description of the spill, what caused it, and the cleanup measures will also be included.

The superintendent responsible for the day-to-day operations will be the spill prevention and cleanup coordinator. She/he will designate at least three other personnel who will receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of responsible spill personnel will be posted in the material storage area and in the office trailer.

2.3 Post-Construction

The existing site grade will be maintained after the construction activities are completed. Therefore, the site drainage patterns will not be altered after the construction. Any areas where impacted soils have been disturbed will be re-graded to the pre-construction grade, as possible. If any disturbed areas appear to have the potential to pose erosion impacts at the site, these areas will be identified and appropriate measures will be taken, such as re-grading these areas to reduce the erosion potential.

3 Inspections

3.1 Inspection Duties

Each contractor will designate a qualified person or persons to perform the following inspections:

- Disturbed areas and areas used for storage of materials that are exposed to precipitation will be inspected for evidence of, or the potential for, erosion and/or runoff.

- Erosion and sediment control measures identified in this SWPPP will be observed to ensure that they are operating correctly.

- Locations where vehicles enter or exit the construction area will be inspected for evidence of off-site sediment tracking.

- Silt fences will be inspected within 24 hours after a storm event of 0.5 inch or more, daily during periods of prolonged rainfall, and at a minimum of once per week. Repair or replacement of damaged sections will be completed immediately and sediment deposits will be removed when silt reaches a depth of approximately 6-inches.

3.2 Schedule

During active construction, the above inspections will be conducted by the responsible person at least once every seven calendar-days and within 24 hours after a storm of 0.5 inch of precipitation or greater. During inactive construction (after environmental remedy implementation, but prior to site redevelopment), the area will be inspected only within 24 hours after a storm of 0.5 inch of precipitation or greater.

3.3 SWPPP Revision

Based on the results of inspecting control measures described in this SWPPP, this report may be revised as appropriate to better reflect site conditions, but in no case later than 7 calendar days following the inspection.

3.4 Inspection Documentation

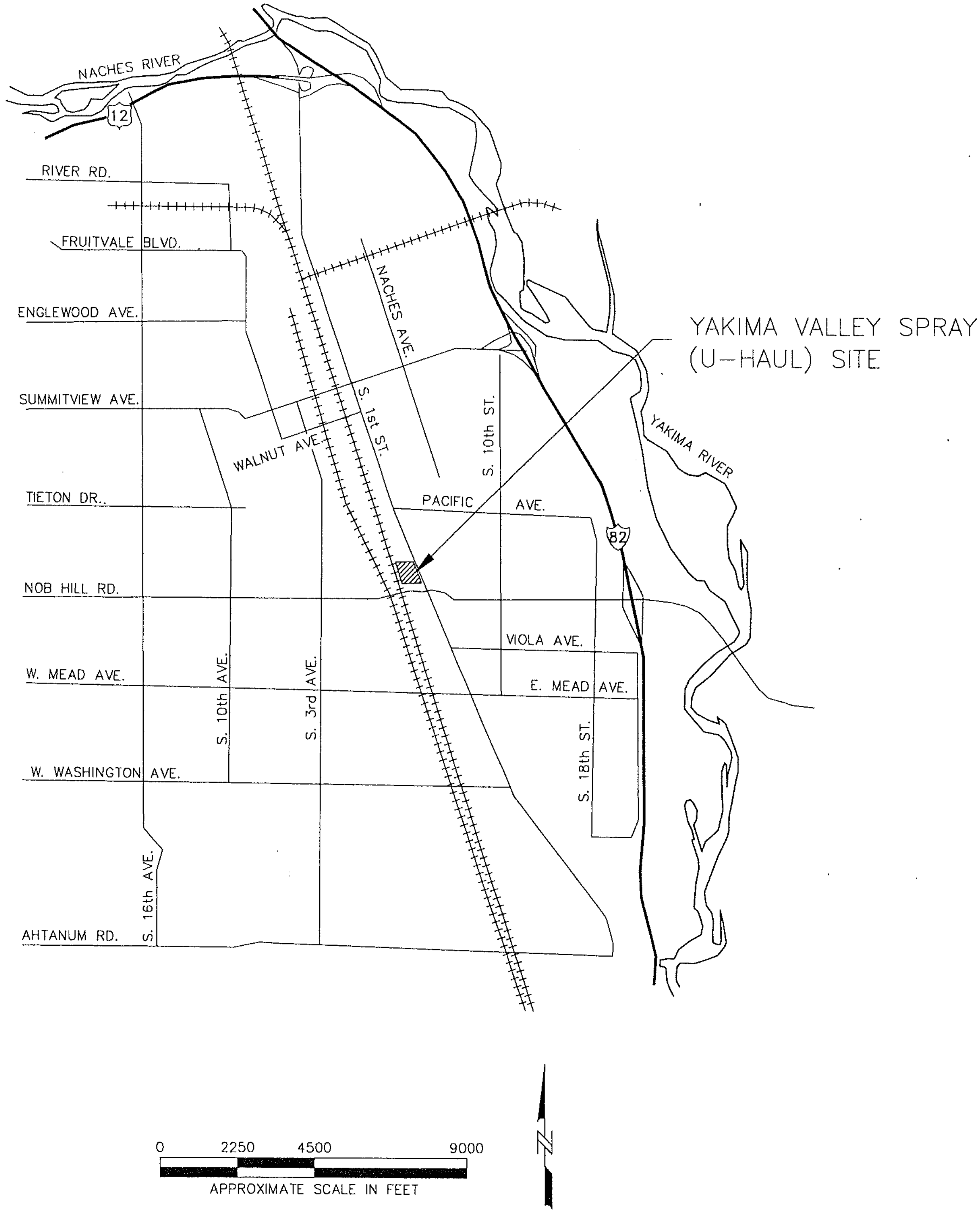
Inspection logs summarizing the scope of the inspection, major observations and actions taken in accordance with the inspection duties listed above, will be completed and retained as part of the SWPPP for at least 3 years from the date that construction is complete.

4 Employee Training

All on-site workers will have OSHA 40-hour Training for Hazardous Waste Site Work in accordance with 29 CFR 1910.120 (e)(3), and be current with their 8-Hour Refersher Training in accordance with OSHA 29 CFR 1910.120(e)(8). All on-site workers will also be required to read the site specific Health and Safety Plan and this SWPPP.

Personnel managing or supervising work onsite must also have successfully completed 8 Hours of Manager/Supervisor Training, meeting the requirements of 29 CFR 1910.120(e)(4). Documentation of OSHA training is required prior to personnel being permitted to work onsite.

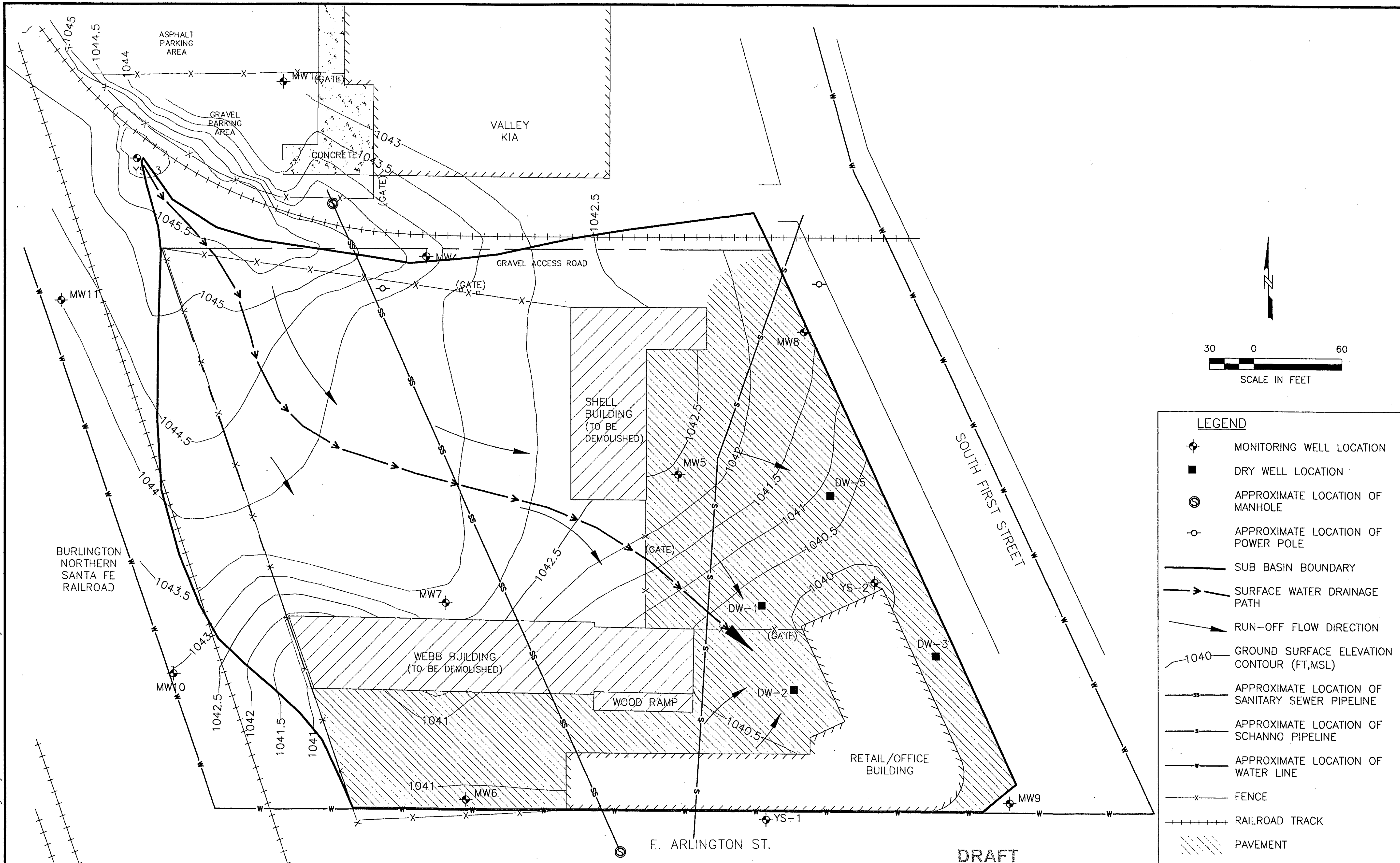
Figures



File: H:\16457\16457S015.dwg Layout: ANSI_AVI-LJ User: astenberg Plotted: Oct 15, 2003 - 9:24am Xref's:

RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE YAKIMA, WASHINGTON DWT40-16457-300	SITE LOCATION MAP
DATE: 04/04/03 DRWN: A.S./SEA	FIGURE 1



File: H:\16457\16457S014.dwg Layout: ANSL_BI-CP User: astenberg Plotted: Oct 15, 2003 - 9:25am Xref's: 16457b002

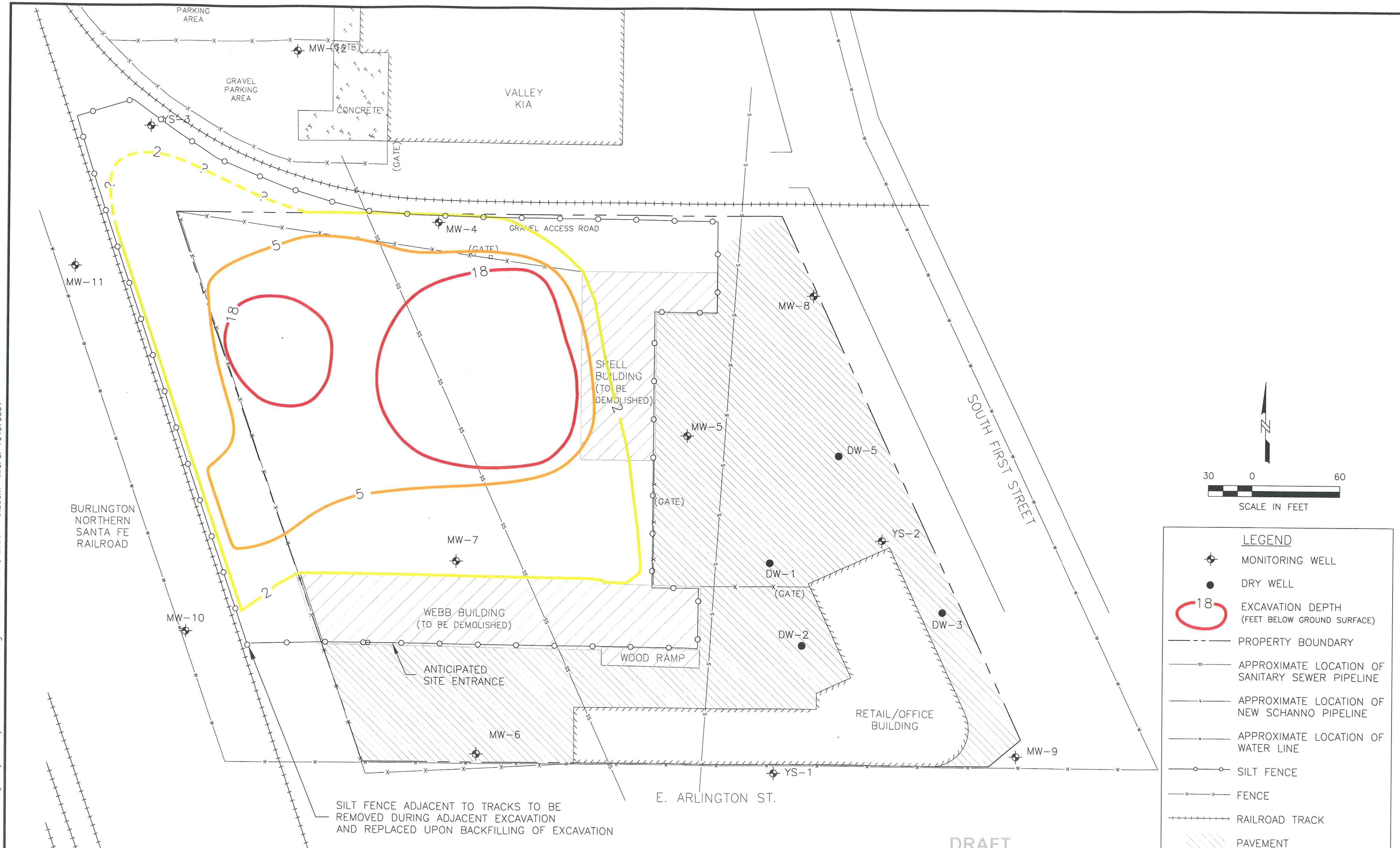
RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 04/04/03 | DRWN: A.S./SEA

DRAINAGE MAP

FIGURE 2



File: H:\16457\16457S016.dwg Layout: Layout1 User: aslenberg Plotted: Oct 15, 2003 - 9:26am Xref's: 16457b001

RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 03/13/03 | DRWN: A.S./SEA

REMEDIAL ACTIONS

FIGURE 3

Attachment A

Hydrologic Analysis

Hydrologic Analysis for
Yakima Valley Spray (U-Haul) Site

The objectives of the hydrologic analysis were to determine volumes of runoff at the Yakima Valley Spray (U-Haul) Site under the existing condition and during remediation construction activities, and to propose a runoff control method. The hydrologic analyses were performed in accordance with the procedures described in the "Draft Stormwater Management Manual for Eastern Washington", published by Washington State Department of Ecology (Ecology) in September 2002. The following paragraphs summarize the calculations presented herein.

1. Area: The sub-basin drainage area consists of impervious area and pervious area. These sub-areas were measured from the site topographic map. The complete breakdowns of the sub-areas are shown in the attached calculation sheets.

2. Curve Number: Runoff curve numbers for each soil cover were estimated using Table 4-5.2 of the above-mentioned reference. The weighted curve numbers of the existing and post-construction site conditions were calculated to be 90 and 88 respectively.

3. Time of Concentration: The flow lengths were measured from the site topographic map. Sheet flow Manning's effective roughness coefficients (n_s) and time of concentration velocity factor (k) were obtained from Table 4-6.1 of the above-mentioned reference.

4. Hydrograph: The Santa Barbara Urban Hydrograph (SBUH) method was used to calculate runoff hydrographs. Calculations were performed using an Excel spreadsheet prepared by Ecology. A 10-year 24-hour rainfall event was used for the calculations. Hydrographs for existing and post-construction conditions are also included.

5. Results: Results of the SBUH calculations showed that post-construction there will be approximately a 19 % decrease in runoff volume.

6. Recommended Runoff Control Measure: Due to the small volume of run-off from the site no runoff control measures are recommended at this time.

Project No.	DNT40-16457-300	Page	1 of 5
Client		Date	13 March 03
Site	Yakima Valley Spray (U-Haul)	By	S. Albano
Subject	Hydrologic Analysis	App.	WC

RETEC

Existing Conditions:

1.) Site Areas.

- Total Subbasin Area = 4.02 acres
- Impervious Areas (buildings & pavement) = 2.32 acre
- Pervious area = 4.02 - 2.32 = 1.7 acres

2.) Hydrologic Soil Type

Based on Yakima County Soil Survey (1985), surface soil at the site is Weirman gravelly fine sandy loam which has a hydrologic soil type "B". (see attached soil distribution map and description of soil series).

3.) Calculations of Runoff Curve Number

Soil Name	Cover Description	CN*	Area (acres)	CN*Area
Pervious (Weirman)	sparse herbaceous	80	1.7	136
Impervious	pavement/buildings	98	2.32	227.36
			Σ = 4.02	Σ = 363.36

$$CN(\text{weighted}) = \frac{363.36}{4.02} = 90.3$$

use CN = 90

* Based on Table 4-5.2

4.) Time of concentration
Based on attached Figure 1 - Existing condition, the longest surface water drainage path = 530'

(1) Sheet Flow

$$T_t = \frac{0.42\,(n_s L)^{0.8}}{P_{10}^{0.527}\,(S_o)^{0.04}}$$

where n_s = modified Manning's effective roughness coefficient
Based on Table 4-6.1, since the site cover is sparse short prairie grass, $n_s = 0.15$

L = 300' (maximum for sheet flow)

P_{10} = 10-year, 24 hour rainfall (in) = 0.15"

S_o = slope of hydraulic grade line (land slope ft/ft)
= 0.01

$$\therefore T_1 = \frac{(0.42)(0.15 \times 300)^{0.8}}{(0.15)^{0.529}\,(0.01)^{0.04}} = \frac{0.42 \times 21.016}{0.368 \times 0.832} \approx 28.8 \text{ min}$$

✓

(2) Shallow concentrated Flow

$$T_t = \frac{L}{60\,V}$$

where $L = 530' - 300' = 230'$
V = average flow velocity (ft/s) = $K\sqrt{S_o}$

Based on Table 4-6.1, K = 11
$\therefore V = (11)\sqrt{0.01} = 1.1$ ft/s

$$T_2 = \frac{230}{60 \times 1.1} \approx 3.9 \text{ min}$$

Time of Concentration, $T_c = 28.8 + 3.9 = 32.7$ use 33 min

Project No. DWT40-16457-300
Client
Site Yakima Valley Spray (H-Haul)
Subject Hydrologic Analysis

Date 13 March 2003
By S. Albano
App. WC

RETEC

5.) Runoff Calculations

Using Santa Barbara Urban Hydrograph (SBUH) Method. A spread sheet for SBUH calculations was obtained from the Washington Dept. of Ecology. Input to the spread sheet includes:

- Total Rainfall = 0.15 (10-yr. 24-hr. rainfall) (from NOAA Atlas 2, Volume IX, available on http://www.wrcc.dri.edu/pcpnfreq/wa10y24.gif attached)

- Time of concentration = 33 min
- Total Sub-basin Area = 4.02 acres
- Pervious Area = 1.7 acres
- Impervious Area = 2.32 acres

Computer printouts of the calculations are attached

Post Construction

1.) Site Areas

- Total Subbasin Area = 4.02 acres
- Impervious Areas (buildings & pavement) = 1.86 acres
- Pervious Areas = 4.02 - 1.86 = 2.16 acres

2.) Runoff Curve Number

Soil Name	Cover Description	CN	Area (acres)	CN * Area
Pervious (weirman)	Sparse herbaceous	80	2.16	172.8
Impervious	pavement/ buildings	98	1.86	182.28
			Σ = 4.02	Σ = 355.08

$$CN\,(\text{weighted}) = \frac{355.08}{4.02} = 88.3$$

Use CN = 88

3.) Time of concentration

The demolition of the two buildings does not affect the flowpath.

(1) Sheet Flow:

Evaluate input parameters for T_t calculations

$n_s = 0.15$

$L = 300'$

$P_{10} = 0.15''$

$S_0 = 0.01$

$$T_1 = \frac{(0.42)(0.15 \times 300)^{0.8}}{(0.15)^{0.527}(0.01)^{0.4}} = 28.8\,\text{min}$$

Project No. QWT40-16457-300	Page 5 of 5	RETEC
Client	Date 13 March 2003	
Site Yakima Valley Spray (Uttaw)	By S. Albano	
Subject Hydrologic Analysis	App. LOC	

(2) Shallow concentrated Flow

$$T_2 = \frac{530' - 300'}{60 \times 1.1}$$

where $V = K\sqrt{S_o} = 11\sqrt{0.01} = 1.1$

$$T_2 = \frac{230'}{60 \cdot 1.1} = 3.9 \text{ min}$$

$Tc = 28.8 + 3.9 = 32.7$ use 33 min

4.) Runoff Calculations

Using SBUH spreadsheet based on the following data

- Total Rainfall = 0.15"
- Tc = 33 min
- Total Area = 4.02 acres
- Pervious Area = 2.16 acres
- Impervious Area = 1.86 acres

See attached spreadsheet printout for calculations

	Runoff volume (ft^3) for 10 yr. storm
Existing	310.97
Post-Construction	249.31

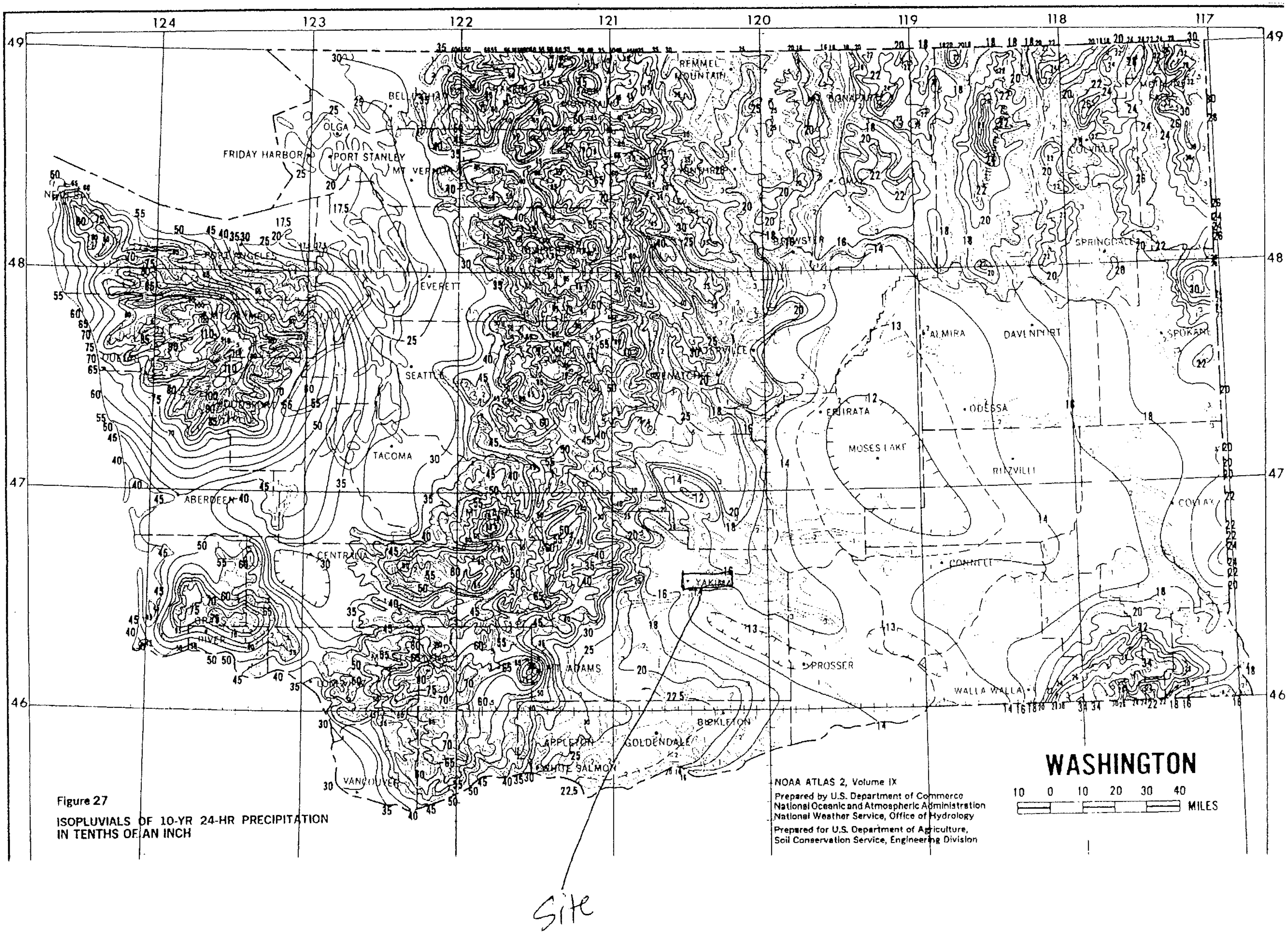


Figure 27

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

TABLE 18.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
155----- Tekison	C	None-----	---	---	>6.0	---	---
156, 157, 158, 159, 160, 161----- Tieton	B	None-----	---	---	>6.0	---	---
162*: Tieton-----	B	None-----	---	---	>6.0	---	---
Rock outcrop.							
163----- Toppenish	C	Rare-----	---	---	2.0-4.0	Apparent	Jun-Nov
164. Torriorthents							
165----- Track	C	Rare-----	---	---	2.0-4.0	Apparent	Jun-Nov
166, 167----- Tumac	B	None-----	---	---	>6.0	---	---
168----- Umapine	C	Occasional-----	Brief-----	Jan-Apr	1.0-3.5	Apparent	Nov-Jun
169, 170----- Umapine	C	Rare-----	---	---	2.0-4.0	Apparent	Nov-Jun
171----- Wanser	B	Rare-----	---	---	3.5-5.0	Apparent	Jan-Jun
172, 173, 174, 175, 176, 177, 178, 179, 180----- Warden	B	None-----	---	---	>6.0	---	---
181----- Weirman	B	Frequent-----	Long-----	Jan-Apr	3.0-5.0	Apparent	Apr-Nov
182, 183----- Weirman	B	Rare-----	---	---	>6.0	---	---
184----- Weirman	D	Occasional-----	Long-----	Jan-Apr	1.0-2.0	Apparent	Apr-Nov
185----- Wenas	C	Rare-----	---	---	2.0-3.5	Apparent	Jun-Nov
186, 187, 188, 189----- Willis	C	None-----	---	---	>6.0	---	---
190----- Yakima	B	Occasional-----	Brief to long	Jan-Mar	>6.0	---	---
191, 192----- Zillah	C	Rare-----	---	---	2.0-4.0	Apparent	Apr-Nov
193----- Zillah	C	Frequent-----	Long-----	Jan-Mar	0-1.0	Apparent	Apr-Nov

* See description of the map unit for composition and behavior characteristics of the map unit.

possible. Cutbanks are not stable and are subject to caving in.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass IVe, irrigated.

183—Weirman gravelly fine sandy loam. This very deep, somewhat excessively drained soil is on low terraces and flood plains. It formed in mixed alluvium. Slope is 0 to 5 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,700 feet. The average annual precipitation is 7 to 14 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown gravelly fine sandy loam about 8 inches thick. The upper part of the underlying material is stratified, grayish brown and light brownish gray loamy fine sand about 13 inches thick, and the lower part to a depth of 60 inches or more is grayish brown extremely gravelly sand. In some areas the surface layer is sandy loam or fine sandy loam, or it is gravelly, cobbly, or stony.

Included in this unit are areas of Zillah, Logy, and Yakima soils.

Permeability of this Weirman soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. The soil is subject to rare periods of flooding.

The unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are corn, grain, and grapes. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are low available water capacity and the hazard of soil blowing. Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short and establishing them on the contour or across the slope. Use of sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and reduce soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation and using vegetative barriers and windbreaks also reduce soil blowing. The soil should be protected from soil blowing by maintaining crop residue on the surface until the crops are well established in spring. Crop rows and irrigation furrows should be established at right angles to the prevailing wind where feasible. Mulch can be used to stabilize small areas where soil blowing begins. Using vegetated filter strips at the end of rows reduces the volume of sediment in the tailwater. Exposing the extremely gravelly underlying material should be avoided when leveling fields. Shallow cuts are feasible in some areas.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding. Flooding can be controlled by the use of dikes and channels that have outlets to bypass floodwater. Soil blowing can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage.

This map unit is in capability subclass IVe, irrigated.

184—Weirman fine sandy loam, wet. This very deep soil is on flood plains. It formed in mixed alluvium. Slope is 0 to 2 percent. The native vegetation is mainly water-tolerant sedges and rushes. Elevation is 700 to 1,700 feet. The average annual precipitation is 7 to 14 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown fine sandy loam about 8 inches thick. The upper part of the underlying material is stratified, grayish brown and light brownish gray loamy fine sand about 13 inches thick, and the lower part to a depth of 60 inches or more is grayish brown gravelly sand. In some areas the surface layer is silt loam or is gravelly or cobbly.

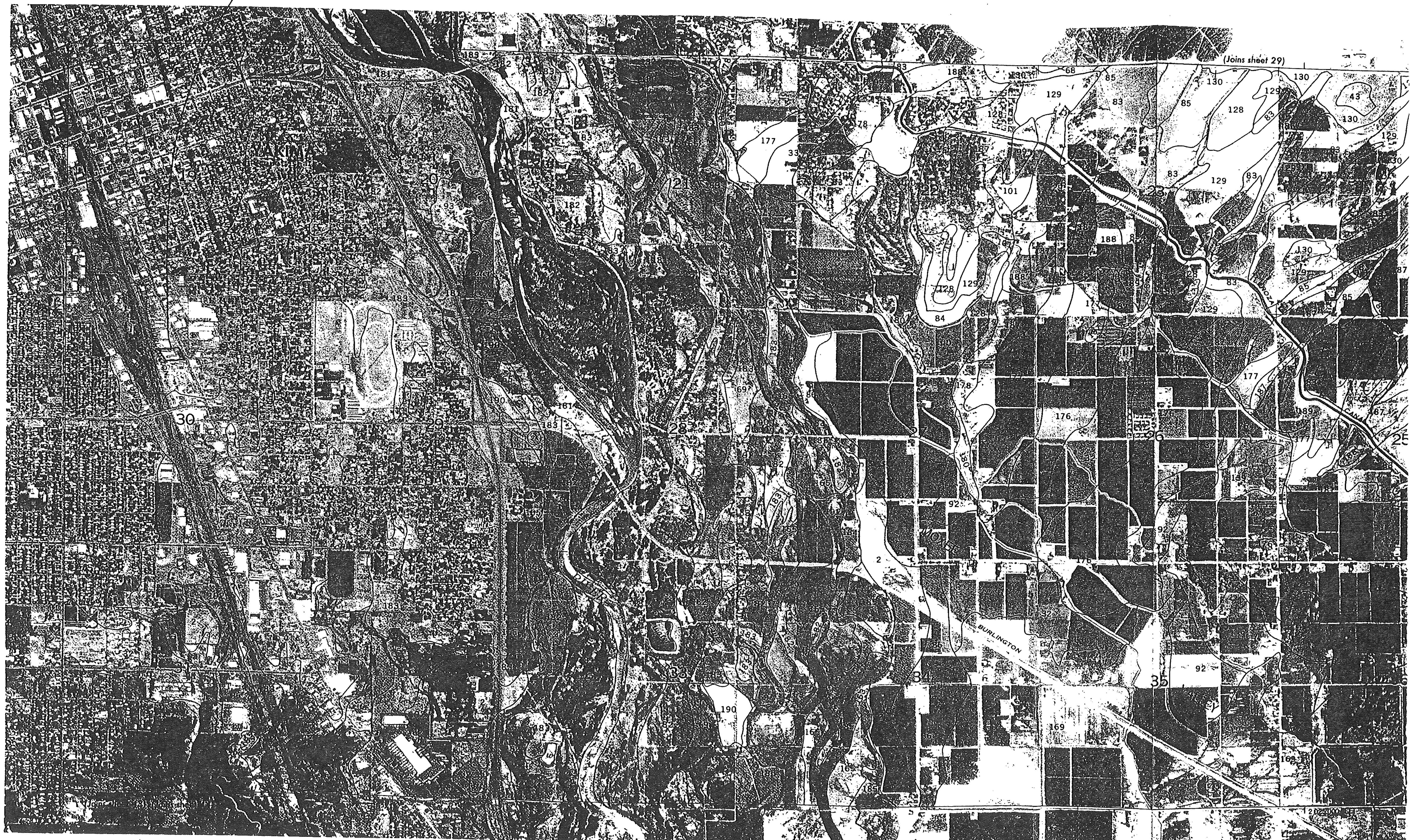
Included in this unit are areas of Zillah, Logy, and Yakima soils.

Permeability of this Weirman soil is rapid. Available water capacity is low. Effective rooting depth is limited by a seasonal high water table that is at a depth of 12 to 24 inches from April to November. Runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. The soil is subject to occasional periods of flooding in spring.

This unit is used for irrigated crops and as homesites. Where the soil in the unit is drained and protected from flooding, the main irrigated crops are corn, grain, and peas. Grasses and legumes are grown for hay and pasture.

The main limitations for irrigated crops are wetness, the hazard of soil blowing, and low available water capacity. Deep-rooted crops are suited to areas where the natural drainage is adequate or where a drainage system has been installed. Dikes can be used to divert floodwater.

Site



1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

Coordinate grid ticks and land division corners, if shown, are approximately positioned.

Base maps are orthophotographs prepared by the State of Washington, Department of Natural Resources from 1975 aerial photography.

SBUH Hydrograph - EXISTING CONDITION (10-YR, 24-HR RAINFALL)

Area = 4.02 acres
Pt = 0.15 inches (Total rainfall for a 24-hour storm event)
dt = 10 min.
Tc = 33 min. (Developed site conditions)

Time to peak (hrs.) = 0.14
Max Q (cfs) = 0.01
Vol (cu-ft) = 310.97

PERVIOUS Parcel		IMPERVIOUS Parcel	
Area =	1.7 acres	Area =	2.32 acres
CN =	80	CN =	98
S =	2.50	S =	0.20
0.2S =	0.50	0.2S =	0.04

w = 0.1316

Column (1) = Time Increment
Column (2) = Time (min)
Column (3) = Incremental Precipitation Fraction
Column (4) = Column (3) * P_t
Column (5) = Accumulated sum of Column (4)
Column (6) = If ($P \leq 0.2S$) = 0, If ($P > 0.2S$) = (Column (5) - 0.2S)^2/(Column (5) + 0.8S), where the PERVIOUS AREA S value is used
Column (7) = Column (6) of the present step - Column (6) of the previous step
Column (8) = Same as Column (6) except use IMPERVIOUS AREA S value
Column (9) = Column (8) of the present step - Column (8) of the previous step
Column (10) = (PERVIOUS AREA/TOTAL AREA)*Column (7)+(IMPERVIOUS AREA/TOTAL AREA)*Column (9)
Column (11) = (60.5*Column (10)*Total Area)/dt, where dt = 10 or 60 minutes
Column (12) = Column (12) of previous time step + w * [(Column (11) of previous time step + Column (11) of present time step) - (2 * Column (12) of previous time step)] where w = routing constant = dt/(2Tc + dt) = 0.0641

(1) Time Increment	(2) Time (hrs.)	(3) Precip. Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS AREA Accum. Runoff (inches)	(7) PERVIOUS AREA Incre. Runoff (inches)	(8) IMPERVIOUS AREA Accum. Runoff (inches)	(9) IMPERVIOUS AREA Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
1	0.000	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
2	0.167	0.004	0.0006	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
3	0.333	0.004	0.0006	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
4	0.500	0.004	0.0006	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
5	0.667	0.004	0.0006	0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
6	0.833	0.004	0.0006	0.0030	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
7	1.000	0.004	0.0006	0.0036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
8	1.167	0.004	0.0006	0.0042	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
9	1.333	0.004	0.0006	0.0048	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
10	1.500	0.004	0.0006	0.0054	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
11	1.667	0.004	0.0006	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
12	1.833	0.005	0.0008	0.0068	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
13	2.000	0.005	0.0008	0.0075	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
14	2.167	0.005	0.0008	0.0083	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
15	2.333	0.005	0.0008	0.0090	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
16	2.500	0.005	0.0008	0.0098	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
17	2.667	0.005	0.0008	0.0105	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
18	2.833	0.006	0.0009	0.0114	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
19	3.000	0.006	0.0009	0.0123	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
20	3.167	0.006	0.0009	0.0132	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
21	3.333	0.006	0.0009	0.0141	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
22	3.500	0.006	0.0009	0.0150	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
23	3.667	0.006	0.0009	0.0159	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
24	3.833	0.007	0.0011	0.0170	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
25	4.000	0.007	0.0010	0.0180	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
26	4.167	0.007	0.0011	0.0191	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
27	4.333	0.007	0.0011	0.0201	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
28	4.500	0.007	0.0011	0.0212	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
29	4.667	0.007	0.0011	0.0222	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
30	4.833	0.0082	0.0012	0.0234	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
31	5.000	0.0082	0.0012	0.0247	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
32	5.167	0.0082	0.0012	0.0259	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
33	5.333	0.0082	0.0012	0.0271	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
34	5.500	0.0082	0.0012	0.0284	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
35	5.667	0.0082	0.0012	0.0296	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0

(1) Time Increment	(2) Time (hrs.)	(3) Precip. Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS AREA Accum. Runoff (inches)	(7) Incre. Runoff (inches)	(8) IMPERVIOUS AREA Accum. Runoff (inches)	(9) Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
36	5.833	0.0095	0.0014	0.0310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
37	6.000	0.0095	0.0014	0.0324	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
38	6.167	0.0095	0.0014	0.0339	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
39	6.333	0.0095	0.0014	0.0353	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
40	6.500	0.0095	0.0014	0.0367	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
41	6.667	0.0095	0.0014	0.0381	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
42	6.833	0.0134	0.0020	0.0401	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
43	7.000	0.0134	0.0020	0.0422	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
44	7.167	0.0134	0.0020	0.0442	0.0000	0.0000	0.0001	0.0000	0.0000	0.0	0.0
45	7.333	0.018	0.0027	0.0469	0.0000	0.0000	0.0002	0.0001	0.0001	0.0	0.0
46	7.500	0.018	0.0027	0.0496	0.0000	0.0000	0.0004	0.0002	0.0001	0.0	0.0
47	7.667	0.034	0.0051	0.0547	0.0000	0.0000	0.0009	0.0005	0.0003	0.0	0.0
48	7.833	0.054	0.0081	0.0628	0.0000	0.0000	0.0021	0.0013	0.0007	0.0	0.0
49	8.000	0.027	0.0041	0.0668	0.0000	0.0000	0.0029	0.0008	0.0005	0.0	0.0
50	8.167	0.018	0.0027	0.0695	0.0000	0.0000	0.0035	0.0006	0.0003	0.0	0.0
51	8.333	0.0134	0.0020	0.0715	0.0000	0.0000	0.0040	0.0005	0.0003	0.0	0.0
52	8.500	0.0134	0.0020	0.0735	0.0000	0.0000	0.0045	0.0005	0.0003	0.0	0.0
53	8.667	0.0134	0.0020	0.0755	0.0000	0.0000	0.0050	0.0005	0.0003	0.0	0.0
54	8.833	0.0088	0.0013	0.0769	0.0000	0.0000	0.0054	0.0004	0.0002	0.0	0.0
55	9.000	0.0088	0.0013	0.0782	0.0000	0.0000	0.0058	0.0004	0.0002	0.0	0.0
56	9.167	0.0088	0.0013	0.0795	0.0000	0.0000	0.0062	0.0004	0.0002	0.0	0.0
57	9.333	0.0088	0.0013	0.0808	0.0000	0.0000	0.0066	0.0004	0.0002	0.0	0.0
58	9.500	0.0088	0.0013	0.0821	0.0000	0.0000	0.0070	0.0004	0.0002	0.0	0.0
59	9.667	0.0088	0.0013	0.0835	0.0000	0.0000	0.0074	0.0004	0.0002	0.0	0.0
60	9.833	0.0088	0.0013	0.0848	0.0000	0.0000	0.0078	0.0004	0.0002	0.0	0.0
61	10.000	0.0088	0.0013	0.0861	0.0000	0.0000	0.0082	0.0004	0.0002	0.0	0.0
62	10.167	0.0088	0.0013	0.0874	0.0000	0.0000	0.0087	0.0004	0.0003	0.0	0.0
63	10.333	0.0088	0.0013	0.0887	0.0000	0.0000	0.0091	0.0004	0.0003	0.0	0.0
64	10.500	0.0088	0.0013	0.0901	0.0000	0.0000	0.0096	0.0005	0.0003	0.0	0.0
65	10.667	0.0088	0.0013	0.0914	0.0000	0.0000	0.0100	0.0005	0.0003	0.0	0.0
66	10.833	0.0072	0.0011	0.0925	0.0000	0.0000	0.0104	0.0004	0.0002	0.0	0.0
67	11.000	0.0072	0.0011	0.0935	0.0000	0.0000	0.0108	0.0004	0.0002	0.0	0.0
68	11.167	0.0072	0.0011	0.0946	0.0000	0.0000	0.0112	0.0004	0.0002	0.0	0.0
69	11.333	0.0072	0.0011	0.0957	0.0000	0.0000	0.0116	0.0004	0.0002	0.0	0.0
70	11.500	0.0072	0.0011	0.0968	0.0000	0.0000	0.0120	0.0004	0.0002	0.0	0.0
71	11.667	0.0072	0.0011	0.0979	0.0000	0.0000	0.0125	0.0004	0.0002	0.0	0.0
72	11.833	0.0072	0.0011	0.0989	0.0000	0.0000	0.0129	0.0004	0.0002	0.0	0.0
73	12.000	0.0072	0.0011	0.1000	0.0000	0.0000	0.0133	0.0004	0.0002	0.0	0.0
74	12.167	0.0072	0.0011	0.1011	0.0000	0.0000	0.0137	0.0004	0.0003	0.0	0.0
75	12.333	0.0072	0.0011	0.1022	0.0000	0.0000	0.0142	0.0004	0.0003	0.0	0.0
76	12.500	0.0072	0.0011	0.1033	0.0000	0.0000	0.0146	0.0004	0.0003	0.0	0.0
77	12.667	0.0072	0.0011	0.1043	0.0000	0.0000	0.0151	0.0004	0.0003	0.0	0.0
78	12.833	0.0057	0.0009	0.1052	0.0000	0.0000	0.0154	0.0004	0.0002	0.0	0.0
79	13.000	0.0057	0.0009	0.1061	0.0000	0.0000	0.0158	0.0004	0.0002	0.0	0.0
80	13.167	0.0057	0.0009	0.1069	0.0000	0.0000	0.0162	0.0004	0.0002	0.0	0.0
81	13.333	0.0057	0.0009	0.1078	0.0000	0.0000	0.0165	0.0004	0.0002	0.0	0.0
82	13.500	0.0057	0.0009	0.1086	0.0000	0.0000	0.0169	0.0004	0.0002	0.0	0.0
83	13.667	0.0057	0.0009	0.1095	0.0000	0.0000	0.0173	0.0004	0.0002	0.0	0.0
84	13.833	0.0057	0.0009	0.1103	0.0000	0.0000	0.0177	0.0004	0.0002	0.0	0.0
85	14.000	0.0057	0.0009	0.1112	0.0000	0.0000	0.0180	0.0004	0.0002	0.0	0.0
86	14.167	0.0057	0.0009	0.1120	0.0000	0.0000	0.0184	0.0004	0.0002	0.0	0.0
87	14.333	0.0057	0.0009	0.1129	0.0000	0.0000	0.0188	0.0004	0.0002	0.0	0.0
88	14.500	0.0057	0.0009	0.1137	0.0000	0.0000	0.0192	0.0004	0.0002	0.0	0.0
89	14.667	0.0057	0.0009	0.1146	0.0000	0.0000	0.0196	0.0004	0.0002	0.0	0.0
90	14.833	0.005	0.0008	0.1154	0.0000	0.0000	0.0199	0.0003	0.0002	0.0	0.0
91	15.000	0.005	0.0008	0.1161	0.0000	0.0000	0.0203	0.0003	0.0002	0.0	0.0
92	15.167	0.005	0.0008	0.1169	0.0000	0.0000	0.0206	0.0004	0.0002	0.0	0.0
93	15.333	0.005	0.0008	0.1176	0.0000	0.0000	0.0210	0.0004	0.0002	0.0	0.0
94	15.500	0.005	0.0008	0.1184	0.0000	0.0000	0.0213	0.0004	0.0002	0.0	0.0
95	15.667	0.005	0.0008	0.1191	0.0000	0.0000	0.0217	0.0004	0.0002	0.0	0.0
96	15.833	0.005	0.0008	0.1199	0.0000	0.0000	0.0221	0.0004	0.0002	0.0	0.0

(1) Time Increment	(2) Time (hrs.)	(3) Precip. Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS AREA Accum. Runoff (inches)	(7) Incre. Runoff (inches)	(8) IMPERVIOUS AREA Accum. Runoff (inches)	(9) Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
97	16.000	0.005	0.0008	0.1206	0.0000	0.0000	0.0224	0.0004	0.0002	0.0	0.0
98	16.167	0.005	0.0008	0.1214	0.0000	0.0000	0.0228	0.0004	0.0002	0.0	0.0
99	16.333	0.005	0.0008	0.1221	0.0000	0.0000	0.0232	0.0004	0.0002	0.0	0.0
100	16.500	0.005	0.0008	0.1229	0.0000	0.0000	0.0235	0.0004	0.0002	0.0	0.0
101	16.667	0.005	0.0008	0.1236	0.0000	0.0000	0.0239	0.0004	0.0002	0.0	0.0
102	16.833	0.004	0.0006	0.1242	0.0000	0.0000	0.0242	0.0003	0.0002	0.0	0.0
103	17.000	0.004	0.0006	0.1248	0.0000	0.0000	0.0245	0.0003	0.0002	0.0	0.0
104	17.167	0.004	0.0006	0.1254	0.0000	0.0000	0.0248	0.0003	0.0002	0.0	0.0
105	17.333	0.004	0.0006	0.1260	0.0000	0.0000	0.0251	0.0003	0.0002	0.0	0.0
106	17.500	0.004	0.0006	0.1266	0.0000	0.0000	0.0254	0.0003	0.0002	0.0	0.0
107	17.667	0.004	0.0006	0.1272	0.0000	0.0000	0.0257	0.0003	0.0002	0.0	0.0
108	17.833	0.004	0.0006	0.1278	0.0000	0.0000	0.0260	0.0003	0.0002	0.0	0.0
109	18.000	0.004	0.0006	0.1284	0.0000	0.0000	0.0263	0.0003	0.0002	0.0	0.0
110	18.167	0.004	0.0006	0.1290	0.0000	0.0000	0.0266	0.0003	0.0002	0.0	0.0
111	18.333	0.004	0.0006	0.1296	0.0000	0.0000	0.0269	0.0003	0.0002	0.0	0.0
112	18.500	0.004	0.0006	0.1302	0.0000	0.0000	0.0272	0.0003	0.0002	0.0	0.0
113	18.667	0.004	0.0006	0.1308	0.0000	0.0000	0.0275	0.0003	0.0002	0.0	0.0
114	18.833	0.004	0.0006	0.1314	0.0000	0.0000	0.0278	0.0003	0.0002	0.0	0.0
115	19.000	0.004	0.0006	0.1320	0.0000	0.0000	0.0282	0.0003	0.0002	0.0	0.0
116	19.167	0.004	0.0006	0.1326	0.0000	0.0000	0.0285	0.0003	0.0002	0.0	0.0
117	19.333	0.004	0.0006	0.1332	0.0000	0.0000	0.0288	0.0003	0.0002	0.0	0.0
118	19.500	0.004	0.0006	0.1338	0.0000	0.0000	0.0291	0.0003	0.0002	0.0	0.0
119	19.667	0.004	0.0006	0.1344	0.0000	0.0000	0.0294	0.0003	0.0002	0.0	0.0
120	19.833	0.004	0.0006	0.1350	0.0000	0.0000	0.0297	0.0003	0.0002	0.0	0.0
121	20.000	0.004	0.0006	0.1356	0.0000	0.0000	0.0301	0.0003	0.0002	0.0	0.0
122	20.167	0.004	0.0006	0.1362	0.0000	0.0000	0.0304	0.0003	0.0002	0.0	0.0
123	20.333	0.004	0.0006	0.1368	0.0000	0.0000	0.0307	0.0003	0.0002	0.0	0.0
124	20.500	0.004	0.0006	0.1374	0.0000	0.0000	0.0310	0.0003	0.0002	0.0	0.0
125	20.667	0.004	0.0006	0.1380	0.0000	0.0000	0.0313	0.0003	0.0002	0.0	0.0
126	20.833	0.004	0.0006	0.1386	0.0000	0.0000	0.0317	0.0003	0.0002	0.0	0.0
127	21.000	0.004	0.0006	0.1392	0.0000	0.0000	0.0320	0.0003	0.0002	0.0	0.0
128	21.167	0.004	0.0006	0.1398	0.0000	0.0000	0.0323	0.0003	0.0002	0.0	0.0
129	21.333	0.004	0.0006	0.1404	0.0000	0.0000	0.0327	0.0003	0.0002	0.0	0.0
130	21.500	0.004	0.0006	0.1410	0.0000	0.0000	0.0330	0.0003	0.0002	0.0	0.0
131	21.667	0.004	0.0006	0.1416	0.0000	0.0000	0.0333	0.0003	0.0002	0.0	0.0
132	21.833	0.004	0.0006	0.1422	0.0000	0.0000	0.0336	0.0003	0.0002	0.0	0.0
133	22.000	0.004	0.0006	0.1428	0.0000	0.0000	0.0340	0.0003	0.0002	0.0	0.0
134	22.167	0.004	0.0006	0.1434	0.0000	0.0000	0.0343	0.0003	0.0002	0.0	0.0
135	22.333	0.004	0.0006	0.1440	0.0000	0.0000	0.0347	0.0003	0.0002	0.0	0.0
136	22.500	0.004	0.0006	0.1446	0.0000	0.0000	0.0350	0.0003	0.0002	0.0	0.0
137	22.667	0.004	0.0006	0.1452	0.0000	0.0000	0.0353	0.0003	0.0002	0.0	0.0
138	22.833	0.004	0.0006	0.1458	0.0000	0.0000	0.0357	0.0003	0.0002	0.0	0.0
139	23.000	0.004	0.0006	0.1464	0.0000	0.0000	0.0360	0.0003	0.0002	0.0	0.0
140	23.167	0.004	0.0006	0.1470	0.0000	0.0000	0.0363	0.0003	0.0002	0.0	0.0
141	23.333	0.004	0.0006	0.1476	0.0000	0.0000	0.0367	0.0003	0.0002	0.0	0.0
142	23.500	0.004	0.0006	0.1482	0.0000	0.0000	0.0370	0.0003	0.0002	0.0	0.0
143	23.667	0.004	0.0006	0.1488	0.0000	0.0000	0.0374	0.0003	0.0002	0.0	0.0
144	23.833	0.004	0.0006	0.1494	0.0000	0.0000	0.0377	0.0003	0.0002	0.0	0.0
145	24.000	0.004	0.0006	0.1500	0.0000	0.0000	0.0381	0.0003	0.0002	0.0	0.0

SBUH Hydrograph - DEVELOPED CONDITION (10-YR, 24-HR RAINFALL)

Area = 4.02 acres
Pt = 0.15 inches (Total rainfall for a 24-hour storm event)
dt = 10 min.
Tc = 33 min. (Developed site conditions)

Time to peak (hrs.) = 0.14
Max Q (cfs) = 0.01
Vol (cu-ft) = 249.31

PERVIOUS Parcel		IMPERVIOUS Parcel	
Area =	2.16 acres	Area =	1.86 acres
CN =	80	CN =	98
S =	2.50	S =	0.20
0.2S =	0.50	0.2S =	0.04

w = 0.1316

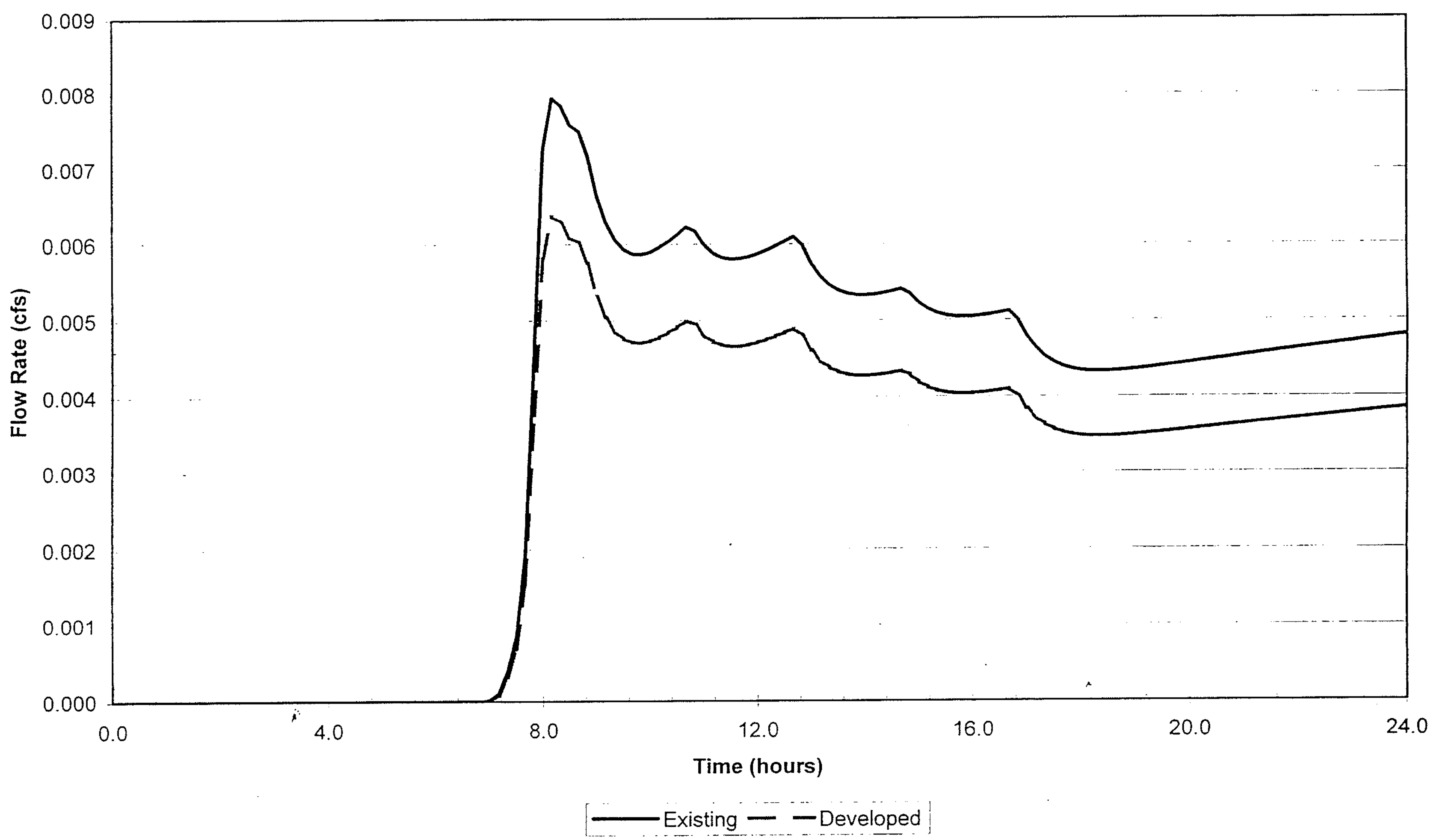
Column (1) = Time Increment
Column (2) = Time (min)
Column (3) = Incremental Precipitation Fraction
Column (4) = Column (3) * P_t
Column (5) = Accumulated sum of Column (4)
Column (6) = If ($P \leq 0.2S$) = 0, If ($P > 0.2S$) = (Column (5) - 0.2S)^2/(Column (5) + 0.8S), where the PERVIOUS AREA S value is used
Column (7) = Column (6) of the present step - Column (6) of the previous step
Column (8) = Same as Column (6) except use IMPERVIOUS AREA S value
Column (9) = Column (8) of the present step - Column (8) of the previous step
Column (10) = (PERVIOUS AREA/TOTAL AREA)*Column (7)+(IMPERVIOUS AREA/TOTAL AREA)*Column (9)
Column (11) = (60.5*Column (10)*Total Area)/dt, where dt = 10 or 60 minutes
Column (12) = Column (12) of previous time step + w * [(Column (11) of previous time step + Column (11) of present time step) - (2 * Column (12) of previous time step)] where w = routing constant = dt/(2Tc + dt) = 0.0641

(1) Time Increment	(2) Time (hrs.)	(3) Precip. Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS AREA Accum. Runoff (inches)	(7) PERVIOUS AREA Incre. Runoff (inches)	(8) IMPERVIOUS AREA Accum. Runoff (inches)	(9) IMPERVIOUS AREA Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
1	0.000	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
2	0.167	0.004	0.0006	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
3	0.333	0.004	0.0006	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
4	0.500	0.004	0.0006	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
5	0.667	0.004	0.0006	0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
6	0.833	0.004	0.0006	0.0030	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
7	1.000	0.004	0.0006	0.0036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
8	1.167	0.004	0.0006	0.0042	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
9	1.333	0.004	0.0006	0.0048	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
10	1.500	0.004	0.0006	0.0054	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
11	1.667	0.004	0.0006	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
12	1.833	0.005	0.0008	0.0068	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
13	2.000	0.005	0.0008	0.0075	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
14	2.167	0.005	0.0008	0.0083	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
15	2.333	0.005	0.0008	0.0090	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
16	2.500	0.005	0.0008	0.0098	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
17	2.667	0.005	0.0008	0.0105	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
18	2.833	0.006	0.0009	0.0114	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
19	3.000	0.006	0.0009	0.0123	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
20	3.167	0.006	0.0009	0.0132	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
21	3.333	0.006	0.0009	0.0141	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
22	3.500	0.006	0.0009	0.0150	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
23	3.667	0.006	0.0009	0.0159	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
24	3.833	0.007	0.0011	0.0170	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
25	4.000	0.007	0.0010	0.0180	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
26	4.167	0.007	0.0011	0.0191	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
27	4.333	0.007	0.0011	0.0201	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
28	4.500	0.007	0.0011	0.0212	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
29	4.667	0.007	0.0011	0.0222	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
30	4.833	0.0082	0.0012	0.0234	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
31	5.000	0.0082	0.0012	0.0247	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
32	5.167	0.0082	0.0012	0.0259	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
33	5.333	0.0082	0.0012	0.0271	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
34	5.500	0.0082	0.0012	0.0284	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
35	5.667	0.0082	0.0012	0.0296	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
36	5.833	0.0095	0.0014	0.0310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
37	6.000	0.0095	0.0014	0.0324	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
38	6.167	0.0095	0.0014	0.0339	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
39	6.333	0.0095	0.0014	0.0353	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0

(1) Time Increment	(2) Time (hrs.)	(3) Precip. Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS AREA Accum. Runoff (inches)	(7) Incre. Runoff (inches)	(8) IMPERVIOUS AREA Accum. Runoff (inches)	(9) Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
40	6.500	0.0095	0.0014	0.0367	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
41	6.667	0.0095	0.0014	0.0381	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
42	6.833	0.0134	0.0020	0.0401	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
43	7.000	0.0134	0.0020	0.0422	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	0.0
44	7.167	0.0134	0.0020	0.0442	0.0000	0.0000	0.0001	0.0000	0.0000	0.0	0.0
45	7.333	0.018	0.0027	0.0469	0.0000	0.0000	0.0002	0.0001	0.0001	0.0	0.0
46	7.500	0.018	0.0027	0.0496	0.0000	0.0000	0.0004	0.0002	0.0001	0.0	0.0
47	7.667	0.034	0.0051	0.0547	0.0000	0.0000	0.0009	0.0005	0.0002	0.0	0.0
48	7.833	0.054	0.0081	0.0628	0.0000	0.0000	0.0021	0.0013	0.0006	0.0	0.0
49	8.000	0.027	0.0041	0.0668	0.0000	0.0000	0.0029	0.0008	0.0004	0.0	0.0
50	8.167	0.018	0.0027	0.0695	0.0000	0.0000	0.0035	0.0006	0.0003	0.0	0.0
51	8.333	0.0134	0.0020	0.0715	0.0000	0.0000	0.0040	0.0005	0.0002	0.0	0.0
52	8.500	0.0134	0.0020	0.0735	0.0000	0.0000	0.0045	0.0005	0.0002	0.0	0.0
53	8.667	0.0134	0.0020	0.0755	0.0000	0.0000	0.0050	0.0005	0.0002	0.0	0.0
54	8.833	0.0088	0.0013	0.0769	0.0000	0.0000	0.0054	0.0004	0.0002	0.0	0.0
55	9.000	0.0088	0.0013	0.0782	0.0000	0.0000	0.0058	0.0004	0.0002	0.0	0.0
56	9.167	0.0088	0.0013	0.0795	0.0000	0.0000	0.0062	0.0004	0.0002	0.0	0.0
57	9.333	0.0088	0.0013	0.0808	0.0000	0.0000	0.0066	0.0004	0.0002	0.0	0.0
58	9.500	0.0088	0.0013	0.0821	0.0000	0.0000	0.0070	0.0004	0.0002	0.0	0.0
59	9.667	0.0088	0.0013	0.0835	0.0000	0.0000	0.0074	0.0004	0.0002	0.0	0.0
60	9.833	0.0088	0.0013	0.0848	0.0000	0.0000	0.0078	0.0004	0.0002	0.0	0.0
61	10.000	0.0088	0.0013	0.0861	0.0000	0.0000	0.0082	0.0004	0.0002	0.0	0.0
62	10.167	0.0088	0.0013	0.0874	0.0000	0.0000	0.0087	0.0004	0.0002	0.0	0.0
63	10.333	0.0088	0.0013	0.0887	0.0000	0.0000	0.0091	0.0004	0.0002	0.0	0.0
64	10.500	0.0088	0.0013	0.0901	0.0000	0.0000	0.0096	0.0005	0.0002	0.0	0.0
65	10.667	0.0088	0.0013	0.0914	0.0000	0.0000	0.0100	0.0005	0.0002	0.0	0.0
66	10.833	0.0072	0.0011	0.0925	0.0000	0.0000	0.0104	0.0004	0.0002	0.0	0.0
67	11.000	0.0072	0.0011	0.0935	0.0000	0.0000	0.0108	0.0004	0.0002	0.0	0.0
68	11.167	0.0072	0.0011	0.0946	0.0000	0.0000	0.0112	0.0004	0.0002	0.0	0.0
69	11.333	0.0072	0.0011	0.0957	0.0000	0.0000	0.0116	0.0004	0.0002	0.0	0.0
70	11.500	0.0072	0.0011	0.0968	0.0000	0.0000	0.0120	0.0004	0.0002	0.0	0.0
71	11.667	0.0072	0.0011	0.0979	0.0000	0.0000	0.0125	0.0004	0.0002	0.0	0.0
72	11.833	0.0072	0.0011	0.0989	0.0000	0.0000	0.0129	0.0004	0.0002	0.0	0.0
73	12.000	0.0072	0.0011	0.1000	0.0000	0.0000	0.0133	0.0004	0.0002	0.0	0.0
74	12.167	0.0072	0.0011	0.1011	0.0000	0.0000	0.0137	0.0004	0.0002	0.0	0.0
75	12.333	0.0072	0.0011	0.1022	0.0000	0.0000	0.0142	0.0004	0.0002	0.0	0.0
76	12.500	0.0072	0.0011	0.1033	0.0000	0.0000	0.0146	0.0004	0.0002	0.0	0.0
77	12.667	0.0072	0.0011	0.1043	0.0000	0.0000	0.0151	0.0004	0.0002	0.0	0.0
78	12.833	0.0057	0.0009	0.1052	0.0000	0.0000	0.0154	0.0004	0.0002	0.0	0.0
79	13.000	0.0057	0.0009	0.1061	0.0000	0.0000	0.0158	0.0004	0.0002	0.0	0.0
80	13.167	0.0057	0.0009	0.1069	0.0000	0.0000	0.0162	0.0004	0.0002	0.0	0.0
81	13.333	0.0057	0.0009	0.1078	0.0000	0.0000	0.0165	0.0004	0.0002	0.0	0.0
82	13.500	0.0057	0.0009	0.1086	0.0000	0.0000	0.0169	0.0004	0.0002	0.0	0.0
83	13.667	0.0057	0.0009	0.1095	0.0000	0.0000	0.0173	0.0004	0.0002	0.0	0.0
84	13.833	0.0057	0.0009	0.1103	0.0000	0.0000	0.0177	0.0004	0.0002	0.0	0.0
85	14.000	0.0057	0.0009	0.1112	0.0000	0.0000	0.0180	0.0004	0.0002	0.0	0.0
86	14.167	0.0057	0.0009	0.1120	0.0000	0.0000	0.0184	0.0004	0.0002	0.0	0.0
87	14.333	0.0057	0.0009	0.1129	0.0000	0.0000	0.0188	0.0004	0.0002	0.0	0.0
88	14.500	0.0057	0.0009	0.1137	0.0000	0.0000	0.0192	0.0004	0.0002	0.0	0.0
89	14.667	0.0057	0.0009	0.1146	0.0000	0.0000	0.0196	0.0004	0.0002	0.0	0.0
90	14.833	0.005	0.0008	0.1154	0.0000	0.0000	0.0199	0.0003	0.0002	0.0	0.0
91	15.000	0.005	0.0008	0.1161	0.0000	0.0000	0.0203	0.0003	0.0002	0.0	0.0
92	15.167	0.005	0.0008	0.1169	0.0000	0.0000	0.0206	0.0004	0.0002	0.0	0.0
93	15.333	0.005	0.0008	0.1176	0.0000	0.0000	0.0210	0.0004	0.0002	0.0	0.0
94	15.500	0.005	0.0008	0.1184	0.0000	0.0000	0.0213	0.0004	0.0002	0.0	0.0
95	15.667	0.005	0.0008	0.1191	0.0000	0.0000	0.0217	0.0004	0.0002	0.0	0.0
96	15.833	0.005	0.0008	0.1199	0.0000	0.0000	0.0221	0.0004	0.0002	0.0	0.0
97	16.000	0.005	0.0008	0.1206	0.0000	0.0000	0.0224	0.0004	0.0002	0.0	0.0
98	16.167	0.005	0.0008	0.1214	0.0000	0.0000	0.0228	0.0004	0.0002	0.0	0.0
99	16.333	0.005	0.0008	0.1221	0.0000	0.0000	0.0232	0.0004	0.0002	0.0	0.0
100	16.500	0.005	0.0008	0.1229	0.0000	0.0000	0.0235	0.0004	0.0002	0.0	0.0
101	16.667	0.005	0.0008	0.1236	0.0000	0.0000	0.0239	0.0004	0.0002	0.0	0.0
102	16.833	0.004	0.0006	0.1242	0.0000	0.0000	0.0242	0.0003	0.0001	0.0	0.0
103	17.000	0.004	0.0006	0.1248	0.0000	0.0000	0.0245	0.0003	0.0001	0.0	0.0
104	17.167	0.004	0.0006	0.1254	0.0000	0.0000	0.0248	0.0003	0.0001	0.0	0.0

(1) Time Increment	(2) Time (hrs.)	(3) Precip. Distrib. (fraction)	(4) Incre. Rainfall (inches)	(5) Accumul. Rainfall (inches)	(6) PERVIOUS AREA Accum. Runoff (inches)	(7) Incre. Runoff (inches)	(8) IMPERVIOUS AREA Accum. Runoff (inches)	(9) Incre. Runoff (inches)	(10) Total Runoff (inches)	(11) Instant Flowrate (cfs)	(12) Design Flowrate (cfs)
105	17.333	0.004	0.0006	0.1260	0.0000	0.0000	0.0251	0.0003	0.0001	0.0	0.0
106	17.500	0.004	0.0006	0.1266	0.0000	0.0000	0.0254	0.0003	0.0001	0.0	0.0
107	17.667	0.004	0.0006	0.1272	0.0000	0.0000	0.0257	0.0003	0.0001	0.0	0.0
108	17.833	0.004	0.0006	0.1278	0.0000	0.0000	0.0260	0.0003	0.0001	0.0	0.0
109	18.000	0.004	0.0006	0.1284	0.0000	0.0000	0.0263	0.0003	0.0001	0.0	0.0
110	18.167	0.004	0.0006	0.1290	0.0000	0.0000	0.0266	0.0003	0.0001	0.0	0.0
111	18.333	0.004	0.0006	0.1296	0.0000	0.0000	0.0269	0.0003	0.0001	0.0	0.0
112	18.500	0.004	0.0006	0.1302	0.0000	0.0000	0.0272	0.0003	0.0001	0.0	0.0
113	18.667	0.004	0.0006	0.1308	0.0000	0.0000	0.0275	0.0003	0.0001	0.0	0.0
114	18.833	0.004	0.0006	0.1314	0.0000	0.0000	0.0278	0.0003	0.0001	0.0	0.0
115	19.000	0.004	0.0006	0.1320	0.0000	0.0000	0.0282	0.0003	0.0001	0.0	0.0
116	19.167	0.004	0.0006	0.1326	0.0000	0.0000	0.0285	0.0003	0.0001	0.0	0.0
117	19.333	0.004	0.0006	0.1332	0.0000	0.0000	0.0288	0.0003	0.0001	0.0	0.0
118	19.500	0.004	0.0006	0.1338	0.0000	0.0000	0.0291	0.0003	0.0001	0.0	0.0
119	19.667	0.004	0.0006	0.1344	0.0000	0.0000	0.0294	0.0003	0.0001	0.0	0.0
120	19.833	0.004	0.0006	0.1350	0.0000	0.0000	0.0297	0.0003	0.0001	0.0	0.0
121	20.000	0.004	0.0006	0.1356	0.0000	0.0000	0.0301	0.0003	0.0001	0.0	0.0
122	20.167	0.004	0.0006	0.1362	0.0000	0.0000	0.0304	0.0003	0.0001	0.0	0.0
123	20.333	0.004	0.0006	0.1368	0.0000	0.0000	0.0307	0.0003	0.0001	0.0	0.0
124	20.500	0.004	0.0006	0.1374	0.0000	0.0000	0.0310	0.0003	0.0001	0.0	0.0
125	20.667	0.004	0.0006	0.1380	0.0000	0.0000	0.0313	0.0003	0.0001	0.0	0.0
126	20.833	0.004	0.0006	0.1386	0.0000	0.0000	0.0317	0.0003	0.0002	0.0	0.0
127	21.000	0.004	0.0006	0.1392	0.0000	0.0000	0.0320	0.0003	0.0002	0.0	0.0
128	21.167	0.004	0.0006	0.1398	0.0000	0.0000	0.0323	0.0003	0.0002	0.0	0.0
129	21.333	0.004	0.0006	0.1404	0.0000	0.0000	0.0327	0.0003	0.0002	0.0	0.0
130	21.500	0.004	0.0006	0.1410	0.0000	0.0000	0.0330	0.0003	0.0002	0.0	0.0
131	21.667	0.004	0.0006	0.1416	0.0000	0.0000	0.0333	0.0003	0.0002	0.0	0.0
132	21.833	0.004	0.0006	0.1422	0.0000	0.0000	0.0336	0.0003	0.0002	0.0	0.0
133	22.000	0.004	0.0006	0.1428	0.0000	0.0000	0.0340	0.0003	0.0002	0.0	0.0
134	22.167	0.004	0.0006	0.1434	0.0000	0.0000	0.0343	0.0003	0.0002	0.0	0.0
135	22.333	0.004	0.0006	0.1440	0.0000	0.0000	0.0347	0.0003	0.0002	0.0	0.0
136	22.500	0.004	0.0006	0.1446	0.0000	0.0000	0.0350	0.0003	0.0002	0.0	0.0
137	22.667	0.004	0.0006	0.1452	0.0000	0.0000	0.0353	0.0003	0.0002	0.0	0.0
138	22.833	0.004	0.0006	0.1458	0.0000	0.0000	0.0357	0.0003	0.0002	0.0	0.0
139	23.000	0.004	0.0006	0.1464	0.0000	0.0000	0.0360	0.0003	0.0002	0.0	0.0
140	23.167	0.004	0.0006	0.1470	0.0000	0.0000	0.0363	0.0003	0.0002	0.0	0.0
141	23.333	0.004	0.0006	0.1476	0.0000	0.0000	0.0367	0.0003	0.0002	0.0	0.0
142	23.500	0.004	0.0006	0.1482	0.0000	0.0000	0.0370	0.0003	0.0002	0.0	0.0
143	23.667	0.004	0.0006	0.1488	0.0000	0.0000	0.0374	0.0003	0.0002	0.0	0.0
144	23.833	0.004	0.0006	0.1494	0.0000	0.0000	0.0377	0.0003	0.0002	0.0	0.0
145	24.000	0.004	0.0006	0.1500	0.0000	0.0000	0.0381	0.0003	0.0002	0.0	0.0

SBUH Hydrograph for Existing and Developed Site Conditions
10-Yr, 24-Hr Rainfall



Post-D Runoff-10YR.XLS

4/4/2003 1:37 PM

Appendix B

Sampling and Analysis Plan

Sampling and Analysis Plan – Environmental Sampling and Monitoring

Yakima Valley Spray (U-Haul) Site
Yakima, Washington

Prepared by:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162

RETEC Project Number: DWT40-16457-300

Prepared for:

Yakima Valley Spray Steering Committee

April 4, 2003

Table of Contents

Table of Contents

List of Tables

List of Attachments

1 Introduction

This sampling and analysis plan (SAP) presents the project organization, objectives, and specific Quality Assurance (QA) and Quality Control (QC) activities associated with the collection of environmental samples at the Yakima Valley Spray (U-Haul) Site in Yakima, Washington. This SAP meets the requirements of the Model Toxics Control Act (WAC 173-340-820). All QA/QC procedures detailed in this SAP are in accordance with applicable professional technical standards, Washington Department of Ecology guidelines (Ecology, 1991, 1995), and project-specific goals. This SAP describes the procedures that will be implemented to ensure that the precision, accuracy, representativeness and completeness of the project data are sufficient to satisfy the project objectives.

2 Project Organization

2.1 Project Structure

The organizational structure for the project will consist of a Program Manager, Project Manager, Regional Health and Safety Officer, Project Engineer, Quality Assurance (QA) Officer, Site Safety Officer, Laboratory Coordinator, and Data Validator. Figure 2-1 provides a project organization chart, which depicts the project team.

2.2 Responsibilities of Project Personnel

The responsibilities of project personnel are described in the following paragraphs. In some cases one person may assume more than one role.

2.2.1 Program Manager

The Program Manager will be an alternate point of contact and will have responsibility for the overall success of the project. The Program Manager's duties will include:

- Project oversight;
- Review of all major project deliverables for technical accuracy and completeness;
- Assist Project Manager as needed in negotiations and strategy development.

2.2.2 Project Manager

The Project Manager (PM) will be the primary point of contact and will have responsibility for technical, financial, and scheduling matters. The PM's responsibilities will include:

- Ecology contact;
- Assignment of duties to the project staff and orientation of the staff to the needs and requirements of the project;
- Supervision of the performance of project team members;
- Monitoring all aspects of the project to verify that all work is being completed in accordance with this SAP;
- Budget and schedule control;
- Establishment of a project record-keeping system;

- Coordination of all major project deliverables for technical accuracy and completeness.

2.2.3 Regional Health and Safety Officer

The Regional Health and Safety Officer (HSO) has the following responsibilities:

- Interface with the Project Manager as required in matters of health and safety;
- Approve the site-specific Health and Safety Plan (HASP) for the project;
- Amend the approved HASP as site conditions warrant;
- Appoint or approve a Site Safety Officer (SSO) to assist in implementing the HASP;
- Monitor compliance with the approved HASP;
- Assist the Project Manager in ensuring that proper health and safety equipment is available for the project;
- Approve personnel to work on the site with regard to medical examinations and health and safety training.

2.2.4 Project Engineer

The Project Engineer has the following responsibilities:

- Reviewing subcontractors' work and approving all subcontractor invoices;
- Working with the subcontractors and analytical laboratories to ensure that all field activities are conducted appropriately and that field activities are properly documented;
- Coordinating the sampling operations to verify that the sampling team members adhere to this SAP;
- Providing daily schedules for field personnel including subcontractors;
- Maintaining a log for all work completed on site;
- Preparing the field investigation data and information for reports.

Note that it is not necessary for the Project Engineer to be present on-site during all sampling activities or field operations. Thorough coordination and communication with the sampling team members will ensure compliance with this SAP.

2.2.5 Quality Assurance Officer

The Quality Assurance (QA) Officer will be responsible for audits and monitoring adherence to the project QA objectives. The QA Officer reports directly to the Project Manager. The QA Officer has the following responsibilities:

- Reviewing laboratory analytical data;
- Coordinating QA/QC operation with the Laboratory Coordinator;
- Providing the Data Validator with the laboratory analytical data and sampling field notes.

2.2.6 Site Safety Officer

The Site Safety Officer (SSO) will be responsible for verifying that project personnel adhere to the site safety requirements outlined in the HASP. These responsibilities will include:

- Conducting the health and safety training for project personnel as appropriate;
- Modifying health and safety equipment or procedure requirements based on data gathered during the site work;
- Determining the posting locations and routes to medical facilities, including poison-control centers, and arranging for emergency transportation to medical facilities;
- Posting the telephone numbers of local public emergency services and facilities;
- Performing site audits to verify adherence to the requirements of the HASP.

The SSO has authority to stop any operation that threatens the health or safety of the work team or surrounding populace. The daily health and safety activities may be conducted by the SSO or a designated replacement.

2.2.7 Laboratory Coordinator

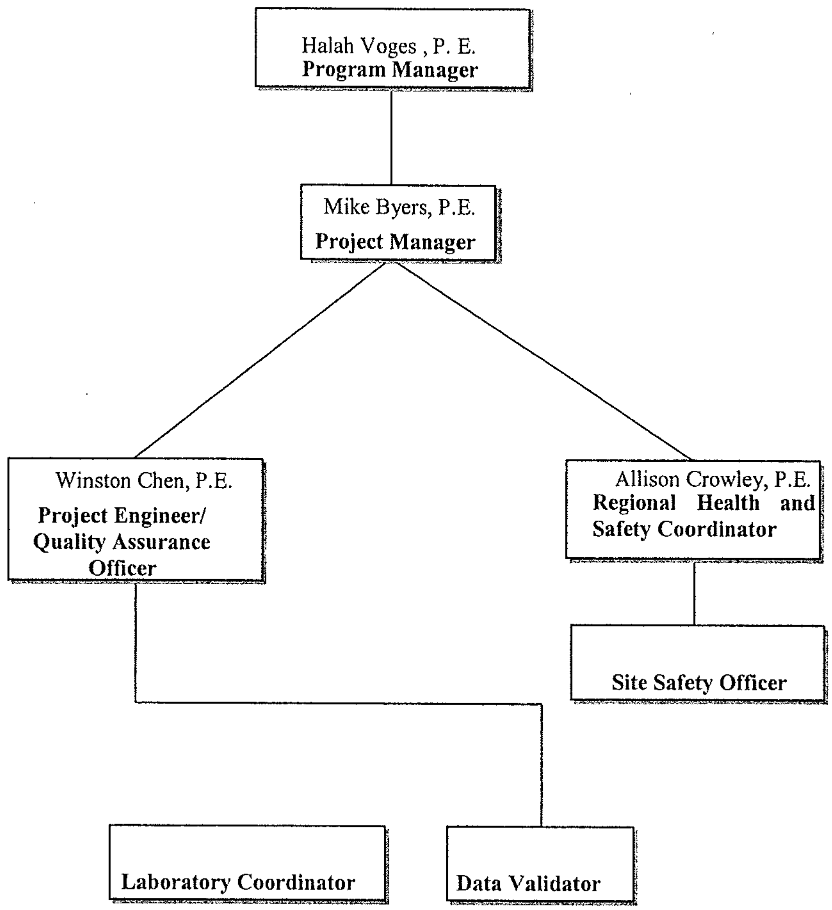
Responsibilities of the Laboratory Coordinator will include:

- Collaborating with the Project Engineer in establishing sampling and analysis programs;
- Serving as liaison between the laboratory and Project Engineer or QA Officer;
- Serving as the "focal point" for laboratory activities;
- Coordinating laboratory and data activities by the analytical services staff;
- Notifying the laboratory and QA Officer of specific laboratory nonconformances and changes;
- Maintaining a complete set of laboratory data;
- Releasing testing data and results to the Project Engineer.

2.2.8 Data Validator

Responsibilities of the Data Validator will include:

- Identifying data to be classified as questionable or qualitative;
- Comparing actual sampling and laboratory procedures to those outlined in this plan;
- Reporting the validation results to the Project Engineer and QA Officer.


Halah Voges , P. E.
Program Manager
Mike Byers, P.E.
Project Manager
Winston Chen, P.E.
Project Engineer/
Quality Assurance
Officer
Allison Crowley, P.E.
Regional Health and
Safety Coordinator
Site Safety Officer
Laboratory Coordinator
Data Validator

RETEC

3 Quality Assurance Objectives

Groundwater and soil samples will be collected for laboratory analysis as described in Section 4 in order to meet the objectives described in project specific work plans. To help achieve the data quality requirements, the following quality-control parameters will be evaluated throughout the course of this project:

- Detection limits;
- Data precision;
- Data accuracy;
- Representativeness;
- Comparability and completeness.

These quality-assessment parameters are described in greater detail in the following paragraphs.

3.1 Detection Limits

The method detection limit for a given parameter is determined by procedures specified in the analytical method. Detection limits will be observed for all laboratory analyses performed during this project, except where matrix interferences and high concentrations of target and non-target compounds increase the reporting detection limits.

3.2 Precision

Precision will be determined for field duplicate samples by examining sample results for degree of variance and determining if sampling error has occurred.

Precision is a measure of agreement among individual measurements of the same parameter, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. The relative percent difference (RPD) parameter will be calculated to define the precision between duplicate analyses.

The RPD for each component is calculated using the following equation:

$$\% \mathrm{RPD} = \frac{(X_2 - X_1)}{[(X_1 + X_2)/2]} \times 100$$

where:

X_1 = first duplicate sample value

X_2 = second duplicate sample value

The laboratory objective for precision is to generate RPD values that fall within the established control limits for the method employed. The field objective for precision is to generate RPD values that are between 0 and 50 percent for soil samples and 0 to 30 percent for groundwater samples. If the criteria are not met, the data reviewer will examine other quality-control criteria to determine the need for some qualification of the data.

3.3 Accuracy

Accuracy is defined as the degree of agreement between a measurement and an accepted reference of true concentration. Accuracy is determined by spiking samples with a known concentration of standard compounds and comparing the analytical results with the known value. Data accuracy will be assessed by determining the percent recovery of a spiked compound. Percent recovery (%R) is determined by the equation:

$$\%R = \frac{(C_1 - C_0)}{C_S} \times 100$$

where:

C_1 = measured concentration in the spiked sample

Co = measured concentration in the unspiked sample

C_s = concentration at which the sample was spiked

The concentration at which the sample was spiked (C_s) is calculated, using the following equation:

$$C_S = \frac{(C_{spike} \times V_{spike})}{V_{sample} + V_{spike}}$$

where:

C_s = concentration at which the sample was spiked

C_{spike} = spike concentration

V_{spike} = volume of spike

V_{sample} = volume of sample

The laboratory objective for accuracy is to generate %R_s that fall within established control limits for the method employed.

Surrogate and matrix spiking compounds and sample selection for spiking are determined by current SW-846 methodologies. Percent recoveries indicate the actual performance of the analytical method on real world samples. Surrogate spikes, matrix spikes, matrix spike duplicates, and QC spikes will be conducted using standard laboratory methods.

3.4 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic population, a process control or an environmental condition. Appropriate sampling procedures will be implemented so that the samples are representative of the environmental matrices from which they were obtained.

3.5 Comparability and Completeness

Comparability is achieved through the use of the same analytical methods that were used previously, through use of trained personnel and through following procedures in this SAP. Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The completeness goal will be at least 90 percent.

4 Environmental Sampling Procedures

This section describes standard procedures for collection of groundwater and soil samples. Specific procedures included in project-specific work plans supercede the procedures presented in this section. Sampling scope (including locations and depths of samples) is defined in separate documents.

4.1 Groundwater Sampling

4.1.1 Water Level Measurement

Water level data are used to indicate the direction of groundwater flow and areas of recharge and discharge, to evaluate the effects of manmade and natural stresses on the groundwater system, to define the hydraulic characteristics of aquifers, and to evaluate stream-aquifer relations. Measurements of the static-water level are also needed to estimate the amount of water to be purged from a well prior to sample collection when purge volumes are based on well volumes, rather than stabilization of parameters (i.e., for samples collected by bailing, rather than using low flow techniques). Well volumes are calculated from the length of the water column and the well casing diameter.

When taking a series of fluid-level measurements at a number of monitoring wells, it is generally good practice to go in order from the least- to most-contaminated well. Additionally, the measurement of all site wells should be done consecutively and before any sampling activities begin. This will ensure the data are representative of aquifer conditions. All pertinent data will be entered in the fluid-level monitoring log sheet or the project field book.

Well Evaluation

Upon arrival at a monitoring well, the surface seal and well protective casing should be examined for any evidence of frost heaving, cracking or vandalism. All observations should be recorded in the fluid-level monitoring log or the project field book, and repairs scheduled as necessary.

Measuring Point Location

The measuring point location for the well should be clearly marked on the inner casing (PVC riser) or identified in previous sample collection records. This point is usually established on the well casing itself, but may be marked on the protective steel casing in some cases. In either case, it is important that the marked point coincide with the same point of measurement used by the surveyor. If not marked from previous investigations, the water level measuring point should be marked on the north side of the well casing and noted in the fluid-level monitoring log or the project field book. Monitoring well measurements for total depth and water level should be consistently measured from one reference point so that these data can be used for assessing trends in the groundwater.

Water Level Measurement

Water level measurements shall be made using an electronic or mechanical device. Many types of electrical instruments are available for water level measurement; most operate on the principle that a circuit is completed when two electrodes are immersed in water. Electrodes are generally contained in a weighted probe that keeps the tape taut while providing some shielding of the electrodes against false indications as the probe is being lowered into the well. Before lowering the probe in the well, the circuitry can be checked by dipping the probe in water and observing the indicator (a light, sound, and/or meter).

To obtain a water level measurement, slowly lower the decontaminated probe into the monitoring well until the indicator (light, sound, and/or meter) shows water contact. At this time the precise measurement should be determined by repeatedly raising and lowering the tape or cable to converge on the exact measurement.

Water level measurement should be entered in the fluid-level monitoring log or the project field book. The water level measurement device shall be decontaminated immediately after use following the procedures described in Section 4.3.

Measurement of Total Depth

During water level measurement, the total depth of the well may also be measured periodically. This measurement gives an indication of possible sediment buildup within the well that may significantly reduce the screened depth. If total depth is to be measured, the same methods used for measuring water levels (e.g., steel tape or electrical probes) may be used to measure the total well depth. The most convenient time to measure the total well depth is immediately following measurement of the water level and prior to removing the measurement device completely from the well. The measurement device (steel tape or electrical probe) is lowered down the well until the measurement tape becomes slack indicating the weighted end of the tape or probe has reached the bottom of the well. The total well depth shall be recorded in the field book.

Total depth will not be routinely measured in wells containing in-well, dedicated pumps. If sediment buildup is suspected, in-well equipment may be removed so that total depth can be measured.

4.1.2 Sample Collection Using a Bailer

Water Level Measurement

After unlocking and/or opening a monitoring well, the first task will be to obtain a water level measurement. A static water level will be measured in the well prior to the purging and collection of any samples. The water level is needed for estimating the purge volume and may also be used for mapping the potentiometric surface of the groundwater. Water level measurements will be made using an electronic or mechanical device following the methods described above.

Purging

Well purging is the activity of removing some volume of water from a monitoring well in order to induce "fresh" groundwater to flow into the well prior to sampling. Under most well construction and hydrogeologic conditions, this provides water that is more representative of the groundwater in saturated materials adjoining the well.

For wells that will be sampled using a bailer, the volume of water to be removed, referred to as the purge volume, is a function of the water yielding capacity of the well, the well diameter and depth. The depth to water should be measured just prior to purging. The purge volume should equal at least three well volumes when bailing.

According to the EPA, the well should be purged until measurements of turbidity, redox potential, and dissolved oxygen in in-line or down hole analyses have stabilized within about 10% over at least two measurements (EPA, 1992). During purging, pH, specific conductance and temperature will be monitored. Field parameter values will be entered on the groundwater sampling form along with the corresponding purge volume.

Purging generally will be performed for all groundwater monitoring wells prior to sample collection. Purge water is removed from the well using a bailer, using the bailing techniques described above. Purge water should be placed in appropriate storage containers pending disposal. After purging a groundwater sample may be collected.

Sample Collection

Obtain a clean decontaminated bailer and new, clean length of polypropylene rope or equivalent bailer cord. Tie a knot to secure the bailer cord to the bailer. Test the knot for effectiveness. Tie an additional knot, if necessary.

If bailer cord is from a spool, the sampler may lower the bailer to the bottom of the monitoring well, remove an additional five feet of cord from the spool and cut the cord at the spool.

Raise the bailer by grasping a section of cord using each hand alternately. This bailer lift method is used so that the bailer cord will not come into contact with the ground or other potentially contaminated surfaces.

Samples collected by bailing will be poured directly into sample containers from bailers that are full of fresh groundwater. Samples will be collected in the following order for those methods specified in the work plan:

- Volatile organic compounds;
- Semivolatile organic compounds;
- Pesticides/Herbicides/PCBs/Dioxins;
- Organic indicator compounds;
- Metals (total and/or dissolved);
- Miscellaneous inorganic compounds;
- Radiometric compounds; and
- Microbial analyses.

During sample collection, bailers will not be allowed to contact the sample containers.

4.1.3 Sample Collection Using Low Flow Methods

Groundwater withdrawal using pumps is commonly performed with centrifugal, peristaltic, submersible, or bladder pumps. Peristaltic and centrifugal pumps are limited to conditions where groundwater need only be raised through approximately 20 to 25 feet of vertical distance. Submersible or bladder pumps can be used when groundwater is greater than 25 feet below grade. Specific methods for pumps will be discussed in the project specific sampling plan.

Purging

Purging is required prior to sample collection when using low flow techniques; however, three well volumes are not required. Instead, purging is considered complete when consecutive measurements of turbidity, dissolved oxygen, oxidation-reduction potential, pH, specific conductance, and temperature are within 10 percent of the previous measurement, and when consecutive measurements of conductivity are within 3 percent.

Sample Collection

Samples may be collected using dedicated pumps or a single pump. If a single pump is used, new, clean tubing will be used at each well, and equipment that contacts water directly will be decontaminated as appropriate.

Upon stabilization of parameters, the purge rate is reduced to approximately 100-200 mL/min. Samples are collected from the discharge tube of the pump into appropriate sample containers.

4.1.4 Quality Control of Groundwater Sample Collection

At least one duplicate sample shall be collected for every 10 investigation samples. Duplicate water samples will be collected by filling two containers (or sets of containers) simultaneously from the sampling device.

Trip blanks will be carried each day that more than one well is sampled for volatile constituents. The laboratory will prepare trip blanks by filling representative glassware with known deionized water. These samples will be transported with the sample collection glassware and analyzed for evidence of systematic contamination from sample transport, glassware cleaning and laboratory storage. Trip blanks will be shipped with each day's samples. If samples are hand-delivered, trip blanks will be submitted for analysis with each batch of samples delivered.

Field blanks and field duplicates will not be labeled as such on the sample labels or chain-or-custody forms, but they will be identified as such in the field notebook and on the sample logs. A summary of the QA samples to be collected is provided in Table 4-1.

Table 4-1 Summary of Quality-Assurance Samples for Water

Matrix	Parameter	Trip Blank	Field Duplicates	Matrix Spikes
Water	A	1 per shipment when samples require volatile analysis	1 per 10 samples	1 per 20

Notes:
A – The field duplicate and equipment blank will be analyzed for the same parameters as the investigative samples.

4.1.5 Documentation

Various documents will be completed and maintained as a part of groundwater sample collection. These documents will provide a summary of the sample collection procedures and conditions, shipment method, analyses requested, and the custody history. These documents may include:

- Field books;
- Groundwater sampling forms;
- Sample labels;
- Chain-of-custody forms; and
- Shipping receipts.

All documentation will be stored in the project files.

4.2 Soil Sampling

4.2.1 Excavation and Test Pit Sampling

Soil samples for excavations and test pits are generally collected as grab samples. The locations and numbers of samples to be collected are determined in the project-specific work plan. Samples may be collected from excavation/test pit sidewalls, bottoms, or directly from the backhoe during excavation.

Soil samples may be collected from excavations or test pits using a shovel or trowel. Sampling to obtain uniform coverage within a specified area will often require the use of an area grid. These considerations will be followed based upon project specific requirements.

There are two types of samples that may be required by the project sampling plan, grab or composite:

- A grab sample is collected from a specific location or depth and placed in the appropriate sample container. For a grab sample to be representative of a stockpile or excavation sidewall, it is important to collect a sample from at least 6 inches below the surface, particularly for volatile compounds.

- A composite sample consists of samples from several discrete locations (or depths) mixed to provide a homogeneous, representative sample. To ensure that the sample is representative, the sample volume and collection method from each discrete location should be as identical as possible.

Grab Sampling

Prior to grab sampling, remove all surface materials that are not to be included in the sample such as rocks, twigs and leaves. For sample collection taken within the upper two to three feet, use a decontaminated shovel or trowel to remove adequate soil volume to fill sampling containers. Sampling containers are filled to minimize headspace, and are appropriately labeled and stored prior to shipment to the laboratory. All sampling equipment shall be decontaminated between sample locations as described in Section 4.3.

Composite Sampling

Composite sampling is completed by collecting several grab samples and homogenizing the samples in a clean container. Generally, samples are placed in a decontaminated stainless steel bowl and a clean stainless spoon is used to mix the samples. A portion of the homogenized sample is then placed in the proper sampling container. Note that if samples are collected for volatile compounds, it may not be appropriate to composite samples.

4.2.2 Stockpile Sampling

Excavated soils whose contamination level exceeds CULs and are less than 1.0 inch in diameter will be designated under WAC 173-303 and disposed of at an appropriate licensed facility. The remaining coarse material will be stockpiled and sampled to determine if disposal is required or if the material can be re-used on the site as backfill.

A composite small sampling pile will be composed of materials drawn from various levels and locations in the main stockpile either using power equipment or sampling from the top, middle, and bottom third of the volume of the main stockpile. A representative composite sample will be collected in approximately gallon-sized containers to be shipped to the laboratory.

The screening operation is expected to remove most of the finer grained soil that may cling to oversized material, leaving the oversized fraction relatively free of impacts. Discussions with Ecology personnel about a nearby site (Cameron-Yakima) suggest that the screening operation will result in oversized material that will be below Site CULs. Oversized material will be tested either by crushing or by using a wipe test on a representative fraction of the oversized material. Once the Ecology site manager determines a relationship between visual impacts and laboratory testing results of the oversized material, visual observation will primarily be used to evaluate the oversized material impacts.

4.2.3 Quality Control of Soil Sample Collection

At least one soil sample in every 10 will be collected in duplicate for chemical analysis. Duplicate samples will be collected by vertically splitting the soil sample while still in the soil sampler or immediately after removing it from the sampler and filling two sets of sample containers with the soils collected. Soils will not be mixed and split due to the potential loss of volatile organic constituents during the mixing process. Samples collected for volatile analysis will be placed in containers with no headspace. Field duplicates will not be identified as duplicates on the sample labels or chain-of-custody forms but will be identified as such in the field notebook and the sample logs. A summary of the QA samples to be collected is summarized in Table 4-2.

Table 4-2 Summary of Quality-Assurance Soil Samples

Matrix	Parameter	Trip Blank	Field Duplicates	Matrix Spikes
Soil	A	None	1 per 10 samples	1 per 20

Notes:
A – The field duplicate and equipment blank will be analyzed for the same parameters as the investigative samples.

4.2.4 Soil Sampling from Borings

Soil samples may be obtained in conjunction with soil boring and monitoring well installation programs. These procedures will discuss sampling of the subsurface material by augers and split spoons.

Soil samples will be collected at depth during advancement of boreholes using a variety of collection methods depending upon the drilling method.

Rotosonic Drilling

It is anticipated that a rotosonic drill rig will be used for boring at this site. With a rotosonic rig a continuous core sample is extruded directly into plastic sleeves by gently vibrating the core tube used for advancement. Soil samples are logged then collected from the plastic sleeve. Sleeves are cut open and a discrete sample retrieved using stainless steel spoons and may be placed directly into sample containers. If an air-rotary rig is employed, samples will be collected directly from the air cuttings as a grab sample and confirmed using split-spoon sampler techniques as described below.

Hollow Stem Auger Drilling

In the event that hollow stem augering is used at this site, subsurface soil samples shall typically be obtained using a split-tube type sampler (split-spoon), however, other devices (Shelby tubes, core, etc.) may be used. Split-spoons come in a variety of sizes with the most standard having a two-inch OD, a 1 3/8-inch ID and a 24-inch long barrel with an 18-inch sample capacity. Split spoons shall be equipped with a check valve at the top and a flap valve or basket-type retainer at the bottom. Samples shall be obtained using the standard penetration test (SPT), which allows for qualitative determination of mechanical properties and aids in identification of material type. The number of hammer blows shall be recorded on the boring logs for each six-inch drive distance.

The split spoon shall be opened immediately upon removal from the casing. If the recovery is inadequate (i.e., most of the penetrated material was not retained inside the sampler), a note will be made on the boring log stating that "no recovery" was possible at that depth. In the event that gravels or other material prevent penetration by the split spoon, samples may be collected from the auger flights. Slowly remove the auger and collect the sample at the point corresponding to the required depth. Samples collected in this manner must be documented on the boring log.

Sample Logging

The field geologist will log each soil sample under the Unified Soil Classification System (USCS). The color, moisture content, visual and/or olfactory evidence of hydrocarbon and/or pesticide impact will be documented on a form similar to the Boring Log Forms (Attachment A).

Each soil sample collected will be screened for volatile organic compounds (VOCs) in approximately 5-foot intervals using a photoionization detector (PID). Headspace screening will include placement of soil into Ziploc bags, heating to allow partitioning of vapors (15 minutes), and inserting the probe of the PID (10.2-electron volt [eV] lamp) into the bag headspace. The peak organic vapor reading from each sample will be recorded on the boring logs.

To ensure consistent descriptions of soil or rock material, the following criteria should be included on the sampling logs:

- Soil or rock type;
- Depth ranges, recorded in feet;
- Grain size;
- Roundness;
- Sorting;
- Moisture;
- Color;
- Degree of visible impact; and
- Remarks.

4.2.5 Documentation

Various documents will be completed and maintained as a part of soil sample collection. These documents will provide a summary of the sample collection procedures and conditions, shipment method, analyses requested, and the custody history. These documents may include:

- Field books;
- Soil sampling forms;
- Sample labels;
- Chain-of-custody forms; and
- Shipping receipts.

All documentation will be stored in the project files.

4.3 Decontamination

Decontamination is performed as a quality assurance measure and as a safety precaution. It prevents cross-contamination between samples and also helps maintain a clean working environment. Equipment requiring decontamination may include hand tools, monitoring and testing equipment, personal protective equipment, or heavy equipment (e.g., loaders, backhoes, drill rigs, etc.).

Decontamination is achieved mainly by rinsing with liquids that may include: soap and/or detergent solutions, tap water, distilled water and methanol.

Equipment may be allowed to air dry after being cleaned or may be wiped dry with paper towels or chemical-free cloths.

All sampling equipment will be decontaminated prior to use and between each sample collection point. Waste products produced by the decontamination procedures such as rinse liquids, solids, rags, gloves, etc. will be collected and disposed of properly based on the nature of site impact and site protocols. Any materials and equipment that will be reused must be decontaminated or properly protected before being taken off-site.

All soil sample collection apparatus will be fully decontaminated before sampling and between sampling points. At least one equipment rinseate sample will be collected after decontamination for every 20 soil samples collected. Duplicate and equipment rinseate samples will be analyzed for the same constituents as the environmental samples.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

The following are decontamination procedures for sampling equipment:

1) Remove gross visible solids from the equipment by brushing and then rinse with tap water.

2) Wash with detergent or soap solution (e.g., Alconox® and tap water).

3) Rinse with tap or distilled water.

4) Repeat entire procedure or any parts of the procedure as necessary.

5) Rinse with distilled water.

6) After decontamination procedure is completed, avoid placing equipment directly on ground surface.

Downhole drilling equipment, such as augers, split spoons, Shelby tubes, and sandlines may also be decontaminated with pressurized hot water or steam wash, followed by a fresh water rinse. No additional decontamination procedures will be required if the equipment appears to be visually clean. If impacts are visible after hot water/steam cleaning, then a detergent wash solution with brushes (if necessary) will be used.

5 Well Installation and Development

Specific drilling, sampling and installation equipment and methodology will be dictated by the geologic characteristics of the site, the types of impacts being monitored and local and state regulations.

5.1 Drilling Methods

At this site, all monitoring well boreholes will be drilled using either a rotosonic drill rig or an air rotary rig. Air rotary drilling is accomplished by using either a rotating tri-cone bit or a down-hole air hammer. When a tri-cone bit is used, air is forced down the drill pipe and through small openings at the bottom of the drill bit. The air then returns to the ground surface through the annular space between the drill bit and the outer casing. As the air travels up the borehole, it carries drill cuttings created by the motion and downward force of the drill bit. The cuttings are blown out of the top of the borehole into a cyclone where the cuttings are cooled and re-directed to a container or lined pit.

A down-hole air hammer is a pneumatically operated drill bit that continually strikes the formation while the bit is slowly rotated. Air used to power the hammer discharges at the base of the bit and lifts cuttings in a manner similar to tri-cone bit drilling.

Rotosonic drilling is accomplished by advancing a cylindrical drill bit by a combination of rotation and high-frequency sonic vibration. A rotosonic rig uses an oscillator or head with eccentric weights driven by hydraulic motors to generate high sinusoidal frequency in combination with downward pressure and rotation of a drill pipe. The frequency of vibration (generally between 50 and 120 hertz) of the drill bit or core barrel can be varied to allow optimum penetration of subsurface materials. The drill bit on the end of the core barrel is a steel cylinder with carbide steel nubs impregnated to its leading edge, making it hard enough to core through large gravels if necessary. An approximately 5-foot-long continuous core of subsurface material is retrieved from the borehole at each sample interval. After logging and sampling, remaining material is easily stored in a variety of containers for later disposal.

5.2 Monitoring Well Construction and Installation

Monitoring wells will be constructed according to the Washington well construction standards (Chapter 173-160 WAC). The drilling rods, augers, etc., may be decontaminated between boreholes by steam cleaning. All sampling equipment will be decontaminated between samples by washing with a soap solution and rinsing with de-ionized water as described in Section 5.2.3.

Full documentation of the well construction activities will be prepared and the field geologist or other qualified professional will maintain a log of construction details and final well completion design.

All decontamination water and drill cuttings will be drummed separately. Soil cuttings will be handled as described in Section 5.2.1. Water will be sampled based on results of the cuttings sampling and properly disposed.

Backfilling of the borehole with native cuttings or clean sand to the well screen tip elevation shall be required if the tip is to be above the bottom of the borehole. A heavy plumb bob or a calibrated tape shall be used to determine the depth of the boring and the depth to the top of the backfill.

The well screen and riser pipe shall then be assembled. The riser pipe/screen shall be connected by flush-threaded joints. No solvent or anti-seize compound shall be used on the joints. The length of the screened area and the gauge of the screen or slots shall be determined by the inspecting geologist depending upon the grain-size distribution of the sediments. The assembled screen and riser, or its constituent parts, shall be steam cleaned prior to installation. The riser and screen shall be carefully placed in the borehole to ensure that it is centered in the hole and is true, straight, and vertical throughout. Centering can be accomplished with well centralizers.

The annular space surrounding the screened section of the monitoring well and two feet above the top of the screen shall be filled with clean silica sand. The well screen shall have a bentonite seal placed on top of the sand. The bentonite seal shall be approximately two feet thick to prevent vertical flow within the boring from affecting the screened area.

The remaining length of the borehole shall be backfilled or tremmied with grout to within two feet of the ground surface. This grouting may consist of a bentonite/cement mixture made to required specification.

For wells with a flush-mount completion, a steel monument with a 12 to 18-inch apron will be installed around the riser. The monument will be positioned at the ground surface so as to minimize potential damage to the monument or passing traffic. The monument will have a rubber gasket to minimize water intrusion.

For wells with aboveground completions, the steel guard-pipe shall be placed around the riser. "Weep" holes will be drilled in the guard-pipe at separate locations. The borehole around the guard-pipe shall be dug out to a depth of two feet and a one-foot radius that will be filled with concrete. Bumper posts may be necessary depending upon the location of the well. All completed wells will have identification numbers clearly marked.

5.2.1 Drilling Cuttings

Cuttings will be appropriately contained on site, pending analysis for profiling required by the disposal facilty.

5.2.2 Decontamination

Equipment and tools used during drilling activities will be cleaned prior to work startup. If necessary, an additional decontamination will be conducted prior to initiation of drilling. All equipment and tools used during drilling will be cleaned prior to leaving the site. Cleaning of drilling equipment and tools will comply with the procedures detailed in Section 4.3. Decontamination residue will be handled in an appropriate manner detailed in individual work plans.

5.2.3 Documentation

A series of measurements shall be taken during the installation of each monitoring well. These measurements shall include:

- Screen length;
- Riser pipe length;
- Total well depth; and
- Depth to stabilized water level.

Other data include type and length of casing, diameter of the respective components, thickness and different types of filter pack and grouting materials, and elevation of the top of the guard pipe and ground surface after surveying is complete. All data shall be recorded on site onto the groundwater monitoring well completion form. All wells shall be surveyed and referenced onto the appropriate site map. A field book and/or boring log can be used as other means of recording data. All documentation shall be kept in the project files.

5.2.4 Groundwater Well Development

Well development is the process of cleaning the face of the borehole and the formation around the outside of the well screen to permit groundwater to flow easily into the monitoring well.

Monitoring wells must be developed for the following reasons:

- To restore the natural permeability of the formation adjacent to the borehole to permit the water to flow into the screen easily

- To remove the clay, silt, and other fines from the formation so that during subsequent sampling the water will not be turbid or contain suspended matter which can easily interfere with chemical analysis

- To remove any formation damage that may have occurred as a result of well drilling

Well development is necessary for all newly completed wells and may be required for wells which have been left dormant for some time or have accumulated significant quantities of sediment in the well, gravel pack, or surrounding formation.

Well development should remove clay particles deposited on the surface of the formation along with sufficient quantity of water to ensure the removal of fluids introduced into the formation during drilling or prolonged inactivity. The development process should also effectively loosen and remove finer particles from the formation matrix.

During any drilling process the side of the borehole becomes smeared with clays or other fines. This plugging action substantially reduces the permeability and retards the movement of water into the well screen. If these fines are not removed, especially in formations having low permeability, it then becomes difficult and time consuming to remove sufficient water from the well before obtaining a fresh groundwater sample because the water cannot flow easily into the well. Existing wells may also require development due to the buildup of sediments in the well or surrounding formation.

Well development is accomplished by causing the natural formation water inside the well to move vigorously in and out through the screen. The suspended sediment is then removed from the well by bailing or pumping. Several techniques may be employed in developing a well. To be effective, all require reversals or surges in flow to avoid bridging by particles. These surges can be created by using surge blocks, air lifts, bailers or pumps. The use of water other than the natural formation water is not recommended during well development.

Before developing the well, water depth, and well depth will be measured using an electronic or mechanical device. Approximately 10 well volumes should be removed from the well during development. The discharge from the well should be continuously monitored and development should be continued until a particulate free discharge is apparent and the field parameters (pH, conductivity, and temperature) have stabilized within 10 percent of the previous reading. Field parameters should be recorded on the well development record after each volume is removed. All materials and equipment used in conjunction with development must be decontaminated prior to use and all provisions made to prevent cross-contamination during development. Well depths will be measured following development to determine whether sand or silt has accumulated in the well.

Regardless of the method employed, any discharges from the well must be properly disposed of depending on the nature of the liquid removed from the well. Additionally, all materials and equipment placed into the well in conjunction with development must be decontaminated prior to use.

Surge Block

A surge block is a round plunger with pliable edges that will not catch on the well screen. For two-inch diameter wells, the surge block can be constructed of two aluminum plates 1.75 inches in diameter surrounding a thin section of neoprene rubber approximately 2 inches in diameter. The surge block assembly is lowered by hand down the well by connecting sections of one-half inch threaded PVC pipe. Once within the screen interval, the block is rapidly raised and lowered to agitate the water within the well.

If the surge block method is employed, development can be continued using a nitrogen driven bladder pump to evacuate the well. The bladder pump is lowered down the well and is connected to a section of Teflon tubing. The nitrogen supply is turned on to activate the pump and discharge liquid from the well.

Air Lift

Compressed air pumped down a pipe inside the well casing can be used to blow water out of the monitoring well. If air is applied to the well intermittently and for short periods then the water is only raised inside the casing rather than blown out and will fall back down the casing causing the desired backwashing action. Finally, blowing the water out will remove the fines brought into the screen by the agitating action.

Considerable care must be exercised to avoid injecting air into the well screen. Such air can become trapped in the formation outside the well screen and alter subsequent chemical analyses of water samples. For this reason, the bottom of the air pipe should never be placed down inside the screen.

Another consideration is the submergence factor. Submergence is the feet of water above the bottom of the air pipe while pumping (blowing water out) divided by the total length of the air pipe. Submergence should be on the order of at least 20 percent.

Bailer

A bailer, sufficiently heavy so that it will sink rapidly through the water, can be raised and lowered through the well screen. The resulting agitation action of the water is similar to that caused by a surge block. The bailer, however, has the added advantage of removing the fines each time it is brought to the surface and emptied. Bailers can be custom-made for small diameter wells and can be hand-operated in shallow wells.

Pumping

Starting and stopping a pump so that the water is alternately pulled into the well through the screen and backflushed through the screen is an effective development method. Periodically pumping the waste will remove the fines from the well and permit checking the progress to ensure that development is complete.

6 Sample Handling

6.1 Sample Handling

Analytical methods and requirements for soil are summarized in Table 6-1 and for water are summarized in Table 6-2. Some or all of these methods may be used in investigation work. Actual analytical methods will be specified in work plans. Groundwater and soil samples will be analyzed for some or all of the following constituents:

- Volatiles (Benzene and PCE);
- Metals (arsenic);
- Pesticides (DDT, Aldrin, Dieldrin, Beta BHC, Gamma BHC [Lindane]); and
- Petroleum Hydrocarbons (TPH-gas and TPH-diesel).

Table 6-1 Sample Handling and Preservation Requirements for Soil

Parameter	Method	Container Water	Preservation	Holding Time Soil
Metals	6010 series	4 oz. WMG	Cool to 4° C & 5 ml (f)+	6 months
Pesticides	8081	8 oz. WMG	Cool to 4° C	14 days
Gasoline	8015 (mod)	2 oz. WMG/ Septa*	Cool to 4° C & (b)	14 days
Diesel Extended	8015 (mod)	8 oz. WMG	Cool to 4° C	14 days
Volatile Organic Compounds (VOCs)	8260	2 oz. WMG/ Septa*	Cool to 4° C & (b)	14 days

Notes:

Container
WMG = wide mouth glass
HDPE = high-density polyurethane

Preservation
(b) HCl to pH<2
(f) 1:1 HNO_3

* No headspace
\+ Total field/filtered only

Table 6-2 Sample Handling and Preservation Requirements for Water

Parameter	Method	Container Water	Preservation	Holding Time Water
Pesticides	8081	2- 500 mL AG	Cool to 4° C	7 days
Gasoline	8015 (mod)	40 ml vial (2)*	Cool to 4° C & (b)	14 days (7 if unpreserved)
Diesel Extended	8015 (mod)	1 Liter AG	Cool to 4° C	7 days
Volatile Organic Compounds (VOCs)	8260	40 ml vial (3)*	Cool to 4° C & (b)	14 days (7 if unpreserved)

Notes:

Container
WMG = wide mouth glass
HDPE = high-density polyurethane

Preservation
(b) HCl to pH<2

* No headspace
\+ Total field/filtered only

6.2 Procedures

Chain-of-custody procedures are intended to document sample possession from the time of collection to disposal. Chain-of-custody procedures are detailed below.

All samples must be packaged so that they do not leak, break, vaporize or cause cross-contamination of other samples. Waste samples and environmental samples (e.g., groundwater, soil, etc.) should not be placed in the same container. Each individual sample must be properly labeled and identified. A chain-of-custody record must accompany each shipping container. When refrigeration is required for sample preservation, samples must be kept cool during the time between collection and final packaging.

All samples must be clearly identified immediately upon collection. Each sample bottle label will include the following information:

- Client or project name, or unique identifier, if confidential;
- A unique sample description;
- Sample collection date and time;
- Sampler's name or initials;
- Indication of filtering or addition of preservative, if applicable; and
- Analyses to be performed.

After collection, identification and preservation (if necessary), the samples will be maintained under chain-of-custody procedures as described below.

6.3 Chain of Custody

A sample is considered to be under custody if it is in one's possession, view, or in a designated secure area. Chain-of-custody forms must document transfers of sample custody. The chain-of-custody record will include, at a minimum, the following information:

- Client or project name, or unique identifier, if confidential;
- Sample collector's name;
- Company's (RETEC) mailing address and telephone number;
- Designated recipient of data (name and telephone number);
- Analytical laboratory's name and city;
- Description of each sample (i.e., unique identifier and matrix);
- Date and time of collection;
- Quantity of each sample or number of containers;
- Type of analysis required; and
- Date and method of shipment.

Additional information may include type of sample containers, shipping identification air bill numbers, etc.

When transferring custody, both the individual(s) relinquishing custody of samples and the individual(s) receiving custody of samples will sign, date, and note the time on the form. If samples are to leave the collector's possession for shipment to the laboratory, the subsequent packaging procedures will be followed.

6.3.1 Packing for Shipment

To prepare a cooler for shipment, the sample bottles will be inventoried and logged on the chain-of-custody form. At least one layer of protective material will be placed in the bottom of the container. As each sample bottle is logged on the chain-of-custody form, it should be wrapped with protective material (e.g., bubble wrap, matting, plastic gridding, or similar material) to prevent breakage. Each sample bottle should be placed upright in the shipping container. Each sample bottle cap should be checked during wrapping and tightened if needed. Avoid over tightening, which may cause bottle cap to crack and allow leakage. Additional packaging material such as bubble wrap or Styrofoam pellets should be spread throughout the voids between the sample bottles.

Most samples require refrigeration as a minimum preservative. If needed, reusable cold packs or ice placed in heavy-duty zip-lock type bags should be distributed over the top of the samples. Two or more cold packs or bags should be used. Additional packing material should then be placed to fill the balance of the cooler or container.

Place the original completed chain-of-custody record in a zip-lock type plastic bag and place the bag on the top of the contents within the cooler or shipping container. Alternatively, the bag may be taped to the underside of the container lid. Retain a copy of the chain-of-custody record with the field records.

Close the top or lid of the cooler or shipping container and rotate/shake the container to verify that the contents are packed so that they do not move. Add additional packaging if needed and reseal. Place signed and dated chain-of-custody seal at two different locations (front and back) on the cooler or container lid and overlap with transparent packaging tape. The chain-of-custody tape should be placed on the container in such a way that opening the container will destroy the tape. Packaging tape should encircle each end of the cooler at the hinges.

Sample shipment should be sent via courier or an overnight express service that can guarantee 24-hour delivery. Retain copies of all shipment records as provided by the shipper.

Chain-of-custody records will be maintained in an appropriate file with the Project Manager. Copies of these records will be submitted in an appendix to the final report. Chain-of-custody information will also be recorded in field notebooks.

6.4 Sample Log-In

Upon receipt of samples (which will be accompanied by a completed chain-of-custody record detailing requested analyses), the Laboratory Coordinator(s) or his/her delegate will:

- Verify all paperwork, chain-of-custody records, and similar documentation;
- Log-in samples, assign unique laboratory sample numbers, and attach the numbers to the sample container(s);
- Store samples in a refrigerated sample bank.

7 Calibration Procedures and Frequency

This section establishes the procedures for maintaining the accuracy of instruments and measuring equipment to conduct field measurements and tests.

7.1 Responsibilities

The field sampler is responsible for the calibration of field equipment following the equipment manufacturer's instructions for calibration. The responsibility for the calibration of laboratory equipment lies with the Laboratory Coordinator(s). For discussion of laboratory equipment calibration, see the laboratory QA manual.

7.2 General Calibration Procedures

Field-testing equipment used for analytical determinations falls into two categories: those calibrated prior to each use and those calibrated on a scheduled periodic basis. Frequency of calibration will be based on the type of equipment, inherent stability, manufacturer's recommendations, values given in national standards and the intended use and experience. Table 7-1 presents the calibration frequency of the field sampling equipment.

Table 7-1 Field Sampling Equipment Calibration Frequency

Instrument	Calibration Procedure	Calibration Frequency
pH meter	Two-point calibration with pH buffers 7 and 4, or 10, as appropriate	Daily
Conductivity meter	None	Not Applicable
DO meter	Two-point calibration	Daily
Redox meter	None	Not Applicable
Thermometer	Check with ohm meter or standard thermometer	Annually
Photoionization detector	Isobutylene gas standard;	Daily
Electric water level probe	Test probe in tap water; check tape against known length	Probe; as needed if malfunctions; tape length: annually
Turbidity Meter	3-point calibration	Daily

Equipment will be calibrated using reference standards (i.e., National Bureau of Standards (NBS) or accepted values of natural physical constants). If national standards do not exist, the basis for calibration will be documented in the daily field activity log. Field equipment calibration will be performed, as described by the equipment manufacturer.

Calibrated equipment will be uniquely identified by using the manufacturer's serial number or other means. A label with the identification number and the date when the next calibration is due will be physically attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference.

Scheduled periodic calibration of testing equipment will not relieve field personnel of the responsibility to verify that equipment is functioning properly. If an individual suspects an equipment malfunction, she/he will remove the device from service, tag it so that it is not inadvertently used, and see that recalibration is performed or substitute equipment is obtained. Instruments past due for calibration will be immediately removed from service either physically or, if this is impractical, by tagging, sealing, labeling, or other means.

7.3 Calibration Failures

Equipment that fails calibration or becomes inoperable during use will be removed from service, tagged to indicate that it is out of calibration and segregated to prevent inadvertent use. Such equipment will be repaired and recalibrated or replaced as appropriate.

The Project Engineer will evaluate results of activities performed using equipment that has failed recalibration. If the activity results are adversely affected, the results of the evaluation will be documented, and the appropriate personnel notified. If water level measurements are found to be in error due to recalibration failure of the water level probe, the appropriate modifications will be made to the measurement according to the recalibration data and recorded in the data logbook. If pH, conductivity or temperature meters fail recalibration, the data will be reviewed to determine whether alternate parameter data are sufficient to accept the groundwater sampling results. For instance, if the conductivity meter fails recalibration, pH and temperature readings will be used to verify that the purge water has stabilized. Since these parameters are calibrated prior to each use, it is unlikely that the data will be unacceptable.

7.4 Calibration Records

Calibration records will be maintained in daily field activity logs or on appropriate forms.

7.5 Maintenance

Each piece of equipment used in activities affecting data quality will be maintained according to specifications provided by the manufacturer. The Project Engineer will be responsible for performing routine maintenance and will have available tools and spare parts to conduct routine maintenance. If the equipment or instrument cannot be maintained to manufacturer's specifications or cannot be properly calibrated, it will be returned to the manufacturer or other repair facility for proper maintenance and repair. Once received back from the manufacturer, the instrument will be checked for compliance to project specifications before being returned to routine field use.

8 Analytical Procedures

The laboratories utilized for analysis of samples collected under the SAP shall perform all analysis according to EPA-accepted methods. Accepted EPA methods consist of those methods that are documented in the "Contract Lab Program Statement of Work for Organic Analysis" or any alternative method that has been approved by EPA for use during this project. The specific analytical methods to be used during the investigation will be specified in work plans. The analytical method procedures are detailed in the laboratory QA manual.

8.1 Analytical Laboratories

A laboratory accredited by Ecology will perform analysis on all water and soil samples collected as described in Section 4 of this SAP.

8.2 General Requirements

In general, the laboratory will adhere to those recommendations as promulgated in 21 CFR Part 58, "Good Laboratory Practices," criteria described in Methods for Chemical Analysis of Water and Wastes, 1979 (EPA-600/4-79-020); procedures described in SW-846 Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, Third Edition, 1994; and those criteria presented in 40 CFR 136, "Guidelines Establishing Test Procedures for Analysis of Pollutants Under the Clean Water Act."

8.3 Analytical Data Review

The QA Officer will perform a review of the data received from the analytical laboratory to ensure that all of the project QC criteria have been met. Every component of the data package will be inspected. A series of QC forms will be supplied by the laboratory with the analytical data package and will be used as part of the data review process.

The results of all environmental sampling will be sent to the Data Validator for validation. A report containing the results of the validation will be submitted to the QA Officer.

9 Review and Reporting

Data quality and utility depends on many factors, including sampling methods, sample preparation, analytical methods, quality control and documentation. Physical and chemical data have been divided into five categories (EPA Region V Model Quality Assurance Project Plan, 1991), as follows:

- **Level V B Nonstandard Methods.** Analyses by nonstandard protocols, such as ultra-low detection limits or analysis of an unusual chemical compound. These analyses often require method modification and/or development. CLP (Contract Laboratory Program) Special Analytical Services (SAS) projects are considered Level V.

- **Level IV B CLP Routine Analytical Services (RAS).** This level is characterized by rigorous QA/QC protocols and documentation, and it provides qualitative and quantitative analytical data. Some EPA regions have obtained similar support via their own regional laboratories, university laboratories or other commercial laboratories.

- **Level III B Laboratory Analysis (using methods other than the CLP RAS).** This level is used primarily in support of engineering studies, using standard EPA-approved procedures. Some procedures may be equivalent to CLP RAS, without the CLP document requirements.

- **Level II B Field Analysis.** This level is characterized by the use of portable analytical instruments that can be used on-site or in mobile laboratories stationed near a site (close-support labs). Depending upon the types of impacts, sample matrix and personnel skills, qualitative and quantitative data can be obtained.

- **Level I B Field Screening.** This level is characterized by the use of portable instruments that can provide real-time data to assist in the optimization of sampling point locations and for health and safety support. The types of data included are those generated on site through the use of PID, pH, conductivity, or other real-time monitoring equipment. Data can be generated regarding the presence or absence of certain materials (especially volatiles) at sampling locations.

The data generated in this project will be prepared and reviewed for Level III validation. The laboratory will use EPA methods to identify analytical values that do not meet the required ranges for surrogate recoveries and matrix spike recoveries. If such values are identified, then the analysis must be repeated. If the re-analyzed values are within required limits and holding times, they will be reported as true values. If, in the repeated analysis, the values are still outside required limits, the data are considered to be invalid, and matrix effects are considered to have caused the values to be outside of the acceptable recovery limits.

9.1 Analytical Data

The laboratory will submit results that are supported by sufficient backup data and QA/QC results to enable the quality of the data to be determined conclusively. Prior to release of data, the laboratory coordinator(s) will: review the data package for reasonableness; review QC data results; verify that calculation checks were properly performed; review chain-of-custody record(s), sample preservation, and holding-time requirements; and write a project narrative. Data that are not acceptable will be held until the problems are resolved. Section 3 of this SAP describes the procedures that are employed to evaluate the precision, accuracy, representativeness, and completeness of the analytical test data generated during this project. It is the responsibility of the QA Officer to review these parameters. Validity of all data will be determined based on the criteria described in Section 3.

9.2 Final Reporting and Archiving of Documents

Upon successful completion of the data validation process, all data generated at the site will be tabulated and stored on computer disk. Data summaries and results will be submitted in final report form. This report will consist of all pertinent sample and project information. It will also identify analytical procedures.

Copies of all analytical data and/or final reports will be retained in the laboratory files, and at the discretion of the Laboratory Coordinator(s), the data will be stored on computer disks for a minimum of 1 year.

After one year, or whenever the data become inactive, the files will be transferred to archives in accordance with standard laboratory procedure. Data may be retrieved from archives upon request.

10 Data Management and Assessment

The data collected and validated as part of the project scope of work will be combined with the data already compiled for the facility. This section discusses the management of data generated as part the field effort.

10.1 Data Management

10.1.1 Reporting

After receipt of the analytical results, the QA Officer will review all raw data, including QA/QC data from the sample analyses.

Periodic reports will include a summary of data reduction results and a discussion of any inconsistencies that exist from a data-use standpoint. All field data sheets will be included as an appendix in the reports. All raw data will be appropriately identified in reports and included in a separate appendix of the report. Raw data will be submitted to Ecology following the schedule and format specified in the Consent Decree for this project.

10.1.2 Representativeness

The determination of the representativeness of the data will be performed by:

- Comparing actual sampling procedures to those delineated in this plan;

- Examining the results of QC blanks for evidence of external contamination or cross-contamination; such evidence may be cause for invalidations or qualification of the affected samples;

- Invalidating non-representative data or identifying data to be classified as questionable or qualitative. Only representative data will be used in subsequent data reduction, validation activities and facility characterization.

The analytical results of the equipment blank samples (cross-contamination) and trip blank samples (external contamination) will be compared to the results of the field samples to determine if the level of impact is significant. The rule of 5x will be used when chemicals are measured in a blank sample. This rule states that if a sample concentration is less than five times (5x) the blank, the sample should be qualified as non-detectable (EPA, 1988).

10.1.3 Data Review

The objective of the data review is to identify any qualitative, unreliable or invalid laboratory measurements. Data review entails a review of the laboratory-provided QC data to verify that the laboratory is properly performing the QC program and is operating within the required control limits. As a result, it will be possible to determine which samples, if any, are related to out-of-control laboratory QC samples. Laboratory data will be screened for inclusion of and frequency of the necessary QC supporting information, such as detection limit verification, duplicates, spikes and method blanks. QC supporting information will be screened to determine whether any data are outside established control limits. Any out-of-control data without appropriate corrective action will be cause to qualify the affected measurement data. Missing or infrequent QC information will be cause to contact the laboratory concerning affected measurement data and to request additional QC supporting information for re-analysis.

10.2 Data Assessment

10.2.1 Field Procedures

Quality control procedures for field instruments will be limited to periodic instrument calibration as described in Section 7.

10.2.2 Laboratory Procedures

Following the assessment of laboratory data for the inclusion of required QC data, the QC data will be analyzed for accuracy and precision. If quality control audits result in the detection of unacceptable data, the QA Officer will be responsible for initiating corrective action, which may include:

- Reanalyzing samples if holding-time criteria permit;
- Resampling and analyzing;
- Evaluating and amending sampling and analytical procedures; and
- Accepting data and acknowledging the level of uncertainty.

10.2.3 Accuracy

The accuracy of the data will be determined as follows:

- Computing percent recoveries for spiked samples;
- Calculating the standard deviation in the overall average recovery value; and
- Determining the range of uncertainty at a given level of confidence.

The accuracy of the data will be used to determine any bias in the analytical methods. The field sample results will not be adjusted for bias, but the bias will be considered in the interpretation of the data.

10.2.4 Precision

The determination of the precision of the data will be performed by examining duplicate samples for degree of variance and by determining if sampling error has occurred by the variance of duplicates. The precision values calculated from the field duplicates will be used in the data interpretations to determine how sensitive the site characterizations are to the variances in the data.

Specific precision targets cannot be formulated without baseline precision data. However, the precision data will be summarized into the following categories. For each compound or element, the number of field duplicates with variance in the following ranges will be evaluated:

- Less than 10 percent;
- 10 to 25 percent;
- 25 to 50 percent; and
- Greater than 50 percent.

This will provide qualitative information to the individuals interpreting the data as to the range of variances and will also allow the proper planning for QC samples in future sampling episodes.

10.3 Data Validation

After reviewing the laboratory analytical data, the QA officer will provide the Data Validator with the data and field notes from the applicable sampling activities. The Data Validator will compare the actual sampling and laboratory procedures to those explained in this plan, identify any questionable or qualitative data, and report the validation results to the QA Officer.

11 References

Ecology, 1991. *Guidance and Specifications for Preparing Quality Assurance Project Plans.* Washington State Department of Ecology.

Ecology, 1995. *Guidance on Sampling and Data Analysis Methods.* Washington State Department of Ecology Toxics Cleanup Program.

EPA, 1979. 21 CFR, Part 58. *Good Laboratory Practices.* In: Methods for Chemical Analysis of Water and Wastes. U.S. Environmental Protection Agency, EPA-600/4-79-020.

EPA, 1988. *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses.* U.S. Environmental Protection Agency, Region I.

EPA, 1991. *EPA Region V Model Quality Assurance Project Plan.* U.S. Environmental Protection Agency, Region V, Office of Superfund.

EPA, 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance.* U.S. Environmental Protection Agency, Office of Solid Waste.

EPA, 1994. *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods.* Third Edition. U.S. Environmental Protection Agency. SW-846.

Guidelines Establishing Test Procedures for Analysis of Pollutants Under the Clean Water Act. In: 40 CFR, Part 136.

Attachment A

Log Forms

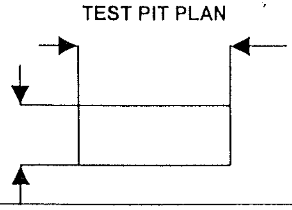
The RETEC Group
Test Pit Log

TEST PIT: TP-
SHEET:

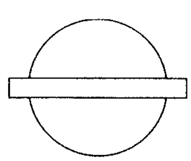
PROJECT:		LOCATION:	CONTRACTOR:
PROJECT NO.:		EQUIPMENT USED:	
DATE:		TOTAL DEPTH (ft.):	
START TIME:	FINISH TIME:	LOGGED BY:	

Depth Range	Sample Type and Number	USCS	Depth (ft.)	Soil and Rock Description and Comments
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	

TEST PIT PLAN



NORTH



Groundwater		
Date	Time (hours after completion)	Depth (ft.)

Comments:

The RETEC Group	**BORING LOG**	BORING SHEET OF
PROJECT	CONTRACTOR	MONUMENT
PROJECT #	DRILLER	RISER
LOCATION	RIG TYPE	SCREEN
TOTAL DEPTH	METHOD	FILTER PACK
DATE	CASING ID	SEAL
START FINISH	BORING ID	GROUT
LOGGED BY DMS	BIT TYPE	GROUND ELEV.

SAMPLE TYPE AND NUMBER	BLOWS PER 6" INCH	DEPTH RANGE	% REC	DEPTH FEET	SAMPLE DESCRIPTION CLASSIFICATION SCHEME____________________

GROUNDWATER DEPTH (FT)	DATE/TIME
REMARKS	

Appendix C

Supplemental Exploration Test Pit Logs

and

Lab Report

Test Pit Log

Test Pit #: NTR-1
Sheet 1 of 1

Project: Yakima Valley Spray (U-Haul) Site	Contractor: Hollenbeck Excavation	Easting:
Project #: DWT40-16457-200	Operator:	Northing:
Client: YVS Steering Committee	Equipment Type: Komatsu- PC228	Ground Elevation:
Start Date & Time: 03/10/2003 11:00	Logged By: Winston Chen	Total Depth: 14
Finish Date & Time: 03/10/2003 14:05	Location: Yakima, WA	

Sample Name	Sample Depth Range (ft.)	Sample PID (ppm)	Depth (ft.)	Soil and Rock Description (Classification Scheme:)	Elevation (ft.)	Comments
			0	Asphalt	0	
			0.8–1.6	Brown to dark brown silty sand with gravel (Fill)		
NTR-1-2			1.6–2.8	Silty sand with gravel andcobbles (3"-6" diameter), moist		
			2.8–4	Silty sand and gravel with more and larger cobbles		
			4–7	Silty sand and gravel, cobbles increase in size		
NTR-1-7			7–10.5	Cobbles (predominant in volume) with silty sand		
NTR-1-10.5			10.5–13	Cobbles with gravels, silt, sand		
NTR-1-14			13–14	Cobbles with gravels, silt, sand, rusty color, top of smear zone	14	

Remarks and Datum Used: Groundwater not encountered at bottom of test pit

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Test Pit Plan View: 20 × 14

North

Groundwater		
Date	Time	Depth (ft.)

Test Pit Log

Test Pit #: SCHANNO
Sheet 1 of 1

Project: Yakima Valley Spray (U-Haul) Site	Contractor: Hollenbeck Excavation	Easting:
Project #: DWT40-16457-200	Operator:	Northing:
Client: YVS Steering Committee	Equipment Type: Komatsu-PC228	Ground Elevation:
Start Date & Time: 03/11/2003 7:15	Logged By: Winston Chen	Total Depth: 4
Finish Date & Time: 03/11/2003 8:50	Location: Yakima, WA	

Sample Name	Sample Depth Range (ft.)	Sample PID (ppm)	Graphic	Depth (ft.)	Soil and Rock Description Classification Scheme:	Elevation (ft.)	Comments
				0	Asphalt (2"-3" thick) Brown silty/clayey sand and gravel, low plasticity	0	
				1	Fill (silt, broken pieces of brick, concrete blocks) Top of New Schanno Pipeline at 8" below ground	1	
				2	More concrete pieces, cobbles with brown and dark brown silt, clay, low plasticity	2	
SCHAN NO-1				3		3	
				4		4	

Remarks and Datum Used: Groundwater not encountered at bottom of test pit

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Test Pit Plan View
16
4

North

Groundwater		
Date	Time	Depth (ft.)

Test Pit Log

RETEC

Test Pit #: STR-1
Sheet 1 of 1

Project: Yakima Valley Spray (U-Haul) Site	Contractor: Hollenbeck Excavation	Easting:
Project #: DWT40-16457-200	Operator:	Northing:
Client: YVS Steering Committee	Equipment Type: Komatsu-PC228	Ground Elevation:
Start Date & Time: 03/10/2003 11:00	Logged By: Winston Chen	Total Depth: 12
Finish Date & Time: 03/10/2003 14:05	Location: Yakima, WA	

Sample Name	Sample Depth Range (ft.)	Sample PID (ppm)	Graphic	Depth (ft.)	Soil and Rock Description Classification Scheme:	Elevation (ft.)	Comments
				0	Asphalt (varied patch thicknesses)	0	
				1	Dark brown silty sand, gravel, and cobbles	1	
				2		2	
				3		3	
STR-1-4				4	Dark brown silty sand, gravel, and cobbles. Cobbles increase in size and volume with depth	4	
				5		5	
				6		6	
				7		7	
STR-1-8				8		8	
				9		9	
				10		10	
				11		11	
STR-1-12				12	Cobbles, gravel w/some coarse sand, little silt. Rusty zone begins (top of smear zone)	12	

Remarks and Datum Used: Groundwater not encountered at bottom of test pit

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Test Pit Plan View

24

14

North

Groundwater		
Date	Time	Depth (ft.)

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

21 March 2003

Winston Chen
The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134

RE: YVS (U-Haul) Site

Enclosed are the results of analyses for samples received by the laboratory on 03/12/03 13:35. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Kortland Orr
PM

North Creek Analytical, Inc.
Environmental Laboratory Network

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
NTR-1-2	B3C0312-01	Soil	03/10/03 11:15	03/12/03 13:35
NTR-1-14	B3C0312-02	Soil	03/10/03 13:30	03/12/03 13:35
STR-1-4	B3C0312-03	Soil	03/10/03 14:30	03/12/03 13:35
STR-1-12	B3C0312-04	Soil	03/10/03 15:30	03/12/03 13:35
SCHANNO-1	B3C0312-05	Soil	03/11/03 07:35	03/12/03 13:35
STR-COMP	B3C0312-06	Soil	03/10/03 15:30	03/12/03 13:35

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc. 1011 SW Klickitat Way, Suite 207 Seattle WA, 98134	Project: YVS (U-Haul) Site Project Number: DWT40-16457-200 Project Manager: Winston Chen	**Reported:** 03/21/03 20:52

Volatile Petroleum Products by NWTPH-Gx
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
NTR-1-2 (B3C0312-01) Soil Sampled: 03/10/03 11:15 Received: 03/12/03 13:35									
Gasoline Range Hydrocarbons	ND	5.00	mg/kg dry	1	3C14019	03/14/03	03/17/03	NWTPH-Gx	
Surrogate: 4-BFB (FID)	*87.3 %*	*59-125*			"	"	"	"	
NTR-1-14 (B3C0312-02) Soil Sampled: 03/10/03 13:30 Received: 03/12/03 13:35									
Gasoline Range Hydrocarbons	ND	5.00	mg/kg dry	1	3C14019	03/14/03	03/17/03	NWTPH-Gx	
Surrogate: 4-BFB (FID)	*96.7 %*	*59-125*			"	"	"	"	
STR-1-4 (B3C0312-03) Soil Sampled: 03/10/03 14:30 Received: 03/12/03 13:35									
Gasoline Range Hydrocarbons	ND	5.00	mg/kg dry	1	3C14019	03/14/03	03/17/03	NWTPH-Gx	
Surrogate: 4-BFB (FID)	*98.9 %*	*59-125*			"	"	"	"	
STR-1-12 (B3C0312-04) Soil Sampled: 03/10/03 15:30 Received: 03/12/03 13:35									
Gasoline Range Hydrocarbons	ND	5.00	mg/kg dry	1	3C14019	03/14/03	03/17/03	NWTPH-Gx	
Surrogate: 4-BFB (FID)	*101 %*	*59-125*			"	"	"	"	
SCHANNO-1 (B3C0312-05) Soil Sampled: 03/11/03 07:35 Received: 03/12/03 13:35									
Gasoline Range Hydrocarbons	ND	5.00	mg/kg dry	1	3C14019	03/14/03	03/17/03	NWTPH-Gx	
Surrogate: 4-BFB (FID)	*57.8 %*	*59-125*			"	"	"	"	*S-04*

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Clean-up)
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
NTR-1-2 (B3C0312-01) Soil Sampled: 03/10/03 11:15 Received: 03/12/03 13:35									
Diesel Range Hydrocarbons	**11.9**	10.0	mg/kg dry	1	3C14024	03/14/03	03/15/03	NWTPH-Dx	
Lube Oil Range Hydrocarbons	**46.6**	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*81.5 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*92.6 %*	*57-120*			"	"	"	"	
NTR-1-14 (B3C0312-02) Soil Sampled: 03/10/03 13:30 Received: 03/12/03 13:35									
Diesel Range Hydrocarbons	ND	10.0	mg/kg dry	1	3C14024	03/14/03	03/15/03	NWTPH-Dx	
Lube Oil Range Hydrocarbons	ND	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*79.5 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*100 %*	*57-120*			"	"	"	"	
STR-1-4 (B3C0312-03) Soil Sampled: 03/10/03 14:30 Received: 03/12/03 13:35									
Diesel Range Hydrocarbons	**62.1**	10.0	mg/kg dry	1	3C14024	03/14/03	03/16/03	NWTPH-Dx	D-09
Lube Oil Range Hydrocarbons	**208**	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*79.6 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*101 %*	*57-120*			"	"	"	"	
STR-1-12 (B3C0312-04) Soil Sampled: 03/10/03 15:30 Received: 03/12/03 13:35									
Diesel Range Hydrocarbons	ND	10.0	mg/kg dry	1	3C14024	03/14/03	03/15/03	NWTPH-Dx	
Lube Oil Range Hydrocarbons	ND	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*80.2 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*101 %*	*57-120*			"	"	"	"	
SCHANNO-1 (B3C0312-05) Soil Sampled: 03/11/03 07:35 Received: 03/12/03 13:35									
Diesel Range Hydrocarbons	**98.6**	10.0	mg/kg dry	1	3C14024	03/14/03	03/16/03	NWTPH-Dx	D-09
Lube Oil Range Hydrocarbons	**198**	25.0	"	"	"	"	"	"	
Surrogate: 2-FBP	*83.1 %*	*50-150*			"	"	"	"	
Surrogate: Octacosane	*103 %*	*57-120*			"	"	"	"	

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Total Metals by EPA 6000/7000 Series Methods

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
NTR-1-2 (B3C0312-01) Soil Sampled: 03/10/03 11:15 Received: 03/12/03 13:35									
Arsenic	**3.21**	0.500	mg/kg dry	1	3C18046	03/19/03	03/20/03	EPA 6020	
Lead	**81.7**	0.500	"	"	"	"	"	"	
NTR-1-14 (B3C0312-02) Soil Sampled: 03/10/03 13:30 Received: 03/12/03 13:35									
Arsenic	**1.43**	0.500	mg/kg dry	1	3C18046	03/18/03	03/19/03	EPA 6020	
Lead	**1.68**	0.500	"	"	"	"	"	"	
STR-1-4 (B3C0312-03) Soil Sampled: 03/10/03 14:30 Received: 03/12/03 13:35									
Arsenic	**7.53**	0.500	mg/kg dry	1	3C18046	03/18/03	03/19/03	EPA 6020	
Lead	**72.7**	0.500	"	"	"	"	"	"	
STR-1-12 (B3C0312-04) Soil Sampled: 03/10/03 15:30 Received: 03/12/03 13:35									
Arsenic	**2.22**	0.500	mg/kg dry	1	3C18046	03/18/03	03/19/03	EPA 6020	
Lead	**3.01**	0.500	"	"	"	"	"	"	
SCHANNO-1 (B3C0312-05) Soil Sampled: 03/11/03 07:35 Received: 03/12/03 13:35									
Arsenic	**34.3**	0.500	mg/kg dry	1	3C18046	03/18/03	03/19/03	EPA 6020	
Lead	**1600**	5.00	"	10	"	"	03/19/03	"	

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Organochlorine Pesticides by EPA Method 8081A
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
STR-COMP (B3C0312-06) Soil Sampled: 03/10/03 15:30 Received: 03/12/03 13:35									
Aldrin	ND	1.00	ug/kg dry	1	3C13023	03/13/03	03/16/03	EPA 8081A	
alpha-BHC	ND	1.00	"	"	"	"	"	"	
beta-BHC	ND	2.00	"	"	"	"	"	"	
delta-BHC	ND	1.00	"	"	"	"	"	"	
gamma-BHC (Lindane)	ND	1.00	"	"	"	"	"	"	
Chlordane (tech)	ND	10.0	"	"	"	"	"	"	
alpha-Chlordane	ND	1.00	"	"	"	"	"	"	
gamma-Chlordane	ND	1.00	"	"	"	"	"	"	
4,4´-DDD	ND	2.00	"	"	"	"	"	"	
4,4´-DDE	**2.85**	2.00	"	"	"	"	"	"	P-01
4,4´-DDT	**11.7**	2.00	"	"	"	"	"	"	P-01
Dieldrin	ND	2.00	"	"	"	"	"	"	
Endosulfan I	ND	1.00	"	"	"	"	"	"	
Endosulfan II	ND	2.00	"	"	"	"	"	"	
Endosulfan sulfate	ND	2.00	"	"	"	"	"	"	
Endrin	ND	2.00	"	"	"	"	"	"	
Endrin aldehyde	ND	2.00	"	"	"	"	"	"	
Endrin ketone	ND	2.00	"	"	"	"	"	"	
Heptachlor	ND	1.00	"	"	"	"	"	"	
Heptachlor epoxide	ND	1.00	"	"	"	"	"	"	
Methoxychlor	ND	10.0	"	"	"	"	"	"	
Toxaphene	ND	50.0	"	"	"	"	"	"	
Surrogate: TCX	*91.5 %*	*28-128*			"	"	"	"	
Surrogate: Decachlorobiphenyl	*82.6 %*	*29-141*			"	"	"	"	

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Physical Parameters by APHA/ASTM/EPA Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
NTR-1-2 (B3C0312-01) Soil Sampled: 03/10/03 11:15 Received: 03/12/03 13:35									
Dry Weight	**71.3**	1.00	%	1	3C14040	03/14/03	03/18/03	BSOPSPL003R07	
NTR-1-14 (B3C0312-02) Soil Sampled: 03/10/03 13:30 Received: 03/12/03 13:35									
Dry Weight	**93.4**	1.00	%	1	3C14040	03/14/03	03/18/03	BSOPSPL003R07	
STR-1-4 (B3C0312-03) Soil Sampled: 03/10/03 14:30 Received: 03/12/03 13:35									
Dry Weight	**90.8**	1.00	%	1	3C14040	03/14/03	03/18/03	BSOPSPL003R07	
STR-1-12 (B3C0312-04) Soil Sampled: 03/10/03 15:30 Received: 03/12/03 13:35									
Dry Weight	**92.7**	1.00	%	1	3C14040	03/14/03	03/18/03	BSOPSPL003R07	
SCHANNO-1 (B3C0312-05) Soil Sampled: 03/11/03 07:35 Received: 03/12/03 13:35									
Dry Weight	**63.9**	1.00	%	1	3C14040	03/14/03	03/18/03	BSOPSPL003R07	
STR-COMP (B3C0312-06) Soil Sampled: 03/10/03 15:30 Received: 03/12/03 13:35									
Dry Weight	**92.5**	1.00	%	1	3C14040	03/14/03	03/18/03	BSOPSPL003R07	

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Kortland Orr, PM

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Volatile Petroleum Products by NWTPH-Gx - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3C14019: Prepared 03/14/03 Using EPA 5030B (MeOH)										
Blank (3C14019-BLK1)										
Gasoline Range Hydrocarbons	ND	5.00	mg/kg							
Surrogate: 4-BFB (FID)	*4.61*		"	*4.00*		*115*	*59-125*			
LCS (3C14019-BS1)										
Gasoline Range Hydrocarbons	28.3	5.00	mg/kg	27.5		103	80-120			
Surrogate: 4-BFB (FID)	*4.55*		"	*4.00*		*114*	*59-125*			
LCS Dup (3C14019-BSD1)										
Gasoline Range Hydrocarbons	28.0	5.00	mg/kg	27.5		102	80-120	1.07	40	
Surrogate: 4-BFB (FID)	*4.65*		"	*4.00*		*116*	*59-125*			
Matrix Spike (3C14019-MS1)					**Source: B3C0359-01**					
Gasoline Range Hydrocarbons	27.6	5.00	mg/kg dry	33.9	ND	81.4	53-120			
Surrogate: 4-BFB (FID)	*4.13*		"	*4.94*		*83.6*	*59-125*			
Matrix Spike Dup (3C14019-MSD1)					**Source: B3C0359-01**					
Gasoline Range Hydrocarbons	24.6	5.00	mg/kg dry	33.9	ND	72.6	53-120	11.5	40	
Surrogate: 4-BFB (FID)	*4.73*		"	*4.94*		*95.7*	*59-125*			

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Clean-up) - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3C14024: Prepared 03/14/03 Using EPA 3550B										
Blank (3C14024-BLK1)										
Diesel Range Hydrocarbons	ND	10.0	mg/kg							
Lube Oil Range Hydrocarbons	ND	25.0	"							
Surrogate: 2-FBP	*7.24*		"	*10.7*		*67.7*	*50-150*			
Surrogate: Octacosane	*4.99*		"	*5.33*		*93.6*	*57-120*			
LCS (3C14024-BS1)										
Diesel Range Hydrocarbons	60.2	10.0	mg/kg	66.7		90.3	70-130			
Surrogate: 2-FBP	*8.59*		"	*10.7*		*80.3*	*50-150*			
LCS Dup (3C14024-BSD1)										
Diesel Range Hydrocarbons	62.3	10.0	mg/kg	66.7		93.4	70-130	3.43	40	
Surrogate: 2-FBP	*9.01*		"	*10.7*		*84.2*	*50-150*			
Duplicate (3C14024-DUP1)					**Source: B3C0333-02**					
Diesel Range Hydrocarbons	67.0	10.0	mg/kg dry		42.3			45.2	40	Q-07
Lube Oil Range Hydrocarbons	157	25.0	"		120			26.7	40	
Surrogate: 2-FBP	*13.1*		"	*16.4*		*79.9*	*50-150*			
Surrogate: Octacosane	*8.56*		"	*8.18*		*105*	*57-120*			

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Total Metals by EPA 6000/7000 Series Methods - Quality Control

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3C18046: Prepared 03/18/03 Using EPA 3050B										
Blank (3C18046-BLK1)										
Arsenic	ND	0.500	mg/kg							
Lead	ND	0.500	"							
Blank (3C18046-BLK2)										
Arsenic	ND	0.500	mg/kg							
Lead	ND	0.500	"							
LCS (3C18046-BS1)										
Arsenic	41.6	0.500	mg/kg	41.2		101	80-120			
Lead	41.2	0.500	"	41.2		100	80-120			
LCS (3C18046-BS2)										
Arsenic	40.8	0.500	mg/kg	40.0		102	80-120			
Lead	41.3	0.500	"	40.0		103	80-120			
LCS Dup (3C18046-BSD1)										
Arsenic	43.5	0.500	mg/kg	42.6		102	80-120	4.47	20	
Lead	42.9	0.500	"	42.6		101	80-120	4.04	20	
LCS Dup (3C18046-BSD2)										
Arsenic	41.3	0.500	mg/kg	40.0		103	80-120	1.22	20	
Lead	41.7	0.500	"	40.0		104	80-120	0.964	20	
Matrix Spike (3C18046-MS1)					**Source: B3C0312-01**					
Arsenic	57.6	0.500	mg/kg dry	60.9	3.21	89.3	72-130			
Lead	72.0	0.500	"	60.9	81.7	-15.9	62-137			Q-01
Matrix Spike Dup (3C18046-MSD1)					**Source: B3C0312-01**					
Arsenic	63.5	0.500	mg/kg dry	61.6	3.21	97.9	72-130	9.74	30	
Lead	203	0.500	"	61.6	81.7	197	62-137	95.3	30	Q-01, Q-07

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	Reported:
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Total Metals by EPA 6000/7000 Series Methods - Quality Control

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3C18046: Prepared 03/18/03 Using EPA 3050B										
Post Spike (3C18046-PS1)					**Source: B3C0312-01**					
Arsenic	75.4	0.500	mg/kg dry	71.5	3.21	101	75-125			
Lead	153	0.500	"	71.5	81.7	99.7	75-125			

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Organochlorine Pesticides by EPA Method 8081A - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3C13023: Prepared 03/13/03 Using EPA 3550B										
Blank (3C13023-BLK1)										
Aldrin	ND	1.00	ug/kg							
alpha-BHC	ND	1.00	"							
beta-BHC	ND	2.00	"							
delta-BHC	ND	1.00	"							
gamma-BHC (Lindane)	ND	1.00	"							
Chlordane (tech)	ND	10.0	"							
alpha-Chlordane	ND	1.00	"							
gamma-Chlordane	ND	1.00	"							
4,4´-DDD	ND	2.00	"							
4,4´-DDE	ND	2.00	"							
4,4´-DDT	ND	2.00	"							
Dieldrin	ND	2.00	"							
Endosulfan I	ND	1.00	"							
Endosulfan II	ND	2.00	"							
Endosulfan sulfate	ND	2.00	"							
Endrin	ND	2.00	"							
Endrin aldehyde	ND	2.00	"							
Endrin ketone	ND	2.00	"							
Heptachlor	ND	1.00	"							
Heptachlor epoxide	ND	1.00	"							
Methoxychlor	ND	10.0	"							
Toxaphene	ND	50.0	"							
Surrogate: TCX	*5.67*		*"*	*6.67*		*85.0*	*28-128*			
Surrogate: Decachlorobiphenyl	*6.21*		*"*	*6.67*		*93.1*	*29-141*			
LCS (3C13023-BS1)										
Aldrin	8.34	1.00	ug/kg	8.33		100	40-122			
alpha-BHC	6.74	1.00	"	8.33		80.9	40-160			
beta-BHC	6.87	2.00	"	8.33		82.5	40-160			
delta-BHC	3.40	1.00	"	8.33		40.8	40-160			
gamma-BHC (Lindane)	6.95	1.00	"	8.33		83.4	38-125			
4,4´-DDD	7.03	2.00	"	8.33		84.4	40-160			
4,4´-DDE	7.13	2.00	"	8.33		85.6	40-160			
4,4´-DDT	7.60	2.00	"	8.33		91.2	40-160			

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

Organochlorine Pesticides by EPA Method 8081A - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3C13023: Prepared 03/13/03 Using EPA 3550B										
LCS (3C13023-BS1)										
Dieldrin	7.22	2.00	ug/kg	8.33		86.7	40-160			
Endosulfan I	7.47	1.00	"	8.33		89.7	40-160			
Endosulfan II	7.26	2.00	"	8.33		87.2	40-160			
Endosulfan sulfate	4.85	2.00	"	8.33		58.2	40-160			
Endrin	8.20	2.00	"	8.33		98.4	40-160			
Endrin aldehyde	3.40	2.00	"	8.33		40.8	40-160			
Endrin ketone	6.12	2.00	"	8.33		73.5	40-160			
Heptachlor	7.66	1.00	"	8.33		92.0	47-132			
Heptachlor epoxide	7.65	1.00	"	8.33		91.8	40-160			
Methoxychlor	ND	10.0	"	8.33		90.3	40-160			
Surrogate: TCX	*5.71*		"	*6.67*		*85.6*	*28-128*			
Surrogate: Decachlorobiphenyl	*6.49*		"	*6.67*		*97.3*	*29-141*			
LCS Dup (3C13023-BSD1)										
Aldrin	7.56	1.00	ug/kg	8.33		90.8	40-122	9.81	30	
alpha-BHC	7.20	1.00	"	8.33		86.4	40-160	6.60	35	
beta-BHC	8.85	2.00	"	8.33		106	40-160	25.2	35	
delta-BHC	3.61	1.00	"	8.33		43.3	40-160	5.99	35	
gamma-BHC (Lindane)	7.75	1.00	"	8.33		93.0	38-125	10.9	30	
4,4′-DDD	7.39	2.00	"	8.33		88.7	40-160	4.99	35	
4,4′-DDE	7.43	2.00	"	8.33		89.2	40-160	4.12	35	
4,4′-DDT	7.96	2.00	"	8.33		95.6	40-160	4.63	35	
Dieldrin	7.49	2.00	"	8.33		89.9	40-160	3.67	35	
Endosulfan I	7.76	1.00	"	8.33		93.2	40-160	3.81	35	
Endosulfan II	7.81	2.00	"	8.33		93.8	40-160	7.30	35	
Endosulfan sulfate	5.97	2.00	"	8.33		71.7	40-160	20.7	35	
Endrin	8.58	2.00	"	8.33		103	40-160	4.53	35	
Endrin aldehyde	4.02	2.00	"	8.33		48.3	40-160	16.7	35	
Endrin ketone	7.10	2.00	"	8.33		85.2	40-160	14.8	35	
Heptachlor	7.93	1.00	"	8.33		95.2	47-132	3.46	30	
Heptachlor epoxide	7.90	1.00	"	8.33		94.8	40-160	3.22	35	
Methoxychlor	ND	10.0	"	8.33		97.7	40-160	7.92	35	
Surrogate: TCX	*6.02*		"	*6.67*		*90.3*	*28-128*			
Surrogate: Decachlorobiphenyl	*6.82*		"	*6.67*		*102*	*29-141*			

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Organochlorine Pesticides by EPA Method 8081A - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3C13023: Prepared 03/13/03 Using EPA 3550B										
Matrix Spike (3C13023-MS1)					**Source: B3C0268-02**					
Aldrin	6.84	1.00	ug/kg dry	9.43	ND	72.5	32-130			
alpha-BHC	7.87	1.00	"	9.43	ND	83.5	30-150			
beta-BHC	7.99	2.00	"	9.43	ND	84.7	30-150			
delta-BHC	3.17	1.00	"	9.43	ND	33.6	30-150			
gamma-BHC (Lindane)	7.77	1.00	"	9.43	ND	82.4	31-120			
4,4′-DDD	7.98	2.00	"	9.43	ND	84.6	30-150			
4,4′-DDE	20.4	2.00	"	9.43	ND	216	30-150			Q-02
4,4′-DDT	8.56	2.00	"	9.43	ND	90.8	30-150			
Dieldrin	11.2	2.00	"	9.43	ND	119	30-150			
Endosulfan I	5.40	1.00	"	9.43	ND	57.3	30-150			
Endosulfan II	6.70	2.00	"	9.43	ND	71.0	30-150			
Endosulfan sulfate	4.48	2.00	"	9.43	ND	47.5	30-150			
Endrin	10.2	2.00	"	9.43	ND	108	30-150			
Endrin aldehyde	3.64	2.00	"	9.43	ND	38.6	30-150			
Endrin ketone	5.85	2.00	"	9.43	ND	62.0	30-150			
Heptachlor	6.33	1.00	"	9.43	ND	67.1	40-129			
Heptachlor epoxide	6.80	1.00	"	9.43	ND	72.1	30-150			
Methoxychlor	ND	10.0	"	9.43	ND	103	30-150	NA		
Surrogate: TCX	*5.68*		*"*	*7.54*		*75.3*	*28-128*			
Surrogate: Decachlorobiphenyl	*6.07*		*"*	*7.54*		*80.5*	*29-141*			
Matrix Spike Dup (3C13023-MSD1)					**Source: B3C0268-02**					
Aldrin	6.89	1.00	ug/kg dry	9.43	ND	73.1	32-130	0.728	35	
alpha-BHC	6.84	1.00	"	9.43	ND	72.5	30-150	14.0	35	
beta-BHC	7.60	2.00	"	9.43	ND	80.6	30-150	5.00	35	
delta-BHC	3.20	1.00	"	9.43	ND	33.9	30-150	0.942	35	
gamma-BHC (Lindane)	6.93	1.00	"	9.43	ND	73.5	31-120	11.4	35	
4,4′-DDD	8.03	2.00	"	9.43	ND	85.2	30-150	0.625	35	
4,4′-DDE	17.9	2.00	"	9.43	ND	190	30-150	13.1	35	Q-02
4,4′-DDT	10.0	2.00	"	9.43	ND	106	30-150	15.5	35	
Dieldrin	10.5	2.00	"	9.43	ND	111	30-150	6.45	35	
Endosulfan I	5.54	1.00	"	9.43	ND	58.7	30-150	2.56	35	
Endosulfan II	6.98	2.00	"	9.43	ND	74.0	30-150	4.09	35	
Endosulfan sulfate	4.66	2.00	"	9.43	ND	49.4	30-150	3.94	35	

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Organochlorine Pesticides by EPA Method 8081A - Quality Control
North Creek Analytical - Bothell

Batch 3C13023: Prepared 03/13/03 Using EPA 3550B

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Matrix Spike Dup (3C13023-MSD1)					**Source: B3C0268-02**					
Endrin	9.90	2.00	ug/kg dry	9.43	ND	105	30-150	2.99	35	
Endrin aldehyde	4.50	2.00	"	9.43	ND	47.7	30-150	21.1	35	
Endrin ketone	6.55	2.00	"	9.43	ND	69.5	30-150	11.3	35	
Heptachlor	7.57	1.00	"	9.43	ND	80.3	40-129	17.8	35	
Heptachlor epoxide	5.45	1.00	"	9.43	ND	57.8	30-150	22.0	35	
Methoxychlor	11.4	10.0	"	9.43	ND	121	30-150	16.4	35	
Surrogate: TCX	*5.73*		*"*	*7.54*		*76.0*	*28-128*			
Surrogate: Decachlorobiphenyl	*6.35*		*"*	*7.54*		*84.2*	*29-141*			

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Physical Parameters by APHA/ASTM/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3C14040: Prepared 03/14/03 Using Dry Weight										
Blank (3C14040-BLK1)										
Dry Weight	100	1.00	%							
Blank (3C14040-BLK2)										
Dry Weight	100	1.00	%							

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Kortland Orr, PM

www.ncalabs.com

Seattle 11720 North Creek Pkwy N, Suite 400, Bothell, WA 98011-8244
425.420.9200 fax 425.420.9210
Spokane East 11115 Montgomery, Suite B, Spokane, WA 99206-4776
509.924.9200 fax 509.924.9290
Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
503.906.9200 fax 503.906.9210
Bend 20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711
541.383.9310 fax 541.382.7588
Anchorage 3209 Denali Street, Anchorage, AK 99503
907.334.9200 fax 907.334.9210

The RETEC Group, Inc.	Project: YVS (U-Haul) Site	
1011 SW Klickitat Way, Suite 207	Project Number: DWT40-16457-200	**Reported:**
Seattle WA, 98134	Project Manager: Winston Chen	03/21/03 20:52

Notes and Definitions

D-09	Results in the diesel organics range are primarily due to overlap from a heavy oil range product.
P-01	Greater than 40% difference between results from two dissimilar columns.
Q-01	The spike recovery for this QC sample is outside of established control limits. Review of associated batch QC indicates the recovery for this analyte does not represent an out-of-control condition for the batch.
Q-02	The spike recovery for this QC sample is outside of NCA established control limits due to sample matrix interference.
Q-07	The RPD value for this QC sample is above the established control limit. Review of associated QC indicates the high RPD does not represent an out-of-control condition for the batch.
S-04	The surrogate recovery for this sample is outside of established control limits due to a sample matrix effect.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Kortland Orr, PM

North Creek Analytical, Inc.
Environmental Laboratory Network
www.ncalabs.com

East 11115 Montgomery, Suite B, Spokane, WA 99206-4776 (509) 924-9200 FAX 924-9290
9405 S.W. Nimbus Avenue, Beaverton, OR 97008-7132 (503) 906-9200 FAX 906-9210
20332 Empire Avenue, Suite F-1, Bend, OR 97701-5711 (541) 383-9310 FAX 382-7588

4-0 FH44

03-2616 03-2621

CHAIN OF CUSTODY REPORT

Work Order #: B3C0312

CLIENT: The RETEC Group
REPORT TO: Winston Chen
ADDRESS: 1011 SW Klickitat Way, Suite 207, Seattle, WA 98134
PHONE: (206) 624-9349 FAX:

INVOICE TO: Winston Chen, The RETEC Group, 1011 SW Klickitat Way, Suite 207, Seattle, WA 98134
P.O. NUMBER:

TURNAROUND REQUEST in Business Days*
Organic & Inorganic Analyses: 10 (STD.) 7 5 4 3 2 1 <1
Petroleum Hydrocarbon Analyses: ☒ (STD.) 4 3 2 1 <1
OTHER Please Specify
*Turnaround Requests less than standard may incur Rush Charges.

PROJECT NAME: YVS (U-Haul) Site
PROJECT NUMBER: DWT40-16457-200
SAMPLED BY: Winston Chen

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	NWTPH-Gx	NWTPH-Dx	EPA 6010B Arsenic, Lead	EPA 8080 Org Pesticides										MATRIX (W, S, O)	# OF CONT.	COMMENTS	NCA WO ID
1.	NTR-1-2	3/10/03, 11:15	✓	✓	✓												2		01
2.	NTR-1-14	3/10/03, 13:30	✓	✓	✓												2		02
3.	STR-1-4	3/10/03, 14:30	✓	✓	✓												~~2~~ 1		03
4.	STR-1-12	3/10/03, 15:30	✓	✓	✓												~~2~~ 1		04
5.	SCHANNO-1	3/11/03, 7:35	✓	✓	✓												2		05
6.	STR-COMP	3/10/03, 15:30				✓											1	(Composite sample of STR-1-4, STR-1-8 & STR-1-12)	06
7.																			
8.																			
9.																			
10.																			
11.																			
12.																			
13.																			
14.																			
15.																			

RELINQUISHED BY: Winston Chen DATE: 3/11/03
PRINT NAME: Winston Chen FIRM: RETEC TIME: 15:30
RECEIVED BY: Darrell Anderson DATE: 3/11/03
PRINT NAME: Darrell Anderson FIRM: RETEC TIME: 1530

RELINQUISHED BY: Darrell Anderson DATE: 3/11/03
PRINT NAME: Darrell Anderson FIRM: RETEC TIME: 1640
RECEIVED BY: Eric Branson DATE: 3/11/03
PRINT NAME: Eric Branson FIRM: ARI TIME: 1640

ADDITIONAL REMARKS: 3-12-03 12:42 Darrell Anderson 3/12/03 1242
3/12/03 13:35

TEMP: 8.1
PAGE OF

COC REV 3/99

Appendix D

Biosparging/Venting Design Calculations

Project No. DWT40-16457-300 | Page 1 of 8
Client | Date 4/2/03
Site YVS (U-Haul) Site | By WC
Subject Biosparging / Bioventing System Design | App. CM

RETEC

Objectives:

Design biosparging/venting system to remediate TPH-diesel range impacted soils in areas where contaminants concentrations above cleanup levels but lower than remediation levels. The system will be installed only in areas where the impacted soil with contaminant concentrations described earlier, and the soil will not be part of the excavation activity. The system will be operated until the cleanup level is achieved. Performance monitoring will be performed to ensure the goal is met.

Assumptions:

1. The site soil is homogeneous
2. The groundwater table - seasonal high and low are based on historical measurements during site investigation

Calculations:

<u>Biosparging System</u>

The system consists of a series of air injection wells. Location of the system is selected based on: (1) distribution of contaminants; (2) excavation depth; and (3) concentrations of contaminants. Figure 3-2 and 3-3 of EDR (Attachment 1) show the horizontal & vertical extend of TPH-diesel, which is the primary contaminant used to design the system. Fig 3-4 shows the air injection well locations.

• <u>Radius of Influence</u> (ROI):

As stated in Section 3.3.1 of EDR, the empirical calculation for ROI of an air injection well is: ROI = 1.5 * D

The design D = 10'

∴ ROI = 1.5 * 10'

= 15'

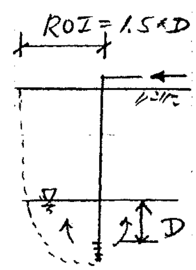


Figure 3-5 shows the ROI of each air injection well, and the coverage of the biosparging system.

Project No. DW740-16457-300
Client
Site YVS (U-Haul) Site
Subject Biosparging / Venting

Date 4/2/03
By WC
App. GM

RETEC

· Spacing of wells:

As shown on Fig 3-5, ROIs are overlapped so the coverage will be contiguous. The spacing between 2 wells is 20'.

· Air Injection Rate & Pressure:

Based on past experience on similar system design & operation, the max. design airflow for each well is 2~3 scfm. 3 scfm is selected for design. This is the air flow that will be injected into the aquifer via the screen of each well. The system consists of 32 wells, a min. of $3 \times 32 = 96$ scfm is required. Total air pressure req'd for the system consists of 2 major components:

(1) The air pressure to the formation is determined based on the following Eq.

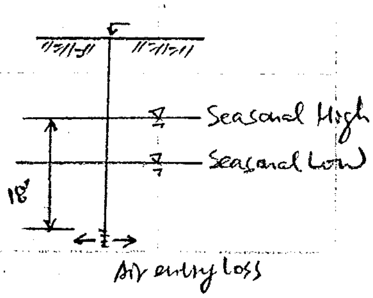
Pressure of Injection (P_i) = $H_i + P_a + P_d$ (Ref. 1)

where H_i = saturated zone thickness above sparge point (ft of H_2O)
P_a = air entry pressure of formation (ft of H_2O)
P_d = air entry pressure for the screen and packing

Based on Fig 3-6, H_i = 18'
The above equation can be converted to pressure (psi) in lieu of ft of water.
∵ 1 psig = 2.3 ft of water
The pressure req'd to push the saturated zone water depth = $18/2.3 = 7.8$ psig
The air entry pressure to formation & screen/packing is estimated to be 1 psig (the formation is mostly gravel, cobbles)

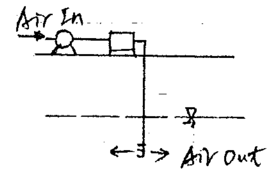
∴ The min. air pressure to formation = $7.8 + 1 = 8.8$ psi

⇒ use 9 psig



(2) The second component of air pressure involves the pressure losses associated with parts, e.g. blower, rotameter, fittings of pipe, etc.

The diagram on the right shows the schematic of air pressure flow path.



Air In = Air out + Pressure Losses

Air out = the min. pressure to formation, determined in (1), i.e. 9 psig.
The min. Air In = 9 psig + pressure losses
Pressure losses are related to system layout and piping.
A Spreasheet is used to calculate the min. Air In. pressure. See Attachment 3.

After entering all design data, the inlet pressure of blower is entered on a trial-and-error basis to ensure the net outlet pressure is > 9 psig.
As shown, the min Inlet Pressure is ≈ 26 psia

- Selection of Air Blower

Min. Air Flow = 96 scfm
Min. Air Pressure = 26 psia − 14.7 psiA (Note: Air at standard conditions
= 11.3 psia Sea level, 14.7 psiA)

Select Gardner Denver blower, Sutorbilt Legend Rotary Positive Displacement blower
- 12 psig, 112 cfm
- 9.5 HP (Attachment 4)

RETEC

Bioventing System:

The bioventing system design is based on the procedures and equations in Ref. 2
Air extraction will be used due to: (1) relatively high soil permeability, (2) TPH-diesel range is relatively biodegradable, (3) near property boundary.

- System Location
  The bioventing system will be placed in the areas where contaminants remained in the vadose zone after remedial excavation is complete. The areas were determined based on review of site cross sections (Fig. 3-2, 3-3). Fig. 3-4 ~ 3-6 show the system layout.

- Required Air Flowrate
  Using Eq. 2-1 of Ref. 2

$$Q = \frac{K_o V \theta_a}{(20.9\% - 5\%) \times 60 \frac{min}{hr}} \quad \text{(Eq 2-1)}$$

where Q = flow rate (ft^3/min)
K_o = oxygen utilization rate (%/hr)
V = volume of contaminated soil (ft^3)
θ_a = gas-filled porosity (fraction, i.e., 0.2, 0.3)

To determine K_o, oxygen utilization rate, typically an in-situ respiration test is required. To estimate K_o, Table 2-2 of Ref. 3 is used. Table 2-2 summarizes actual field testing data. For diesel, the respiration rates ranged from 6.0 ~ 30 mg/kg-day. The typical range from 3 out of the 4 sites listed indicates 6 ~ 12 mg/kg-day. For design purposes, a respiration rate of 12 mg/kg-day is selected.

∴ Biodegradation Rate = 12 mg/kg-day

Project No. DWT 40-16457-300
Client
Site YVS (U-Haul) Site
Subject Biosparging/venting

Date 4/2/03
By WC
App. GH

RETEC

Eq 1-2 of Ref. 2 is used to calculate K_0,

$$K_B = \frac{-K_0 \theta a (\rho O_2) C \cdot (0.01)}{\rho_K} \qquad (Eq.\ 1\text{-}2)$$

Where K_B = biodegradation rate (mg/kg-day)
K_0 = oxygen utilization rate (%/day)
θa = gas-filled pore space
ρO_2 = density of oxygen (mg/L)
C = mass ratio of hydrocarbon to oxygen (1/3.5)
ρ_K = soil bulk density (g/cm³)

Tables 1-6, 1-7 can be used to obtain θa, ρO_2, ρ_K.
A spreadsheet was set up to calculate K_0, (Attachment 2)
∴ $K_0 = 10.0\ \%/day$

Required air flowrate $Q = \frac{K_0 \cdot V \cdot \theta a}{15.9\% \times 60}$ (Eq. 2-1)

Vol. of contaminated soil is estimated based on the bioventing area shown on Fig 3-5. Two areas, with 40'x40', 18' deep. The vol. is 57,600 ft³, which is conservative because not the entire vadose zone within the footprint of the area need to be remediated.

The calculated Q = 11 cfm per well

Project No. DWT40-16457-300 | Page 6 of 8
Client ______ | Date 4/2/03
Site YVS (U-Haul) Site | By WL
Subject Biosparging/Venting | App. GH

RETEC

- Radius of Influence

Use Eq. 2-2 of Ref. 2 to calculate radius of influence (ROI).

$$R_I = \sqrt{\frac{Q(20.9\% - 5\%)}{\pi h k_o \theta_a}} \quad (Eq\ 2\text{-}2)$$

where R_I = ROI

Q = air flowrate (ft^3/day)

k_o = oxygen utilization rate (%/day)

θ_a = air filled porosity (cm^3 air/cm^3 soil)

h = aerated thickness (ft)

The calculation is shown on Attachment 2.

R_I = 24 ft.

A radius of 20 ft is shown on Fig 3-5 to provide overlapping area between the bioventing wells

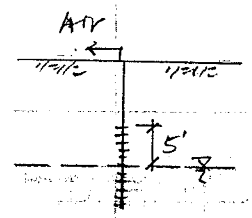
To enhance the system performance, a liner will be installed at ~12" below ground surface in the ROI. The liner will prevent the suction generated by the well from shortcircuiting near the well. Note that the liner installation is expected to increase the ROI, but is not considered in the calculations. Any additional increase in ROI can be considered increased F.S.

- Blower Sizing

Two factors considered: (1) required air flowrate, (2) total system pressure drop.

(1) Required air flowrate: 11 cfm

(2) Total system pressure drop includes (i) vacuum in the well and formation (ii) pressure drop in system piping.



The maximum pressure (vacuum) from the blower is 1 atm, which is 14.7 psi. The first pressure drop in the extraction system is screened zone above water table. In order not to apply pressure which will suck water in the saturated zone, the dry screened depth is converted into pressure drop, i.e., 5 ft ÷ 2.3 ft of H_2O/1 psi = 2.17 psi.

1 psi = 2.3 ft of H_2O

5 ft / 2.3 ft = 2.17 psi.

Other system pressure drop due to piping is included in a spreadsheet calculation on Attachment 3.

Project No. DW740-16457-300
Client
Site YUS (U-Haul) site
Subject Biosparging/venting

Date 4/2/03
By WG
App. GH

RETEC

Based on the calculation,
The blower requirement is: - 22 scfm (2 bioventing wells @ 11 scfm each)
- 61 in of water
- 13 psi

A regenerative centrifugal blower is selected. This type of blower provides efficient air movement in the flowrate and pressure drop ranges in bioventing.

An EG&G Rotron EN/CP 513 Explosion-proof regenerative blower is selected. Blower performance curve and standard features of this blower is included in Attachment 5.

Max. air flowrate = 78 scfm
max. pressure = 88" WG
max. vacuum = 75" WG
Standard motor = 1.5 hp.

Project No. DWT40-16457-300	Page 8 of 8
Client	Date 4/2/03
Site YVS (U-Haul) Site	By WL
Subject Biospaying/venting	App. GH

RETEC

References:

1. Suthan S. Suthersan, "Remediation Engineering Design Concepts", 1997, p.105. CRC, Lewis Publishers

2. Andrea Leeson, et al "Principles and Practices of Bioventing, Vol. II" September 1996.

3. Andrea Leeson et al "Principles and Practices of Bioventing Vol. I" September 1996

Attachments:

1. RETEC, "Engineering Design Report" Figures 3-2 to 3-6.
2. Bioventing Design Calculations
3. Biospaying/Bioventing pressure calculations
4. Biospaying Blower Manufacturer's Data
5. Bioventing Blower manufacturer's Data

Project No.
Client
Site
Subject

Page of
Date
By
App.

RETEC

REFERENCES

Winston

PRINCIPLES AND PRACTICES OF BIOVENTING

VOLUME II: BIOVENTING DESIGN

by

Andrea Leeson and Robert E. Hinchee
Battelle Memorial Institute
Columbus OH

with contributions by

Bruce A. Alleman, Douglas C. Downey, Gregory Headington,
Jeffrey A. Kittel, Priti Kumar, Lt Colonel Ross N. Miller, Say Kee Ong,
Gregory D. Sayles, Lawrence Smith, Catherine M. Vogel

for

Catherine M. Vogel
Environics Directorate of
the Armstrong Laboratory
Tyndall AFB FL

Gregory D. Sayles
National Risk Management
Research Laboratory
U.S. Environmental
Protection Agency
Cincinnati OH

Lt Colonel Ross N. Miller
U.S. Air Force Center for
Environmental Excellence
Technology Transfer Division
Brooks AFB TX

29 September 1996

Reference 2 1/6

used as the representative hydrocarbon, If a site is contaminated with compounds other then petroleum hydrocarbons, a suitable compound should be used to determine stoichiometry. The stoichiometric relationship used to determine petroleum degradation rates is:

$$C_6H_{14} + 9.5O_2 \rightarrow 6CO_2 + 7H_2O \tag{1-1}$$

Based on the utilization rates (% oxygen per day), the biodegradation rate in terms of mg hexane-equivalent per kg of soil per day is estimated using Equation (1-2).

$$k_B = \frac{-\frac{k_o}{100}\,\theta_a\,\frac{1L}{1{,}000\ cm^3}\,\rho_{O_2}\,C}{\rho_k\left(\frac{1\ kg}{1{,}000\ g}\right)} = \frac{-k_o\,\theta_a\,\rho_{O_2}\,C\,(0.01)}{\rho_k} \tag{1-2}$$

where: k_B = biodegradation rate (mg/kg-day)

k_o = oxygen utilization rate (%/day) In-Situ respiration test.

θ_a = gas-filled pore space (volumetric content at the vapor phase, m^3 gas/cm^3 soil) Table 1-7

ρ_{O2} = density of oxygen (mg/L) Table 1-6

C = mass ratio of hydrocarbons to oxygen required for mineralization (1/3.5)

ρ_k = soil bulk density (g/cm^3) Table 1-7

These terms may be derived through either direct measurement or estimation. The oxygen utilization rate, k_o is directly measured in the in situ respiration test. The ratio of hydrocarbons to oxygen required for mineralization, C, can be calculated based on stoichiometry (see Equation (1-1) for hexane) but generally will fall between 0.29 and 0.33. This neglects any conversion to biomass, which probably is small and difficult, if not impossible, to measure. The density of oxygen may be obtained from a handbook for a given temperature and pressure or calculated from the ideal gas law. Table 1-6 provides some useful oxygen density information. The bulk density of soil is difficult to

Table 1-6. Oxygen Density Versus Temperature

Temperature (°C)	Temperature(°F)	Density (mg/L)[1]	Density (lb/ft^3)[1]
-33	-27.4	1,627[2]	0.10[2]
-3	26.6	1,446[3]	0.090[3]
0	32	1,429[3]	0.089[3]
5	41	1,403[3]	0.088[3]
10	50	1,378[3]	0.086[3]
15	59	1,354[3]	0.084[3]
20	68	1,331[3]	0.083[3]
27	80.6	1,301[2]	0.082[2]
30	86	1,287[3]	0.080[3]
35	95	1,266[3]	0.079[3]
40	104	1,246[3]	0.078[3]
57	134.6	1,182[2]	0.074[2]
87	188.6	1,083[2]	0.067[2]
127	260.0	975[2]	0.061[2]

1 Oxygen density at standard pressure.
2 Density values from Braker and Mossmon, 1980.
3 Density calculated using the second virial coefficient to the equation of state for oxygen gas:

$$P = \frac{RT}{V}\left[1 + \frac{B(T)}{V}\right]$$

where P = pressure (atm), R = gas constant, V = molar volume, and B = second virial coefficient. The temperature dependence of B was calculated from:

$$B(T) = \sum_{i=1}^{n} A_i \left[\frac{T_0}{T} - 1\right]^{i-1}$$

The constants A^i were obtained from Lide and Kehianian (1994).

Ref. 2 3/6

Table 1-7. Bulk Density of Various Soils[1]

Soil Description	Porosity	Soil Bulk Density, ρ_k (dry g/cm^3)
Uniform sand, loose	0.46	1.43
Uniform sand, dense	0.34	1.75
Mixed-grain sand, loose	0.40	1.59
Mixed-grain sand, dense	0.30	1.86
Windblown silt (loess)	0.50	1.36
Glacial till, very mixed-grained	0.20	2.12
Soft glacial clay	0.55	1.22
Stiff glacial clay	0.37	1.70
Soft slightly organic clay	0.66	0.93
Soft very organic clay	0.75	0.68
Soft montmorillonitic clay (calcium bentonite)	0.84	0.43

1 From Peck et al. (1962).

Ref. 2 4/6

was connected to the horizontal pipe to extract gas from along the utilidor for vapor control. The extracted soil gas then was reinjected into a contaminated area at the site (Figure 2-13).

2.2 Determining Required Air Flowrates

The flowrate required to operate the bioventing system is dependent on the oxygen demand of the indigenous microorganisms. This is best determined from maximum oxygen utilization rates measured during an in situ respiration test. Equation (2-1) is used to estimate the required air flowrate:

$$Q = \frac{k_o\ V\ \theta_a}{(20.9\% - 5\%) \times 60\frac{\text{min}}{\text{hr}}} \qquad (2\text{-}1)$$

where: Q = flowrate (ft^3/min)

k_o = oxygen utilization rate (%/hr)

V = volume of contaminated soil (ft^3)

θ_a = gas-filled porosity (fraction, i.e. 0.2 or 0.3)

Example 2-2 illustrates the use of this calculation.

Example 2-2. Determination of Required Air Flowrate: Given a volume of contaminated soil of approximately 170,000 ft^3 (4,760 m^3), an air-filled void volume (2_a) at this site of 0.36[1], and an oxygen utilization rate of 0.25%/hr, the flowrate is calculated as follows:

$$Q = \frac{(0.26\ \%/\text{hr})(170{,}000\ ft^3)(0.36)}{(20.9\% - 5\%) \times 60\ \text{min/hr}}$$

Therefore, the required flowrate is approximately 16 cfm (453 L/min).

---

[1] Refer to Section 1.4.2 on using moisture content to estimate this parameter.

Ref. 2 5/6

assuming that the radius of influence is much greater than the well radius, the following equation can be used:

$$R_I = \sqrt{\frac{Q(20.9\% - 5\%)}{\pi\ h\ k_o\ \theta_a}} \quad (2\text{-}2)$$

where: R_I	=	radius of influence (ft)
Q	=	air flowrate (ft^3/day)
20.9 - 5%	=	oxygen %
k_o	=	oxygen utilization rate (%/day)
θa	=	air filled porosity (cm^3_{air}/cm^3_{soil})
h	=	aerated thickness (ft)

Example 2-3. Calculation of Radius of Influence: To calculate the radius of influence at Dover AFB, Equation (2-2) is used with the following parameters:

Q	=	20 cfm (570 L/min) = 28,800 ft^3/day (820,800 L/day)
k_o	=	4%/day
θ_a	=	0.25
h	=	20 ft (6.1 m)

$$R_I = \sqrt{\frac{\left(28{,}800\frac{ft^3}{day}\right)(20.9\% - 5\%)}{\pi(20\ ft)(4\%/day)(0.25)}}$$

Therefore, the radius of influence at this site is approximately equal to 85 ft (26 m).

In practice, it is best to estimate the radius of influence from both pressure measurements and oxygen utilization. This incorporates all three of the key factors: pressure connection, air flow, and oxygen utilization. We have never encountered a site where this combined approach has overestimated the radius of influence.

Ref. 2 6/6

Table 2-2. Summary of Reported In Situ Respiration Rates and Bioventing Data

Site	Scale of Application	Contaminant	In Situ Respiration Rates (mg/kg-day unless marked)	Reference
Albemarle County, VA	Pilot scale	Acetone, toluene, benzene, naphthalene	1.5 — 26	Leeson et al., 1994
Eielson AFB, AK	Pilot scale	JP-4 jet fuel	0.82 — 8.2	Hinchee & Ong, 1992 Leeson et al., 1995 Sayles et al., 1994a
Fallon NAS, NE	In situ respiration test	JP-5 jet fuel	4.2	Hinchee et al., 1991b
Galena AFS, AK, Saddle Tank Farm	Pilot scale	Diesel	11 — 30	Ong et al., 1994
Hill AFB, Utah, Site 914	Full scale, 2 years	JP-4 jet fuel	up to 8.5	Hinchee et al., 1991a
Hill AFB, Utah, Site 280	Full scale	JP-4 jet fuel	0.27 (site average)	Battelle, 1994 Sayles et al., 1994b
Eglin AFB, FL	Full Scale	Gasoline	4.0	Downey et al., 1994
Kenai, Alaska, Site 1-33	Pilot scale	Crude oil, petroleum	2.7 — 25	Hinchee, unpublished data
Kenai, Alaska, Site 3-9	Pilot scale	Crude oil	0.64 — 12	Hinchee, unpublished data
Massachusetts	Full scale	Gasoline	Not measured	Brown & Crosbie, 1994
Minnesota	Full scale	Gasoline	15, 4.9, 3.1, 0.20	Newman et al., 1993
The Netherlands	Full scale	Gasoline	570 kg hydrocarbon removed during 2-yr study	van Eyk, 1994
The Netherlands	Undefined	Undefined	1.6 — 4.2	Urlings et al., 1990
The Netherlands	Field pilot, 1 year	Diesel	6.9	van Eyk & Vreeken, 1989b
Patuxent River NAS, MD	In situ respiration test	JP-5 jet fuel	2.6	Hinchee et al., 1991b

Reference 3
1/2

Reference 3
p. 1

Table 2-2. Summary of Reported In Situ Respiration Rates and Bioventing Data (continued)

Site	Scale of Application	Contaminant	In Situ Respiration Rates (mg/kg-day unless marked)	Reference
Prudhoe Bay	Pilot scale	Diesel	8.6 — 11	Ong et al., 1994
St. Louis Park, MN, Reilly Tar Site	Pilot scale	PAH	0.55 — 2.2 mg PAH/kg-day	Alleman et al., 1995
Seattle, WA	Full Scale	Diesel	6.0	Baker et al., 1993
Southern CA	Full scale	Gasoline, hydraulic oil	0.14	Zachary & Everett, 1993
Tinker AFB, OK	In situ respiration test	JP-4 and mixed fuels	2.3 — 15	Hinchee & Smith, 1991
Tyndall AFB, FL	Field pilot, 1 year and in situ respiration test	JP-4 jet fuel	1.6 — 16	Miller, 1990 Hinchee et al., 1991b
Undefined	Full scale	Gasoline and diesel	50 kg/(well day)	Ely & Heffner, 1988
Undefined	Full scale	Diesel	100 kg/(well day)	Ely & Heffner, 1988
Undefined	Full scale	Fuel oil	60 kg/(well day)	Ely & Heffner, 1988
Valdez, Site A	Pilot scale	Crude oil	8.7 — 16.0	Foor and Hinchee, 1993

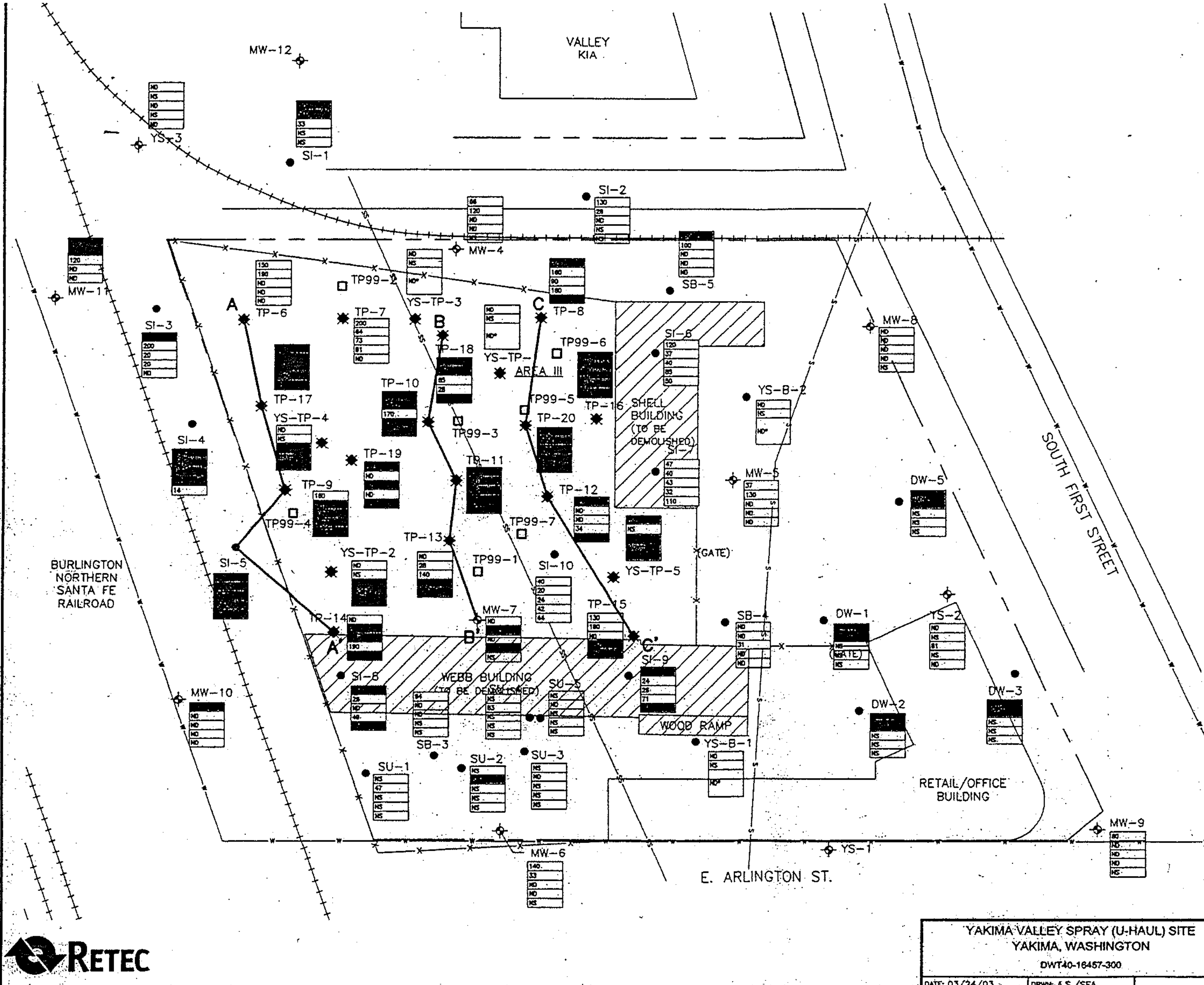
Reference 3 2/2

Reference 3 P.2

Project No. ______________________ Page ______ of ______
Client ______________________ Date ______________________
Site ______________________ By ______________________
Subject ______________________ App. ______________________

RETEC

ATTACHMENTS



LEGEND

SAMPLES TAKEN AT 0.3'
SAMPLES TAKEN AT 2'
SAMPLES TAKEN AT 5'
SAMPLES TAKEN AT 10'
SAMPLES TAKEN AT 17'

CONCENTRATIONS MIN–200 mg/kg
CONCENTRATIONS 200–5100 mg/kg
CONCENTRATIONS 5100–10000 mg/kg
CONCENTRATIONS >10000 mg/kg

NS NOT SAMPLED
ND NOT DETECTED
* COMPOSITE 5–15'
** COMPOSITE 0–2'

Test Pit	Depth (feet below ground surface)	Concentration (mg/kg)
TP99-1	5	<10
	14	4520
TP99-2	5	4010
	8	681
TP99-3	5	16100
TP99-4	16	9140
TP99-5	6	5540
TP99-6	5	<10
	15	13800
TP99-7	5	37.1
	15	3440

30 0 60
SCALE IN FEET

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 03/24/03 DRWN: A.S./SEA

TPH DIESEL CONCENTRATIONS IN SOIL

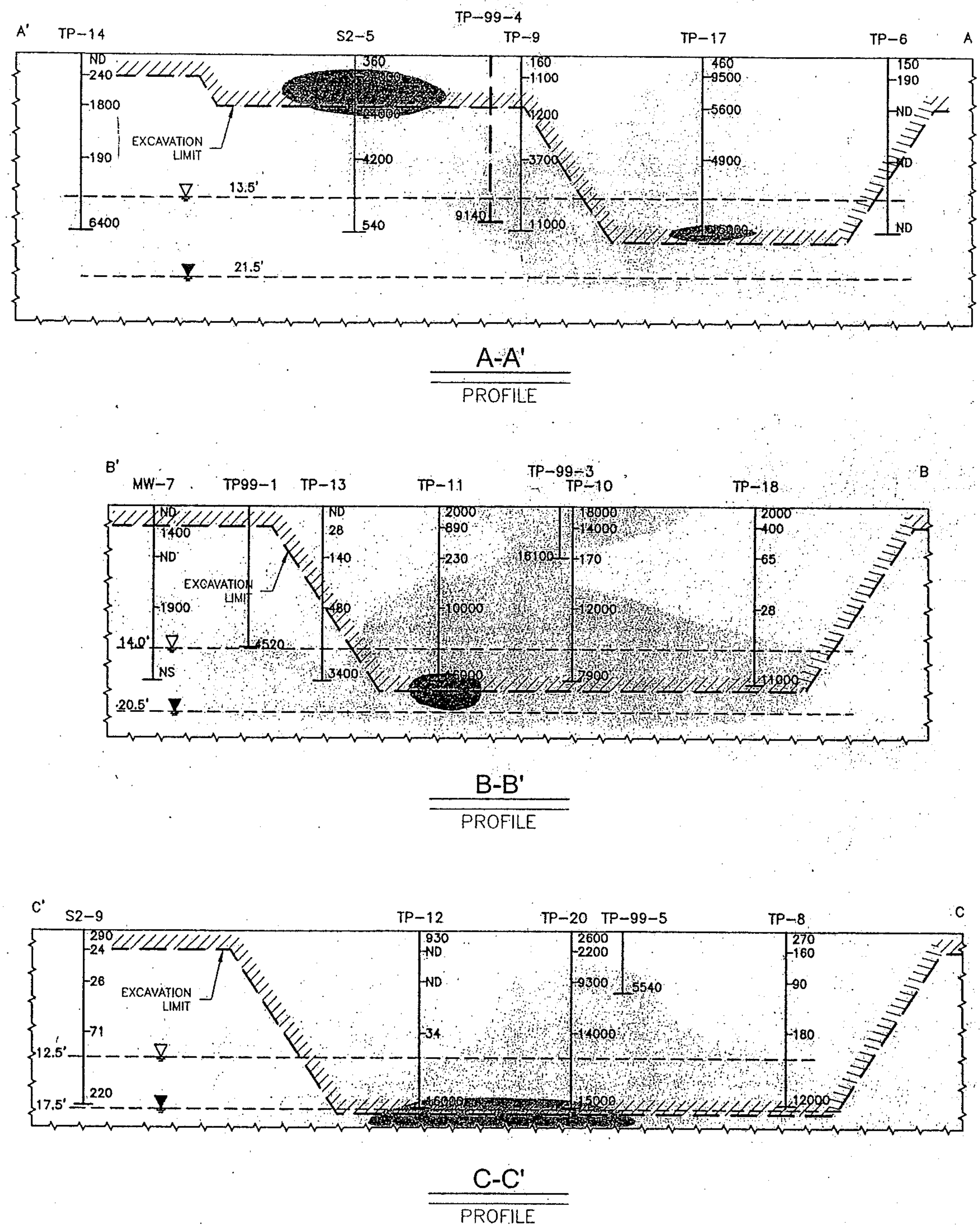
FIGURE 5-3-2

File: H:\16457\16457S020.dwg Layout: ANSI-BI-CP User: ostenberg Plotted: Mar 25, 2003 - 1:49pm Xref's: 16457G001

Attachment 1

Attachment 1
1/5

File: H:\16457\... 'G002.dwg Layout: ANSI_A-CP User: astenberg Plotted: Mar 25, 2003 - 1:41pm



LEGEND

- CLEANUP LEVEL (3500 mg/kg OR GREATER)
- REMEDIATION LEVEL (14950 mg/kg OR GREATER)
- – 71 TPH-DIESEL LEVEL mg/kg
- SEASONAL HIGH WATER TABLE
- SEASONAL LOW WATER TABLE
- ND NOT DETECTED
- EXCAVATION LIMITS

15 0 30

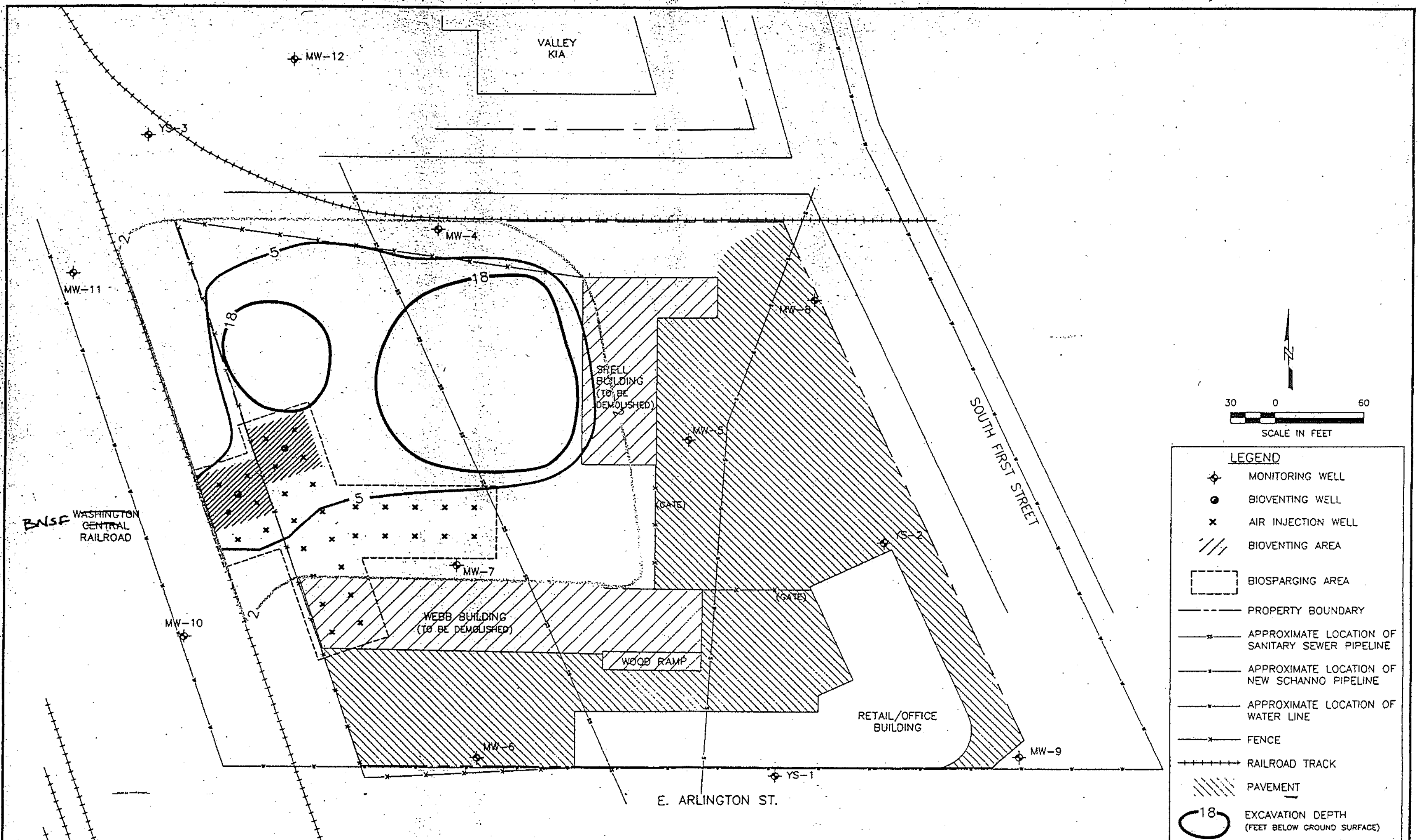
1"=30' HORIZONTAL
1"=10' VERTICAL

RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE YAKIMA, WASHINGTON DWT40-16457-300	TPH-DIESEL CONCENTRATION PROFILES
DATE: 03/25/03 DRWN: A.S./SEA	FIGURE 3-3

Attachment 1

2/5



RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

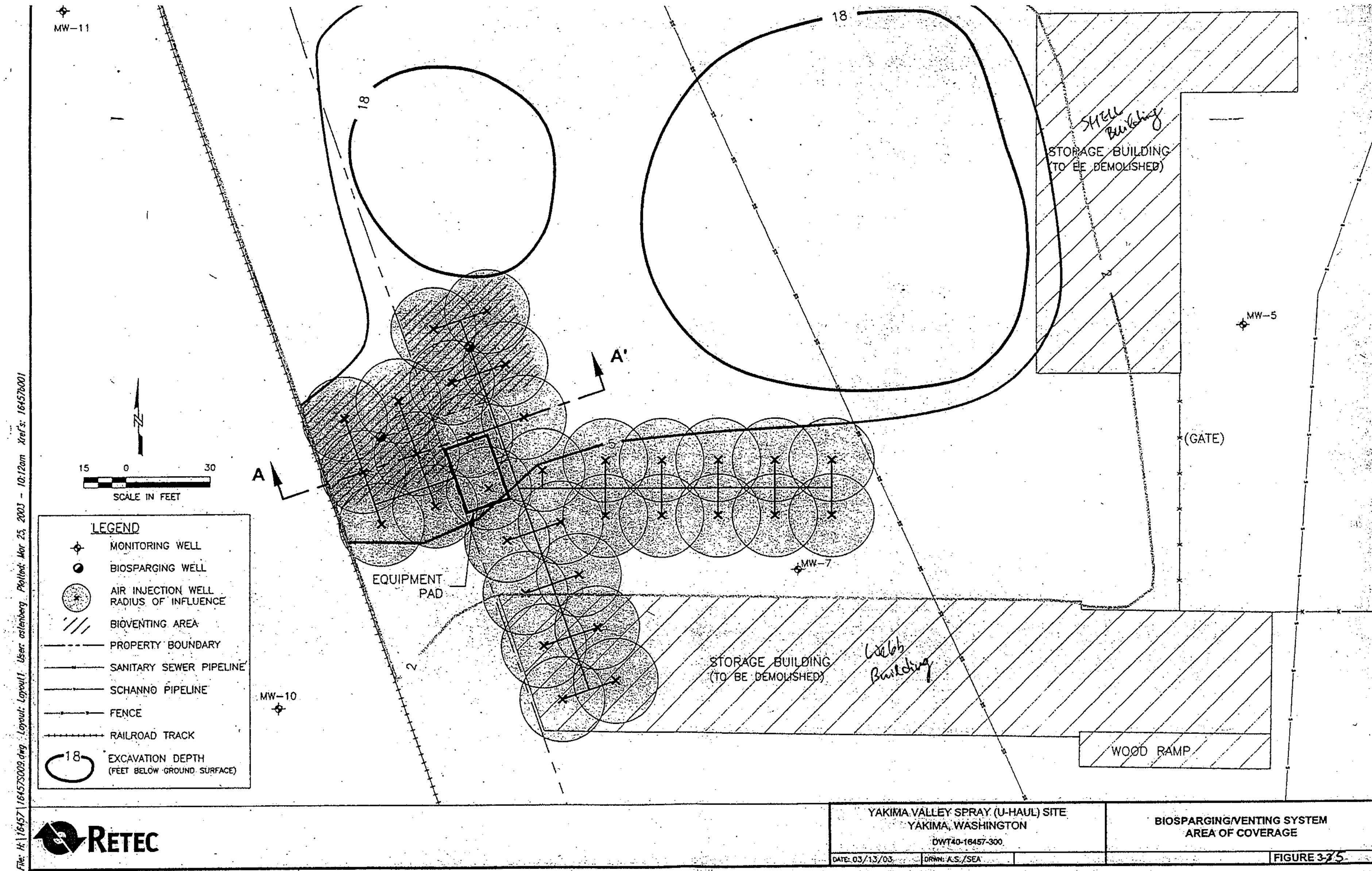
DATE: 03/13/03 | DRWN: A.S./SEA

BIOSPARGING/VENTING SYSTEM LAYOUT

FIGURE 3-4

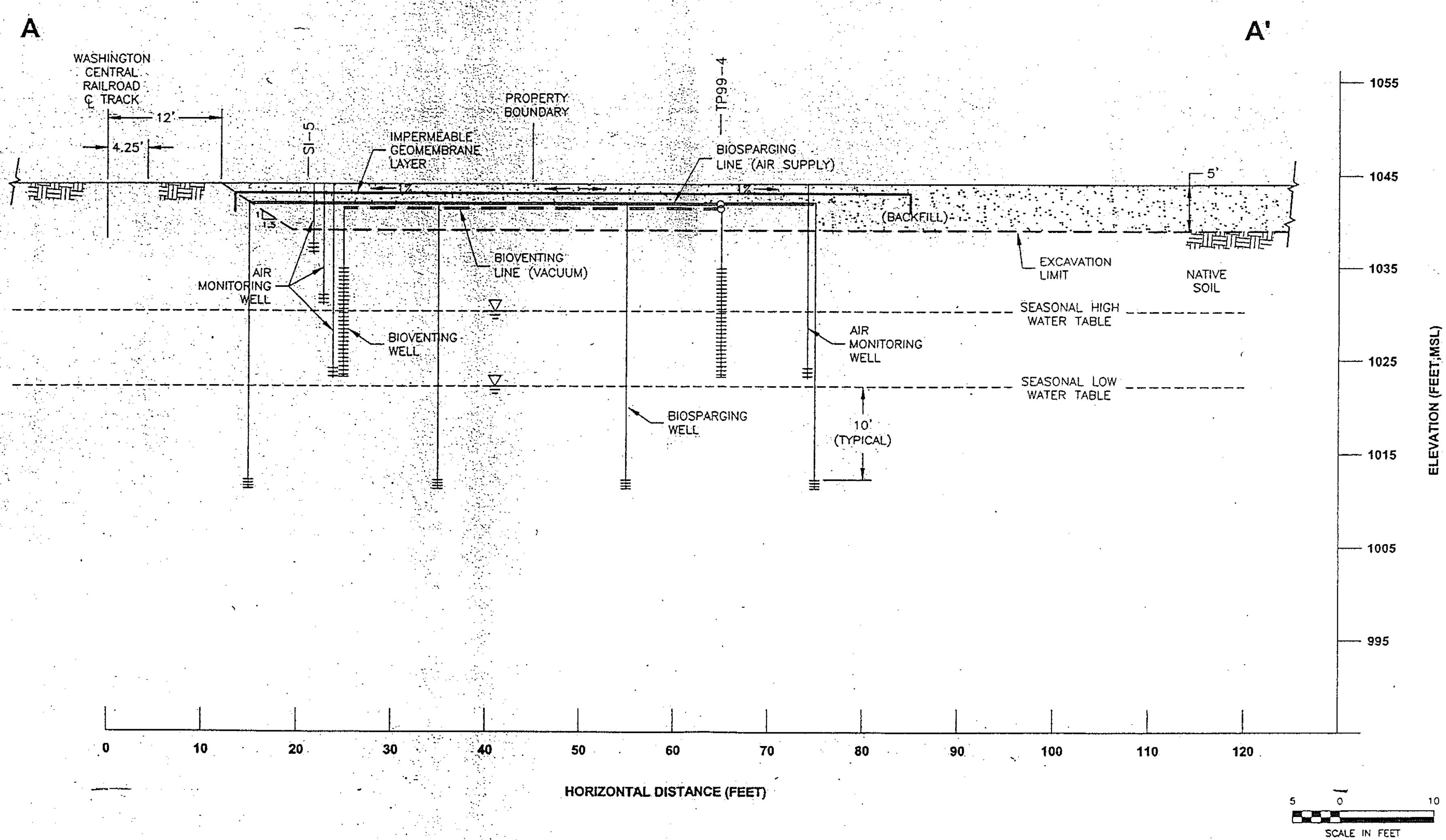
File: H:\16457\16457S008.dwg Layout: Layout1 User: astenberg Plotted: Mar 25, 2003 - 10:01am Xref's: 16457b001

Attachment 1 3/5



4/5

Attachment 1



RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE YAKIMA, WASHINGTON DWT40-16457-300	CROSS-SECTION A-A'
DATE: 03/11/03 DRWN: A.S./SEA	FIGURE 3-6

File: H:\16457\16457G001.dwg Layout: ANSI_B1-LJ User: astenberg Plotted: Mar 25, 2003 - 2:52pm Xrefs:

Attachment 1 5/5

Yakima Valley Spray (U-Haul) Site				
Bioventing Design Calculations				
Biodegradation Rate				**Notes**
				Shaded Cell = input value
Biodegradation Rate	=	**11.84**	**(mg/kg-day)**	estimated Table 2-2, respiration rate for diesel
oxygen utilization rate	=	10.00	(%/day)	trial and error to match estimated respiration rate
gas-filled pore space	=	0.43	(cm^3 gas/cm^3 soil)	estimated from Table 1-7
density of oxygen	=	1,378	(mg/L)	from Table 1-6, assuming Temp = 50 deg F
mass ratio of hydrocarbon to oxygen	=	0.286	(1/3.5)	from Eq. 1-2
soil bulk density	=	1.43	(g/cm^3)	from Table 1-7
Required Air Flowrate				
Flowrate, Q	=	**10.8**	**(ft^3/min)**	calculated
oxygen utilization rate	=	0.42	(%/hour)	calculated
volume of contaminated soil	=	57,600	(ft^3)	based on area of 40'x40', 18' deep, 2 areas
gas-filled porosity	=	0.43	(fraction)	copied from other input
==> use flow rate		6		
Radius of Influence				
Radius of influence	=	**23.8**	**(ft)**	calculated
air flowrate	=	8,640	(ft^3/day)	calculated
oxygen	=	15.90	(%)	calculated
oxygen utilization rate	=	10.00	(%/day)	calculated
air filled porosity	=	0.43	(cm^3 air/cm^3 soil)	calculated
aeration thickness	=	18	(ft)	depth between liner and bottom of extraction well

Attachment 2 1/1

Yakima Valley Spray (U-Haul) Site

Bioventing System:

LINE NUMBER	FLUID	SERVICE FROM	SERVICE TO	PIPE DIA (in)	MAX. FLOW (scfm)	TEMP (deg F)	INLET PRESSURE (psia)	INLET FLOW (acfm)	INLET VEL. (fps)	PIPE LENGTH (ft)	NO. OF FITTINGS Ell	Side Tee	Thru Tee	Pipe Entr.	Pipe Exit	Gate Vlve.	Cont. Vlve.	Chck Vlve.	TOT. EQUIV ft	PRESS. DROP, psi	OUTLET PRESS. psia
CONTAINMENT SYSTEM																					
5 feet screened zne above high water table (5/2.3=2.17 psi) vacuum in formation																					
	Air	well inlet	beginning of manifold	4	25	55	12.53	29	5.6	30				1	1				110	0.01	12.52
	Air	beginning of manifold	Rotameter	4	25	55	12.52	29	5.6	2		1		1	1				107	0.01	12.52
	Air	Rotameter	Moisture Seperator	4	25	55	12.52	29	5.6	3		1		1	1				108	0.01	12.51
	Air	Moisture Seperator	Blower	4	25	55	12.51	29	5.6	2				1	1		1		142	0.01	12.50
																					2.20
Min. Pressure of Bioventing Blower (inches of water) =				61																	

60.63 In of H2O

Biosparging System:

LINE NUMBER	FLUID	SERVICE FROM	SERVICE TO	PIPE DIA (in)	MAX. FLOW (scfm)	TEMP (deg F)	INLET PRESSURE (psia)	INLET FLOW (acfm)	INLET VEL. (fps)	PIPE LENGTH (ft)	NO. OF FITTINGS Ell	Side Tee	Thru Tee	Pipe Entr.	Pipe Exit	Gate Vlve.	Cont. Vlve.	Chck Vlve.	TOT. EQUIV ft	PRESS. DROP, psi	OUTLET PRESS. psia
CONTAINMENT SYSTEM																					
1	Air	Blower	Rotameter	4	96	270	25.80	76.8	14.7	2	1	1		1	1	1			157	0.06	25.74
2	Air	Rotameter (0.18 psi loss)	End of Manifold	0.5	3	120	25.56	1.9	23.5	1			1	1	1	1			121	0.59	24.97
3	Air	End of Manifold	Sparge Lateral	0.5	3	80	24.97	1.8	22.4	130				1			1		220	1.04	23.93
4	Air	Sparge Lateral	Well Inlet	1	3	80	23.93	1.9	5.9	1		1		1					56	0.02	23.91
5	Air	Well Inlet	Well Discharge	2	3	80	23.91	1.9	1.5	30	1			1	1				130	0.00	23.91
Min. Pressure of Sparging Blower (psia) =			11.10																		9.21 psig

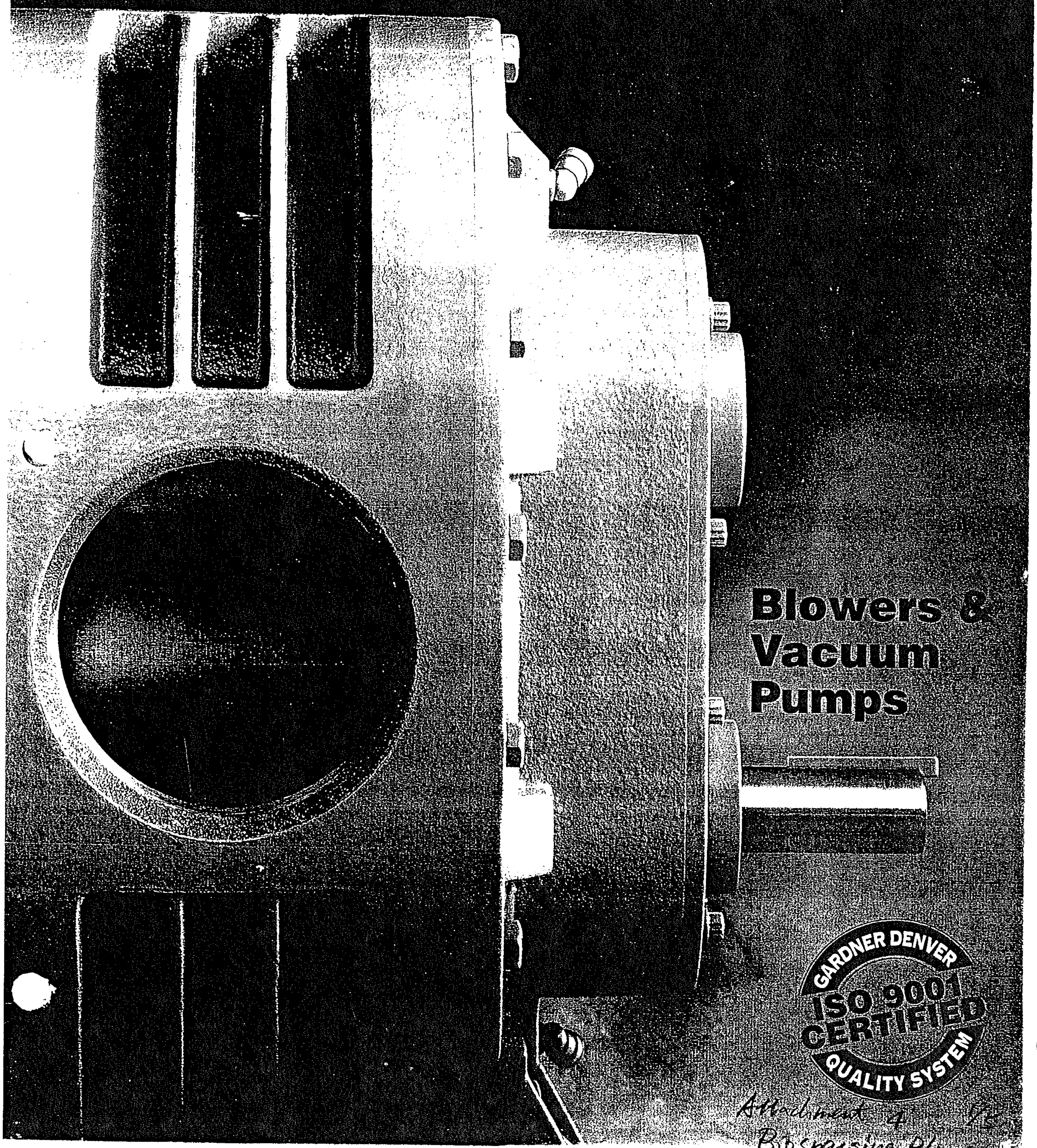
Notes:
1. Based on 18 feet of saturdated water depth above the top of the air outlet (screened interval), (18 ft of H2O) / (2.3 ft per 1 psig) = 7.8 (use 8 psig). Plus 1 psig of entry loss to aquifer formation, the min. total pressure to deliver the air is 9 psig.
In addition, to pump 1 atmosphere of air to the aquifer is 14.7 psig (1 atm). Therefore, the total inlet pressure is 14.7 + 9 psig = 23.7 psig
2. 1 pound per square inch (psia) = 2.3 feet of water.

Attachment 3

1/1

Attachment 3

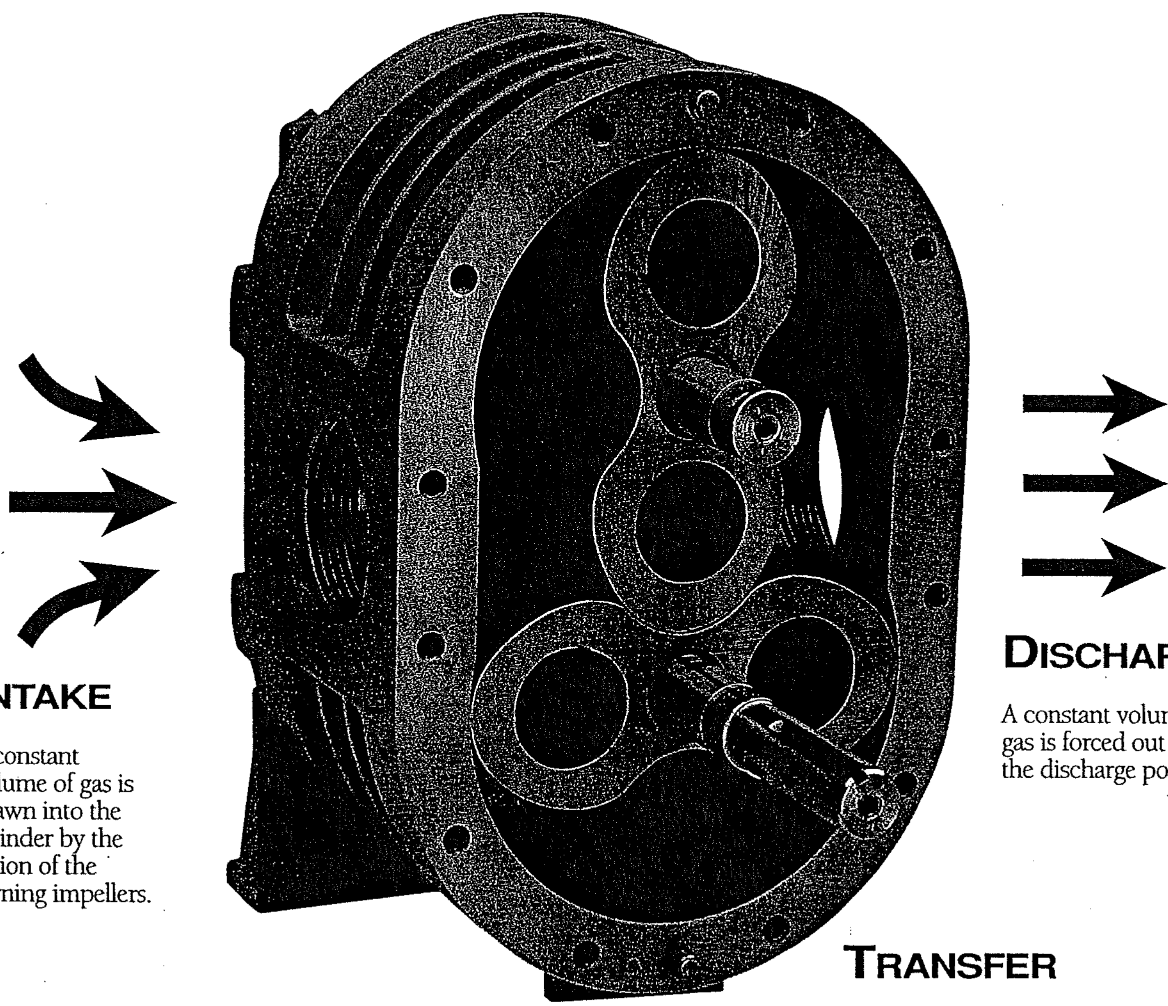
Gardner Denver



Blowers & Vacuum Pumps

Attachment 4
Biosparging Blower

The Sutorbilt Positive Displacement Cycle



INTAKE

A constant volume of gas is drawn into the cylinder by the action of the turning impellers.

DISCHARGE

A constant volume of gas is forced out through the discharge port.

TRANSFER

A constant volume of trapped gas is transferred around the cylinder to the discharge port.

Two specially designed figure-eight impellers turn in opposite directions within a machined housing, transferring a constant volume of gas from the inlet to the discharge with every rotation of the blower drive shaft. No lubrication within the cylinder is required as the rotating components are held in close tolerance to each other and do not make contact. The impeller positioning is maintained by precision timing gears affixed to each impeller shaft. All essential gear and bearing lubrication occurs externally to the cylinder assuring clean, oil-free gas delivery under all operating conditions. Compression occurs after the gas leaves the blower and encounters system resistance in performing its intended work.

2/5

Attachment 4

PRESSURE PERFORMANCE DATA

For Air at Standard Conditions: Sea Level 14.7 PSIA, 68° F Inlet Temperature, 36% Relative Humidity.
For performance with gases other than air, or at non-standard conditions, contact your authorized Sutorbilt distributor.

LOW PRESSURE UNITS

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT. REV.	RPM	2 PSIG		3 PSIG		4 PSIG		5 PSIG		6 PSIG		7 PSIG	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
2LP 2LVP	2"-S	0.035	2800	76	1.1	71	1.6	66	2.1	63	2.5	59	3.0	56	3.5
			3250	91	1.3	86	1.8	82	2.4	78	2.9	75	3.4	72	4.0
			3560	102	1.4	97	2.0	93	2.6	89	3.2	86	3.7	83	4.3
			5275	162	2.0	157	2.8	153	3.7	149	4.6	146	5.3	143	6.1
3LP 3LVP	2½"-S	0.104	1760	149	1.9	142	2.8	135	3.7	129	4.5	124	5.2	120	6.1
			2265	202	2.4	194	3.5	188	4.7	182	5.6	177	6.7	172	7.8
			2770	254	2.9	247	4.3	240	5.5	235	6.8	229	8.2	225	9.6
			3600	341	3.7	333	5.3	326	7.1	321	8.9	316	10.6	311	12.4
4LP 4LVP	3"-S	0.170	1760	253	3.0	243	4.5	234	5.7	226	7.1	220	8.5	213	9.9
			2190	326	3.7	316	5.3	307	7.1	300	8.8	293	10.6	286	12.4
			2620	399	4.4	389	6.3	380	8.4	373	10.6	366	12.7	359	14.8
			3600	566	5.8	556	8.7	547	11.6	539	14.5	532	17.4	526	20.3
5LP 5LVP	4"-S	0.350	1500	463	5.2	449	7.5	437	10.0	427	12.4	418	14.9	409	17.4
			1760	554	5.8	540	8.8	528	11.7	518	14.6	509	17.5	500	20.4
			2100	673	7.0	659	10.5	647	13.9	637	17.4	628	20.9	619	24.4
			2850	936	9.5	922	14.2	910	18.9	900	23.6	890	28.4	882	33.1
6LP 6LVP	6"-F	0.718	1170	738	8.0	715	11.9	696	15.9	679	19.9	664	23.9	650	27.9
			1760	1162	12.0	1139	18.0	1120	24.0	1103	29.9	1088	35.9	1073	41.9
			1930	1284	13.1	1261	19.7	1242	26.3	1225	32.8	1210	39.4	1195	46.0
			2350	1586	16.0	1563	24.0	1543	32.0	1526	40.0	1511	48.0	1497	56.0
7LP 7LVP	8"-F	1.200	1170	1277	13.3	1248	20.0	1224	26.6	1202	33.3	1183	39.9		
			1465	1631	16.7	1602	25.0	1578	33.3	1556	41.7	1537	50.0		
			1760	1985	20.0	1956	30.0	1932	40.0	1910	50.1	1891	60.1		
			2050	2333	23.3	2304	35.0	2280	46.6	2258	58.3	2239	70.0		
8LP 8LVP	10"-F	1.740	880	1366	14.5	1329	21.8	1298	29.0	1270	36.3	1245	43.5		
			1170	1871	19.3	1834	28.9	1802	38.6	1775	48.2	1750	57.9		
			1375	2227	22.7	2190	34.0	2159	45.4	2131	56.7	2106	68.0		
			1800	2967	29.7	2930	44.5	2898	59.4	2871	74.2	2846	89.1		

MEDIUM PRESSURE UNITS

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT. REV.	RPM	7 PSIG		9 PSIG		10 PSIG		12 PSIG		13 PSIG		14 PSIG	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
2MP 2MVP	1"-S	0.017	2800	25	1.7										
			3250	33	1.9	30	2.5								
			3560	38	2.1	35	2.7								
			5275	67	3.1	64	3.9	63	4.4	60	5.1				
3MP 3MVP	2"-S	0.060	1760	64	3.6	59	4.6								
			2265	95	4.6	89	5.8	86	6.4						
			2770	125	5.5	119	7.1	117	7.9	112	9.5				
			3600	175	7.2	169	9.2	167	10.2	162	12.3				
4MP 4MVP	2½"-S	0.117	1760	144	6.8	136	8.8	132	9.8						
			2190	194	8.5	186	10.9	182	12.1						
			2620	245	10.2	236	13.1	232	14.5						
			3600	359	14.0	351	18.0	347	20.0						
5MP 5MVP	4"-S	0.210	1500	237	10.5	227	13.4	222	14.9	213	17.9	209	19.4		
			1760	292	12.3	281	15.8	276	17.5	268	21.0	263	22.8		
			2100	363	14.6	353	18.8	348	20.9	339	25.1	335	27.2		
			2850	521	19.9	510	25.5	505	28.4	496	34.0	492	36.9		
6MP 6MVP	5"-S	0.383	1170	331	14.9	316	19.1	309	21.2	295	25.5	289	27.6	283	29.7
			1760	557	22.4	542	28.8	535	32.0	521	38.3	515	41.5	509	44.7
			1930	622	24.5	607	31.5	600	35.0	586	42.0	580	45.5	574	49.1
			2350	783	29.9	768	38.4	761	42.7	747	51.2	741	55.5	735	59.7
7MP 7MVP	6"-F	0.733	1170	693	28.5	670	36.6	660	40.7						
			1465	909	35.6	887	45.8	877	50.9						
			1760	1125	42.8	1103	55.0	1093	61.1						
			2050	1338	49.9	1315	64.1	1305	71.2						
8MP 8MVP	8"-F	1.040	880	709	30.4	681	39.0	668	43.4						
			1170	1010	40.4	982	51.9	970	57.7						
			1375	1223	47.4	1196	61.0	1183	67.8						
			1800	1665	62.1	1638	79.9	1625	88.7						

min blower 11 psi
Min. motor size

HIGH PRESSURE UNITS

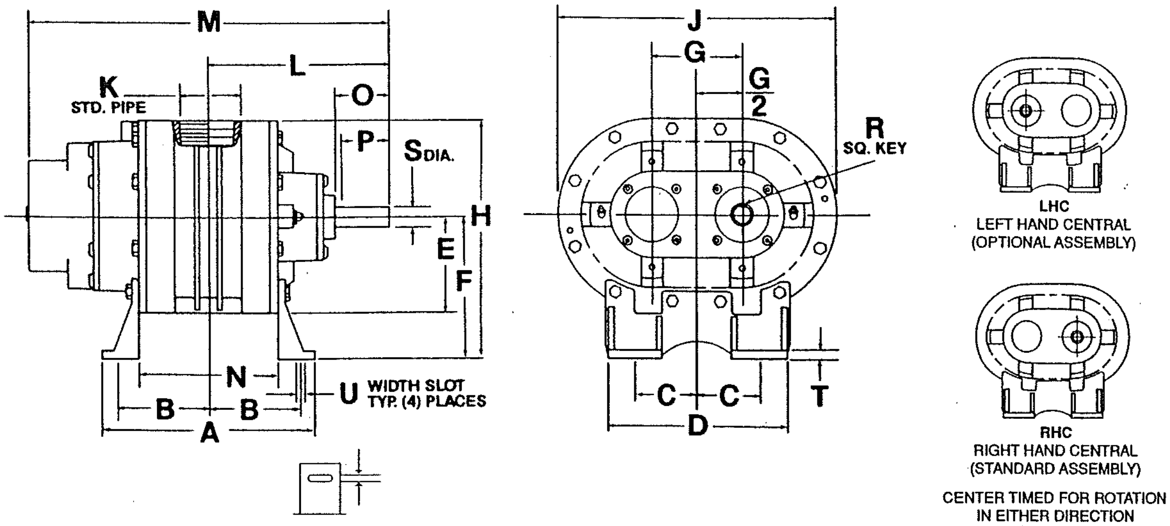
SIZE	DIA. INLET & OUTLET	DISPL. CU. FT. REV.	RPM	7 PSIG		8 PSIG		9 PSIG		11 PSIG		13 PSIG		15 PSIG	
				CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP
3HP 3HVP	1¼"-S	0.045	1760	46	2.8	44	3.2								
			2265	69	3.6	66	4.1	64	4.5						
			2770	91	4.3	89	4.9	87	5.3	83	6.5				
			3600	129	5.4	126	6.1	124	6.9	120	8.4	116	10.0	113	11.5
4HP 4HVP	1½"-S	0.069	1760	80	4.2	77	4.8	74	5.2						
			2190	110	5.0	107	5.7	104	6.4	99	7.9				
			2620	139	6.0	136	6.9	134	7.7	129	9.4				
			3600	207	8.2	204	9.4	201	10.6	196	13.0	192	15.3	188	17.7
5HP 5HVP	2½"-S	0.140	1500	154	7.0	151	8.0	147	9.0	140	10.9				
			1760	191	8.2	187	9.3	183	10.5	177	12.8	171	15.2	165	17.5
			2100	238	9.8	235	11.1	231	12.5	224	15.3	218	18.1	213	20.9
			2850	343	13.2	340	15.1	336	17.0	329	20.8	323	24.6	318	28.4
6HP 6HVP	3"-S	0.227	1170	187	8.8	182	10.1	177	11.3	168	13.8	159	16.4		
			1760	321	13.3	316	15.1	311	17.0	301	20.8	293	24.6	285	28.4
			1930	360	14.5	355	16.6	349	18.7	340	22.8	332	27.0	324	31.1
			2350	455	17.7	450	20.2	445	22.8	435	27.8	427	32.9	419	37.9
7HP 7HVP	4"-S	0.367	1170	332	14.2	325	16.3	319	18.3	307	22.4	297	26.5	287	30.5
			1465	440	17.8	434	20.4	427	22.9	416	28.0	405	33.1	395	38.2
			1760	549	21.4	542	24.5	536	27.6	524	33.7	513	39.8	504	45.9
			2050	655	25.0	648	28.5	642	32.1	630	39.2	620	46.4	610	53.5
8HP 8HVP	4"-S	0.566	880	363	16.5	354	18.9	345	21.2	329	26.0	314	30.7	300	35.4
			1170	527	22.0	518	25.1	509	28.3	493	34.5	478	40.8	465	47.1
			1375	643	25.8	634	29.5	625	33.2	609	40.6	594	48.0	581	55.3
			1800	884	33.8	874	38.6	866	43.5	850	53.1	835	62.8	821	72.4

S=SCREWED CONNECTIONS STD. PIPE F=FLANGE CONNECTIONS STD. PIPE
INTAKE AND OUTLET PIPE CONNECTIONS SAME TYPE AND SIZE

Attachment 4
3/5

[redacted]

HORIZONTAL BLOWER DIMENSIONS



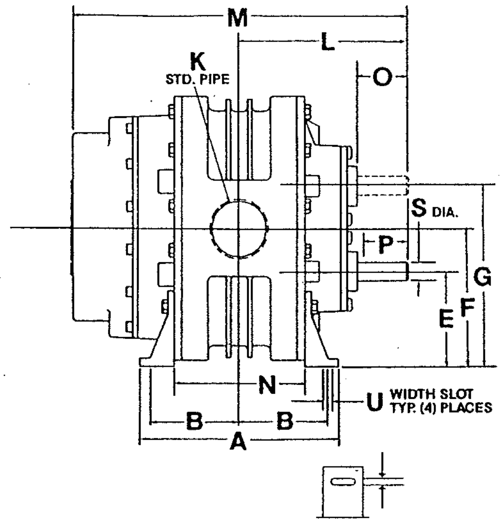
SIZE	WT.	CONN.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	U
[redacted]																					
3H	71	S	6¾	2¹¹⁄₁₆	2⅞	7¾	3⅞	5	3½	8⅞	11¼	1¼	5¹³⁄₁₆	11⅞	3½	2	1⁷⁄₁₆	³⁄₁₆	.750	¼	½ x ¾
3M	79	S	7⅝	3⅛	2⅞	7¾	3⅞	5	3½	8⅞	11¼	2	6¼	12¾	4⅜	2	1⁷⁄₁₆	³⁄₁₆	.750	¼	½ x ¾
3L	95	S	10¼	4⁷⁄₁₆	2⅞	7¾	3⅞	5	3½	8⅞	11¼	2½	7⁹⁄₁₆	15⅜	7	2	1⁷⁄₁₆	³⁄₁₆	.750	¼	½ x ¾
[redacted]																					
5H	205	S	8½	3½	3½	9	5³⁄₁₆	7	5	12³⁄₁₆	15⅜	2½	8³⁄₁₆	17³⁄₁₆	4⅞	2½	1¹³⁄₁₆	¼	1.125	⅜	⁹⁄₁₆ x ¾
5M	237	S	10½	4½	3½	9	5³⁄₁₆	7	5	12³⁄₁₆	15⅜	4	9³⁄₁₆	19³⁄₁₆	6⅞	2½	1¹³⁄₁₆	¼	1.125	⅜	⁹⁄₁₆ x ¾
5L	270	S	14½	6½	3½	9	5³⁄₁₆	7	5	12³⁄₁₆	15⅜	4	11³⁄₁₆	23³⁄₁₆	10⅞	2½	1¹³⁄₁₆	¼	1.125	⅜	⁹⁄₁₆ x ¾
[redacted]																					
7H	523	S	12	4⅝	5½	15	9¹¹⁄₁₆	11	7	20¹¹⁄₁₆	22	4	10	21⅛	5¾	3³⁄₁₆	2½	⅜	1.562	½	¾ x 1
7M	671	F	17½	7⅜	5½	15	8½	11	7	19½	22	6	12¾	26⅝	11¼	3³⁄₁₆	2½	⅜	1.562	½	¾ x 1
7L	804	F	24½	10⅞	5½	15	8½	11	7	19½	22	8	16¼	33⅝	18¼	3³⁄₁₆	2½	⅜	1.562	½	¾ x 1
[redacted]																					

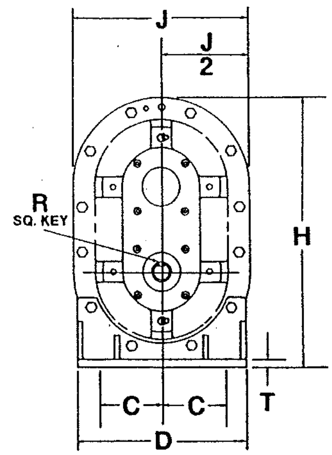
S=SCREWED CONNECTIONS STD. NPT F=FLANGE CONNECTIONS STD. PIPE
INTAKE AND OUTLET PIPE CONNECTIONS SAME TYPE AND SIZE.

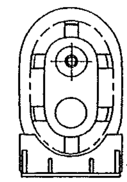
The dimensions shown above are nominal. Dimensions for installation purposes will be furnished upon request.

Attachment 4
4/5

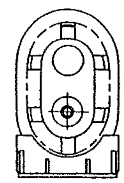
Vertical Blower Dimensions







THC
TOP HAND CENTRAL
(OPTIONAL ASSEMBLY)



BHC
BOTTOM HAND CENTRAL
(STANDARD ASSEMBLY)

CENTER TIMED FOR ROTATION
IN EITHER DIRECTION

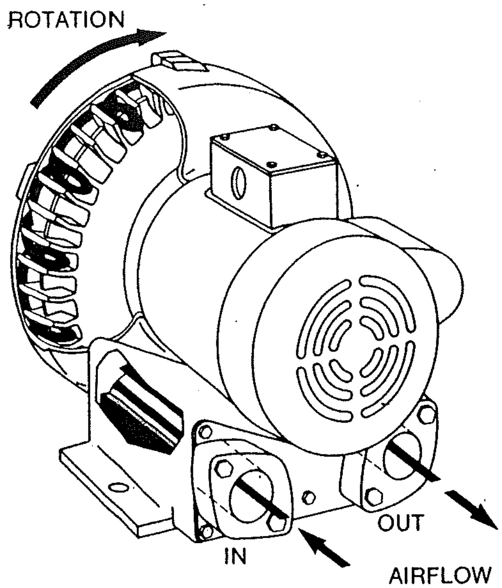
SIZE	WT.	CONN.	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	R	S	T	U
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3HV	71	S	6 3/4	2 11/16	2 1/2	6 3/4	4 1/2	6 1/4	8	11 7/8	7 3/4	1 1/4	5 13/16	11 7/8	3 1/2	2	1 7/16	3/16	.750	1/4	1/2 x 3/4
3MV	79	S	7 5/8	3 1/16	2 1/2	6 3/4	4 1/2	6 1/4	8	11 7/8	7 3/4	2	6 1/4	12 3/4	4 3/8	2	1 7/16	3/16	.750	1/4	1/2 x 3/4
3LV	95	S	10 1/4	4 3/8	2 1/2	6 3/4	4 1/2	6 1/4	8	11 7/8	7 3/4	2 1/2	7 9/16	15 3/8	7	2	1 7/16	3/16	.750	1/4	1/2 x 3/4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5HV	205	S	8 1/2	3 1/2	3 1/2	9	5 1/2	8	10 1/2	15 11/16	10 3/8	2 1/2	8 9/16	17 3/16	4 7/8	2 1/2	1 13/16	1/4	1.125	3/8	9/16 x 3/4
5MV	237	S	10 1/2	4 1/2	3 1/2	9	5 1/2	8	10 1/2	15 11/16	10 3/8	4	9 9/16	19 3/16	6 7/8	2 1/2	1 13/16	1/4	1.125	3/8	9/16 x 3/4
5LV	270	S	14 1/2	6 1/2	3 1/2	9	5 1/2	8	10 1/2	15 11/16	10 3/8	4	11 9/16	23 3/16	10 7/8	2 1/2	1 13/16	1/4	1.125	3/8	9/16 x 3/4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7HV	523	S	12	4 5/8	5 1/2	14	11	14 1/2	18	25 1/2	19 3/8	4	10	21 1/8	5 3/4	3 3/16	2 1/2	3/8	1.562	1/2	3/4 x 1
7MV	671	F	17 1/2	7 3/8	5 1/2	14	11	14 1/2	18	25 1/2	17	6	12 3/4	26 5/8	11 1/4	3 3/16	2 1/2	3/8	1.562	1/2	3/4 x 1
7LV	804	F	24 1/2	10 7/8	5 1/2	14	11	14 1/2	18	25 1/2	17	8	16 1/4	33 5/8	18 1/4	3 3/16	2 1/2	3/8	1.562	1/2	3/4 x 1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

S=SCREWED CONNECTIONS STD. NPT F=FLANGE CONNECTIONS STD. PIPE
INTAKE AND OUTLET PIPE CONNECTIONS SAME TYPE AND SIZE.

Attachment 4
5/5

The dimensions shown above are nominal. Dimensions for installation purposes will be furnished upon request.

Regenerative Principle



The impeller blades passing the inlet port draw air or other gasses into the blower. The impeller blades then, by centrifugal action, accelerate the air outward and forward. Here the "regenerative" principle takes effect as the air is turned back by the annular shaped housing to the base of the following blades where it is again hurled outward. Each "regeneration" imparts more pressure to the air. When the air reaches the stripper section at the outlet (the stripper is the part of the blower located between the inlet and the outlet in which the annulus is reduced in size to fit closely to the sides and tips of the impeller blades) the air is "stripped" from the impeller and diverted out of the blower. The pressures or vacuums generated by the one or two spinning, non-contacting, oil-free impellers are equal to those obtained by many larger multi-stage or positive displacement blowers.

Regenerative DR/EN/CP Features

DR (Domestic Regenerative)

Our industrial regenerative blowers include:

- Rugged cast aluminum housing, cover, impeller and muffler tower
- Removable cast iron flanges bolted to a sheet metal manifold
- TEFC motors on single-ended models, ODP motors on all double-ended models
- Carbon steel shaft and zinc plated hardware
- Permanently sealed motor bearings good for 20,000-25,000 hours life

EN (Environmental Regenerative)

Our explosion-proof blowers are designed the same as the DR blowers, except added features include:

- Heavy duty cast aluminum manifold
- Our spark resistant housing, cover, impeller, muffler tower and manifold are vacuum impregnated
- Teflon lip seal in a stainless steel case standard for leakage containment to 5 cc/min or less
- Explosion-proof motors standard and available in a variety of world voltages
- All metal-to-metal surfaces are sealed with RTV sealant

CP (Chemical Processing Regenerative)

Our chemical processing/specialty gas blowers are designed the same as DR/EN blowers except added features include:

- Chem-Tough™ surface conversion corrosion resistant treatment for all castings
- Teflon lip seal in a stainless steel case standard for leakage containment to 5 cc/min or less
- Chemical duty motors with 303 stainless steel motor shafts
- Stainless steel hardware throughout
- Nickel plated flanges and muffler retainers

EP (Engineered Product Regenerative)

Built custom to your specifications

Your Choice. Our Commitment.

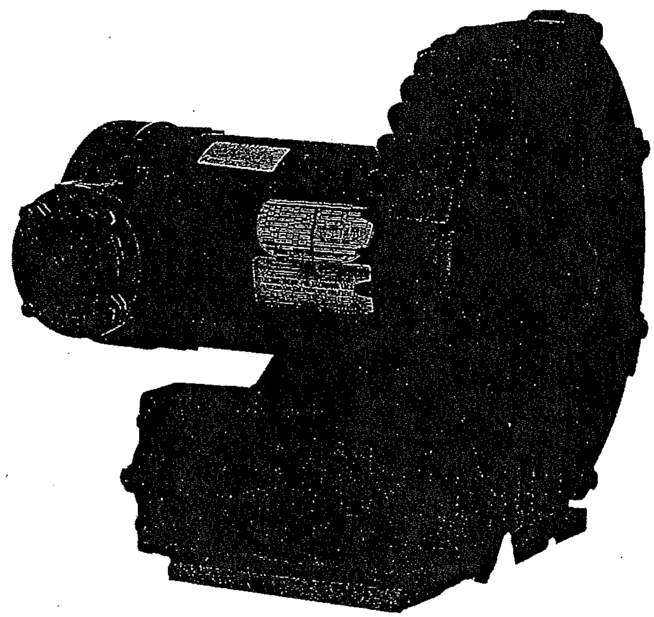
Attachment 5.
Bioventing Blower

EN/CP 513
Explosion-Proof Regenerative Blower

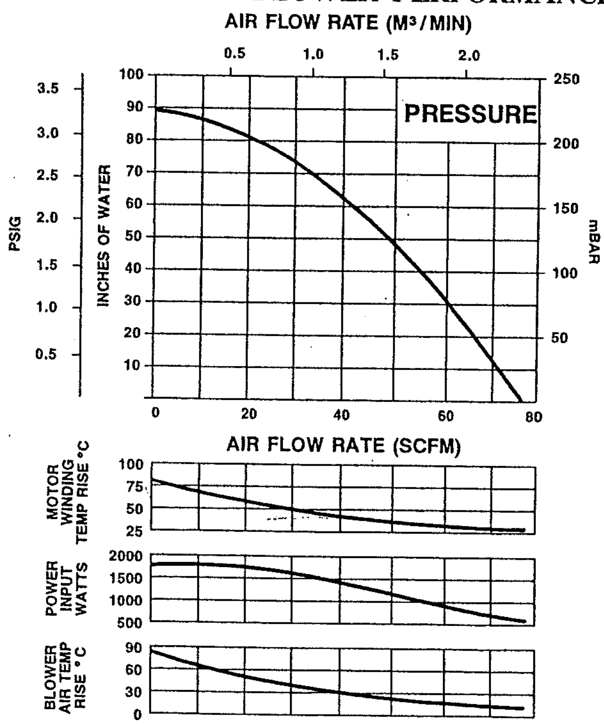
EN FEATURES
- Manufactured in the USA
- Maximum flow: 78 SCFM
- Maximum pressure: 88" WG
- Maximum vacuum: 75" WG
- Standard motor: 1.5 HP
- Blower construction – cast aluminum housing, cover, impeller & manifold; cast iron flanges
- UL & CSA approved motors for Class I, Group D atmospheres
- Sealed blower assembly
- Quiet operation within OSHA standards

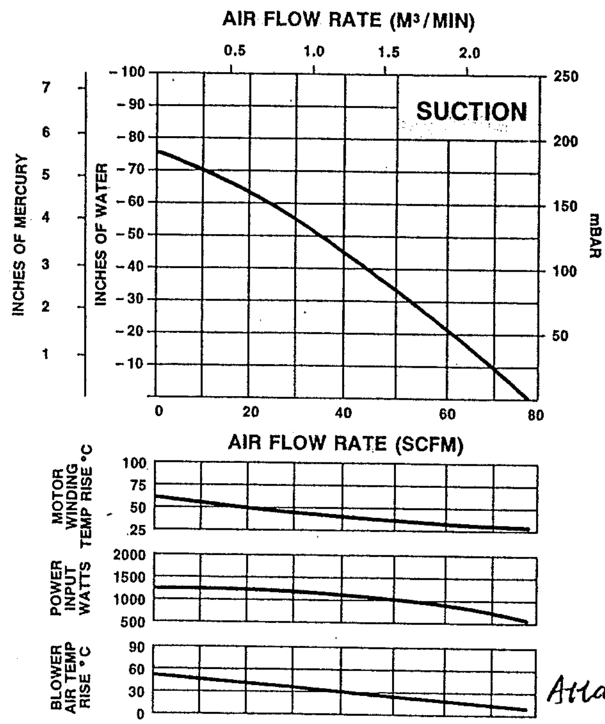
OPTIONS
- TEFC motors
- 50 Hz motors
- International voltages
- Other HP motors
- Corrosion resistant surface treatments
- Remote drive (motorless) models

ACCESSORIES
- Moisture serarators
- Explosion-proof motor starters
- Inline & inlet filters
- Vacuum & pressure gauges
- Relief valves
- External mufflers



BLOWER PERFORMANCE AT STANDARD CONDITIONS



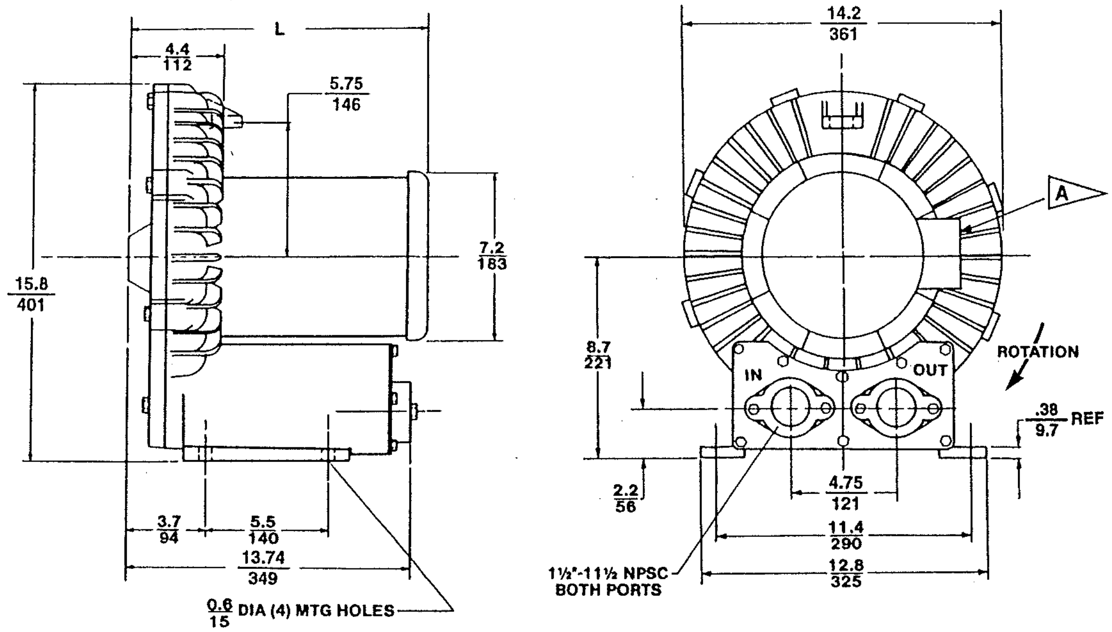


Attachment 5

EG&G ROTRON, SAUGERTIES, N.Y. 12477 • 914/246-3401 • FAX 914/246-3802

2/3

EN/CP 513
Explosion-Proof Regenerative Blower



DIMENSIONS:	IN / MM
TOLERANCES: .XX ±	.1 / 2.5
(UNLESS OTHERWISE NOTED)	

MODEL	L (IN) ± .31	L (MM) ± 8
EN/CP513W58L	16.65	423
EN/CP513W72L	15.74	400

A — 0.75" NPT CONDUIT CONNECTION AT 12 O'CLOCK POSITION

SPECIFICATIONS

MODEL	EN513W58L		EN513W72L		CP513FR58LR	CP513FR72LR
Part No.	038183		038037		–	038966
Motor Enclosure – Shaft Material	Explosion-proof – **CS**		Explosion-proof – **CS**		Chem XP – **SS**	Chem XP – **SS**
Horsepower	1.5		1.5		Same as EN513W58L – 038183 except add Chemical Processing (CP) features from catalog inside front cover	Same as EN513W72L – 038037 except add Chemical Processing (CP) features from catalog inside front cover
Phase – Frequency	Single - 60 Hz		Three - 60 Hz			
Voltage [1]	115	208-230	230	460		
Motor Nameplate Amps	15	7.9-7.5	4.6	2.3		
Maximum Blower Amps [3]	19.4	9.7-9.0	4.8	2.4		
Inrush Amps	96	48	32	16		
Starter Size	1	0	00	00		
Service Factor	1.0		1.0			
Thermal Protection [2]	Pilot Duty		Pilot Duty			
Bearing Type	Sealed, Ball		Sealed, Ball			
Shipping Weight	98 lb (45 kg)		92 lb (42 kg)			

BLOWER LIMITATIONS FOR 60 Hz

Min. Flow @ Max. Suction	0 SCFM @ –75" WG	0 SCFM @ –75" WG	0 SCFM @ –75" WG	0 SCFM @ –75" WG
Min. Flow @ Max. Pressure	0 SCFM @ 88" WG	0 SCFM @ 88" WG	0 SCFM @ 88" WG	0 SCFM @ 88" WG

[1] All dual voltage 3 phase motors are factory tested and certified to operate on 200-230/400-460 VAC-3 ph-60 Hz and 220-240/380-415 VAC-3 ph-50 Hz. All dual voltage 1 phase motors are factory tested and certified to operate on 110-120/200-230 VAC-1 ph-60 Hz and 220-240 VAC-1 ph-50 Hz.
[2] Maximum operating temperatures: Motor winding temperature (winding rise plus ambient) should not exceed 140° for Class F insulation or 120° for Class B insulation. Blower outlet air temperature should not exceed 140° (air temperature rise plus ambient).
[3] Corresponds to the performance point at which the blower and / or motor temperature rise reaches the limit of the thermal protection in the motor.

Attachment 5

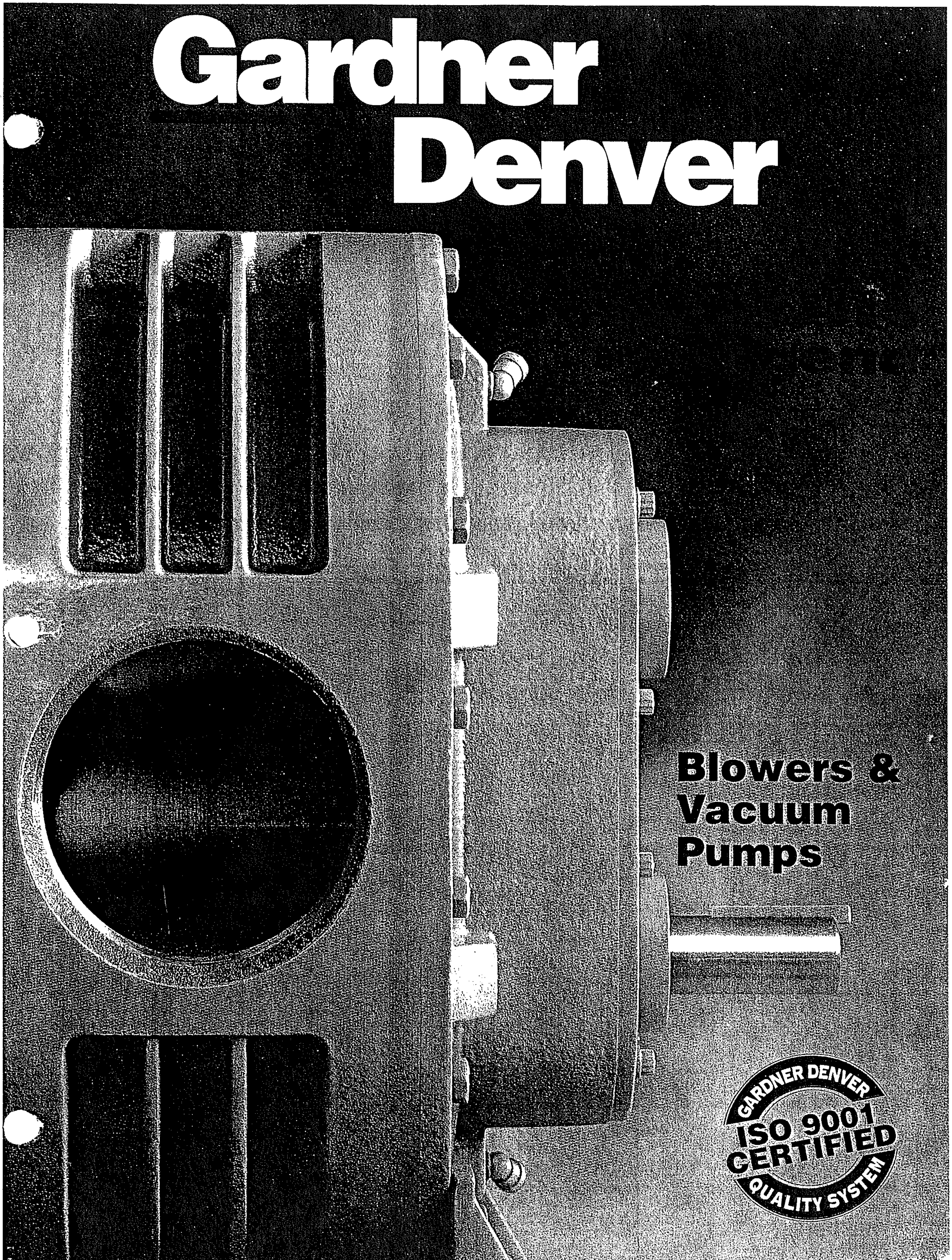
Specifications subject to change without notice. Please contact factory for specification updates.

Appendix E

Manufacturer's Cut Sheets

Gardner Denver

Blowers & Vacuum Pumps



PRESSURE PERFORMANCE DATA

Biosparging Blower 6

For Air at Standard Conditions: Sea Level 14.7 PSIA, 68° F Inlet Temperature, 36% Relative Humidity.
For performance with gases other than air, or at non-standard conditions, contact your authorized Sutorbilt distributor.

LOW PRESSURE UNITS

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT. REV.	RPM	2 PSIG CFM	2 PSIG BHP	3 PSIG CFM	3 PSIG BHP	4 PSIG CFM	4 PSIG BHP	5 PSIG CFM	5 PSIG BHP	6 PSIG CFM	6 PSIG BHP	7 PSIG CFM	7 PSIG BHP
2LP 2LVP	2"-S	0.035	2800	76	1.1	71	1.6	66	2.1	63	2.5	59	3.0	56	3.5
			3250	91	1.3	86	1.8	82	2.4	78	2.9	75	3.4	72	4.0
			3560	102	1.4	97	2.0	93	2.6	89	3.2	86	3.7	83	4.3
			5275	162	2.0	157	2.8	153	3.7	149	4.6	146	5.3	143	6.1
3LP 3LVP	2½"-S	0.104	1760	149	1.9	142	2.8	135	3.7	129	4.5	124	5.2	120	6.1
			2265	202	2.4	194	3.5	188	4.7	182	5.6	177	6.7	172	7.8
			2770	254	2.9	247	4.3	240	5.5	235	6.8	229	8.2	225	9.6
			3600	341	3.7	333	5.3	326	7.1	321	8.9	316	10.6	311	12.4
4LP 4LVP	3"-S	0.170	1760	253	3.0	243	4.5	234	5.7	226	7.1	220	8.5	213	9.9
			2190	326	3.7	316	5.3	307	7.1	300	8.8	293	10.6	286	12.4
			2620	399	4.4	389	6.3	380	8.4	373	10.6	366	12.7	359	14.8
			3600	566	5.8	556	8.7	547	11.6	539	14.5	532	17.4	526	20.3
5LP 5LVP	4"-S	0.350	1500	463	5.2	449	7.5	437	10.0	427	12.4	418	14.9	409	17.4
			1760	554	5.8	540	8.8	528	11.7	518	14.6	509	17.5	500	20.4
			2100	673	7.0	659	10.5	647	13.9	637	17.4	628	20.9	619	24.4
			2850	936	9.5	922	14.2	910	18.9	900	23.6	890	28.4	882	33.1
6LP 6LVP	6"-F	0.718	1170	738	8.0	715	11.9	696	15.9	679	19.9	664	23.9	650	27.9
			1760	1162	12.0	1139	18.0	1120	24.0	1103	29.9	1088	35.9	1073	41.9
			1930	1284	13.1	1261	19.7	1242	26.3	1225	32.8	1210	39.4	1195	46.0
			2350	1586	16.0	1563	24.0	1543	32.0	1526	40.0	1511	48.0	1497	56.0
7LP 7LVP	8"-F	1.200	1170	1277	13.3	1248	20.0	1224	26.6	1202	33.3	1183	39.9		
			1465	1631	16.7	1602	25.0	1578	33.3	1556	41.7	1537	50.0		
			1760	1985	20.0	1956	30.0	1932	40.0	1910	50.1	1891	60.1		
			2050	2333	23.3	2304	35.0	2280	46.6	2258	58.3	2239	70.0		
8LP 8LVP	10"-F	1.740	880	1366	14.5	1329	21.8	1298	29.0	1270	36.3	1245	43.5		
			1170	1871	19.3	1834	28.9	1802	38.6	1775	48.2	1750	57.9		
			1375	2227	22.7	2190	34.0	2159	45.4	2131	56.7	2106	68.0		
			1800	2967	29.7	2930	44.5	2898	59.4	2871	74.2	2846	89.1		

MEDIUM PRESSURE UNITS

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT. REV.	RPM	7 PSIG CFM	7 PSIG BHP	9 PSIG CFM	9 PSIG BHP	10 PSIG CFM	10 PSIG BHP	12 PSIG CFM	12 PSIG BHP	13 PSIG CFM	13 PSIG BHP	14 PSIG CFM	14 PSIG BHP
2MP 2MVP	1"-S	0.017	2800	25	1.7										
			3250	33	1.9	30	2.5								
			3560	38	2.1	35	2.7								
			5275	67	3.1	64	3.9	63	4.4	60	5.1				
3MP 3MVP	2"-S	0.060	1760	64	3.6	59	4.6								
			2265	95	4.6	89	5.8	86	6.4						
			2770	125	5.5	119	7.1	117	7.9	112	9.5				
			3600	175	7.2	169	9.2	167	10.2	162	12.3				
4MP 4MVP	2½"-S	0.117	1760	144	6.8	136	8.8	132	9.8						
			2190	194	8.5	186	10.9	182	12.1						
			2620	245	10.2	236	13.1	232	14.5						
			3600	359	14.0	351	18.0	347	20.0						
5MP 5MVP	4"-S	0.210	1500	237	10.5	227	13.4	222	14.9	213	17.9	209	19.4		
			1760	292	12.3	281	15.8	276	17.5	268	21.0	263	22.8		
			2100	363	14.6	353	18.8	348	20.9	339	25.1	335	27.2		
			2850	521	19.9	510	25.5	505	28.4	496	34.0	492	36.9		
6MP 6MVP	5"-S	0.383	1170	331	14.9	316	19.1	309	21.2	295	25.5	289	27.6	283	29.7
			1760	557	22.4	542	28.8	535	32.0	521	38.3	515	41.5	509	44.7
			1930	622	24.5	607	31.5	600	35.0	586	42.0	580	45.5	574	49.1
			2350	783	29.9	768	38.4	761	42.7	747	51.2	741	55.5	735	59.7
7MP 7MVP	6"-F	0.733	1170	693	28.5	670	36.6	660	40.7						
			1465	909	35.6	887	45.8	877	50.9						
			1760	1125	42.8	1103	55.0	1093	61.1						
			2050	1338	49.9	1315	64.1	1305	71.2						
8MP 8MVP	8"-F	1.040	880	709	30.4	681	39.0	668	43.4						
			1170	1010	40.4	982	51.9	970	57.7						
			1375	1223	47.4	1196	61.0	1183	67.8						
			1800	1665	62.1	1638	79.9	1625	88.7						

HIGH PRESSURE UNITS

SIZE	DIA. INLET & OUTLET	DISPL. CU. FT. REV.	RPM	7 PSIG CFM	7 PSIG BHP	8 PSIG CFM	8 PSIG BHP	9 PSIG CFM	9 PSIG BHP	11 PSIG CFM	11 PSIG BHP	13 PSIG CFM	13 PSIG BHP	15 PSIG CFM	15 PSIG BHP
3HP 3HVP	1¼"-S	0.045	1760	46	2.8	44	3.2								
			2265	69	3.6	66	4.1	64	4.5						
			2770	91	4.3	89	4.9	87	5.3	83	6.5				
			3600	129	5.4	126	6.1	124	6.9	120	8.4	116	10.0	113	11.5
4HP 4HVP	1½"-S	0.069	1760	80	4.2	77	4.8	74	5.2						
			2190	110	5.0	107	5.7	104	6.4	99	7.9				
			2620	139	6.0	136	6.9	134	7.7	129	9.4				
			3600	207	8.2	204	9.4	201	10.6	196	13.0	192	15.3	188	17.7
5HP 5HVP	2½"-S	0.140	1500	154	7.0	151	8.0	147	9.0	140	10.9				
			1760	191	8.2	187	9.3	183	10.5	177	12.8	171	15.2	165	17.5
			2100	238	9.8	235	11.1	231	12.5	224	15.3	218	18.1	213	20.9
			2850	343	13.2	340	15.1	336	17.0	329	20.8	323	24.6	318	28.4
6HP 6HVP	3"-S	0.227	1170	187	8.8	182	10.1	177	11.3	168	13.8	159	16.4		
			1760	321	13.3	316	15.1	311	17.0	301	20.8	293	24.6	285	28.4
			1930	360	14.5	355	16.6	349	18.7	340	22.8	332	27.0	324	31.1
			2350	455	17.7	450	20.2	445	22.8	435	27.8	427	32.9	419	37.9
7HP 7HVP	4"-S	0.367	1170	332	14.2	325	16.3	319	18.3	307	22.4	297	26.5	287	30.5
			1465	440	17.8	434	20.4	427	22.9	416	28.0	405	33.1	395	38.2
			1760	549	21.4	542	24.5	536	27.6	524	33.7	513	39.8	504	45.9
			2050	655	25.0	648	28.5	642	32.1	630	39.2	620	46.4	610	53.5
8HP 8HVP	4"-S	0.566	880	363	16.5	354	18.9	345	21.2	329	26.0	314	30.7	300	35.4
			1170	527	22.0	518	25.1	509	28.3	493	34.5	478	40.8	465	47.1
			1375	643	25.8	634	29.5	625	33.2	609	40.6	594	48.0	581	55.3
			1800	884	33.8	874	38.6	866	43.5	850	53.1	835	62.8	821	72.4

S=SCREWED CONNECTIONS STD. PIPE F=FLANGE CONNECTIONS STD. PIPE
INTAKE AND OUTLET PIPE CONNECTIONS SAME TYPE AND SIZE.

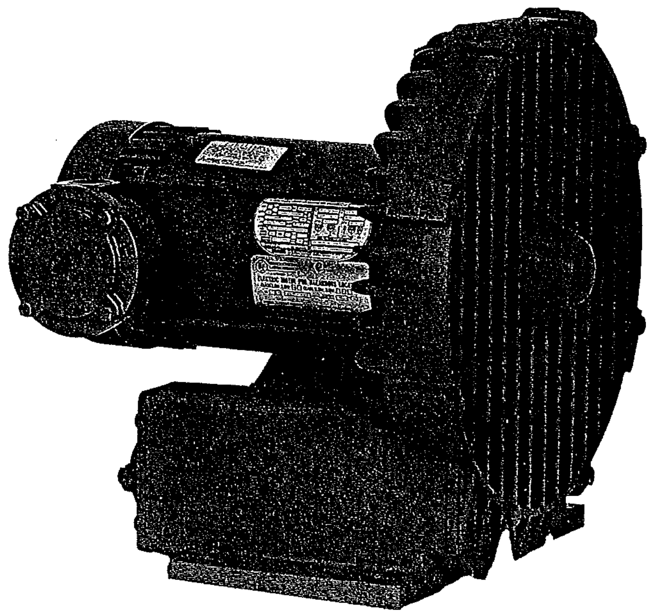
EN/CP 513
Explosion-Proof Regenerative Blower

Bioventing Blower

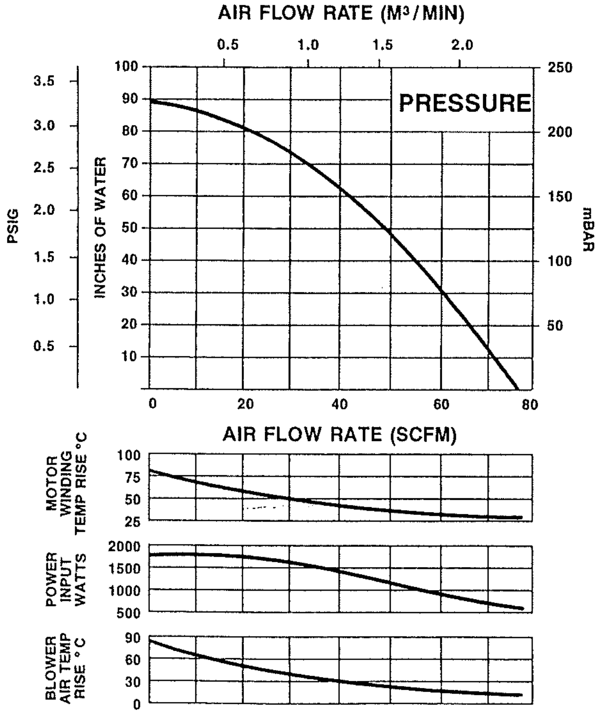
EN FEATURES
- Manufactured in the USA
- Maximum flow: 78 SCFM
- Maximum pressure: 88" WG
- Maximum vacuum: 75" WG
- Standard motor: 1.5 HP
- Blower construction – cast aluminum housing, cover, impeller & manifold; cast iron flanges
- UL & CSA approved motors for Class I, Group D atmospheres
- Sealed blower assembly
- Quiet operation within OSHA standards

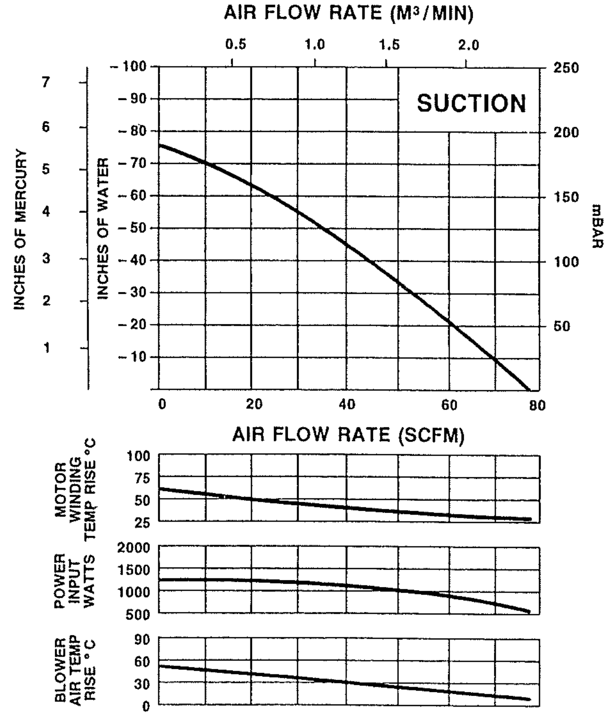
OPTIONS
- TEFC motors
- 50 Hz motors
- International voltages
- Other HP motors
- Corrosion resistant surface treatments
- Remote drive (motorless) models

ACCESSORIES
- Moisture serarators
- Explosion-proof motor starters
- Inline & inlet filters
- Vacuum & pressure gauges
- Relief valves
- External mufflers



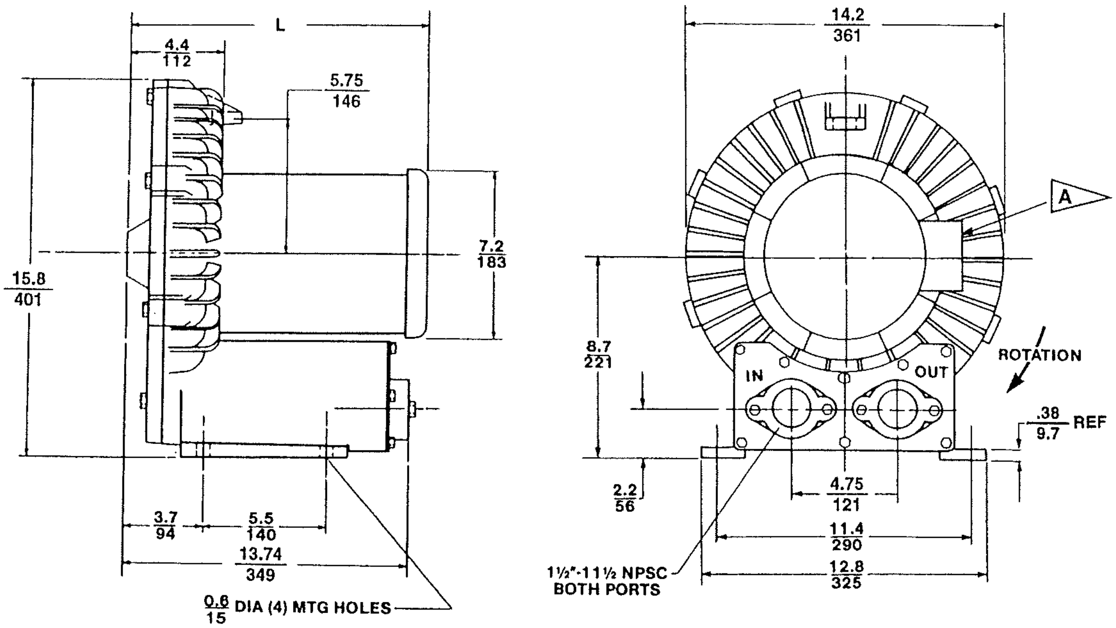
BLOWER PERFORMANCE AT STANDARD CONDITIONS





EG&G ROTRON, SAUGERTIES, N.Y. 12477 • 914/246-3401 • FAX 914/246-3802

EN/CP 513
Explosion-Proof Regenerative Blower



DIMENSIONS:	IN / MM
TOLERANCES: .XX ±	.1 / 2.5
(UNLESS OTHERWISE NOTED)	

MODEL	L (IN) ± .31	L (MM) ± 8
EN/CP513W58L	16.65	423
EN/CP513W72L	15.74	400

A 0.75" NPT CONDUIT CONNECTION AT 12 O'CLOCK POSITION

SPECIFICATIONS

MODEL	EN513W58L		EN513W72L		CP513FR58LR	CP513FR72LR
Part No.	038183		038037		–	038966
Motor Enclosure – Shaft Material	Explosion-proof – **CS**		Explosion-proof – **CS**		Chem XP – **SS**	Chem XP – **SS**
Horsepower	1.5		1.5		Same as EN513W58L – 038183 except add Chemical Processing (CP) features from catalog inside front cover	Same as EN513W72L – 038037 except add Chemical Processing (CP) features from catalog inside front cover
Phase – Frequency	Single - 60 Hz		Three - 60 Hz			
Voltage [1]	115	208-230	230	460		
Motor Nameplate Amps	15	7.9-7.5	4.6	2.3		
Maximum Blower Amps [3]	19.4	9.7-9.0	4.8	2.4		
Inrush Amps	96	48	32	16		
Starter Size	1	0	00	00		
Service Factor	1.0		1.0			
Thermal Protection [2]	Pilot Duty		Pilot Duty			
Bearing Type	Sealed, Ball		Sealed, Ball			
Shipping Weight	98 lb (45 kg)		92 lb (42 kg)			

BLOWER LIMITATIONS FOR 60 Hz

Min. Flow @ Max. Suction	0 SCFM @ –75" WG	0 SCFM @ –75" WG	0 SCFM @ –75" WG	0 SCFM @ –75" WG
Min. Flow @ Max. Pressure	0 SCFM @ 88" WG	0 SCFM @ 88" WG	0 SCFM @ 88" WG	0 SCFM @ 88" WG

1 All dual voltage 3 phase motors are factory tested and certified to operate on 200-230/400-460 VAC-3 ph-60 Hz and 220-240/380-415 VAC-3 ph-50 Hz. All dual voltage 1 phase motors are factory tested and certified to operate on 110-120/200-230 VAC-1 ph-60 Hz and 220-240 VAC-1 ph-50 Hz.
2 Maximum operating temperatures: Motor winding temperature (winding rise plus ambient) should not exceed 140° for Class F insulation or 120° for Class B insulation. Blower outlet air temperature should not exceed 140° (air temperature rise plus ambient).
3 Corresponds to the performance point at which the blower and / or motor temperature rise reaches the limit of the thermal protection in the motor.

Specifications subject to change without notice. Please contact factory for specification updates.

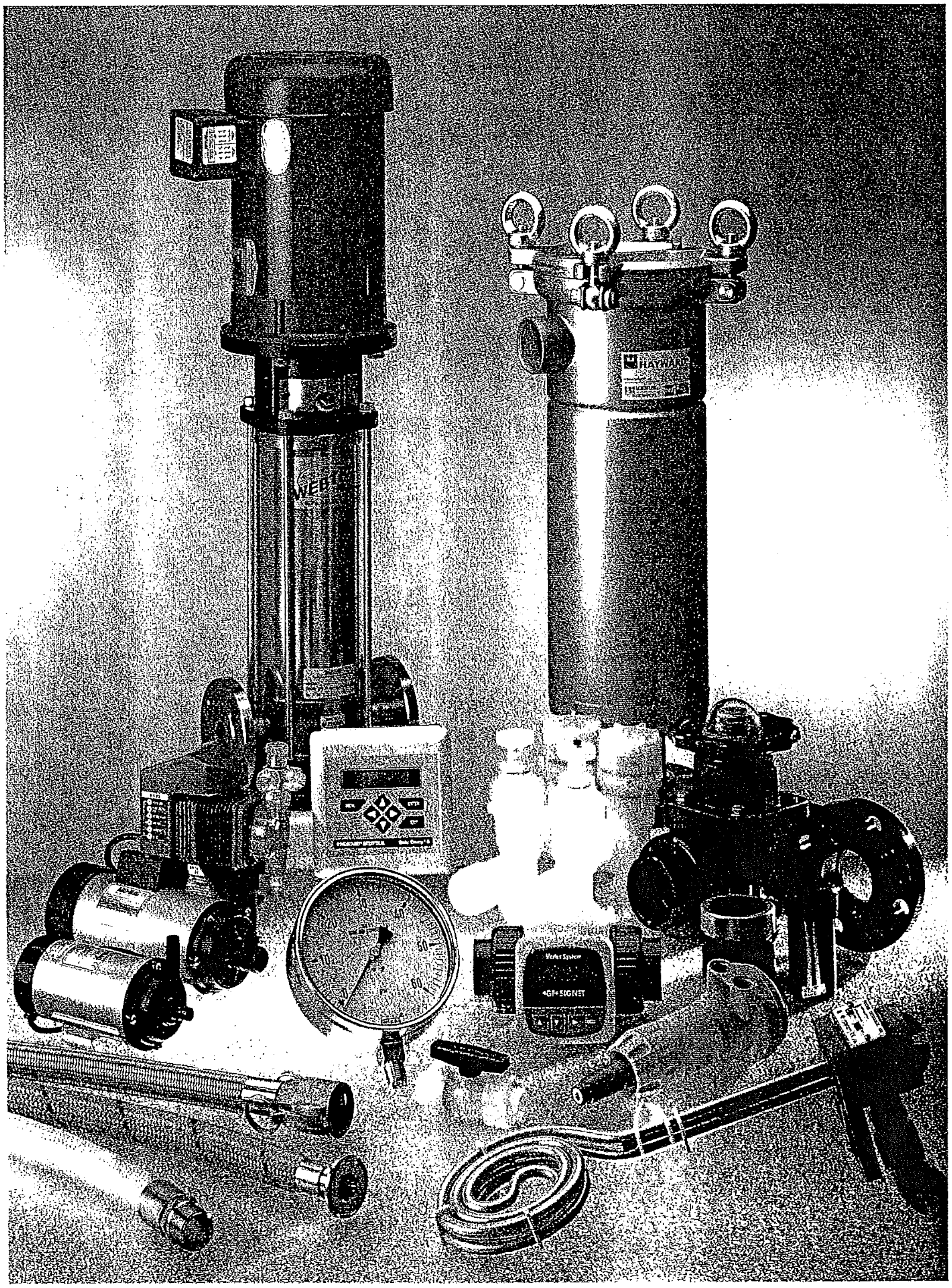
KINNEY

RyanHerco

FLUID FLOW SOLUTIONS

Locations Nationwide

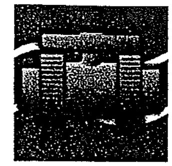
- Albuquerque NM
- Anaheim CA
- Austin TX
- Burbank CA
- Chicago IL
- Charlotte NC
- Cleveland OH
- Colorado Springs CO
- Grand Prairie TX
- Houston TX
- Orlando FL
- Philadelphia PA
- Portland OR
- [illegible]
- [illegible]



"The Perfect Order" ISO 9002 Ryan Herco Quality

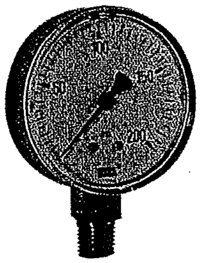
25th Edition

1-800-848-1141

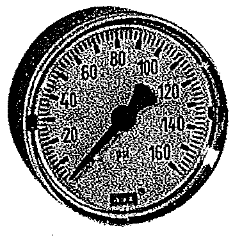


PRESSURE GAUGES

STEEL CASE PRESSURE GAUGES



2" steel case Style A, bottom connection.



2" steel case Style B, back connection.

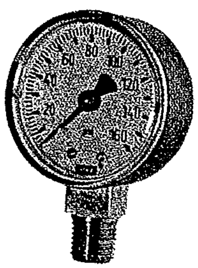
FEATURES
- 2" diameter gauge.
- Acrylic window.
- Black painted steel case & ring snap.
- White aluminum dial.
- Copper alloy bourdon tube and movement.
- 1/4" MNPT connection.
- Choice of two styles.
- ABS plastic dial and pointer.
- Accuracy ±3/2/3% of span.
- Made in U.S.A.

ORDER: 2" STEEL CASE PRESSURE GAUGE
53483-(Size No.) BOTTOM CONNECTION, Style A
53484-(Size No.) BACK CONNECTION, Style B

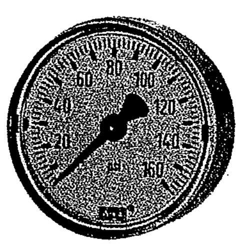
Size No.	Type of Gauge	Price Each	
		53483 Style A	53484 Style B
-130	Vacuum 0-30" Hg	$16.13	$17.03
-015	Pressure 0-15 psi	14.28	14.65
-030	Pressure 0-30 psi	14.28	14.65
-060	Pressure 0-60 psi	14.28	14.65
-100	Pressure 0-100 psi	14.28	14.65
-160	Pressure 0-160 psi	14.28	14.65
-200	Pressure 0-200 psi	14.28	14.65
-300	Pressure 0-300 psi	14.28	14.65

530.110.150 All

PLASTIC CASE PRESSURE GAUGES



2" mm plastic case Style A, bottom connection.



2" mm plastic case Style B, back connection.

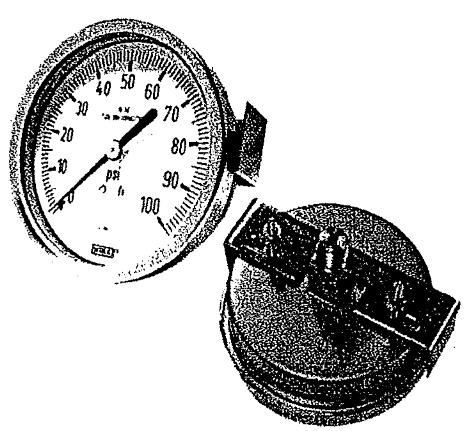
FEATURES
- 2" diameter gauge.
- Acrylic window.
- Black ABS case.
- White ABS dial.
- Accuracy ±3/2/3% of full scale.
- Copper alloy movement and bourdon tube.
- 1/4" MNPT connection.
- Made in USA.

530.110.160 All

ORDER: 2" PLASTIC CASE PRESSURE GAUGE
53481-(Size No.) BOTTOM CONNECTION, Style A
53482-(Size No.) BACK CONNECTION, Style B

Size No.	Type of Gauge	Price Each	
		53481 Style A	53482 Style B
-130	Vacuum 0-30" Hg	$14.23	$15.26
-015	Pressure 0-15 psi	12.31	13.36
-030	Pressure 0-30 psi	12.31	13.36
-060	Pressure 0-60 psi	12.31	13.36
-100	Pressure 0-100 psi	12.31	13.36
-160	Pressure 0-160 psi	12.31	13.36
-200	Pressure 0-200 psi	12.31	13.36
-300	Pressure 0-300 psi	12.31	13.36

PANEL MOUNT PRESSURE GAUGE NEW!



FEATURES
- 3-1/2" Ø panel mount gauge.
- Stainless Steel construction.
- Acrylic window.
- 1/4" MNPT center back process connection standard.
- White aluminum dial.
- Black aluminum pointer (adjustable).
- ±1.0% FS accuracy.
- U-clamp included standard.
- Requires 3-5/8" cutout.
- Made in USA.

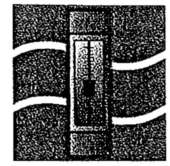
ACCESSORY ITEMS
- Pressure ranges.
- Custom dials.
- Liquid filling (glycerine).
- Special connections.
- Safety glass window.
- Oxygen service cleaning.

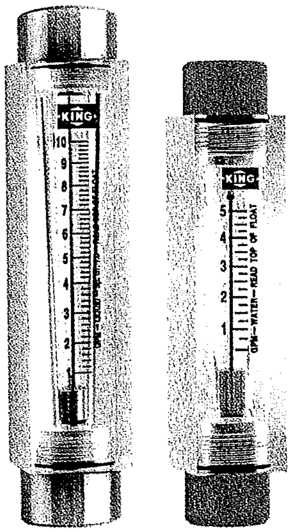
ORDER:5337-(Size No.) PANEL MOUNT PRESSURE GAUGE

Size No.	Vacuum / Pressure Ranges	Price Each
-133	30" Hg	$114.21
-037	30"-0-15 PSI	114.21
-018	0 - 15 PSI	107.77
-033	0 - 30 PSI	107.77
-063	0 - 60 PSI	107.77
-103	0 - 100 PSI	107.77
-163	0 - 160 PSI	107.77
-203	0 - 200 PSI	107.77
-303	0 - 300 PSI	107.77

530.110.180 All

GENERAL-PURPOSE ACRYLIC ROTAMETERS (VERTICAL CONNECTIONS)





STANDARD METER 5847 & 5848

FEATURES

- Vertical (in-line) connections.
- Fitting material is either PVC or brass depending on the model. 316 stainless steel is optional.
- Panel mounting and threaded inserts are included.
- 2, 4, 5, and 10" scale lengths.
- These meters are precision-machined from solid acrylic blocks.
- Direct-reading scales are screen-printed on the meter face, and the white surface backing enhances readability.
- Internal parts are 316 stainless steel or black glass for some low flows.
- EPR O-rings standard.

LARGE-DIAMETER METER 5849 & 5850

FEATURES

- Has the same in-line connections and panel-mount capability as the standard models.
- The large-diameter taper and floats provide reduced pressure loss and superior float stability.
- Choose from either 2" or 5" scale lengths.
- Available in seven flow ranges from 2-5 GPM–water and 8-20 SCFM–air.
- EPR O-rings standard.
- Fitting material is PVC. Brass or 316 stainless steel is optional at additional cost.

ORDER INFORMATION:

STANDARD METERS

5847-(Size No.) 7510 VERTICAL PORT BLOCK STYLE ROTAMETER, acrylic, water

5848-(Size No.) 7510 VERTICAL PORT BLOCK STYLE ROTAMETER, acrylic, air

Size No.	Scale Length (in.)	Block Style	Full Scale Flow Water (gal.)	Full Scale Flow Air St. cu. ft.	Pipe Conn. (in.)	Price Each
-102	2	2A	—	2 scfh	1/4 MNPT	$37.75
-104	2	2A	—	5 scfh	1/4 MNPT	37.75
-106	2	2A	—	10 scfh	1/4 MNPT	37.75
-108	2	2A	—	20 scfh	1/4 MNPT	37.75
-109	2	2A	7 gph	30 scfh	1/4 MNPT	37.75
-115	2	2A	12 gph	60 scfh	1/4 MNPT	37.75
-121	2	2A	22 gph	100 scfh	1/4 MNPT	37.75
-125	2	2A	44 gph	180 scfh	1/4 MNPT	37.75
-130	2	2A	60 gph	4 scfm	1/4 MNPT	37.75
-135	2	2A	75 gph	—	1/4 MNPT	37.75
-238	4	6A	10 gpm	40 scfm	1 FNPT	77.75
-239	4	6A	15 gpm	60 scfm	1 FNPT	77.75
-244	4	6A	20 gpm	—	1 FNPT	77.75
-250	10	7A	2 gpm	8 scfm	3/4 FNPT	108.25
-253	10	7A	3.5 gpm	14.8 scfm	3/4 FNPT	108.25
-256	10	7A	5 gpm	20 scfm	3/4 FNPT	108.25
-259	10	7A	10 gpm	40 scfm	3/4 FNPT	108.25

420.110.110 Water 420.130.110 Air

LARGE-DIAMETER METERS

5849-(Size No.) 7511 VERTICAL PORT LARGE DIAMETER BLOCK STYLE ROTAMETER, acrylic, water

5850-(Size No.) 7511 VERTICAL PORT LARGE DIA. BLOCK STYLE ROTAMETER, acrylic, air

Size No.	Scale Length (in.)	Block Style	Full Scale Flow Water (gal.)	Full Scale Flow Air St. cu. ft.	Pipe Conn. (in.)	Price Each
-002	2	2B	1 gpm	4 scfm	1/2 FNPT	44.70
-004	2	2B	2 gpm	8 scfm	1/2 FNPT	44.70
-006	2	2B	3.6 gpm	15 scfm	1/2 FNPT	44.70
-111	2	2B	5 gpm	20 scfm	1/2 FNPT	44.70
-220	5	5B	1 gpm	4 scfm	1/2 FNPT	65.85
-226	5	5B	2 gpm	8.2 scfm	1/2 FNPT	65.85
-222	5	5B	3.5 gpm	15 scfm	1/2 FNPT	65.85
-229	5	5B	5 gpm	21 scfm	1/2 FNPT	65.85

420.120.110 Water 420.140.110 Air

SPECIFICATIONS

- Capacities: 7 GPH to 20 GPM – Water; 2 SCFH to 62 SCFM – Air.
- Scale length: 2" - 10".
- Materials:
  End Fittings: PVC (standard construction), Brass, 316 Stainless Steel.
  O-rings: EPR*, Buna-N, Viton.

PERFORMANCE

Nominal Scale Length	Full Scale Accuracy (±)
2" (50 mm)	6%
3" (75 mm)	4%
4" (100 mm)	4%
5" (127 mm)	3%
10" (250 mm)	2%

PRESSURE/TEMP. GUIDELINES

Pressure	Temperature
Water 125 psig	130°F- Acrylic Metering Tube (PVC end fittings)
Air 100 psig	100°F- Acrylic Metering Tube (PVC end fittings)

Appendix F

Health and Safety Plan

Site-Specific Health & Safety Plan

Yakima Valley Spray (U-Haul) Site
Yakima, Washington

Prepared by:

The RETEC Group, Inc.
1011 S.W. Klickitat Way, Suite 207
Seattle, Washington 98134

RETEC Project Number: DWT40-16457-300

Prepared for:

Yakima Valley Spray Steering Committee

Onsite Emergency Phone Numbers	
Fire:	911
Police:	911
Ambulance:	911
For more emergency numbers and directions to the hospital, turn to page 7-1.	

April 4, 2003

Site-Specific Health & Safety Plan

Additional Field Characterization
Yakima Valley Spray (U-Haul) Site
Yakima, Washington

Prepared by:

The RETEC Group, Inc.
1011 S.W. Klickitat Way, Suite 207
Seattle, Washington 98134

RETEC Project Number: DWT40-16457-300

Prepared for:

Yakima Valley Spray Steering Committee

Prepared by: DRAFT

____
Winston Chen, P.E., Project Engineer

DRAFT

____
Sarah Albano , Staff Engineer

Approved by: DRAFT

____
Michael Byers, Project Manager

DRAFT

____
Office Health & Safety Coordinator and/or Director of EH&S Date

April 4, 2003

Table of Contents

Table of Contents

Table of Contents

List of Tables

List of Figures

List of Appendices

HEALTH AND SAFETY PLAN CHECKLIST
(For Verification Purposes Only)

Project Number: DWT40-16457-300	**Date:**
Client: Yakima Valley Spray Steering Committee	**Verified by:**
Site: Yakima Valley Spray (U-Haul) Site	

Please make sure that you Verify Compliance with the Following Items:

Necessary Signatures (Health and Safety Officer, Project Manager, HASP Preparer)	☐
Training Requirements (Section 1.3)	☐
Medical Monitoring Requirements (Section 1.4)	☐
Fit-Testing (Section 1.5)	☐
Appendix E Notice Posted (Section 1.7)	☐
Hazard Communication Program Material Posted (Section 1.8)	☐
Appropriate PPE Available (Section 3)	☐
Work Zones Established (Section 5.1) Appropriate Signage in Place (Section 5.1) Appropriate Decon Equipment and Procedures in Place (Section 6.6)	☐
Emergency Telephone Numbers Verified & Posted (Section 7)	☐
Hospital Route Verified & Posted (Section 7)	☐
Evacuation Routes Established (Section 7.6)	☐
Amendments, if applicable, are properly documented (Page VI and Appendix A)	☐
Site Safety Acknowledgment Form Completed (Appendix B)	☐
Kick-Off Meeting Convened and Documented (Appendix D)	☐
Material Safety Data Sheets Included (Appendix H)	☐
Air Monitoring Data Recorded (Appendix I)	☐
Equipment Calibration Log Completed (Appendix J)	☐

Signature ______________________________
Site Health and Safety Officer

Note: ( ) Location in HASP

HEALTH AND SAFETY PLAN AMENDMENT RECORD

Client: Yakima Valley Spray Project Steering Committee		
Project No.: DWT40-16457-300		
Project Manager: Michael Byers		
Site Engineer: Winston Chen		
Amendment No.	**Date**	**Description**

NOTE: See Safety Plan Amendments (Appendix A) for Complete Description.

1 Introduction

This document describes the health and safety protocols developed for the Yakima Valley Spray (U-Haul) Site, located in Yakima, Washington. This plan was developed to protect RETEC personnel, and make others involved with the project (subcontractors directly contracted by RETEC, visitors, and the public) aware of known or suspected health and safety hazards. General site information is summarized in Table 1-1. Background information pertaining to site history and general hazards is listed in Table 1-2.

This is an "evergreen" document, so specific sections of this plan should be changed or revised when additional information is received or when conditions at the site change. Any changes or revisions to this plan will be made by a written amendment which will become a permanent part of this plan and placed in Appendix A. Amendments must be approved by a RETEC Environmental Health and Safety (EHS) coordinator prior to implementation.

1.1 Site Safety Plan Acknowledgment and Acceptance

The project manager or site safety and health officer (SSHO), shall be responsible for informing all individuals assigned to work on the site, or visit the site beyond the clean/support zone, of the contents of this plan and ensuring that each person signs the Site Safety Plan Acknowledgment Form in Appendix B. By signing the Safety Plan Acknowledgment Form, individuals recognize the site health and safety hazards, known or suspected, and will adhere to the protocols required to minimize exposure to such hazards.

Additionally, all personnel visiting the site who do not visit the site beyond the clean/support zone must sign the visitor's log in Appendix C.

1.2 Site Health and Safety Meetings

A pre-work meeting addressing site-specific EHS issues shall be held on the first day of mobilization to the site and prior to the commencement of any work activities. Mandatory attendance is required for all personnel assigned to the site. At the conclusion of the meeting, personnel are to sign the Safety Plan Acknowledgment Form in Appendix B, indicating their attendance and understanding of the health and safety protocols. As additional personnel are assigned to the site, it is the responsibility of the project manager and/or SSHO to ensure that new personnel are briefed on health and safety protocols and that they also have reviewed and signed the Safety Plan Acknowledgment Form.

Additional EHS tailgate meeting will be held on a daily basis. These meetings shall be conducted to inform all personnel of changing site conditions, to review the STAR (see Appendix H-8), to understand any near misses and "lessons learned," to present pertinent site safety topics, and to address any worker health and safety concerns. The SSHO will complete the Site Safety Meeting form in Appendix D indicating the date, time, topics discussed, and personnel in attendance of all health and safety meetings. The STAR Form (Appendix H-8) may be used in place of the Site Safety Meeting Form if signed by all site personnel.

1.3 Training Requirements

All personnel assigned to work on this site beyond the support zone must have successfully completed 40 hours of Training for Hazardous Waste Site Work in accordance with OSHA 29 CFR 1910.120(e)(3), and be current with their 8-Hour Refresher Training in accordance with OSHA 29 CFR 1910.120(e)(8).

Personnel managing or supervising work onsite must also have successfully completed 8 Hours of Manager/Supervisor Training, meeting the requirements of 29 CFR 1910.120(e)(4). Documentation of RETEC staff training is maintained via the RETEC H&S Tracker database. For subcontractors, documentation of OSHA training is required prior to personnel being permitted to work onsite.

Any exceptions to the training requirements will be explicitly specified either in this HASP, or through a HASP amendment.

1.4 Medical Monitoring Requirements

All personnel assigned to work on this site beyond the support zone must be enrolled in a medical surveillance program meeting the requirements of OSHA 29 CFR 1910.120(f). Personnel must have successfully passed an occupational physical during the past 12 months (24 months if approved by RETEC Corporate EHS), be medically cleared to work on hazardous waste sites, and be capable of wearing appropriate person protective equipment (PPE) including any respiratory protection.

Any exceptions to the medical monitoring requirements will be explicitly specified either in this HASP or through a HASP amendment.

1.5 Fit Testing Requirements

All personnel assigned to work on this site beyond the support zone and who must wear a respirator must be familiar with the requirements in RETEC's respiratory protection program and the OSHA respiratory standard (29 CFR 1910.134). All personnel who are required to wear respiratory protection must have successfully passed a respirator fit test within the past 12 months. Personnel who do not have a current fit test are prohibited from working in areas where any potential exists for exceeding OSHA Permissible Exposure Limits. Documentation of a successful respirator fit test for the appropriate type of respirator needed for work on this specific site (half-face or full-face air-purifying respiratory [APR] or supplied air) will be required. The project manager or SSHO is to ensure that the respirator being worn by personnel is the same size, make, and model as that specified on any respirator fit test records from the past 12-month period.

1.6 Project Staff Responsibilities

The project manager or SSHO is responsible for overall project administration and for coordinating health and safety protocols and procedures for all personnel onsite at all times. All applicable U.S. EPA, OSHA, state, and local health and safety requirements shall be maintained throughout the course of the project. This HASP covers all personnel on site; however, each subcontractor is also responsible for the health and safety of its employees. If there is a dispute with regards to health and safety, the following procedures shall be followed:

1) The project manager or SSHO shall attempt to resolve the issue independently with a complete written follow-up to RETEC's Corporate EHS Manager, or

2) If the issue cannot be resolved, the project manager shall consult the RETEC Corporate EHS Manager immediately, and the specific task or operation in dispute shall be discontinued until the issue is resolved.

Any person who observes health and safety problems or infractions should immediately report the problem or infraction to appropriate personnel.

1.7 Access to Employee Exposure and Medical Records

OSHA provides employees and their designated representatives a right-of-access to relevant exposure and medical records (29 CFR 1910.20). The "Notification of Access to Employee Exposure and Medical Records" (Appendix E) is to be made accessible to all employees involved with RETEC field operations.

1.8 Hazard Communication

RETEC will advise everyone assigned to this site of the hazards associated with working on site and the methodology to be utilized to mitigate those hazards and prevent exposures. This information will be presented to personnel prior to initiation of any field activities.

The following information regarding hazardous materials will be presented to site personnel per RETEC's Hazard Communication Program:

- Material Safety Data Sheets (MSDS) located in Appendix G

- Chemical/physical hazards
- Appropriate PPE for protection from exposure
- Labeling

1.9 Behavior Based Safety

RETEC utilizes a behavioral safety process rooted in periodic observation and feedback. This approach seeks to encourage safe behavior through (1) monitoring work activities to confirm safe practices, (2) providing immediate feedback to motivate safe behavior, and (3) taking preemptive actions to correct observed shortcomings before they might result in an accident or injury. These corrective actions focus on uncovering and addressing the root causes of unsafe behavior.

The observation and feedback process consists of the following:

- Certain activities deemed most critical to safe performance are targeted for periodic observation on an O&F checklist. Checklists are included in RETEC O&F booklets.
- O&F checklists will be completed at a frequency of one per week.
- Assigned observers record whether the targeted activities are being performed "100% Safe" or note specific incidents of unsafe behavior (without identifying individuals).
- Observers provide immediate feedback, either commending safe performance or correcting unsafe behaviors.
- Completed O&F checklists are submitted to the local office EHS Coordinator.

More detail on RETEC's safety observation and feedback process can be found in the document entitled BEST: Employees' Guide to Optimizing Environmental, Health and Safety Performance found on the RETEC EHS Forum Database, and in the RETEC O&F booklet.

Table 1-1 General Information

Client: Yakima Valley Spray Steering Committee	**Proj. No.:** DWT40-16457-300
Site Name: Yakima Valley Spray (U-Haul) Site	
Site Location: 1108 S. First Street, Yakima, Washington	
Description of Field Activities: Survey and demolition of 2 buildings, excavation, backfilling of excavation, installation of bioventing/biosparging system	
Dates of Field Activities: April 7, 2003- August 20, 2004	
Project Manager: Michael Byers	**Project Manager Telephone No.:** (206) 624-9349, Cell:206-660-9945
Site Engineer/Manager: Winston Chen	**Office:** (206) 624-9349
Designated SSHO: Winston Chen	
Note: All RETEC personnel assigned to the site are current in their OSHA training, medical surveillance examination, respirator fit test, and first aid/CPR (where applicable). Documentation may be obtained from the RETEC Monroeville office from Tina McHugh, EH&S Program Administrator at (412) 380-0140.	

Table 1-2 Background

Overall Hazard Is:			
High: ☐	**Low:** ☐	**Moderate:** ☒	**Unknown:** ☐
Facility Description: The Yakima Valley Spray (U-Haul) Site is a 3.5-acre facility located in a light industrial and commercial part of town. Evergreen Kia lies to the north, Union Pacific and Burlington Northern railroad lines lie to the west, a cement plant is to the south, and Consolidated Freightways and Hahn Motor Sales lie across South First Street from the site.			
Status: The facility is currently a full service truck rental operation and is used primarily for the storage and service of rental vehicles and administrative operations.			
Unusual Features (containers, dikes, buildings, power lines, terrain, etc.): Underground Schanno Pipeline located east of the work area. Existing sanitary sewer pipeline located in work area. See Figure 5-1 for approximate locations of these pipelines.			

Site History (worker injury, complaints, regulatory agency action):
The Yakima Valley Spray (U-Haul) Site consists of property formerly owned by the Yakima Valley Spray Company (YVS), the Shell Oil Company (Shell), and the Webb Tractor and Equipment Company. Activities at YVS involved the storage of pesticides, and the mixing of commercial-grade pesticides and lime-sulfur. Both persistent and non-persistent pesticides were handled in the facility. A mixing center in the northwest corner of the property was used to store pesticides and mix spray solutions.

The mixing center had a concrete basement that was used for pesticide storage. A fire damaged the YVS plant in 1973 and the plant was demolished thereafter.

Between 1955 and 1971, Shell operated a petroleum bulk storage tank farm and distributed petroleum products from aboveground storage tanks. For many years prior to 1955, a Shell subsidiary, Washington Refinery Company, operated the same business. The Webb Tractor operations involved the sale and maintenance of farm machinery and heavy equipment. Equipment was maintained in the storage building along the northern boundary of the Webb Tractor property.

Based on results from previous site investigations, the Washington Department of Ecology (Ecology) issued Enforcement Order No. DE91TC-C453 to address the site conditions. In 2001, Ecology issued a draft Final Cleanup Action Plan for the site.

Waste Types:			
Liquid: ☒	**Solid:** ☒	**Sludge:** ☐	**Gas:** ☐
Characteristics:			
Corrosive: ☒	**Ignitable:** ☐	**Volatile:** ☐	**Toxic:** ☒
Reactive: ☐	**Unknown:** ☐	**Radioactive:** ☐	
Other (Name): ☒			

Hazards posed by Site Activities:
Chemical Hazardous include: Inhalation, ingestion and skin contact with contaminants. Physical Hazards include: Excavation, heavy equipment, slip/fall, heat and cold stress, noise, plus ongoing site operations and traffic.

Unusual Hazards:
None other than those listed above.

2 Health & Safety Risk Analysis

This section identifies the specific hazards associated with site operations and presents an analysis of documented or potential chemical hazards that exist at the site. Every effort must be made to reduce or eliminate these hazards. Hazards that cannot be eliminated must be abated by use of engineering controls and/or PPE.

2.1 Hazard Analysis Requirements

2.1.1 Job Hazard Analysis

A Job Hazard Analysis (JHA) is a basic tool that allows personnel to think through the steps involved in each job and discuss how to complete the job safety prior to mobilizing to the field. Each JHA accomplishes the following:

- Breaks a job down into individual steps
- Lists the safety hazards in each step
- Lists appropriate precautions to be followed for each hazard and safety resources (equipment, permits, etc) to be obtained and coordinated

Completion of a JHA requires thoroughness and attention to detail as well as input of all those who participate in the job. As part of this HASP and prior to commencement of work, n initial JHA will be completed by the SSHO or field task manager along with other personnel conducting the activity, and reviewed by the Project Manager or local office EHS Coordinator. This JHA will be modified as job scope or conditions change. The completed JHA for this project is included in Appendix I. If additional tasks are added to the scope of work in the field, the JHA form in Appendix H-9 will be completed and approved by the SSHO prior to the commencement of additional tasks.

2.1.2 STAR

A safety task analysis review (STAR) located in Appendix H-8 will be completed daily as a more specific supplement to the pre-project JHA. Specific tasks for the day are listed, potential hazards are identified, and controls to mitigate hazards are identified. Team members sign the form, which can also serve to document the daily safety meeting.

2.2 Precautions When Working Around Heavy Equipment

The following precautions will be taken to minimize heavy equipment hazards:

- All equipment must have back-up alarms.
- Personnel must make eye contact with the operator before approaching the equipment and remain safely outside of the swing radius of the equipment.
- Personnel must wear orange visibility vets in addition to standard Level D PPE.
- Personnel must never stand on track-hoe tracks to communicate to the operator
- Operators must be aware of personnel in the area and use proper hand signals before maneuvering.
- Operators must wear hard hats when operating machines and when going to and from their equipment.
- Operators must be use spotter and be cautious when maneuvering equipment within 15 feet of over-head power lines and utility pole guy wires and maintain safe distances at all times (greater than 10 feet).
- Provisions will be made to prevent the unauthorized start-up of equipment when personnel leave the site at the end of the shift, such as battery ignition locks.

2.3 General Site Hazards

2.3.1 Lighting

Work areas must have adequate lighting for employees to see to work and identify hazards (5-foot candles minimum, comparable to a single 75- to 100-watt bulb). Personnel should have flashlights available in all indoor or dimly lighted areas for use in the event of a power failure, or if working outdoors after daylight hours. Applicable OSHA standards for lighting (29 CFR 1910.120(m)) shall apply.

2.3.2 Electrical Power

All electrical power must have a ground fault circuit interrupter as part of the circuit, including generators. All equipment must be suitable and approved for the class of hazardous atmosphere in which it is being used. Applicable OSHA standards for electric power (29 CFR 1910 Subpart S) shall apply.

2.3.3 Lockout/Tagout

Operations where the unexpected energization, or start-up of equipment, or release of stored energy could cause injury to personnel will be protected by the implementation of a lockout/tagout program meeting the requirements of 29 CFR 1910.147. See Section 11 of this HASP for more details.

Note: For BNSF projects, in all cases where construction equipment is left unattended on or near railroad trackage or when equipment is being repaired or maintained, a master battery disconnect switch must be installed. This is best accomplished by placing a plastic "lock out" case over one of the battery cables equipped with independent lock.

Sites that have structural barriers preventing the equipment from being moved on to the tracks are not required to have these lockable disconnect switches. Fencing, ditches and walls would be considered adequate structural barriers to equipment movement on the tracks.

2.3.4 Fall Protection

Work site slip, trip, and fall accidents can result in serious injuries or fatalities. Procedures to help prevent these types of incidents will be implemented. Elevated work (above 4 feet.) where a fall potential exists will be performed using appropriate ladders and/or fall protection (i.e., body harness, lifeline, etc.) Applicable OSHA standards for fall protection (29 CFR 1910.21 through 29 CFR 1910.32) shall apply. See Section 12 of this HASP for more details.

2.3.5 Drum Handling

The movement, opening, and sampling of drums will be conducted in accordance with 29 CFR 1910.120(j). See Section 8 of this HASP for more details.

2.3.6 Cold Stress

When the temperature falls below 40°F, cold stress protocols shall be followed. Employees must be supplied with adequate clothing to maintain core temperature. Cold stress is discussed in detail in Appendix F.

2.3.7 Heat Stress

When the temperature exceeds 70°F and personnel are wearing personal protective clothing, a heat stress-monitoring program shall be implemented. Employees shall have frequent break periods and access to drinking water. Heat stress is discussed in detail in Appendix F.

2.3.8 Eye Wash Protection

All operations involving the potential for eye injury, splash, etc., must have approved eye wash units locally available as per 29 CFR 1910.151(c).

2.3.9 Hearing Protection

When the noise level of any operation exceeds the 8-hour Time Weight Average (TWA) of 85 decibels, a hearing protection program meeting the requirements of 29 CFR 1910.95 will be implemented.

2.3.10 Fire Prevention

Operations involving the potential for fire hazards shall be conducted in a manner that minimizes the risk. Non-sparking tools and fire extinguishers shall be used or available as required. Sources of ignition shall be removed. When necessary, explosion-proof instruments and/or bonding and grounding will be used to prevent explosion and/or fire.

2.3.11 Utilities

All underground utility hazards shall be identified and/or inspected prior to conducting operations involving potential contact.

2.3.12 Confined Space Entry

If any operation is conducted in an area classified as a permit-required confined space by OSHA, a "Confined Space Entry Permit" will be completed and all applicable procedures meeting the requirements of 29 CFR 1910.146 will be implemented. See Section 10 of this HASP for more details.

2.3.13 Excavation/Trenching

Any excavation/trench greater than units of 4 feet deep in which personnel must enter will be designed and constructed per all applicable requirements of 29 CFR 1926, Subpart P. See Section 9 of this HASP for more details.

2.3.14 Overhead Utilities and Power Lines

Anytime work is performed in the vicinity of overhead utilities, including power lines, a spotter will be assigned to help operators maneuver equipment in and around the wires.

The following distances will always be maintained around high-tension wires:

- For lines rated 50 kV or below, minimum clearance between the lines and any part of the crane or load shall be 10 feet.
- For lines rated over 50 kV, minimum clearance between the lines and any part of the crane or load shall be 10 feet plus 0.4 inch for each 1 kV, over 50 kV, or twice the length of the line insulator, but never less than 10 feet.
- In transit with no load and boom lowered, the equipment clearance shall be a minimum of 4 feet for voltages less than 50 kV, 10 feet for

voltages over 50 kV, up to and including 345 kV, and 16 feet for voltages up to and including 750 kV.

In addition, all utility pole "guy-wire" support cables will be identified, marked, and/or barricaded prior to work. Unintended equipment or vehicle contact with these guy wires may result in utility poles or line power lines falling on personnel or equipment.

2.3.15 Hot Work

Prior to initiation of any hot work, a "Hot Work Permit" (Appendix H-6) must be approved by a client representative and the SSHO. Client forms meeting the substantive requirements of the RETEC permit form may be used in place of Appendix H-6.

2.3.16 Severe Weather and Lightning

The SSHO will monitor local media resources to identify possible severe weather situations at the project site. Site work may be delayed, postponed, or cancelled due to severe weather based on the project manager's discretion. In the event of a weather emergency, the site will be evacuated in accordance with Section 7 of this document.

Lightning can strike up to a distance of 10 miles, but thunder can only be heard at a distance of 8 miles. Therefore, if site personnel working outdoors hear thunder and/or see lightning, work will be stopped and personnel will move to an indoor location. If indoor facilities are not available, personnel will move inside of passenger vehicles such as cars and pickups. During a thunderstorm with thunder/lightning, avoid trees/poles, standing water, high areas, and metal structures (fences, scaffolding, etc.). Work will resume 30 minutes following the final observance of thunder and/or lightning.

2.3.17 Faulty Tools and Equipment

The SSHO will ensure that equipment is properly inspected and tested to reduce hazards posed by faulty tools and equipment. An inspection checklist for various types of equipment used on RETEC sites is included in Appendix H-10.

2.4 Chemical Hazards

Previous sampling and analytical data, or previous site history and investigation, have indicated that the chemical hazards listed in Table 2-1, either documented or suspected, exist at the site. Detailed hazard information for these chemicals is available through MSDS in Appendix G. Workers will use appropriate PPE if exposure to a known or suspected contaminated medium is likely.

2.4.1 Chemicals Potentially Used

In addition to the site contaminants, chemical products will be purchased for use at the site. These chemicals may include diesel fuel, gasoline, bentonite, Portland cement, silica sand, and decontamination materials such as isopropyl alcohol, n-hexane, and soaps (e.g., Alconox). Other materials may be purchased as needed. MSDS's required by OSHA will be obtained for chemical products used at the site. Copies of the MSDS's will be maintained at the site for worker review.

2.4.2 Sample Preservatives

Preservatives including hydrochloric acid, nitric acid, sulfuric acid, zinc acetate, and sodium hydroxide may be encountered during sampling activities. Safe and proper handling techniques are to be used when collecting samples. Individuals should work upwind from the open sample keeping the bottle away from the breathing zone (approximately one arm's length) to minimize potential exposure. Personnel should be aware of any changes in wind direction that may also affect potential for exposure to vapors. Gloves and safety glasses will always be worn when collecting samples. Sample vessel seals should be immediately replaced after sample is gathered.

Should any sample preservatives come in contact with skin, the exposed area should be immediately thoroughly irrigated with fresh water.

Table 2-1 Chemical Hazards

Contaminant	Unit	PEL[a]	TLV[b]	REL[c]	STEL[d]	IDLH[e]	Odor Threshold	IP[f]
Benzene	ppm	1	0.5	0.1	1	500	34– 119	9.24
Toluene	ppm	200, 300 C	50	100	150	500	.021-69	8.82
Ethylbenzene	ppm	100	100	100	125	800	0.092-0.60	8.76
Xylenes	ppm	100	100	100	150	900	0.081-5.4	8.44-8.56
Aldrin	mg/m^3	0.25	0.25	0.25 CA	NA	25 CA	NA	NA
DDT	mg/m^3	1.0	1.0	0.5 CA	NA	500 CA	NA	NA
Dieldrin	mg/m^3	0.25	0.25	0.25 CA	NA	50 CA	NA	NA
Trichloroethylene (TCE)	ppm	100; 200 C	50	25	NA	1,000 CA	82	9.45
Tetrachloroethylene (Perchloroethylene) (PCE)	ppm	100; 200 C	25	CA	100	150 CA	4.7	9.32
Arsenic	mg/m^3	0.01	0.01	0.002	NA	5	NA	NA
Lead	mg/m^3	0.05	0.05	<0.1	NA	100	NA	NA
Chromium	mg/m^3	0.5	0.5	0.5	NA	250	NA	NA

γ– BHC (Lindane)	mg/m^3	.05	.05	.05	NA	50	NA	NA
β– BHC		NA	NA	NA	NA	NA	NA	NA
Asbestos	$fiber/cm^3$	.1	.1	.1	1[g]	CA	NA	NA

Note:
[a]OSHA Permissible Exposure Limit (PEL) (8-hour time weighted average (TWA))
[b]American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) (8-hour TWA)
[c]National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) (8-hour TWA)
[d]Short-Term Exposure Limit (15-minute TWA that should not be exceeded at anytime during the work day)
[e]Immediately Dangerous to Life & Health
[f]Ionization Potential
[g]30-min
C=Ceiling Limit (Concentration that should not be exceeded during any part of the working exposure)
CA=Carcinogenic

2.5 Hazardous Plants and Animals

This section provides an overview of some of the major plant and animal hazards in the US and information on identification and prevention of injury or illness from these hazards.

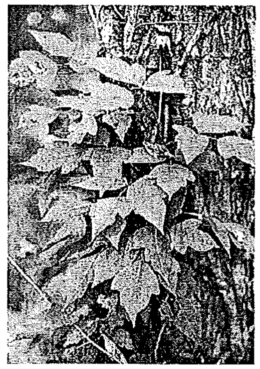
2.5.1 Hazardous Plants

Common poisonous plants in the U.S. that cause allergic reactions include 1) poison ivy, 2) poison oak, and 3) poison sumac. Plant descriptions and photographs to aid in the identification of these plants are shown on Figure 2-1.

Figure 2-1 Hazardous Plant Identification Guide

Poison Ivy

- Grows in West, Midwest, Texas, East.
- Several forms – vine, trailing shrub, or shrub.
- Three leaflets (can very 3-9).
- Leaves green in summer, red in fall.
- Yellow or green flowers.
- White berries.

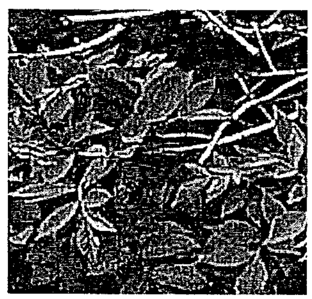
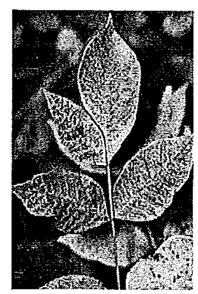



Poison Oak

- East (NJ to Texas), Pacific Coast.
- 6-foot tall shrubs or long vines.
- Oak-like leaves, clusters of three.
- Yellow berries.


Poison Sumac

- Grows in boggy areas, especially in the Southwest and Northern states.
- Shrub up to 15 feet tall.
- Seven to 13 smooth-edged leaflets.
- Glossy pale yellow or cream-colored berries.

If you have been exposed to poison ivy, oak, or sumac, act quickly, because the toxin in the plants penetrate the skin within minutes. If possible, stay outdoors until you complete the first two steps:

1. Cleanse the exposed skin with generous amounts of isopropyl alcohol.

2. Wash the skin with water.

3. Take a regular shower with soap and warm water. Do not use soap until this point because it will pick up the toxin from the surface and move it around.

4. Wash clothes, tools, and anything else that may have been in contact with the toxin, with alcohol and water. Be sure to wear hand protection during that process.

Signs and symptoms of exposure include redness and swelling that appears 12 to 48 hours after exposure. Blistering and itching will follow. If you have had a sever reaction in the past, you should see a physician right away. Otherwise, according to the FDA, there are quite a few effective over-the-counter products to help with symptoms, including Cortaid and Lanacort, baking soda, Aveeno oatmeal bath, and calamine lotion. RETEC's on-call nurse, or a pharmacist can help you make an educated choice.

2.5.2 Bees and Wasps

On RETEC sites, most encounters with bees and wasps occur when nests built in well casings or excavation areas are disturbed. Before opening a well casing, take a few moments to observe whether or not insects are entering or exiting. If they are flying to and from the casing, avoid it if possible. If you must be in an area where disturbing a nest is likely, be sure to wear long pants and a long-sleeved shirt. Stinging insects fly around the top of their target, so if you get into trouble, pull a portion of your shirt over your head and run away.

If you get stung, look for a stinger, and, if present, remove it within 15 seconds of the sting. Several over the counter products or a simple cold compress can be used to alleviate the pain of the sting. If the sting is followed by severe symptoms, or if it occurs in the neck or the mouth, seek medical attention immediately because swelling could cause suffocation.

If you need to destroy a nest, consult with the project manager of the site and your EHS Coordinator first. Commercially available stinging insect control aerosols are very effective, but could potentially contaminate the well. Once the nest is destroyed, fine mesh may be applied over the exit and entry points of a well casing to prevent re-infestation.

2.5.3 Ticks

Ticks in North America can be carriers of several diseases, including Lyme Disease (LD), Rocky Mountain Fever, and ehrlichiosis.

Limiting exposure to ticks reduces the likelihood of infection when you're exposed to tick-infested habitats. Here are some measures that you can take to prevent tick exposure:

- Remove leaf litter and brush in areas where you will be working prior to tick season.
- Wear light colored clothing so that ticks are visible.
- Tuck your pant legs into your socks.
- Apply repellants to discourage tick attachment.

- Promptly inspect your body and remove crawling or attached ticks when you leave a tick-infested area.

If a tick bites you, use the following procedure to remove it:

- Use fine-tipped tweezers or shield your fingers with tissue, paper towel, or rubber gloves.
- Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause mouthparts to break off and remain in the skin.
- Do not squeeze, crush, or puncture the body of the tick because its fluids may contain infectious organisms.
- Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin.
- After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.
- You may wish to save the tick for identification in case you become ill within 2-3 weeks. Place the tick in a zip lock bag in the freezer, and mark the bag with the date of the bite

2.5.4 Mosquitoes

Mosquitoes in the United States have been known to carry West Nile Virus, St. Louis encephalitis, and Dengue Fever. To avoid mosquito bites:

- Apply insect repellent containing DEET (N,N-diethyl-meta-toluamide) when you're outdoors.
- Read and follow the product directions whenever you use insect repellent.
- Wear long-sleeved clothes and long pants treated with repellent will further reduce your risk, as will staying indoors during peak mosquito feeding hours (dusk until dawn).
- Limit the number of places available for mosquitoes to lay their eggs by eliminating standing water sources from around your home.
- Check to see if there is an organized mosquito control program near the project site. If no program exists, work with your local government officials to establish a program.

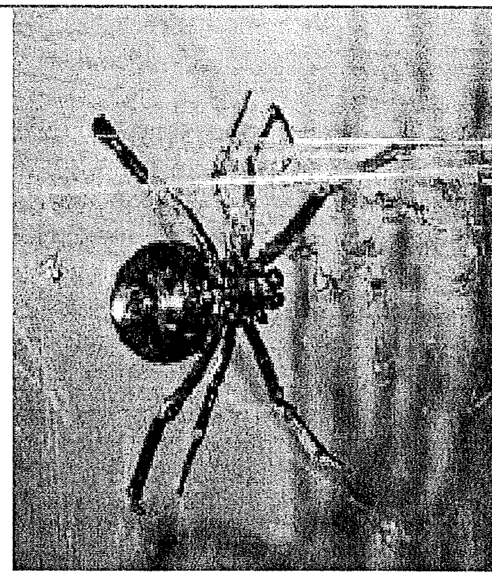
2.5.5 Spiders

The most dangerous spiders to humans in North America are black widows and brown spiders (also known as brown recluse or fiddleback spiders). A guide to identifying these spiders is presented in Figure 2-2.

Figure 2-2 Hazardous Spider Identification Guide

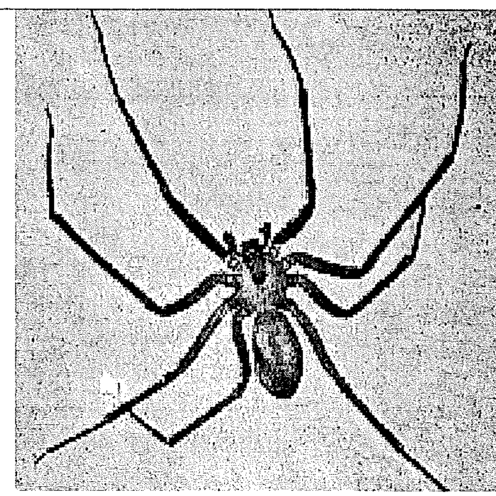
Black Widow Spider

- Abdomen usually shows hourglass marking
- The female is 3-4 centimeters in diameter.
- Have been found them in well casings and flush-mount covers.
- Not aggressive, but more likely to bite if guarding eggs.
- Light local swelling and reddening of the bite are early signs of a bite, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty breathing, and nausea.
- If bitten, see physician as soon as possible.



Brown Spiders (Recluse)

- Central & South US, although in some other areas, as well.
- ¼ to ½ inch long body, and size of silver dollar
- Hide in baseboards, ceiling cracks, and undisturbed piles of material
- Bite either may go unnoticed or may be followed by a severe localized reaction, including scabbing, necrosis of affected tissue, and very slow healing.
- If bitten, see physician as soon as possible.



2.5.6 Bird Droppings

Large populations of roosting birds may present a disease risk. The most serious health risks arise from disease organisms that grow in the accumulations of bird droppings, feathers and debris under a roost—especially if roosts have been active for years. Among the fungal diseases associated with bird droppings, the two most common are Histoplasmosis and Cryptococcosis.

If you are working in an area near large quantities of droppings are present, follow certain precautions to minimize the risk from disease organisms in the droppings:

- Wear a respirator that can filter particles as small as 0.3 microns, such as a HEPA filter.
- Wear disposable protective gloves, hat, coveralls, and boots if you will be in close contact.
- Wash or shower at the work site after cleanup, if possible.
- Modify the structure or use methods to prevent birds from reestablishing the roost.

2.5.7 Snakes

Venomous snakes are native to the US include rattlesnakes, copperheads, and cottonmouths (water moccasins). Precautions to lower the risk of being bitten:

- Leave snakes alone. Many people are bitten because they try to kill a snake or get a closer look at it.
- Stay out of tall grass unless you wear thick leather boots, and remain on paths as much as possible.
- Keep hands and feet out of areas that you can't see.
- If you encounter a snake, walk around it, giving it a berth of about 6 feet.

If someone is a snakebite victim, the following first aid should be administered:

- Wash to bite with soap and water.
- Immobilize the bitten area and keep it lower than the heart.
- Get medical help immediately.

There is a lot of false advice about how to treat snakebites. Do not ice or cool the bite, apply a tourniquet, or cut into the wound!

2.5.8 Chiggers

Chigger bites are from the tiny six-legged larvae of the chigger mite, which are so small that they can't be seen without a magnifying glass. Chiggers hide out in the grass, weeds, and vegetation, and then bite their victim by inserting their mouthparts into a pore or hair follicle of the skin. Within 3 to 6 hours of exposure to a chigger, a small, inflamed welt will appear on the skin, and will itch intensely. Itching can continue for a week or more, and if nothing is done to relive itching, secondary infections may develop from scratching. Chiggers are not known to carry disease in the U.S.

If you have been working in a chigger-infested area, take these special precautions:

- Mow vegetation from the working area.
- Eliminate shade and moisture from the area.
- Wear high boots and pants made out of tightly woven fabric.
- Tuck your pants into your socks or boots.
- Wear an insect repellant that is applied to skin, clothing, and clothing openings.
- Bring a field chair to sit on—don't sit on the grass.
- Stick to roads and trails.

When you return from a chigger-infested area in the field, do the following:

- Wash your clothes in hot, soapy water. If you can't wash your clothes, put them in a sealed, plastic bag in your hotel room. Don't wear clothes until they are washed in hot water or exposed to hot sunshine.
- Take a hot bath or shower, and wash with soap numerous times to dislodge larvae.

If you are bitten, there are numerous over-the-counter treatments that your pharmacist can recommend, such as benzocaine, hydrocortisone, and calamine lotion. Treat your itching as soon as possible to prevent secondary infection from scratching.

2.5.9 Feral Dogs

Feral dogs have shown up on several RETEC jobsites. Packs of feral dogs can be dangerous, so if you observe them on the site, call animal control immediately. If a dog approaches you, the following steps to reduce your chances of being attacked:

- Don't run away or run past the dog.

- Remain calm. Don't scream. If you say anything, speak calmly and firmly. Avoid eye contact. Try to stay still until the dog leaves, or back away slowly until the dog is out of sight. Don't turn and run.

- If you fall to the ground or are knocked down, curl into a ball, placing your hands over your head and neck. Protect your face.

If a dog bites someone, take the following steps:

- Restrain the dog immediately, if it is safe to do so. The dog will have to be quarantined or tested for rabies.

- Check on the victim's condition. Call 911 if paramedic response is required.

- Call the EHS Department to arrange for medical treatment.

3 Personal Protective Equipment

The following is a brief description of the PPE which may be required during various phases of the project. The U.S. EPA terminology for protective equipment will be used: Levels A, B, C, and D.

Respiratory protective equipment shall be NIOSH approved and use shall conform to OSHA 29 CFR 1910.134.

3.1 Level A

Level A protection shall be used when:

- The hazardous substance requires the highest level of protection for skin, eyes, and the respiratory system
- Substances with a high degree of hazard to the skin are known or suspected
- Chemical concentrations are known to be above the Immediately Dangerous to Life and Health (IDLH) levels
- Biological hazards requiring Level A are known or suspected

Level A PPE will not be utilized at this site.

3.2 Level B

Level B protection shall be used when:

- The substance(s) has been identified and requires a high level of respiratory protection but a lesser degree of skin protection

- Concentrations in the air are IDLH or above the maximum use limit of Air Purifying Respirator (APR) with full-face mask

- Oxygen deficient or potentially oxygen deficient atmospheres (<19.5%) are possible

The use of Level B PPE is not anticipated at this site.

3.3 Level C

Level C protection shall be used when:

- Substance(s) require the same level of skin protection as Level B, but a lesser level of respiratory protection
- The types of air contaminants have been identified, concentrations measured, and respirator decision logic indicates that APRs are sufficient to remove the contaminants
- The substance has adequate warning properties and all criteria for the selection of APR has been met

Table 3-1 Level C PPE to be Utilized
(Check Appropriate PPE)

☒	Half-face APR (MSHA/NIOSH approved) or full-face APR Based on air monitoring and possibility of dermal contact
☒	Full-face APR (MSHA/NIOSH approved) or half-face APR
☒	**Type of Cartridges to be Used:** Combination Organic Vapors/HEPA Cartridges
☒	Chemical-resistant clothing <u>check appropriate garments</u> (one-piece coverall; hooded one-or two-piece; chemical splash suit; chemical-resistant hood and apron; disposable chemical coveralls (i.e., Tyvek) ☒ One-Piece Coverall ☐ Hooded one-or-two piece chemical splash suit ☐ Chemical-resistant hood and apron ☐ Disposable Chemical-resistant Coveralls **Fabric Type:** PVC-coated Tyvek
☐	Disposable inner gloves (surgical)
☒	Disposable chemical-resistant outer gloves **Material Type:** Nitrile
☒	Chemical-resistant boots with steel toe and shank or disposable boot covers; booties **Material Type:** Rubber or nitrile
☐	Sleeves to be duct-taped over gloves and pants to be duct-taped over boots
☐	Safety goggles
☒	Safety glasses
☒	Hard hat (Hard hat may not be required for in-water work when no overhead hazard present)
☐	Hard hat with face shield
☒	Hearing Protectors (**REQUIRED** if site noise levels are greater than 85 dB based on an 8-hour TWA)
☐	Two-way radio communication (intrinsically safe)
☐	Long cotton underwear

☒	**Modifications:** Orange reflective safety vest

3.4 Level D

Level D protection will be used when:

- The atmosphere contains no known hazard
- Work functions preclude splashes, immersions, or the potential for unexpected inhalation of or contact with hazardous concentrations of chemicals
- Atmospheric concentrations of contaminants are less than the TLV

Table 3-4 Level D PPE (Minimum Work Uniform Permitted)

(Check Appropriate PPE)

☒	Standard work uniform/coveralls
☒	Work boots with steel toe and shank
☒	Work gloves
☐	Safety goggles
☒	Safety glasses
☒	Hearing Protectors (**REQUIRED** if site noise levels are greater than 85 dB based on an 8-hour TWA)
☒	Hard hat
☐	Hard hat with face shield
☐	Two-way radio communication (intrinsically safe)
☐	Long cotton underwear
☒	**Modifications:** Orange reflective safety vest

Table 3-5 Activity vs. Level of Protection

Activity	Level of PPE	Special Requirements
Demolition	D	Level C contingency if required based on building inspection.
Excavation and Screening	D	Level C contingency if required based on results of air monitoring of if windy, dusty conditions are present Remain aware of surroundings and stay outside of swing radius of heavy equipment.
Soil Sampling	D	Level C contingency if required based on results of air monitoring of if windy, dusty conditions are present Remain aware of surroundings and stay outside of swing radius of heavy equipment.
Backfill and Grading	D	Level C contingency if required based on results of air monitoring of if windy, dusty conditions are present Remain aware of surroundings and stay outside of swing radius of heavy equipment.
Installation of Wells	D	Level C contingency if required based on results of air monitoring of if windy, dusty conditions are present Remain aware of surroundings and stay outside of swing radius of heavy equipment.

4 Air Monitoring and Action Levels

According to 29 CFR 1910.120(h), air monitoring shall be used to identify and quantify airborne levels of hazardous substances and health hazards in order to determine the appropriate level of employee protection required for personnel working onsite.

4.1 Routine Air Monitoring Requirements

Air monitoring shall be conducted at the following times or as specified by the site engineer or SSHO:

- Upon initial entry to the work area to rule out oxygen deficient, flammable, and/or IDLH conditions
- When the possibility of an oxygen deficient, flammable, and/or IDLH condition or flammable atmosphere has developed
- As an on-going check of the levels of contaminants in the breathing zone
- When work is initiated on a different portion of the site
- When contaminants other than those previously identified are encountered
- When a different operation is initiated
- When work involves the handling of leaking drums, containers, or when working in areas with obvious liquid contamination
- During confined space entry
- At the perimeter of the site as required
- Outside the site perimeter as required (e.g., adjacent buildings)

RETEC has used objective historical data from projects similar to this project to establish an initial worker exposure assessment for lead. The data were collected within the last 12 months from sites with soil impacts and scopes of work essentially the same as this project, or with higher levels of lead impact to soil and higher potential for exposure to contaminated media (e.g., excavation rather than drilling). In all cases, the objective historical data for lead are below the PEL of 0.05 mg/m^3. Similarly, arsenic and chromium were also determined to be below the PELs of 0.01 and 0.05 mg/m^3, respectively. These data are available for review and can be obtained from RETEC Corporate EHS. However, to ensure that workers will not be exposed to levels of lead, arsenic and chromium that exceed the PELs during this project, real-time aerosol particulate monitoring will be conducted per Table 4-1.

Table 4-1 Air Monitoring/Instrumentation

(Check Appropriate Instrumentation)

X **Use:**	**Combustible Gas Indicator (CGI)** Detection of Explosive/Flammable Atmospheres		
Action Level:	<10% LEL – Continue work. 10 to 25% LEL – Continue work with caution; Stop all spark producing activities. >25% LEL – EXPLOSION HAZARD – **Evacuate Site Immediately.**		
Frequency:			
X	**Photoionization Detector (specify model):** OVM 580 Please Check Bulb Size:		
	9.5eV: ☐	**10.2eV:** ☒	**11.7eV:** ☐
Use:	Detection of Organic Gases and Vapors		
Action Level:	<1 PPM: No Action. Continue Monitoring >1 PPM: sustained for 5 minutes upgrade to modified or full Level C PPE w/minimum HF APR w/combination organic vapor/HEPA cartridges. Check for benzene with Sensidyne Pump and Benzene Tubes. >10 PPM: sustained for 5 minutes, upgrade to modified or full Level C PPE w/minimum Full Face APR w/combination organic vapor/HEPA cartridges. Check for benzene with Sensidyne Pump and Benzene Tubes. $\geq$ 50 PPM: **Evacuate site.**		
Frequency:	1-hour interval monitoring. Frequency may be decreased if site conditions warrant and after consulting regional H&S Coordinator.		
X **Use:**	**Specify Other Instrument:** Sensidyne Pump and Benzene Tubes Detection of Organic Gases and Vapors		
Action Level:	>1 PPM: upgrade to modified or full Level C PPE w/minimum HF APR w/combination organic vapor/HEPA cartridges. >10 PPM: upgrade to modified or full Level C PPE w/minimum Full Face APR w/combination organic vapor/HEPA cartridges. Check for benzene with Sensidyne Pump and Benzene Tubes. $\geq$ 50 PPM: **Evacuate site**		
Frequency:	Test should follow PID readings > 1 ppm		
X **Use:**	**Specify Other Instrument:** MIE Miniram		
Action Level:	>2.5 mg/m^3—Institute dust suppression measures >5 mg/m^3—Upgrade to FF APR with combination organic vapor/HEPA (P100) cartridges		
Frequency:	1-hour interval monitoring		

5 Site Control

5.1 Work Zones

The primary purpose for site controls is to establish the hazardous area perimeter, to reduce migration of contaminants into clean areas, and to prevent access or exposure to hazardous materials by personnel. At the end of each workday, the site should be secured and/or guarded to prevent unauthorized entry. Site work zones will include:

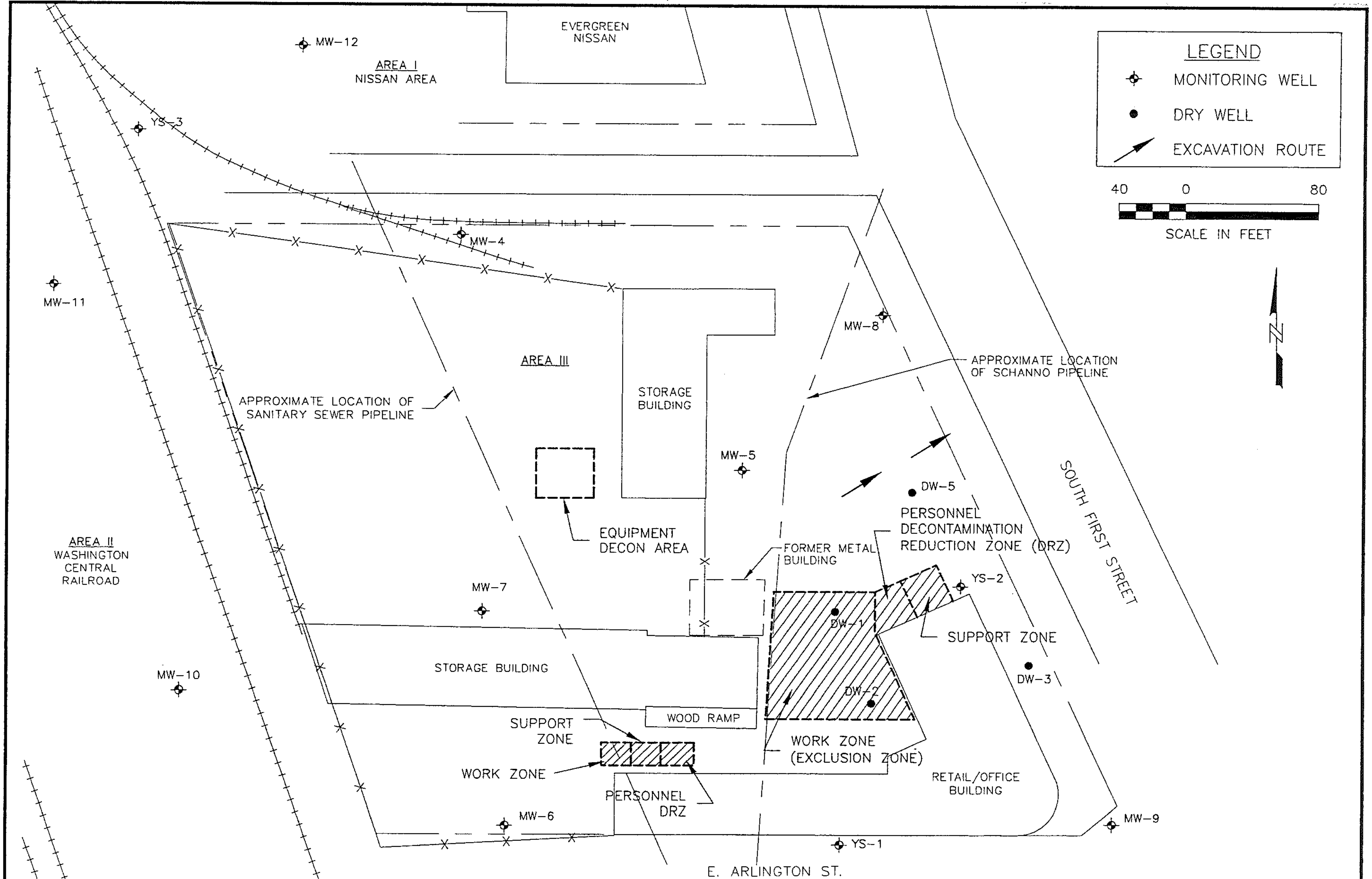
- **Clean Zone/Support Zone.** This uncontaminated zone will be the area outside the exclusion and decontamination zone and within the geographic perimeters of the site (typically the job trailer). This area is used for staging of materials, parking of vehicles, office and laboratory facilities, sanitation facilities, and receipt of deliveries. Personnel entering this zone may include delivery personnel, visitors, security guards, etc., who will not necessarily be permitted in the exclusion zone. All personnel arriving in the support zone will report to the job trailer and sign the visitor sign-in log in Appendix C of this HASP. There will be only one controlled entry/exit point from the clean zone to the decontamination zone.

- **Decontamination Reduction Zone (DRZ).** The decontamination reduction zone will provide a location for removal of contaminated PPE and final decontamination of PPE. A separate decontamination area will be established for heavy equipment. All personnel and equipment must exit via the decon area.

- **Exclusion Zone/Hot Zone.** The exclusion zone will be the "hot zone" or contaminated area inside the site perimeter. Entry to and exit from this zone will be made through a designated point. Appropriate warning signs to identify the exclusion zone should be posted (i.e., "DANGER," "AUTHORIZED PERSONNEL ONLY," "PROTECTIVE EQUIPMENT BEYOND THIS POINT," etc.). Personnel and equipment decontamination must accompany exit from the exclusion zone.

A site map (Figure 5-1) depicting the location of the site and the delineation of the work zone is shown on page 5-2 of this HASP.

File: H:\16457\16457S001.dwg Layout: ANSI_AI-CP User: astenberg Plotted: Feb 28, 2003 - 12:51pm Xref's: 16457b001



RETEC

YAKIMA VALLEY SPRAY (U-HAUL)
YAKIMA, WASHINGTON
DWT40-16457-200

DATE: 02/28/03 | DRWN: A.S./SEA

SITE MAP

FIGURE 5-1

5.2 General Field Safety and Standard Operating Procedures

- The "Buddy System" will be used at all times by all field personnel in the exclusion zone, especially if personnel are required to wear Level C or higher PPE. No one is to perform fieldwork alone unless approved by the office Health and Safety Coordinator and/or Director of EH&S. Maintain visual, voice, and/or radio communication at all times.

- Whenever possible, avoid contact with contaminated (or potentially contaminated) surfaces. Walk around (not through) puddles and discolored surfaces. Do not kneel or set equipment on the ground. Stay away from waste drums unless it is necessary to sample or handle the drums. Protect equipment from contamination by bagging.

- Eating, drinking, and/or smoking are only permitted in designated areas in the support zone.

- Hands and face must be thoroughly washed upon leaving the decon area.

- Beards and/or other facial hair that interferes with respirator fit will preclude admission to the exclusion zone.

- All equipment must be decontaminated or properly discarded upon exit from the exclusion zone as determined by the SSHO.

- All personnel exiting the exclusion zone must go through the decontamination procedures as described in this HASP.

- PPE as described in this HASP will be required for all field personnel working on site.

- Contact lenses may be worn on the site provided safety glasses or goggles are also worn. Any exceptions to wearing of contact lenses will be specified in this HASP or through a HASP amendment.

6 Decontamination

In general, everything that enters the exclusion zone must either be decontaminated or properly discarded upon exit from the exclusion zone. All personnel, including any state or local officials, must enter and exit the exclusion zone through the decon area. Prior to demobilization, contaminated equipment will be decontaminated and inspected by the project manager/site engineer before it is moved into the clean zone. Any material that is generated by decontamination procedures will be stored in a designated area in the exclusion zone pending disposal approvals and disposition.

The type of decontamination solution to be used is dependent on the type of chemical hazards. The decontamination solution for this project is Alconox or Simple Green solution and deionized water rinse. Decontamination solutions will be changed as required and collected and stored onsite until disposal approvals are secured and the arrangements for their final disposition are finalized.

6.1 Personnel Decontamination

Personnel may become contaminated in a number of ways, including but not limited to:

- Contacting vapors, gases, mists, or particulates in the air
- Being splashed by materials while sampling open containers
- Walking through puddles of liquids or on contaminated soil
- Using contaminated instruments or equipment

Even with safeguards personal contamination may occur. Harmful materials can be transferred into the clean area, exposing unprotected personnel. In removing contaminated clothing, personnel may contact contaminants on clothing or inhale them. To prevent such occurrences, decontamination procedures must be developed and established before anyone enters the site and must continue throughout site operations.

Personnel decontamination procedures will be based on the contaminants of concern and the level of protection being worn by site personnel.

6.2 Sampling Equipment

Sampling devices, when used onsite, require special cleaning procedures, which are delineated in Table 6-1.

6.3 Equipment Decontamination

Heavy equipment will be decontaminated by moving the equipment to the designated decon area and brushing off the heavy contamination with a broom, etc. The equipment will then be steam cleaned with the decon waters collected for proper disposition. Following the decontamination and prior to exiting the decontamination zone, the project manager/site engineer and/or SSHO will inspect the equipment, and if it is properly decontaminated, make note of the date, time, method, and name of decon personnel in the field notebook. The equipment may then be tagged by using a tag containing the same information as that entered into the field log.

6.4 Disposal of Contaminated Materials

All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be properly packaged and stored onsite until disposal arrangements are finalized. Clothing not completely decontaminated onsite should be secured in plastic bags before being removed from the site.

The proper disposal methods for the site are outlined in Table 6-1.

6.5 Emergency Decontamination

Personnel with medical problems or injuries may also require decontamination. There is the possibility that the decontamination may aggravate or cause more serious health effects. If prompt lifesaving, first aid, and medical treatment are required, decontamination procedures will be omitted. In either case, a member of the site management team will accompany contaminated personnel to the medical facility to advise on matters involving decontamination.

Emergency decontamination procedures for this site are discussed in the chart in Table 6-1.

6.6 Sanitizing of Personal Protective Equipment

Respirators, reusable protective clothing, and other personal articles not only must be decontaminated before being reused, but also sanitized. The insides of masks and clothing become soiled due to exhalation, body oils, and perspiration. Manufacturer's instructions should be used to sanitize the respirator masks. If practical, reusable protective clothing should be machine-washed after a thorough decontamination; otherwise it must be cleaned by hand.

Table 6-1 Decontamination Procedures

☐	**Level A:** Not Applicable. **Modifications:**
☐	**Level B:** Not Applicable. **Modifications:**
☒	**Level C:** Segregated equipment drop, boot cover and glove wash, boot cover and glove rinse, boot cover removal, outer glove removal, suit/safety boot wash, suit safety boot rinse, (canister or mask change), safety boot removal, splash suit removal, inner glove wash, face piece removal, inner glove removal, inner clothing removal, field wash, re-dress. **Modifications**:
☒	**Level D:** Segregated equipment drop, boot and glove wash, boot and glove rinse. **Modifications:**
☒	**Sampling Equipment:** Spoons, bowls, split spoon samplers will be washed with water and alconox solution and rinsed twice, once in clean water and again in deionized water.
☒	**Heavy Equipment Decontamination:** High pressure/temperature wash. Physical removal of soils attached to the equipment via brushing.
☒	**Decontamination Disposal Procedures:** Clothing, tools, and equipment that is contaminated must be properly packaged and stored onsite until disposal arrangements are finalized. Rinse water will be collected in drums for proper disposal
☒	**Emergency Decontamination Equipment Procedures:** Any person who becomes ill or injured in the exclusion zone must be decontaminated to the maximum extent possible. If the injury and/or illness is minor, full decontamination should be completed and, if possible, first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in blanket).

7 Emergency Response/Contingency Plan

It is essential that site personnel be prepared in the event of an emergency. Emergencies can take many forms: illnesses/injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in weather. Table 7-1 outlines the contact information for emergencies.

7.1 Emergency Contacts/Telephone Numbers

Table 7-1 Emergency Contacts/Telephone Numbers

Fire:	911
Police:	911
Ambulance:	911
Capable of Transporting Contaminated Personnel?	**Yes:** ☒ **No:** ☐
Hospital:	Providence Yakima Medical Center 110 S. 9th Ave. Yakima, WA 98902 (509)575-5000
Chemical Trauma Capabilities?	**Yes:** ☒ **No:** ☐
Decontamination Capabilities?	**Yes:** ☒ **No:** ☐
Directions from Site to Hospital:	From project area: 1. Drive north on South First Street toward E. Walnut St.. 2. Turn left onto E. Walnut St.. 3. Turn right onto S. 9th Ave.
Note: See map for route to hospital at the end of this section. ***The route to the hospital was verified by:*** ______________________. Distance from the Site to the hospital is: _____ miles. The approximate driving time is: _____ minutes.	
Poison Control Center	(800) 222-1222
Electric Company: Pacific Power	(888) 221-7070
Gas Company: Cascade Natural Gas	(509) 457-8175
Water Company: City of Yakima	(509) 575-6080
Airport: Yakima Airport	(509) 575-6150
National Response Center	(800) 424-8802
Center for Disease Control	(404) 639-3311 (24-hour)
ATF (explosion information)	(202) 927-8210
Chemtrec	(800) 424-9300
State Environmental Agency	(360) 956-3262
U.S. EPA Region Name: Region 10	(206) 553-1200
RETEC Corporate Office	Mr. Michael Knupp (978) 371-1422
RETEC Personnel Office (local)	(206) 624-9349
RETEC Corporate EH&S Manager	Mr. Jim Colbert (970) 493-3700
RETEC Personnel Medical Consultant (Corporate)	Ms. Barbara Giordani Health Resources (800) 350-4511, ext. 670 600 West Cumming Park, Suite 3400 Woburn, MA 018101-6350

RETEC Project Manager	Michael Byers (206) 624-9349
Client Contact	Frank Fossati-Shell Oil Company (949) 699-0386 Jerry Sedgwick-Chevron Environmental Company (925) 842-1813 Bob King-Unocal Corporation (714) 577-2950

Table 7-2 Emergency Equipment Available Onsite

Communication Equipment:	
☒	Public Telephones
☐	Private Telephones ( ) - ( ) -
☒	Cellular Telephones Winston Chen(425) 417-0537; Mike Byers (206) 660-9945
☐	Emergency Alarms/Horns
Medical Equipment:	
☒	First Aid Kits
☐	Stretcher
☒	Eye Wash Station and/or Bottle
☐	Safety Shower
☐	Blankets
☐	Other (please specify):
Fire Fighting Equipment:	
☒	Fire Extinguisher Type: ABC on MSS vessel
☐	Other:
Spill/Leak Equipment	
☐	Absorbent Boom Pads
☐	Dry Absorbent
Additional Safety Equipment:	

7.2 Personal Responsibilities During Emergencies

The SSHO or designee has primary responsibility for responding to and correcting emergency situations. The onsite SSHO will:

- Take appropriate measures to protect personnel including withdrawal from the exclusion zone, total evacuation and securing of the site, or upgrading/downgrading the level of protective clothing and respiratory protection
- Notify the Project Manager.

- Take appropriate measures to protect the public and the environment including isolating and securing the site, preventing run-off to surface waters, and ending and/or controlling the emergency to the extent possible

- Ensure that the appropriate federal, state, and local agencies are informed, and emergency response plans are coordinated. In the event of a fire or explosion, the local fire department should be summoned immediately. In the event of an air release of toxic materials, the local authorities should be informed in order to assess the need for evacuation. In the event of a spill, sanitary districts and drinking water systems may need to be alerted.

- Ensure that appropriate decon treatment for exposed or injured personnel is obtained.

- Determine the cause of the incident and make recommendations to prevent recurrence.

- Ensure that all required reports have been prepared.

- If an injury has occurred, depending on the type and severity, notify RETEC's Medical Consultant and/or Occupational Physician.

- Notify RETEC's Environmental Health & Safety Department and Human Resources Department.

- Notify the injured person's regional office.

- ***Prepare an Injury/Exposure Report (Appendix K) and submit the report to RETEC's Environmental Health & Safety Department, Human Resource Department, Regional Manager, Operations Manager, and Health & Safety Coordinator within 24 hours.***

- If the incident results in one or more fatalities or hospitalization of three or more personnel, notify the local OSHA office within 8 hours.

7.3 Medical Emergencies

Any person who becomes ill or injured in the exclusion zone must be decontaminated to the maximum extent possible. If the injury and/or illness is minor, full decontamination should be completed and, if possible, first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket). First aid should be administered while awaiting an ambulance or paramedics. ***All*** *injuries and illnesses must be reported to the Project Manager, SSHO, Health* *and Safety Department, Human Resources Department, Regional Manager, Operations Manager, and Health and Safety Coordinator.*

Any person transporting an injured/exposed person to a hospital for treatment should take directions to the hospital with them (Figure 7-1), and information on the chemicals involved. Any vehicle used to transport contaminated personnel will be cleaned or decontaminated as necessary.

7.4 Fire or Explosion

In the event of a fire or explosion, the local fire department must be summoned immediately. Upon their arrival, the project manager/site engineer and/or SSHO will advise the fire commander of the location and nature of the fire and identification of all hazardous materials onsite.

If it is safe to do so and personnel have been properly trained, site personnel may use fire-fighting equipment available on site, or remove or isolate flammable or other hazardous materials, which may contribute to the fire (i.e., incipient stage fire-fighting only).

7.5 Spill or Leaks

In the event of a spill or leak, appropriately trained site personnel will locate the source of the spill and stop the flow, if it can be done safely. Personnel will also begin containment and recovery of the spilled material, if it can be done safely.

7.6 Evacuation Routes and Resources

Evacuation routes will be established by work area locations for the site. Evacuation should be conducted immediately, without regard for equipment, under conditions of extreme emergency. See site map (Figure 5-1) for evacuation routes.

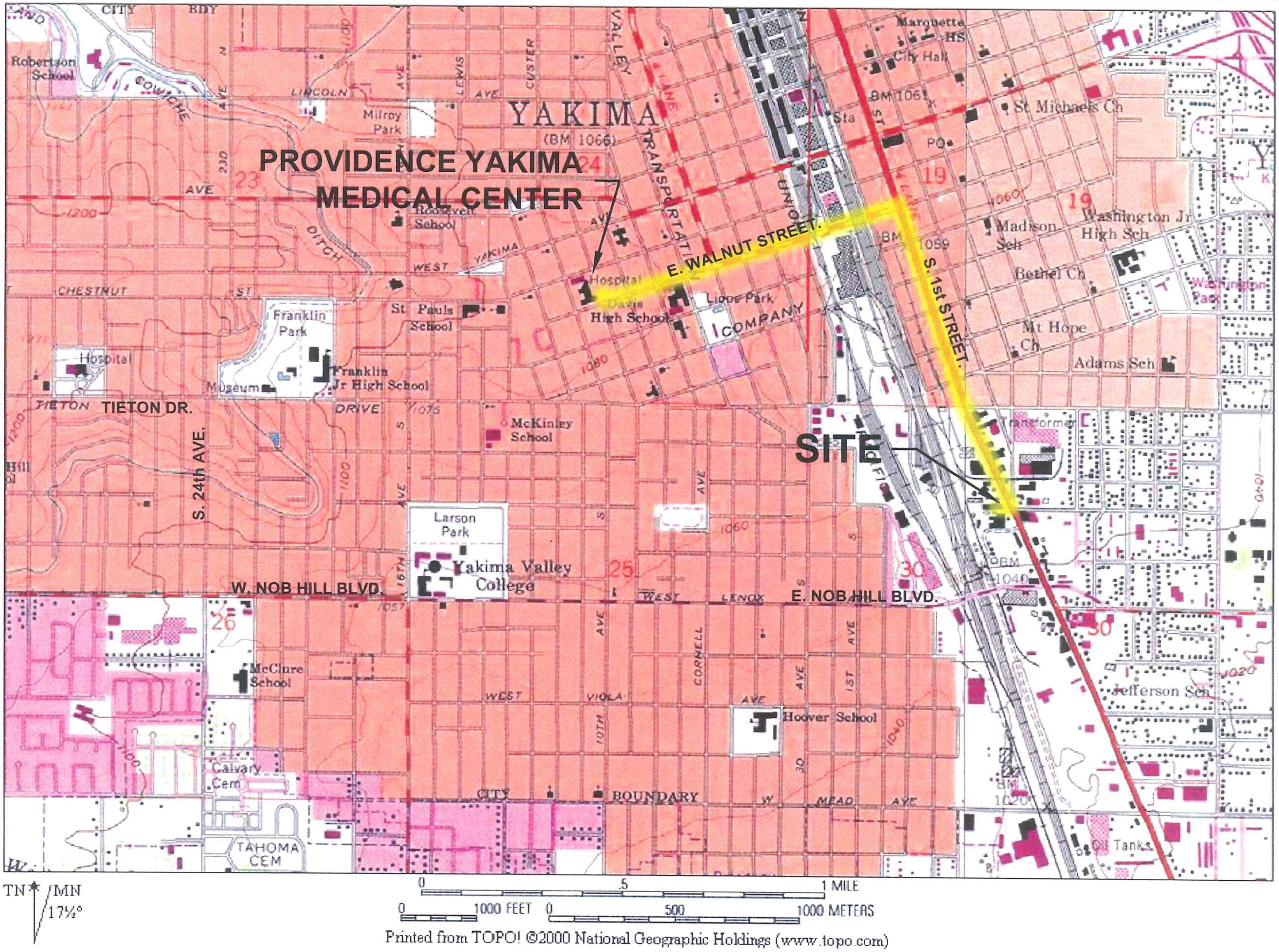
- Evacuation notification will be a continuous blast on an air horn, vehicle horn, or by verbal communication via radio.
- Keep upwind of smoke, vapors, or spill location.
- Exit through the decontamination corridor, if possible.
- If evacuation is not via the decontamination corridor, site personnel should remove contaminated clothing once they are in a location of safety and leave the clothing near the exclusion zone or in a safe place.
- The project manager/site engineer or SSHO will conduct a head count to ensure all personnel have been evacuated safely.
- In the event that a site evacuation is necessary, all personnel are to:

- Escape the emergency situation
- Decontaminate to the maximum extent practical
- Meet at RETEC's site trailer, command post, or some other pre-arranged location

7.7 Near Miss

If anyone onsite witnesses a near-miss, they must complete the Near-Miss Report (Appendix L) and submit it to the Environmental Health and Safety Department and Local Health and Safety Coordinator **within 72 hours.** Near accidents are incidents that, depending on the circumstances, could have resulted in death, personal injury, and/or property/equipment damage.

File: H:\16457\16457S024.dwg Layout: PROVIDENCE User: astenberg Plotted: Apr 04, 2003 - 10:53am Xref's:



Printed from TOPO! ©2000 National Geographic Holdings (www.topo.com)

YAKIMA VALLEY SPRAY (U-HAUL) SITE YAKIMA, WAHSINGTON DWT40-16457-300	ROUTE TO PROVIDENCE YAKIMA MEDICAL CENTER
DATE: 04/03/03 DRWN: A.S./SEA	FIGURE 7-1

8 Drum Handling/Sampling

Will this project require the handling or sampling of drummed materials?

No: ☐	Yes: ☒

If the answer to this question is **NO**, proceed to the next section. If the answer is **YES**, read this section and follow all procedures for safe drum handling and sampling.

Accidents may occur during handling of drums and other hazardous waste containers. Hazards include detonation, fires, explosions, vapor generation, and/or physical injury resulting from moving heavy containers by hand and working around stacked drums, heavy equipment, and deteriorated drums. OSHA regulations (29 CFR Parts 1910 and 1926) include general requirements and standards for storing, containing, and handling chemicals and containers, and for maintaining equipment used for handling materials. EPA regulations 40 CFR Part 265 stipulate requirements for types of containers, maintenance of containers and containment structures, and design and maintenance of storage areas. DOT regulations (49 CFR Parts 171 through 178) also stipulate requirements for containers and procedures for shipment of hazardous waste.

- Have a dry chemical fire extinguisher on hand to control small fires.
- Check for labels, markings, etc., and note conditions of containers. Are the drums bulging, deteriorated, or leaking?
- Before moving any drum or container, determine the most appropriate sequence in which the various containers should be moved.
- Exercise extreme caution in handling drums that are not intact or tightly sealed.
- Use the following types of equipment to move drums and/or containers: (1) drum grappler attached to a hydraulic excavator, (2) small front-end loader with a bucket sling, (3) rough terrain fork lift, or (4) drum cart.
- Train personnel in proper lifting and moving techniques to prevent back injuries.
- Have over packs ready before any attempt is made to move drums.

- Pressurized drums are extremely hazardous. If possible, do not move drums that may be under internal pressure as evidenced by bulging or swelling.

- If a pressurized drum has to be moved, handle the drum with a grappler unit constructed for explosive containment, if possible. Either move the drum only as far as necessary to allow seating on firm ground, or carefully over pack the drum.

- If a drum containing liquid cannot be moved without rupture, immediately transfer its contents to a sound drum using a pump designed for transferring the liquid.

- Unless drum contents are known, exercise extreme caution when opening drums.

- If an explosive situation exists, use non-sparking tools such as a bronze wrench.

- If a drum shows signs of swelling or bulging, relieve excess pressure prior to opening, and if possible, open using such remote devices as pneumatically operated impact wrenches, hydraulically or pneumatically operated drum piercers, or a backhoe equipped with bronze spikes for penetrating drum tops.

- DO NOT use picks, chisels, or firearms to open drums.

- If pressure must be released manually, place a barrier such as explosion-resistant plastic sheeting between the worker and bung to deflect any gas, liquid, or solid that may be expelled as the bung is loosened.

- Reseal open bungs and drill holes with new bungs or plugs to avoid explosions and/or vapor generation. If an open drum cannot be resealed, place the drum into an over pack. Plug any opening in pressurizing drums with pressure venting caps set for 5 psi.

- When manually sampling a drum, keep sampling personnel at a safe distance while drums are being opened. Sample only after opening operations are complete.

- Do not lean over other drums to reach the drum being sampled.

- Cover drum tops with plastic sheeting or other suitable non-chlorinated material to avoid excessive contact with drum tops.

- Never stand on drum tops.

- Obtain samples with either glass rods or vacuum pumps.

9 Excavation and Trenching

Will this project require any excavations or trenches greater than 4 feet. in depth?

No: ☐	Yes: ☒

If excavations or trenches are required and are greater than 4 feet in depth, will personnel be required to enter the excavations and/or trenches?

No: ☐	Yes: ☒

If the answer to the last question is **NO**, proceed to the next section. If the answer is **YES**, OSHA's Final Rule for Excavations (29 CFR 1926 Subpart P) must be implemented, and personnel must comply with the following excavation guidelines and complete the attached excavation worksheet.

- Remove all surface encumbrances.
- Locate all underground installations prior to opening excavation.
- Supply means of egress so that no more than 25 feet of lateral travel is required by personnel in the excavation.
- Supply warning vests for personnel exposed to vehicular traffic.
- Utilize barricades, hand signals, or stop logs for equipment operating next to excavations and slope grade away from excavation.
- Check for hazardous atmospheres (oxygen deficient, flammable, toxic gases).
- Protect excavation and personnel from water accumulation.
- Check stability of adjacent structures.
- Protect personnel from loose rock or soil.
- Inspect excavations and record information from the inspection in the field logbook.
- Stockpile excavation spoils a minimum of 2 feet from edge of excavation.
- Provide for fall protection (refer to Section 12 of this HASP).
- Classify soil.

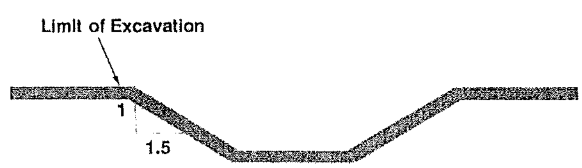
- Describe in detail any protective system used for personnel protection (sloping and benching of sides, support systems, or shield systems).

Trench Dimensions		
Length: 410	Width: 320	Depth: 18

Soil Classification			
Stable Rock ☐	A ☐	B ☐	C ☒
Note: If soil class is unknown, assume Class C for trench/shoring design.			

Support System		
☒	Sloping or benching sides	
☐	Slope to be used based on soil class and trench dimensions	
☐	Shield System	
☐	Support System	
	☐	Upright Dimensions
	☐	Whale Dimensions
	☐	Cross-Bracing Dimensions

Sketch of Protective System To Be Utilized



10 Confined Space Entry

Confined spaces pose unique problems due to their unique contents and/or configuration. Some confined spaces, for example, pose entrapment hazards for entrants, while others restrict air circulation so that hazardous atmospheres may accumulate quickly. Confinement itself can increase the risk of injury or death by making personnel work closer to hazards than they would otherwise. OSHA considers an area to be a Permit Required Confined Space if it is an enclosed space which:

- Is large enough and so configured that an employee can bodily enter and perform assigned work
- Has limited or restricted means for entry and exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, pits, and diked areas)
- Is not designed for continuous employee occupancy
- Has one or more of the following characteristics:
  - Contains or has a potential to contain a hazardous atmosphere
  - Contains a material with the potential for engulfment of an entrant
  - Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls, or a floor which slopes downward and tapers to a smaller cross-section
  - Contains any other recognized serious safety or health hazard

Does this project require personnel to enter a Permit Required Confined Space as defined above?

No: ☒	**Yes:** ☐

If the answer is **NO**, proceed to the next section.

11 Lockout/Tagout

Does this project involve the operation of machines and/or equipment in which the unexpected energization or start up of the machinery or equipment, or release of stored energy, could cause injury to personnel?

No: ☒	**Yes:** ☐

If the answer is **NO**, proceed to the next section.

12 Fall Protection

Does this project involve the use of any floors, platforms, and/or runways 4 feet or more above adjacent flooring or ground level, or the use of ladders, scaffolding, or power platforms?

No: ☒	**Yes:** ☐

If the answer is **NO**, proceed to the next section.

13 Drilling Safety

Will this project require the use of a drill or direct push equipment rig for well installation and/or subsurface sampling?

No: ☐	Yes: ☒

If the answer to this question is **NO,** proceed to the next section. If the answer is **YES**, read this section and follow all procedures for safe work practices around a drill rig.

Note: The SSHO must complete the Drill Rig Inspection Log in Appendix H-7 prior to the initiation of any drilling operations.

Accidents may occur during drilling activities. Hazards include, subsurface and overhead utilities, heavy machinery, heavy falling objects, slip/trip/fall, and potential flying debris. It is the SSHO responsibility to ensure drilling activities are conducted safely. During the site safety meeting, the SSHO should check that all of the following requirements are in place:

- Personnel are 40-Hour OSHA trained
- Personnel are current with 8-Hour Annual Refresher Training
- Personnel are enrolled in a medical monitoring program
- Personnel have been successfully fit-tested within the last 12 months
- Personnel are trained in drill rig safe operating practices
- Personnel are trained in First Aid/CPR
- Personnel are trained in emergency procedures
- Emergency telephone numbers are posted
- Personnel have received site orientation
- Personnel have reviewed the HASP

Every drill crew should have a designated safety supervisor who has authority to enforce safety on the drilling site.

Prior to the commencement of any drilling activities, the SSHO must ensure the following:

PPE

- All drilling crewmembers are wearing appropriate PPE including, at a minimum: hard hat, safety shoes/boots, appropriate gloves, safety glasses, and any other PPE that may be required on a particular site.
- Clothing of drilling crew is close fitting without loose ends, straps, draw strings, belts, or other unfastened parts.
- Drilling crew is not wearing jewelry.

Housekeeping

- Suitable storage is used for tools, materials, and supplies.
- Pipes, drill rods, casings, augers, and other drilling tools are properly placed in racks or sills to prevent rolling and/or sliding.
- Penetration or other driving hammers are placed at a safe location on the ground and secure from moving.
- Work area, platforms, walkways, scaffolding, and other access ways are free of materials, debris, obstructions, and substances.
- All controls and control linkages, warning and operation lights, and lenses are free of oil and grease and/or ice.
- Gasoline is stored only in non-sparking red containers with a flame arrester in the fill spout and the word "gasoline" easily visible.

Maintenance

- The drill rig engine is shut down to make repairs and/or adjustments. Follow lockout/tagout procedures in Section 11.
- Wheels are blocked, leveling jacks are lowered, and hand breaks set before working under a drill rig.
- All pressure on hydraulics, fluid, and air systems, as appropriate, are released prior to performing maintenance.
- Personnel do not touch engine or exhaust systems immediately after a drilling operation.
- Personnel never climb the mast for maintenance or repairs.
- Personnel never weld or cut near fuel tank.
- Drill rig is kept well maintained with appropriate quantities and qualities of lubricants, hydraulic oils, etc.

- Filter plugs, guards, high-pressure hose clamps, chains, and cables that have been removed for maintenance are replaced.

Hand Tools

- All hand tools are kept in good condition.
- All damaged tools are either repaired or replaced immediately.
- Personnel must use the right tool for the right job.

Clear Work Area

- The site is adequately cleared and leveled prior to drilling to accommodate drill rig and supplies.
- Drainage is established to channel away drilling fluids or precipitation

Drilling Operations

- Drill rigs are not to be driven from hole to hole with derrick in raised position.
- Personnel must check for overhead obstruction before raising the derrick.
- The raised mast should be a minimum of one mast length from overhead power lines.
- Drill rig is leveled and stabilized with leveling jacks and/or sold cribbing before derrick is raised.
- Derrick is locked before initiating operations.
- Personnel only operate drill rig from position of controls.
- Exhaust fumes are vented out of area if drilling in a confined or enclosed area.
- Personnel should clean mud and grease from their boots before stepping onto the drill rig platform and use handholds and railings.
- Personnel do not touch any metal parts with exposed flesh during freezing weather.
- All unattended boreholes are adequately covered and marked.
- All operations are terminated during electrical storms.

- Personnel working on an elevated derrick platform must wear appropriate fall protection and attach the lifeline to the derrick just above the derrick platform to a solid structural derrick.

- When drilling in areas of high-level soil and groundwater impact using air rotary methods, ensure the following precautions are taken to avoid splashing workers and equipment with free-phase product or highly impacted groundwater which may "air lift" rapidly from the borehole:

    - Attempt to complete the boring to total depth without work stoppages, which may allow liquids to accumulate in the boring (unless unsafe conditions arise).

    - Upgrade to modified Level D including polycoated Tyvek if impacted soil is expected or encountered.

    - Ensure the work zone is properly ventilated by positioning personnel and potential ignition sources upwind of the boring or utilizing engineering controls such as fans or blowers.

    - Use the minimum amount of air pressure necessary to evacuate cuttings from the boring once impacted soil is encountered.

- All tools are attached to derrick with safety lines.

- While working on a derrick platform, never guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or traveling block.

- Loose tools are never left on derrick platform.

- Personnel must use appropriate lifting techniques to prevent bodily injury.

Overhead and Buried Utilities

- All overhead and buried utilities are identified and located and noted on all boring location plans and boring assignment sheets.

- Utility pole guy wires will be identified, marked, and avoided

Supplying Power to Job Site

- All wiring and fixtures used to provide electricity for drilling operations are installed by a qualified person in accordance with the National Electric Code (NFPA 70-1984) with consideration with the American Petroleum Institutes recommended practices for electrical installation for production facilities (API-RP-500 B).

- Ground fault protection should be used for all separators and remote power sources.

Contact with Electricity

- If a drilling rig or a drill rig carrier makes contact with overhead or underground electrical wiring, that the operator and the person in the seat of the vehicle remain seated and not leave the vehicle and not touch any part of the vehicle or drill rig.

- If personnel must evacuate the drill rig, they must jump clear, as far as possible, and land with both feet together, and then hop from the scene.

Safety Operating Practices

- There exists a system of responsibility between the operator and the tool handler when connecting and disconnecting auger sections.

- Handler stands away from rotating auger when connecting and disconnecting auger sections.

- A pin is inserted and tapped in place, using a hammer or similar device, when securing the augur to a power coupling.

- A tool hoist is used when lowering second section of auger into place.

- Both operators stand clear of auger as it is being lifted into place.

- Long-handled shovels are used to move dirt away from auger.

- No attempt shall be made to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc. The drill rig and tools are to be used only for the purposes for which they are intended and designed.

- Soil and mud are cleaned from rotating augers using appropriate tools and not by hand.

14 Railroad Safety

Working on railroad property or near trackage poses unique EHS hazards. A summary of railroad project procedures and hazards is provided in this section. In addition, RETEC's Roadway Worker Protection requirements are included in Appendix J.

14.1 Job Safety Briefing

Before beginning any task, a complete job safety briefing will be conducted with all individuals involved with the task, and again if the task changes. If the Task is within 25 feet of any track, the job briefing must include the Yakima Valley Spray (U-Haul) Site flagman.

All contractor employees will receive safety instruction from the contractor's safety officer or a qualified Yakima Valley Spray (U-Haul) Site representative prior to the start of any project. Contractor's supervision will review the safety guide lines contained in this briefing card to familiarize their employees with safety issues that exist when working in a railroad environment. This should be reviewed at least weekly, and immediately with any new employee(s) coming on the job. It is the responsibility of the contractor's safety officer to instruct employees on these guidelines and to require their compliance.

14.2 Housekeeping

Good housekeeping is of the utmost importance in the prevention of accidents, injuries and fires. Cleanup will be conducted on a daily basis.

14.3 Personal Protective Equipment

All contractor employees working on Yakima Valley Spray (U-Haul) Site property will be required to wear OSHA approved safety glasses with side shields, hard hats with a high visibility, orange cover and above the ankle, lace up, safety toe boots, with a defined heel. Office employees restricted to office work will not be required to comply. Reflective vests are required in certain locations as specified by the Yakima Valley Spray (U-Haul) Site representative in charge of the project. During inclement weather, proper clothing to protect against frostbite, etc. will be worn. Particular attention to footing and the use of proper footwear are essential when working in snow or other slippery conditions. Hearing protection, fall protection and respirators will be worn as required by state and federal regulations.

14.4 Fouling Tracks

Train or equipment movement should be expected on any track, in any direction, at any time. Work will not be performed at less than 25 feet from the centerline of any track without a Yakima Valley Spray (U-Haul) Site representative present, unless track is protected by track bulletin and work has been authorized by the Yakima Valley Spray (U-Haul) Site representative in charge of the project. Do not walk between rails or foul track, except when duties require and proper protection is provided. When necessary to cross tracks, look in both directions and keep a minimum of 25 feet from the nearest end of stationary rail equipment. Do not crawl under or between rail cars. Under certain conditions, trains and equipment can approach without being heard. Proper attention and protection are essential to personal safety when working near railroad tracks. Work cannot be performed within 8 feet of the nearest rail of any live track without first providing for positive protection for men and equipment.

14.5 Work Protection

If work protection is provided, every employee must know:

- Who the Yakima Valley Spray (U-Haul) Site flagman is, and how to contact him
- Limits of the work protection
- The method of communication to stop and resume work
- Entry into work limits when designated

Note: Men or equipment entering work limits that were not previously job briefed must notify the flagman immediately, and be given a job briefing if working less than 25 feet from the centerline of the track.

14.6 Riding on Equipment

Riding on rail equipment is prohibited unless authorized by the Yakima Valley Spray (U-Haul) Site representative in charge of the project.

14.7 Damage to Yakima Valley Spray (U-Haul) Site Property

Any damage to Yakima Valley Spray (U-Haul) Site property will be reported immediately to the Insert Railroad Client representative in charge of the project. Any vehicle or machine contact with a track, signal equipment or structure (bridge) could result in derailment and is to be reported by the quickest means possible to the Yakima Valley Spray (U-Haul) Site representative in charge of the project or the respective System or Network Operations Center. Emergency numbers are to be obtained from the Yakima Valley Spray (U-Haul) Site representative in charge of the project, prior to the start of any work, and posted at the job site for the duration of the project.

14.8 Passing Trains

When a train is approaching, men or equipment working less than 25 feet from the centerline of track will stop work and move as far away from the track as practical, until the ENTIRE train has passed. This assures the train engineer that the train has been seen and it is safe to proceed. Failure to do this could result in the engineer placing the train into emergency that could result in damage to the train and delay to railroad traffic. After notification by the Yakima Valley Spray (U-Haul) Site flagman that no other trains are within the working limits, work may then resume. If a train is stopped on a track, work can only be performed that is beyond 8 feet of the nearest rail of the track the train is on. No work within 8 feet of the nearest rail can be performed. In passing around the ends of standing cars, engines, roadway machines, or work equipment, leave at least 20 feet between yourself and the end of the equipment. Do not go between pieces of equipment if the opening is less than one car length (50 feet).

NOTE: Some projects may require a different procedure. In these cases, the Yakima Valley Spray (U-Haul) Site **representative in charge of the project will advise the contractor of the proper work procedure adjacent to passing trains.**

Violent arm, flag, or flashlight movement while trains are passing indicates an emergency (requires trains to stop) and must not be done unless an emergency exists. NEVER stand with your back to a moving train. Metal banding and other components sometimes break during shipment and can swing out several feet from the train.

14.9 Stepping or Sitting on Rails

Stepping, walking, or sitting on the top of rail is prohibited. The railhead becomes very slick from oil buildup and presents a slipping hazard.

14.10 Environmental

No contaminates are to be discharged on Yakima Valley Spray (U-Haul) Site property. Should it occur, it must be reported by the quickest means possible to the Yakima Valley Spray (U-Haul) Site representative in charge of the project (this includes oils, diesel fuel, gasoline, etc.)

14.11 Excavation

Excavating on the right-of-way could result in damage to buried cables resulting in delay to railroad traffic. Before any excavation commences, contact the Yakima Valley Spray (U-Haul) Site signal and track representative in charge of the area. All underground and overhead wires are to be considered **HIGH VOLTAGE** and dangerous until verified with the company having ownership of the line. It is the contractor's responsibility to notify any other companies that have underground utilities in the area before excavating.

All excavation will be protected as required by the Yakima Valley Spray (U-Haul) Site representative in charge of the project and back filled as quickly as possible.

14.12 Reporting

Any personal injury sustained by a contractor employee while on railroad property must be reported immediately (by phone mail if unable to contact) to the Yakima Valley Spray (U-Haul) Site representative in charge of the project. The injury report form provided by Yakima Valley Spray (U-Haul) Site is to be completed and sent by Fax to the address indicated on the form, no later than close of shift on the date of injury.

14.13 Weekend/After Hours

When contractor employees are required to work on Yakima Valley Spray (U-Haul) Site property after normal working hours or on weekends, the Yakima Valley Spray (U-Haul) Site representative in charge of the project must be notified. When it is necessary to work during these times, a minimum of two employees are required to be present. This could be an employee with contractor employee or two contractor employees. Exceptions must be approved by the Yakima Valley Spray (U-Haul) Site representative in charge of the project. Any work performed less than 25 feet from the centerline of track must be protected by a flagman or by a qualified lookout.

14.14 Operation of Vehicles and Equipment

Equipment and vehicles must operate at a safe speed being aware of operating conditions as well as other equipment and men working in close proximity. Vehicles left unattended must be secured so as to prevent unexpected roll away.

Extreme caution must be exercised at all grade crossings.

- STOP, LOOK, AND LISTEN
- "THINK"
- When in Doubt, Take the Safe Course

Appendix A

Site Safety Plan Amendments

PLEASE USE THIS DOCUMENT TO MAKE ANY CHANGES TO THE HEALTH AND SAFETY PLAN

Site Safety Plan Amendments

Amendment No.:______________________________

Client:	**Project Number:**
Location:	**Date:**
Project Manger:	**Site Engineer:**
Site EHS Officer:	
Amendment:	
Reason for Amendment:	
Alternative Safeguard Procedures:	
Required Changes in PPE:	

______________________________ ______________________________

Site EHS Officer **Date**

______________________________ ______________________________

Corp. EHS Manager **Effective Date**

Appendix B

Site Safety Plan Acknowledgment

Site Safety Plan
Acknowledgment Form

I have been informed, understand, and will abide by all the procedures and protocols set forth in this Site Health and Safety Plan for the Yakima Valley Spray (U-Haul) Site.

Name (Print)	Signature	Affiliation	Date

Appendix C

Visitor Sign-In Log

Visitor Sign-In Log

Client:______________________ **Project Number**: DWT40-16457-300__________

Location: Yakima, WA______________________ **Site Engr.**: Winston Chen______________________

Project Mgr.: Michael Byers______________________ **Site EHS Officer**: Winston Chen______________________

Date	Name	Affiliation	Purpose of Visit	Site EHS Training		Do you have Level D PPE?		Time In	Time Out
				Yes	No	Yes	No		

Appendix D

Site Safety Meeting Form

Our behavior-based safety process is the key to our success!

Site Safety Meeting

Project Name:____________________ Location:____________________
Date:____________________ Time:____________________
Project Number:____________________ Instructor:____________________

Safety Topics Presented

JHA/STAR:____________________

Lessons Learned:____________________

BEST O&F:____________________

General Safety Topics:____________________

Name	Attendee's Signature

Appendix E
Notification of Access to Employee Exposure and Medical Records

Notice

To All Employees: This Notice Is to Provide Information for Compliance with 29 CFR Part 1910 Subpart C - General Safety and Health Provisions - Paragraph 1910.1020, Access to Employee Exposure and Medical Records.

(i) The existence, location, and availability of any records covered by this section is as follows:

The RETEC Group, Inc.

One Monroeville Center, Suite 1015
Monroeville, PA 15146
PH: (412) 380-0140
FAX: (412) 380-0141

Attn: Tina McHugh

tmchugh@retec.com

Corporate Environmental Health and Safety Administrative/Workers' Comp. Manager

(ii) The person responsible for maintaining and providing access to these records is RETEC's Corporate Environmental Health and Safety Administrative Manager.

(iii) Each employee has the right to access these records.

(iv) A copy of this standard and its appendices are available to all affected employees at each RETEC office location.

For More Information or Questions Contact:

Ms. Tina L. McHugh
Corporate EHS Administrative/Worker's Comp. Manager
(412) 380-0140

Appendix F

Cold & Heat Stress and Other Physiological Factors

Cold Stress

These Threshold Limit Values (TLVs) are intended to protect workers from the severe effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body core temperature from falling below 36°C and to prevent cold injury to body extremities. Deep body temperature is the core temperature of the body as determined by rectal temperature measurements. For a single, occasional exposure to a cold environment, a drop in core temperature to no lower than 35°C should be permitted. In addition to provisions for total body protection, TLV objective is to protect all parts of the body, with emphasis on hands, feet, and head, from cold injury.

Introduction

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body. The clinical presentations of victims of hypothermia are shown in Table 1 (taken from Dembert in AFP, January 1982). Workmen should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision-making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air or to immersion in cold water in temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating clothing to maintain core temperatures above 36°C must be provided to workers if work is performed in air temperatures below 4°C (40°F). Wind chill factor[1] or the cooling power of the air is a critical factor. An equivalent chill temperature chart relating the actual dry bulb air temperature and the wind velocity is presented in Table 2. The equivalent chill temperatures on exposed skin are determined by estimating the combined cooling effect of wind and low air temperatures.

2. Unless there are unusual or extenuating circumstances, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating

[1] Wind chill factor is a unit of heat loss from a body defined in watts per meter squared per hour being a function of the air temperature and wind velocity upon the exposed body.

clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered. The precautionary action to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

Evaluation and Control

For exposed skin, continuous exposure should not be permitted when the air speed and temperature result in an equivalent chill temperature of -32°C (-25°F). Superficial or deep local tissue freezing will occur only at temperatures below -1°C regardless of wind speed.

At air temperatures of 2°C (35.6°F) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

Table 1 Progress Clinical Presentations of Hypothermia[2]

Core Temperature		Clinical Signs
°C	°F	
37.6	99.6	"Normal" rectal temperature
37.0	98.6	"Normal" oral temperature
36.0	96.8	Metabolic rate increases in an attempt to compensate for heat loss
35.0	95.0	Maximum shivering
34.0	93.2	Victim conscious and responsive, with normal blood
33.0	91.4	Severe hypothermia below this temperature
32.0 31.0	89.6 87.8	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
30.0 29.0	86.0 84.2	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases
28.0	82.4	Ventricular fibrillation possible with myocardial irritability
27.0	80.6	Voluntary motion ceases; pupils non-reactive to light; deep tendon and superficial reflexes absent
26.0	78.8	Victim seldom conscious
25.0	77.0	Ventricular fibrillation may occur spontaneously
24.0	75.2	Pulmonary edema
22.0 21.0	71.6 69.8	Maximum risk of ventricular fibrillation
20.0	68.0	Cardiac standstill
18.0	64.4	Lowest accidental hypothermia victim to recover
17.0	62.6	Isoelectric electroencephalogram
9.0	48.2	Lowest artificially cooled hypothermia patient to recover

2 Presentations approximately related to core temperature. Reprinted from the January 1982 issue of American Family Physician published by the American Academy of Fandly Physicians.

Table 2 Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)

Est. Wind Speed (mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-131
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect).	**Little Danger** In < 1 hr. with dry skin. Maximum danger of false sense of security.				**Increasing Danger** Danger from freezing of exposed flesh within one minute.			**Greater Danger** Flesh may freeze within 30 seconds.				
	Trench foot and immersion foot may occur at any point on this chart.											

Note:
Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Recommended limits for properly clothed workers for periods of work at temperatures below freezing are shown in Table 3. Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for more than 10 to 20 minutes in an environment below 16°C (60°F), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars shall be covered by thermal insulating material at temperatures below -1°C (30°F).

To prevent contact frostbite, the workers should wear anti-contact gloves.

1. When cold surfaces below -7°C (20°F) are within reach, a warning should be given to each worker by his supervisor to prevent inadvertent contact by skin.

2. If the air temperature is -17.5°C (9°F) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (40°F). The workers shall wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind shall be reduced by shielding the work area, or by wearing an easily removable outer windbreak layer garment. Wind chill cooling rates are illustrated in Table 4.

2. If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing used may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent and the outerwear should be changed as it becomes wet. The outer garments must include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, and the clothing is wet, the employee shall change into dry clothes before entering the cold area. The workers shall change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change shall be determined empirically and will vary individually and according to the type shoe worn and how much the individual's feet sweat.

3. If extremities (ears, toes, and nose) cannot be protected sufficiently to prevent sensation of excessive cold or frostbite by handwear, footwear, and facemasks, these protective items shall be supplied in auxiliary heated versions.

4. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve.

5. Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperature below 4°C (40°F) shall take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point only just above ambient temperatures.

Table 3 Threshold Limit Values Work/Warm-up Schedule for Four-Hour Shift

Air Temp – Sunny Sky		Non-Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C	°F	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks
-26° to -28°	-15° to -1°	Normal Breaks		Normal Breaks		75	2	55	3	40	4
-29° to -31°	-20° to -24°	Normal Breaks		75	2	55	3	40	4	30	5
-32° to -34°	-25° to -29°	75	2	55	3	40	4	30	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55	3	40	4	30	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40	4	30	5	Non-emergency work should cease					
-40° to -42°	-40° to -44°	30	5	Non-emergency work should cease							
-43° & below	-45° & below	Non-emergency work should cease									

Notes:

1. Schedule applies to moderate-to-heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For light-to-moderate work (limited physical movement): apply the schedule one step lower. For example, at 30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (5).

2. The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph - light flag moves; 10 mph - light flag fully extended; 15 mph - raises newspaper sheet; 20 mph - blowing and drifting snow.

3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be:
   (1) special warm-up breaks should be initiated at a wind chill of about 1720 Wm/2
   (2) all non-emergency work should have ceased at or before a wind chill of 2250 W/m2.

   In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.

   Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labor.

Table 4 Wind Chill Cooling Rate Effects*

Wind Chill Rates (Watts/m^3)	Comments/Effects
700	Conditions considered comfortable when dressed skiing.
1200	Conditions no longer pleasant for outdoor activities on overcast days.
1400	Conditions no longer pleasant for outdoor activities on sunny days.
1600	Freezing of exposed skin begins for most people depending on the degree of activity and the amount of sunshine.
2300	Conditions for outdoor travel such as walking become dangerous. Exposed areas of the face freeze in less than 1 minute for the average person.
2700	Exposed flesh will freeze within half a minute for the average person.

**Adapted from Canadian Department of the Environment, Atmospheric Environment Service.*

Work-Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below -7°C (20°F), heated warming shelters (tents, cabins, rest rooms, etc.) shall be made available nearby and the workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostbite, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for the immediate return to the shelter. When entering the heated shelter, the outer layer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation. Also, a change of dry work clothing may be provided. A change of dry work clothing shall be provided as necessary to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of the diuretic and circulatory effects.

For work practices at or below -12°C (10°F) ECT, the following shall apply:

1. The worker shall be under constant protective observation (buddy system or supervision).

2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods must be taken in heated shelters and opportunity for changing into dry clothing shall be provided.

3. New employees shall not be required to work full time in cold in the first days until they become accustomed to the working conditions and required protective clothing.

4. The weight and bulkiness of clothing shall be included in estimating the required work performance and weights to be lifted by the worker.

5. The work shall be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats shall not be used. The worker should be protected from drafts to the greatest extent possible.

6. The workers shall be instructed in safety and health procedures. The training program shall include, at a minimum, instruction in:

   a) Proper re-warming procedures and appropriate first aid treatment

   b) Proper clothing practices

   c) Proper eating and drinking habits

   d) Recognition of impending frostbite

   e) Recognition of signs and symptoms of impending hypothermia or excessive cooling of body even when shivering does not occur

   f) Safe work practices

Special Workplace Recommendations

Special design requirements for refrigerator rooms include the following:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter per second (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.

2. Special wind-protective clothing shall be provided based upon existing air velocities to which workers are exposed.

Special caution shall be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed outdoors in a snow and/or ice-covered terrain shall be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) and blowing ice crystals are required when there is an expanse of snow coverage causing a potential eye exposure hazard.

Workplace Monitoring is Required as Follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60°F) to enable overall compliance with the requirements of the TLV to be maintained.

2. Whenever the air temperature at a workplace falls below -1°C (30°F), the dry bulb temperature should be measured and recorded at least every 4 hours.

3. In an indoor workplace, the wind speed should also be recorded at least every 2 hours whenever the rate of air movement exceeds 2 meters per second (5 miles per hour).

4. In an outdoor work situation, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below -1°C (30°F).

5. The equivalent chill temperature shall be recorded with the other data whenever the equivalent chill temperature is below -7°C (20°F).

Employees shall be excluded from work in cold at -1°C (30°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below -24°C (-10°F) with wind speeds less than 5 miles per hour should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues, in addition to providing first aid treatment.

Heat Stress and Other Physiological Factors

Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat and fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of most common (and potentially serious) illnesses at hazardous wastes sites, regular monitoring and other preventative precautions are vital.

Individuals vary in their susceptibility to heat stress. Factors that may predispose someone to heat stress include:

- Lack of physical fitness
- Lack of acclimatization
- Age
- Dehydration
- Obesity
- Alcohol and drug use
- Infection
- Sunburn
- Diarrhea
- Chronic disease

Reduced work tolerance and the increased risk of excessive heat stress is directly influenced by the amount and type of PPE worn. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure. Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the following:

- Anticipated work rate
- Ambient temperature and other environmental factors
- Type of protective ensemble
- Individual worker characteristics and fitness

Monitoring

Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

- For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress. If the actual work clothing differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly.

- For workers wearing semi-permeable or impermeable[1] encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 21°C (70°F).

To monitor the worker, measure the following:

- **Heart Rate.** Count the radial pulse during a 30-second period as early as possible in the rest period.

  If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

  If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

- **Oral Temperature.** Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).

  If the oral temperature exceeds 37.7°C (99.6°F) at the beginning of the next rest period, shorten the following work cycle by one-third.

  Do not permit a worker to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 38.1°C (100.6°F).

- **Body Water Loss, If Possible.** Measure weight on a scale accurate to +0.25 pounds at the beginning and end of each workday to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing. The body water loss should not exceed 1.5 percent total body weight loss in a workday.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see Table 1). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

[1] Although no protective ensemble is "completely" impermeable, for practical purposes an outfit may be considered impermeable when calculating heat stress risk.

Table 1 Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[1]

Adjusted Temperature[2]		Normal Ensemble[3]	Impermeable Ensemble
°F	°C		
90 or above	32.2 or above	After each 45 minutes of work	After each 15 minutes of work
87.5 – 90	30.8 – 32.2	After each 60 minutes of work	After each 30 minutes of work
87.5 – 85.5	28.1 – 30.8	After each 90 minutes of work	After each 60 minutes of work
77.5 – 82.5	25.3 – 28.1	After each 120 minutes of work	After each 90 minutes of work
72.5 – 77.5	22.5 – 25.3	After each 150 minutes of work	After each 120 minutes of work

[1]For work levels of 250 Kilocalories/hour.

[2]Calculate the adjusted air temperature (ta adj) using this equation: ta adj = ta ° = (13 + % sunshine). Measure air temp. (ta) with a standard thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distant shadow, 0 percent sunshine = no shadows).

[3]A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Prevention

Proper training and preventive measures will help avert serious illness and decrease in productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, the person may be predisposed to additional heat injuries. To avoid heat stress, management should take the following steps.

- Adjust work schedules:
  - Modify work/rest schedules according to monitoring requirements.
  - Mandate work slowdowns as needed.
  - Rotate personnel: alternate job functions to minimize overstress or overexertion at one task.
  - Add additional personnel to work teams.
  - Perform work during cooler hours of the day, if possible, or at night, if adequate lighting can be provided.
  - Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
  - Maintain workers' body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat. The normal thirst mechanism is not sensitive enough to ensure that enough water will

be drunk to replace lost water. When heavy sweating occurs, encourage the worker to drink more. The following strategies may be useful:

- Maintain water temperature at 10° to 15.6°C (50° to 60°F)
- Provide small disposable cups that hold about 4 ounces (0.1 liter)
- Have workers drink 16 ounces (0.5 liters) of fluid (preferably water or diluted drinks) before beginning work
- Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary to maintain body weight
- Weigh workers before and after work to determine if fluid replacement is adequate

- Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include:
  - Field showers or hose-down areas to reduce body temperature and/or to cool off protective clothing
  - Cooling jackets, vests, or suits
- Train workers to recognize and treat heat stress. As part of training, identify the signs and symptoms of heat stress.

Other Factors

PPE decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. This section discusses the demonstrated physiological responses to PPE, the individual human traits that play a factor in these responses, and some of the precautionary and training measures that need to be taken to avoid PPE-induced injury.

The physiological factors which may affect worker ability to function using PPE include:

- Physical condition
- Level of acclimatization
- Age
- Gender
- Weight

Physical Condition. Physical fitness is a major factor influencing a person's ability to perform work under heat stress. The more fit someone is, the more work they can safely perform. At a given level of work a fit person, relative to an unfit person, will have:

- Less physiological strain
- A lower heart rate
- A lower body temperature, which indicates less retained body heat (a rise in internal temperature precipitates heat injury)
- A more efficient sweating mechanism
- Slightly lower oxygen consumption
- Slightly lower carbon dioxide production

Level of Acclimatization. The degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions affects his or her ability to do work. Acclimatized individuals generally have lower heart rates and body temperatures than non-acclimatized individuals and sweat sooner and more profusely. This enables them to maintain lower skin and body temperatures at a given level of environmental heat and work loads than non-acclimatized workers. Sweat composition also becomes more dilute with acclimatization, which reduces salt loss.

Acclimatization can occur after just a few days of exposure to a hot environment. NIOSH recommends a progressive 6-day acclimatization period for the non-acclimatized worker before allowing him/her to do full work on a hot job. Under this regimen, the first day of work on site is begun using only 50 percent of the anticipated workload and exposure time, and is increased slowly over the next several days. If the workers can acclimatize quickly, this period may be shortened by two or three days. If this period includes time off, however, workers can lose acclimatization in a matter of days, and work regimens should be adjusted taking this into account.

When enclosed in an impermeable suit, fit-acclimatized individuals sweat more profusely than un-fit or non-acclimatized individuals and may, therefore, actually face a greater danger of heat exhaustion due to rapid dehydration. Consuming adequate quantities of water can prevent this. See previous section on prevention for additional information.

Age. Generally, maximum work capacity declines with increasing age, but this is not always the case. Active, well-conditioned seniors often have performance capabilities equal to or greater than young sedentary individuals. However, there is some evidence, indicated by lower sweat rate and higher body core temperatures, that older individuals are less effective in compensating for a given level of environmental heat and work load. At moderate thermal loads, however, the physiological responses of "young" and "old" are similar and performance is not affected.

Age should not be the sole criterion for judging whether or not an individual should be subjected to moderate heat stress. Fitness level is a more important factor.

Gender. The literature indicates that women tolerate heat stress at least as well as their male counterparts. Generally, a woman's work capacity averages 10 to 30 percent less than that of a man. The primary reasons for this are the greater oxygen-carrying capacity and the stronger heart in the male. However, a similar situation exists as with aging: not all men have greater work capacities than all women.

Weight. The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). Heat loss (dissipation) is a function of surface area and heat production is dependent on mass. Therefore, heat balance is described by the ratio of the two.

Since overweight individuals (those with a low ratio) produce more heat per units of surface area than thin individuals (those with a high ratio), overweight individuals should be given special consideration in heat stress situations. However, when wearing impermeable clothing, the weight of an individual is not a critical factor in determining the ability to dissipate excess heat.

Signs and Symptoms of Heat Stress

- Heat rash may result from continuous exposure to heat or humid air.
- Heavy sweating with inadequate electrolyte replacement causes heat cramps. Signs and symptoms include:
  - Muscle spasms
  - Pain in the hands, feet, and abdomen
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - Pale, cool, moist skin
  - Heavy sweating
  - Dizziness
  - Nausea
  - Fainting
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occurs. Competent medical help must be obtained. Signs and symptoms are:
  - Red, hot, usually dry skin
  - Lack of or reduced perspiration
  - Nausea
  - Dizziness and confusion
  - Strong, rapid pulse
  - Coma

References

American Conference of Governmental Industrial Hygienists. 1985. Threshold Limit Values for Chemical Substances and Physical Agents in the Workplace Environment and Biological Exposure Indices with Intended Changes for 1985-86. Cincinnati, OH.

Astrand, I.; Axelson, O.; Erikson, U.; and L. Olander. 1975. Heat stress in occupational work. Ambio 4:37-42.

Dukes-Dubos, F.N., and a Henschel, eds. 1980. Proceeding of a NIOSH Workshop on Recommended Heat Stress Standards. U.S. Department of Health and Human Services, Cincinnati, OH p. 153.

Eocjma. L.W.; Park, C.R.; Nelson, N.; Horvarth, S.M.; and E.D. Palmes. 1950. Thermal regulation during acclimatization in a hot, dry (desert type) environment. Am. J. Physiol. 163:50-56.

Goldman, R.F. 1970. Tactical implications of the Physiological Stress Imposed by Chemical Protective Clothing Systems. Army Science Conference, Natick, MA.

Goldman, R.F. 1983. Heat Stress in Industrial Protective Encapsulating Garments. Contract deliverable to U.S. Department of Health and Human Services, Order No. 83-211.

Henschel, A. 1985. Memorandum to Sheldon Rabinovitz from Austin Henschel, NIOSH, Cincinnati, OH June 20,1985.

Lind, A.R.; Humphreys, P.W.; Collins, K.J.; Foster, K; and K.F. Sweetland. 1970. Influence of age and daily duration of exposure on responses of men to work in heat. J. Appl. Physiol. 28:50-56.

McArdle, W.D.; Katch, F.1; and V.L. Katch. 1981. Exercise Physiology: Energy, Nutrition, and Human Performance. Lea and Febiger, Philadelphia, PA.

NIOSH. 1981. Chemical Control Corporation, Elizabeth New Jersey. Hazard Evaluation Report. TA-80-77-853.

Ramsey, J.D. 1976. NIOSH, Standards Advisory Committee on Heat Stress - Recommended Standard for Work in Hot Environments. Appendix C in Standards for Occupation Exposure to Hot Environments, proceedings of symposium, Cincinnati, OH.

Shapiro, Y.; Pandolf, K.B.; Avellini, B.A.; Pimental, N.A.; and R.F. Goldman. 1981. Heat balance and heat transfer in men and women exercising in hot-dry and hot-wet condition. Ergonomics 24:375-386.

U.S. EPA, 1984. Standard Operating Safety Guides. Office of Emergency and Remedial Response, Hazardous Response Support Division, Edison, NJ. November, 1984.

Appendix G

Material Safety Data Sheets

MATERIAL SAFETY DATA SHEET
MOTIVA MSDS: 840076M-04 09/10/95

ASBESTOS

TELEPHONE NUMBER:

24 HOUR EMERGENCY ASSISTANCE
EQUIVA SERVICES: 877-276-7283
CHEMTREC: 800-424-9300

GENERAL MSDS ASSISTANCE
877-276-7285

NAME AND ADDRESS
MOTIVA ENTERPRISES LLC
PRODUCT STEWARDSHIP
P.O. BOX 674414
HOUSTON, TX 77267-4414

SECTION I NAME

PRODUCT: ASBESTOS
CHEM NAME: AMOSITE, CHRYSOTILE, CROCIDOLITE AND OTHER FORMS COVERED BY THE OSHA HEALTH STANDARD
CHEM FAMILY: WASTE
SHELL CODE: WWWWW
HEALTH HAZARD: 1 FIRE HAZARD: 0 REACTIVITY: 0

SECTION II-A PRODUCT/INGREDIENT

NO.	COMPOSITION	CAS NO.	PERCENT
P	ASBESTOS	1332-21-4	100

SECTION II-B ACUTE TOXICITY DATA

NO.	ACUTE ORAL LD50	ACUTE DERMAL LD50	ACUTE INHALATION LC50
P	NONE		

SECTION III HEALTH INFORMATION

THE HEALTH EFFECTS NOTED BELOW ARE CONSISTENT WITH REQUIREMENTS UNDER THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200).

EYE CONTACT: DUST MAY CAUSE MECHANICAL IRRITATION TO THE EYES.

SKIN CONTACT: HIGH CONCENTRATIONS OF DUST ARE IRRITATING TO THE SKIN AND MAY CAUSE "ASBESTOS CORNS," BENIGN, WART-LIKE GROWTHS.

INHALATION: INHALATION OF ASBESTOS FIBERS MAY CAUSE ASBESTOSIS (FIBROSIS OF THE LUNGS). LUNG CANCER OR MESOTHELIOMA (SEE OTHER HEALTH EFFECTS).

INGESTION: ASBESTOS HAS A LOW LEVEL OF ACUTE TOXICITY UPON INGESTION.

SIGNS AND SYMPTOMS: IRRITATION AS NOTED ABOVE. LUNG DAMAGE (SCARRING, AND TUMORS) MAY BE EVIDENCED BY SHORTNESS OF BREATH, COUGH, CHEST PAIN, CYANOSIS (BLUISH DISCOLORATION OF THE SKIN), CLUBBING OF THE FINGERS, FATIGUE AND WEIGHT LOSS.

AGGRAVATED MEDICAL CONDITIONS:
PREEXISTING SKIN AND RESPIRATORY DISORDERS MAY BE AGGRAVATED BY EXPOSURE TO THIS MATERIAL. IMPAIRED LUNG FUNCTION FROM PREEXISTING DISORDERS MAY BE AGGRAVATED BY EXPOSURE TO THIS MATERIAL.

OTHER HEALTH EFFECTS:
THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION, THE NATIONAL TOXICOLOGY PROGRAM AND THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER HAVE DETERMINED THERE IS SUFFICIENT EVIDENCE FOR THE CARCINOGENICITY OF ASBESTOS IN BOTH HUMANS AND EXPERIMENTAL ANIMALS. THEREFORE, THE HANDLING PROCEDURES AND SAFETY PRECAUTIONS IN THIS MSDS SHOULD BE FOLLOWED TO MINIMIZE EMPLOYEE'S EXPOSURE.

SEE SECTION VI FOR ADDITIONAL HEALTH INFORMATION.

SECTION IV	OCCUPATIONAL EXPOSURE LIMITS

COMP NO.	OSHA PEL/TWA	PEL/CEILING	TLV/TWA	ACGIH TLV/STEL	OTHER
P	0.1 F/CC	1 F/CC*	2 F/CC,A1		
P1			0.5 F/CC,A1		
P2			2 F/CC,A1		
P3			0.2 F/CC,A1		
P4			2 F/CC,A1		

F/CC= FIBERS/CUBIC CENTIMETER; *30-MINUTE EXCURSION LIMIT. P1= AMOSITE; P2= CHRYSOTILE; P3= CROCIDOLITE; P4= OTHER FORMS.

SECTION V	EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT: FLUSH EYES WITH PLENTY OF WATER FOR 15 MINUTES WHILE HOLDING EYELIDS OPEN. GET MEDICAL ATTENTION.

SKIN CONTACT: FLUSH SKIN WITH WATER WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF IRRITATION OCCURS, GET MEDICAL ATTENTION. DO NOT REUSE CLOTHING OR SHOES UNTIL CLEANED.

INHALATION: REMOVE VICTIM TO FRESH AIR AND PROVIDE OXYGEN IF BREATHING IS DIFFICULT. GIVE ARTIFICIAL RESPIRATION IF NOT BREATHING. GET MEDICAL ATTENTION.

INGESTION: DO NOT INDUCE VOMITING. IN GENERAL, NO TREATMENT IS NECESSARY UNLESS LARGE QUANTITIES OF MATERIAL ARE INGESTED. HOWEVER, GET MEDICAL ADVICE.

NOTE TO PHYSICIAN: IN GENERAL, EMESIS INDUCTION IS UNNECESSARY IN HIGH VISCOSITY, LOW VOLATILITY PRODUCTS, I.E..,MOST OILS AND GREASES.

SECTION VI	SUPPLEMENTAL HEALTH INFORMATION

ASBESTOS CAUSED NO DOSE-RELATED INCREASE IN SISTER-CHROMATID EXCHANGE LEVELS IN CHO-K1 CELLS, HUMAN FIBROBLASTS OR HUMAN LYMPHOBLASTOID CELLS. HOWEVER, MITOTIC DELAY WAS INDUCED IN CHO-K1 CELLS AND HUMAN FIBROBLASTS. CHINESE HAMSTER OVARIAN FIBROBLASTS SHOWED AN INCREASE IN THE SISTER CHROMATID EXCHANGE RATE UPON EXPOSURE TO ASBESTOS. ESCHERICHIA COLI AND SALMONELLA TYPHIMURIUM SHOWED ASBESTOS NOT TO BE MUTAGENIC. CYTOGENETICS IN VITRO ASSAY FINDINGS WERE POSITIVE; ASBESTOS WAS NOT METABOLICALLY ACTIVATED.
MARKED TO EXTREME HYPERPLASIA OF THE BONE MARROW AND ABERRATIONS OF HUMORAL AND CELLULAR IMMUNITY HAVE BEEN REPORTED IN INDIVIDUALS EXPOSED TO ASBESTOS.
THE INTERNATIONAL AGENCY FOR RESEARCH ON CANCER HAS CONCLUDED THE FOLLOWING: "CIGARTETTE SMOKING AND OCCUPATIONAL EXPOSURE TO ASBESTOS FIBERS INCREASES LUNG CANCER INCIDENCE INDEPENDENTLY; WHEN THEY OCCUR TOGETHER, THEY ACT MULTIPLICATIVELY." THE HANDLING PROCEDURES AND SAFETY PRECAUTIONS IN THIS MSDS SHOULD BE FOLLOWED TO MINIMIZE EMPLOYEE EXPOSURE.

SECTION VII	PHYSICAL DATA

BOILING POINT (DEG F): NOT APPLICABLE	SPECFIC GRAVITY (H2O = 1): >1	VAPOR PRESSURE (MM HG): NOT APPLICABLE
MELTING POINT (DEG F): NOT APPLICABLE	SOLUBILITY IN WATER: NEGLIGIBLE	VAPOR DENSITY (AIR = 1): NOT APPLICABLE

EVAPORATION RATE (NORMAL BUTYL ACETATE = 1):NOT APPLICABLE
APPEARANCE AND ODOR:FIBROUS SOLID, NO ODOR.
PHYS/CHEM PROPERTIES: SEE ABOVE FOR DETAILS

SECTION VIII	FIRE AND EXPLOSION HAZARDS

FLASH POINT AND METHOD: NONE
FLAMMABLE LIMITS/PERCENT VOLUME IN AIR: LOWER: - HIGHER: -
EXTINGUISHING MEDIA:

USE WATER FOG, FOAM, DRY CHEMICAL OR CO2.

SPECIAL FIRE FIGHTING PROCEDURES AND PRECAUTIONS:

MATERIAL WILL NOT BURN. DO NOT ENTER CONFINED FIRE SPACE WITHOUT FULL BUNKER GEAR (HELMET WITH FACE SHIELD, BUNKER COATS, GLOVES AND RUBBER BOOTS), INCLUDING A POSITIVE PRESSURE NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS. COOL FIRE EXPOSED CONTAINERS WITH WATER.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

NONE IDENTIFIED

SECTION IX REACTIVITY

STABLITY: STABLE HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS AND MATERIALS TO AVOID:

NONE IDENTIFIED

HAZARDOUS DECOMPOSITION PRODUCTS:

THERMAL DECOMPOSITION PRODUCTS ARE HIGHTLY DEPENDENT ON THE COMBUSTION CONDITIONS. A COMPLEX MIXTURE OF AIRBORNE PARTICULATES AND GASES WILL EVOLVE WHEN THIS MATERIAL UNDERGOES PYROLYSIS OR COMBUSTION.

SECTION X EMPLOYEE PROTECTION

RESPIRATORY PROTECTION:

DO NOT BREATHE DUST. IF EXPOSURE MAY OR DOES EXCEED OCCUPATIONAL EXPOSURE LIMITS (SEC. IV) USE A NIOSH-APPROVED RESPIRATOR TO PREVENT OVEREXPOSURE. IN ACCORD WITH 29 CFR 1910.1001 OR 1926.58 USE EITHER AN ATMOSPHERE-SUPPLYING RESPIRATOR OR AN AIR-PURIFYING RESPIRATOR EQUIPPED WITH HIGH-EFFICIENCY PARTICULATE CARTRIDGES. FOR ADDITIONAL REQUIREMENTS, REFER TO 29 CFR 1926.58(H).

PROTECTIVE CLOTHING

AVOID CONTACT WITH EYES. WEAR SAFETY GLASSES OR GOGGLES AS APPROPRIATE. AVOID CONTACT WITH SKIN AND CLOTHING. WEAR CHEMICAL-RESISTANT GLOVES AND PROTECTIVE CLOTHING. FOR ADDITIONAL REQUIREMENTS, REFER TO 29 CFR 1926.58(I).

ADDITIONAL PROTECTIVE MEASURES:

FOR ADDITIONAL REQUIREMENTS, REFER TO 29 CFR 1926.58(G).

SECTION XI ENVIRONMENTAL PROTECTION

SPILL OR LEAK PROCEDURES:

PREVENT BODILY CONTACT WITH SPILLED MATERIAL. WEAR PROTECTIVE CLOTHING AND APPROPRIATE RESPIRATOR. VACUUM THE AREA WITH VACUUM CLEANER EQUIPPED WITH HIGH-EFFICIENCY PARTICULATE AEROSOL (HEPA) FILTERS. FOR ADDITIONAL REQUIREMENTS ON CLEANUP AND DISPOSAL, REFER TO 29 CFR 1926.58(L) AND 40 CFR 61.150. AVOID GENERATING DUST. PUT INTO CONTAINERS FOR DISPOSAL.

SECTION XII SPECIAL PRECAUTIONS

FOR ADDITIONAL REQUIREMENTS, REFER TO 29 CFR 1926.58, 29 CFR 1910.1001, 40 CFR 61.145, AND 40 CFR 61.150.

SECTION XIII TRANSPORTATION REQUIREMENTS

DEPARTMENT OF TRANSPORTATION CLASSIFICATION:

CLASS 9 (MISCELLANEOUS HAZARDOUS MATERIAL), III

DOT PROPER SHIPPING NAME:ASBESTOS

OTHER REQUIREMENTS:NA2212, GUIDE 171. NONFRIABLE ASBESTOS AND FRIABLE ASBESTOS IN QUANTITIES OF LESS THAN 1 POUND PER CONTAINER ARE NOT REGULATED BY D.O.T.

SECTION XIV OTHER REGULATORY CONTROLS

THIS MATERIAL IS LISTED ON THE EPA/TSCA INVENTORY OF CHEMICAL SUBSTANCES.

IN ACCORDANCE WITH SARA TITLE III, SECTION 313, THE ATTACHED ENVIRONMENTAL DATA

SHEET (EDS) SHOULD ALWAYS BE COPIED AND SENT WITH THE MSDS.

SECTION XV STATE REGULATORY INFORMATION

THE FOLLOWING CHEMICALS ARE SPECIFICALLY LISTED BY INDIVIDUAL STATES; OTHER PRODUCT SPECIFIC HEALTH AND SAFETY DATA IN OTHER SECTIONS OF THE MSDS MAY ALSO BE APPLICABLE FOR STATE REQUIREMENTS. FOR DETAILS ON YOUR REGULATORY REQUIREMENTS YOU SHOULD CONTACT THE APPROPRIATE AGENCY IN YOUR STATE.

STATE LISTED COMPONENT	CAS NO	PERCENT	STATE CODE
ASBESTOS	1332-21-4	100	CA, FL, IL, MA, ME, MN, PA, RI, CA65C

CA = CALIFORNIA HAZ. SUBST. LIST; CA65C, CA65R, CA65C/R = CALIFORNIA SAFE DRINKING WATER AND TOXICS ENFORCEMENT ACT OF 1986 OR PROPOSITION 65 LIST; CT = CONNECTICUT TOXIC. SUBST. LIST; FL = FLORIDA SUBST. LIST; IL = ILLINOIS TOX. SUBST. LIST; LA = LOUISIANA HAZ. SUBST. LIST; MA = MASSACHUSETTS SUBST. LIST; ME = MAINE HAZ. SUBST. LIST; MN = MINNESOTA HAZ. SUBST. LIST; NJ = NEW JERSEY HAZ. SUBST. LIST; PA = PENNSYLVANIA HAZ. SUBST. LIST; RI = RHODE ISLAND HAZ. SUBST. LIST.

CALIFORNIA PROPOSITION 65 FOOTNOTE: CA65C = THE CHEMICAL IDENTIFIED WITH THIS CODE IS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER. CA65R = THE CHEMICAL IDENTIFIED WITH THIS CODE IS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM. CA65C/R = THE CHEMICAL IDENTIFIED WITH THIS CODE IS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE BOTH CANCER AND BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

SECTION XVI SPECIAL NOTES

THIS MSDS REVISION HAS CHANGES IN SECTION XV - STATE REGULATORY INFORMATION

THE INFORMATION CONTAINED IN THIS DATA SHEET IS BASED ON THE DATA AVAILABLE TO US AT THIS TIME, AND IS BELIEVED TO BE ACCURATE BASED UPON THAT DATA. IT IS PROVIDED INDEPENDENTLY OF ANY SALE OF THE PRODUCT, FOR PURPOSE OF HAZARD COMMUNICATION. IT IS NOT INTENDED TO CONSTITUTE PRODUCT PERFORMANCE INFORMATION, AND NO EXPRESS OR IMPLIED WARRANTY OF ANY KIND IS MADE WITH RESPECT TO THE PRODUCT, UNDERLYING DATA OR THE INFORMATION CONTAINED HEREIN. YOU ARE URGED TO OBTAIN DATA SHEETS FOR ALL PRODUCTS YOU BUY, PROCESS USE OR DISTRIBUTE, AND ARE ENCOURAGED TO ADVISE THOSE WHO MAY COME IN CONTACT WITH SUCH PRODUCTS OF THE INFORMATION CONTAINED HEREIN.

TO DETERMINE THE APPLICABILITY OR EFFECT OF ANY LAW OR REGULATION WITH RESPECT TO THE PRODUCT, YOU SHOULD CONSULT WITH YOUR LEGAL ADVISOR OR THE APPROPRIATE GOVERNMENT AGENCY. WE WILL NOT PROVIDE ADVICE ON SUCH MATTERS, OR BE RESPONSIBLE FOR ANY INJURY FROM THE USE OF THE PRODUCT DESCRIBED HEREIN. THE UNDERLYING DATA, AND THE INFORMATION PROVIDED HEREIN AS A RESULT OF THAT DATA, IS THE PROPERTY OF EQUIVA SERVICES, LLC AND IS NOT TO BE THE SUBJECT OF SALE OR EXCHANGE WITHOUT THE EXPRESS WRITTEN CONSENT OF EQUIVA SERVICES, LLC.

ENVIRONMENTAL DATA SHEET
MOTIVA EDS: 840076M

ASBESTOS

TELEPHONE NUMBER:

24 HOUR EMERGENCY ASSISTANCE
EQUIVA SERVICES: 877-276-7283
CHEMTREC: 800-424-9300

GENERAL MSDS ASSISTANCE
877-276-7285

NAME AND ADDRESS
MOTIVA ENTERPRISES
PRODUCT STEWARDSHIP
P.O. BOX 674414
HOUSTON, TX 77267-4414

PRODUCT CODE: WWWWW

SECTION I PRODUCT COMPOSITION

NO.	COMPOSITION	CAS	PERCENT
P	ASBESTOS	1332-21-4	100

SECTION II SARA TITLE III INFORMATION

NO.	EHS RQ (*1)	EHS TPQ (*2)	SEC-313 (*3)	313 CATEGORY (*4)	311/312 CATEGORY (*5)
P			YES		H-1, H-2

*1 = REPORTABLE QUANTITY OF EXTREMELY HAZARDOUS SUBSTANCE, SEC 302
*2 = THRESHOLD PLANNING QUANTITY, EXTREMELY HAZARDOUS SUBSTANCE, SEC 302
*3 = TOXIC CHEMICAL, SEC 313
*4 = CATEGORY AS REQUIRED BY SEC 313 (40 CFR 372.65 C), MUST BE USED ON TOXIC RELEASE INVENTORY FORM
*5 = CATEGORY (FOR AGGREGATE REPORTING REQUIREMENTS UNDER SARA 311, 312)
HEALTH: H-1 = IMMEDIATE (ACUTE) HEALTH HAZARD
H-2 = DELAYED (CHRONIC) HEALTH HAZARD
PHYSICAL: P-3 = FIRE HAZARD
P-4 = SUDDEN RELEASE OF PRESSURE HAZARD
P-5 = REACTIVE HAZARD

SECTION III ENVIRONMENTAL RELEASE INFORMATION

EPA - COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT. UNDER EPA-CERCLA ("SUPERFUND") RELEASES TO AIR, LAND OR WATER WHICH EXCEED THE REPORTABLE QUANTITY MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER, 800-424-8802.
THE REPORTABLE QUANTITY (RQ) FOR A RELEASE OF THIS MATERIAL IS 1 LB.

SECTION IV RCRA INFORMATION

IF THIS MATERIAL BECOMES A WASTE, IT WOULD NOT BE A HAZARDOUS WASTE BY RCRA CRITERIA (40 CFR 261). FOR DISPOSAL REQUIREMENTS, SEE 40 CFR 61.150.

THE INFORMATION CONTAINED IN THIS DATA SHEET IS BASED ON THE DATA AVAILABLE TO US AT THIS TIME, AND IS BELIEVED TO BE ACCURATE BASED UPON THAT DATA. IT IS PROVIDED INDEPENDENTLY OF ANY SALE OF THE PRODUCT, FOR PURPOSE OF HAZARD COMMUNICATION. IT IS NOT INTENDED TO CONSTITUTE PRODUCT PERFORMANCE INFORMATION, AND NO EXPRESS OR IMPLIED WARRANTY OF ANY KIND IS MADE WITH RESPECT TO THE PRODUCT, UNDERLYING DATA OR THE INFORMATION CONTAINED HEREIN. YOU ARE URGED TO OBTAIN DATA SHEETS FOR ALL PRODUCTS YOU BUY, PROCESS USE OR DISTRIBUTE, AND ARE ENCOURAGED TO ADVISE THOSE WHO MAY COME IN CONTACT WITH SUCH PRODUCTS OF THE INFORMATION CONTAINED HEREIN.

TO DETERMINE THE APPLICABILITY OR EFFECT OF ANY LAW OR REGULATION WITH RESPECT TO THE PRODUCT, YOU SHOULD CONSULT WITH YOUR LEGAL ADVISOR OR THE APPROPRIATE GOVERNMENT AGENCY. WE WILL NOT PROVIDE ADVICE ON SUCH MATTERS, OR BE RESPONSIBLE FOR ANY INJURY FROM THE USE OF THE PRODUCT DESCRIBED HEREIN. THE UNDERLYING DATA, AND THE INFORMATION PROVIDED HEREIN AS A RESULT OF THAT DATA, IS THE PROPERTY OF EQUIVA SERVICES, LLC AND IS NOT TO BE THE SUBJECT OF SALE OR EXCHANGE WITHOUT THE EXPRESS WRITTEN CONSENT OF EQUIVA SERVICES, LLC.

KAREN G. HAYNES

EQUIVA SERVICES LLC
P.O. BOX 674414

HOUSTON, TX 77267-4414

FOR ADDITIONAL INFORMATION ON THIS ENVIRONMENTAL DATA PLEASE CALL
(877) 276-7285

FOR EMERGENCY ASSISTANCE PLEASE CALL
EQUIVA SERVICES LLC: (877) 276-7283
CHEMTREC: (800) 424-9300

Valid 11/2002 - 01/2003

Fluka Chemie AG
Postfach 260
CH-9471 Buchs
Switzerland
Tel: 081 755 25 11 Fax. 081 756 54 49
Night: 071 228 3600

MATERIAL SAFETY DATA SHEET

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -
CATALOG #: 33900
NAME: (1,2-DIBROMOETHYL)BENZENE

SECTION 2. - - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -
CAS #: 93-52-7
MF: C8H8BR2
EC NO: 202-253-4
SYNONYMS
ALPHA,BETA-DIBROMOETHYLBENZENE * (1,2-DIBROMOETHYL)BENZENE * 1,2-DIBROMO-1-PHENYLETHANE * DOWSPRAY 9 * VIC-STYRENE DIBROMIDE *

SECTION 3. - - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - - -
LABEL PRECAUTIONARY STATEMENTS
CORROSIVE
CAUSES BURNS.
IRRITATING TO EYES AND RESPIRATORY SYSTEM.
LACHRYMATOR.
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
AFTER CONTACT WITH SKIN, WASH IMMEDIATELY WITH PLENTY OF WATER.
TAKE OFF IMMEDIATELY ALL CONTAMINATED CLOTHING.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.

SECTION 4. - - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -
FLUSH SKIN WITH WATER.
CONTAMINATION OF THE EYES SHOULD BE TREATED BY IMMEDIATE AND PROLONGED IRRIGATION WITH COPIOUS AMOUNTS OF WATER.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.
DISCARD CONTAMINATED CLOTHING AND SHOES.

SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -
EXTINGUISHING MEDIA
WATER SPRAY.
CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
UNDER FIRE CONDITIONS, MATERIAL MAY DECOMPOSE
TO FORM FLAMMABLE AND/OR EXPLOSIVE MIXTURES IN AIR.
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. - - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -
REFER TO SECTION 8.

SECTION 8. - - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -
WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
LACHRYMATOR.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -
APPEARANCE AND ODOR
OFF-WHITE POWDER
PHYSICAL PROPERTIES
MELTING POINT: 70 TO 73C

SECTION 10. - - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -
INCOMPATIBILITIES
OXIDIZING AGENTS
BASES
SODIUM
POTASSIUM
MAGNESIUM
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN BROMIDE GAS

SECTION 11. - - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -
ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY RESULT IN SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
CAUSES SEVERE EYE IRRITATION.
RTECS #: CZ1800100
BENZENE, (1,2-DIBROMOETHYL)-
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -
DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -
CONTACT FLUKA CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - -
EUROPEAN INFORMATION
CORROSIVE
R 34
CAUSES BURNS.
R 36/37
IRRITATING TO EYES AND RESPIRATORY SYSTEM.
S 26
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
S 28
AFTER CONTACT WITH SKIN, WASH IMMEDIATELY WITH PLENTY OF WATER.

S 27
TAKE OFF IMMEDIATELY ALL CONTAMINATED CLOTHING.
S 36/37/39
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.

REVIEWS, STANDARDS, AND REGULATIONS
OEL=MAK
EPA TSCA SECTION 8(B) CHEMICAL INVENTORY

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH, FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

MATERIAL SAFETY DATA SHEET

SECTION I

Manufacturer's Name: STAR BRONZE COMPANY, INC.
P.O. Box 2206
Alliance, Ohio 44601-0206

Emergency Telephone Number:
330-823-1550

Telephone Number for Information:
330-823-1550

Identity: 77300 Toluene

Date Prepared: 4/27/01 (Revised)

SECTION II - Ingredients

Ingredient	CAS No.	Percent by Vol.	OSHA PEL (PPM)	ACGIH TLV (PPM)
Toluene	108-88-3	100	100	50(Skin)

Section 313: Supplier Notification. This product contains the following toxic chemicals, subject to the reporting requirements of Section 313 of the Emergency Planning & Community Right to Know Act of 1986, and of 40 CfR 372. Toluene. This information must be included in all Material Safety Data Sheets that are copied and distributed for this material.

SECTION III - Physical/ Chemical Characteristics

Boiling Range: 232°F

Evaporation Rate: (N-Butyl Acetate = 1) 2.0

Percent Volatile: 100%

Appearance and Odor: Clear liquid-aromatic odor

VOC: 871 grams per liter

VOS: 7.27 lbs/gal

Vapor Density: (Air=1) 3.2

Weight per Gallon: 7.27 lbs./gal

Solubility in Water: Nil

Specific Gravity: 0.87

Vapor Pressure: 22 MM Hg @ 20°C

Solvent Density: 0.87

SECTION IV - Fire and Explosion Hazard Data

Flash Point: 45.0°F   Flammable Limits: LEL: 1.2%   UEL: 7.0%

Extinguishing Media: Regular foam, carbon dioxide or dry chemical.

Special Fire Fighting Procedures: Water may be used to keep fire-exposed containers cool until fire is out. Wear a self-contained breathing apparatus with a full facepiece operated in the positive pressure demand mode with appropriate turn-out gear and chemical resistant personal protective equipment.

Unusual Fire and Explosion Hazards: Vapors are heavier than air and may travel along the ground or be moved by ventilation and ignited by heat, pilot lights, smoking, other flames, sparks, heaters, electric motors, static discharge or other ignition sources at locations distant from material handling point. Keep away from heat, sparks, pilot lights and other sources of ignition. Closed containers may explode when exposed to extreme heat. Never use welding or cutting torch on or near drum (even empty) because product (even just residue) can ignite explosively.

HMIS:	Health 1	Flammability 3	Reactivity 0
NFPA:	Health 2	Flammability 3	Reactivity 0

SECTION V - Reactivity Data

Stability: Stable

Conditions to Avoid: Heat, sparks, open flame.

Incompatibility: Avoid contact with strong oxidizing agents and strong acids.

Hazardous Decomposition of By-products: May form: carbon dioxide and carbon monoxide, various hydrocarbons, etc.

Hazardous Polymerization: Product will not undergo hazardous polymerization.

SECTION VI - Health Hazard Data

Routes of Entry: Inhalation - Yes Skin - Yes Ingestion - Yes

Health Hazard Acute and Chronic:

Inhalation: Excessive inhalation of vapors can cause nasal and respiratory irritation, central nervous system effects including dizziness, weakness, fatigue, nausea, headache and possible unconsciousness or in extreme cases, death. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or prove fatal.

Skin: May cause mild skin irritation. Prolonged or repeated exposure may dry the skin. Symptoms may include redness, burning, drying and cracking of skin and skin burns. Passage of this material into the body through the skin is possible, but it is unlikely that this would result in harmful effects during safe handling and use.

Eyes: Can cause eye irritation, redness, tearing, blurred vision.

Ingestion: Can cause gastrointestinal irritation, nausea, vomiting and diarrhea. Aspiration of material into the lungs can cause chemical pneumonitis, which can be fatal.

Chronic Overexposure: Excessive exposure may cause permanent brain and nervous system damage. Intentional misuse by deliberate inhalation of toluene has been associated with liver, kidney and brain damage, cardiac sensitization, and hearing loss progressing to deafness.

Developmental Information: Toluene may be harmful to the human fetus based on positive test results with laboratory animals. Case studies show that prolonged intentional abuse of Toluene during pregnancy can cause birth defects in humans.

Medical Conditions Aggravated by Exposure: Pre-existing disorders of the following organs (or organ systems) may be aggravated by exposure to this material: Respiratory tract, skin, lung (for example, asthma-like conditions), kidney, central nervous system, auditory system. Individuals with preexisting heart disorders may be more susceptible to arrhythmias (irregular heartbeats) if exposed to high concentrations of this material.

Carcinogenicity: IARC - not listed; NTP - not listed; OSHA - not listed.

Emergency First Aid Procedures:

Inhalation: If affected, remove individual to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Keep person warm, quiet and get medical attention.

SECTION VI - Health Hazard Data con't

Skin: Thoroughly wash exposed area with soap and water. Remove contaminated clothing. Launder contami nated clothing before re-use. If irritation persists, seek medical attention.

Eyes: Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids occasion ally. Get medical attention.

Ingestion: Do not induce vomiting. Keep person warm, quiet and get medical attention immediately. Aspiration of material into lungs due to vomiting can cause chemical pneumonitis, which can be fatal.

SECTION VII - Precautions for Safe Handling and Use

Steps to be taken in case material is released or spilled

Small Spill: Absorb liquid on paper, vermiculite, floor absorbent or other absorbent material and transfer to vent hood or closed container.

Large Spill: Eliminate ignition sources (flares, flames, pilot lights, electrical sparks). Contain liquid, stop spill at source and prevent run-off to sewers, streams or other bodies of water. Ventilate area, avoid breathing vapors. Clean up with absorbent material and place in closed container for disposal.

Waste Disposal Method:

Small Spill: Dispose of in accordance with all local, state and federal regulations.

Large Spill: Dispose of in accordance with all local, state and federal regulations.

Precautions to be taken in handling and storing: Store in cool, dry area. Avoid flames and high temperatures. Store upright to prevent leaks. Keep container tightly closed. Containers of this material may be hazardous when emptied. Since emptied containers retain product residues (vapor, liquid, and/or solid), all hazard precautions given in the data sheet must be observed. All five-gallon pails and larger metal containers, should be grounded and/or bonded when material is transferred.

Other precautions: None

SECTION VIII - Control Measures

Respiratory Protection: If workplace exposure limits of product are exceeded, a NIOSH/MSHA-approved air supplied respirator is advised in absence of proper environmental control. OSHA Regulations also permit other NIOSH/MSHA respirators (negative pressure type) under specified conditions (see your safety equipment supplier). Engineering or administrative controls should be implemented to reduce exposure.

Ventilation: Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain exposure below PEL & TLV.

Protective Gloves: Wear resistant gloves, such as polyvinyl alcohol. Your local safety supply can provide alternative glove recommendations.

Eye Protection: Chemical splash goggles in compliance with OSHA Regulations are advised. However, OSHA Regulations also permit other types of safety glasses. Consult your safety equipment supplier.

Other Protective Clothing or Equipment: Where prolonged or frequently repeated contact could occur, use protective clothing impervious to this material. Selection of specific items, such as gloves, boots or aprons, will depend upon operation.

Work/ Hygienic Practices: Avoid contact with eyes, skin and clothing. Avoid breathing vapors. Wash thoroughly after handling and before eating, drinking or smoking. Remove any contaminated clothing promptly and clean before re-use.

SECTION IX - Transportation Data

Container Size	Proper Shipping Description	Hazard Class	ID #	Packaging Group	Label
Gallon	Toluene	3	UN1294	II	Flammable Liquid
Quart	Consumer Commodity	ORMD	None	None	None
5 Gallon Pail	Toluene	3	UN1294	II	Flammable Liquid
55 Gallon Drum	Toluene	3	UN1294	II	Flammable Liquid

SECTION X - Regulatory Information

RQ Reportable Quantity

Toluene 1,000 lbs.

Toxic Substance Control Act - This product is listed.

SARA 311/312 Hazard Categories - Health - Immediate Health, Delayed health, Fire

SARA 313 Components - Toluene 100%

California Proposition 65

This product contains chemicals known to the State of California to cause cancer (benzene).

This product contains chemicals known to the State of California to cause reproductive harm (Toluene and Benzene).

Warning: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

The information and recommendations contained herein have been compiled from sources believed to be accurate and reliable. The information herein is given in good faith, but no warranty, expressed or implied, is made.

MATERIAL SAFETY DATA SHEET

VOC-1S

07/17/89 LAST REVISED JUNE 1989

SECTION I PRODUCT SPECIFICATIONS

CAT. NO. F38S 0.1MG/ML ETHYLBENZENE IN METHANOL.

CAS NO. 100-41-4

SUPPLIED BY CHEM SERVICE, INC. PO BOX 3108, WEST CHESTER PA, 19381

(215)692-3026

EMERGENCY PHONE #: 215-386-2100

SECTION II TOXICITY DATA

SINCE THIS SOLUTION CONTAINS A VERY LOW CONCENTRATION OF ACTIVE COMPONENT, THE PRIMARY HAZARD IS FROM THE SOLVENT.

THE LD50 FOR THE MINOR COMPONENT (ETHYLBENZENE): 3500MG/KG

THE FOLLOWING INFORMATION IS FOR THE SOLVENT:

RAT OR MOUSE LD50	RTECS#	OSHA PEL	ACGIH TLV
5628MG/KG	PC1400000	200PPM (260MG/M3)	200 PPM (260 MG/M3)

THIS COMPOUND IS GENERALLY CONSIDERED TO BE NON-TOXIC.

SECTION III PHYSICAL DATA

FOR THE SOLVENT:

==

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY
-98 C	64.6 C	0.791	97 MM@20 C	1.11

==

EVAPORATION RATE (BUTYL ACETATE=1)	ODOR	COLOR	PHASE	SOLUBILITY IN WATER
NA	NA	COLORLESS	LIQUID	MISCIBLE WITH

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FOR THE SOLVENT:

FLASH POINT: 11 C THIS IS A FLAMMABLE CHEMICAL.

EXTINGUISHING MEDIA: CARBON DIOXIDE OR DRY CHEMICAL POWDER. DO NOT USE WATER!

UPPER EXPLOSION LIMIT: 36%   LOWER EXPLOSION LIMIT: 6.7%

SECTION V   HEALTH HAZARD DATA

FOR THE SOLVENT:

CONTACT LENSES SHOULD NOT BE WORN IN THE LABORATORY.

ALL CHEMICALS SHOULD BE CONSIDERED HAZARDOUS - AVOID DIRECT PHYSICAL CONTACT!

CAN BE FATAL IF ABSORBED THROUGH THE SKIN! CAN BE FATAL IF INHALED!

CAN BE FATAL OR CAUSE BLINDNESS IF SWALLOWED.

REPEATED EXPOSURE TO VAPORS AND/OR DUST CAN CAUSE EYE INJURY.

CAN CAUSE GASTROINTESTINAL DISTURBANCES. CAN CAUSE LIVER INJURY. CAN CAUSE KIDNEY INJURY.

CAN CAUSE CARDIOVASCULAR SYSTEM INJURY. CAN CAUSE CONVULSIONS.

SECTION VI   FIRST AID

FOR THE SOLVENT:

AN ANTIDOTE IS A SUBSTANCE INTENDED TO COUNTERACT THE EFFECT OF A POISON. IT SHOULD BE ADMINISTERED ONLY BY A PHYSICIAN OR TRAINED EMERGENCY PERSONNEL. MEDICAL ADVICE CAN BE OBTAINED FROM A POISON CONTROL CENTER.

IN CASE OF CONTACT: FLUSH EYES CONTINUOUSLY WITH WATER FOR 15-20 MINUTES. FLUSH SKIN WITH WATER FOR 15-20 MINUTES. IF NO BURNS HAVE OCCURRED, USE SOAP AND WATER TO CLEANSE SKIN.

IF INHALED, REMOVE PATIENT TO FRESH AIR. ADMINISTER OXYGEN IF PATIENT IS HAVING DIFFICULTY BREATHING.

IF PATIENT HAS STOPPED BREATHING ADMINISTER ARTIFICIAL RESPIRATION.

IF PATIENT IS IN CARDIAC ARREST ADMINISTER CPR.

CONTINUE LIFE SUPPORTING MEASURES UNTIL MEDICAL ASSISTANCE HAS ARRIVED.

GET MEDICAL ATTENTION IF NECESSARY.

DO NOT WEAR SHOES OR CLOTHING UNTIL ABSOLUTELY FREE OF ALL CHEMICAL ODORS.

SECTION VII REACTIVITY DATA

FOR THE SOLVENT:

FLAMMABLE. HYGROSCOPIC. INCOMPATIBLE WITH STRONG ACIDS. REACTS WITH ACID HALIDES AND ANHYDRIDES.

INCOMPATIBLE WITH STRONG OXIDIZING AGENTS. INCOMPATIBLE WITH STRONG REDUCING AGENTS.

INCOMPATIBLE WITH ACTIVE METALS (E.G. SODIUM). DECOMPOSITION LIBERATES TOXIC FUMES.

SECTION VIII SPILL OR LEAK PROCEDURES

SPILLS OR LEAKS: EVACUATE AREA. WEAR APPROPRIATE OSHA REGULATED EQUIPMENT. VENTILATE AREA. ABSORB ON VERMICULITE OR SIMILAR MATERIAL. SWEEP UP AND PLACE IN AN APPROPRIATE CONTAINER. HOLD FOR DISPOSAL. WASH CONTAMINATED SURFACES TO

REMOVE ANY RESIDUES.

DISPOSAL: BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

THIS CHEMICAL SHOULD BE HANDLED ONLY IN A HOOD. EYE SHIELDS SHOULD BE WORN. USE APPROPRIATE OSHA/MSHA APPROVED SAFETY EQUIPMENT. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. KEEP TIGHTLY CLOSED IN A COOL DRY PLACE. STORE UNDER NITROGEN. STORE ONLY WITH COMPATIBLE CHEMICALS.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT ON THE DATE IT IS PUBLISHED AND MUST NOT BE CONSIDERED ALL INCLUSIVE. THE INFORMATION HAS BEEN OBTAINED ONLY BY A SEARCH OF AVAILABLE LITERATURE AND IS ONLY A GUIDE FOR HANDLING THE CHEMICALS. OSHA REGULATIONS REQUIRE THAT IF OTHER HAZARDS BECOME EVIDENT, AN UPGRADED MSDS MUST BE MADE AVAILABLE TO THE EMPLOYEE WITHIN THREE MONTHS. RESPONSIBILITY FOR UPDATES LIES WITH THE EMPLOYER AND NOT WITH CHEM SERVICE, INC. PERSONS NOT SPECIFICALLY AND PROPERLY TRAINED SHOULD NOT HANDLE THIS CHEMICAL OR ITS CONTAINER. THIS MSDS IS PROVIDED WITHOUT ANY WARRANTY EXPRESSED OR IMPLIED, INCLUDING MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

THIS PRODUCT IS FURNISHED FOR LABORATORY USE ONLY! OUR PRODUCTS MAY NOT BE USED AS DRUGS, COSMETICS, AGRICULTURAL OR PESTICIDAL PRODUCTS, FOOD ADDITIVES OR HOUSEHOLD CHEMICALS.

MATERIAL SAFETY DATA SHEET

F-120SL

07/17/89   LAST REVISED JUNE 1989

SECTION I   PRODUCT SPECIFICATIONS

CAT. NO. F38S   0.1MG/ML ETHYLBENZENE IN METHANOL.

CAS. NO. 100-41-4

SUPPLIED BY CHEM SERVICE, INC. PO BOX 3108, WEST CHESTER PA, 19381

(215)692-3026

EMERGENCY PHONE #: 215-386-2100

SECTION II   TOXICITY DATA

SINCE THIS SOLUTION CONTAINS A VERY LOW CONCENTRATION OF ACTIVE COMPONENT, THE PRIMARY HAZARD IS FROM THE SOLVENT.

THE LD50 FOR THE MINOR COMPONENT (ETHYLBENZENE):   3500MG/KG

THE FOLLOWING INFORMATION IS FOR THE SOLVENT:

RAT OR MOUSE LD50	RTECS#	OSHA PEL	ACGIH TLV
5628MG/KG	PC1400000	200PPM (260MG/M3)	200 PPM (260 MG/M3)

THIS COMPOUND IS GENERALLY CONSIDERED TO BE NON-TOXIC.

SECTION III PHYSICAL DATA

FOR THE SOLVENT:

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY
-98 C	64.6 C	0.791	97 MM@20 C	1.11

EVAPORATION RATE (BUTYL ACETATE=1)	ODOR	COLOR	PHASE	SOLUBILITY IN WATER
NA	NA	COLORLESS	LIQUID	MISCIBLE WITH

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FOR THE SOLVENT:

FLASH POINT: 11 C THIS IS A FLAMMABLE CHEMICAL.

EXTINGUISHING MEDIA: CARBON DIOXIDE OR DRY CHEMICAL POWDER. DO NOT USE WATER!

UPPER EXPLOSION LIMIT: 36% LOWER EXPLOSION LIMIT: 6.7%

SECTION V HEALTH HAZARD DATA

FOR THE SOLVENT:

CONTACT LENSES SHOULD NOT BE WORN IN THE LABORATORY.

ALL CHEMICALS SHOULD BE CONSIDERED HAZARDOUS - AVOID DIRECT PHYSICAL CONTACT!

CAN BE FATAL IF ABSORBED THROUGH THE SKIN! CAN BE FATAL IF INHALED!

CAN BE FATAL OR CAUSE BLINDNESS IF SWALLOWED.

REPEATED EXPOSURE TO VAPORS AND/OR DUST CAN CAUSE EYE INJURY.

CAN CAUSE GASTROINTESTINAL DISTURBANCES. CAN CAUSE LIVER INJURY. CAN CAUSE KIDNEY INJURY.

CAN CAUSE CARDIOVASCULAR SYSTEM INJURY. CAN CAUSE CONVULSIONS.

SECTION VI FIRST AID

FOR THE SOLVENT:

AN ANTIDOTE IS A SUBSTANCE INTENDED TO COUNTERACT THE EFFECT OF A POISON. IT SHOULD BE ADMINISTERED ONLY BY A PHYSICIAN OR TRAINED EMERGENCY PERSONNEL.

MEDICAL ADVICE CAN BE OBTAINED FROM A POISON CONTROL CENTER.

IN CASE OF CONTACT: FLUSH EYES CONTINUOUSLY WITH WATER FOR 15-20 MINUTES.

FLUSH SKIN WITH WATER FOR 15-20 MINUTES. IF NO BURNS HAVE OCCURRED, USE SOAP

AND WATER TO CLEANSE SKIN.

IF INHALED, REMOVE PATIENT TO FRESH AIR. ADMINISTER OXYGEN IF PATIENT IS

HAVING DIFFICULTY BREATHING.

IF PATIENT HAS STOPPED BREATHING ADMINISTER ARTIFICIAL RESPIRATION.

IF PATIENT IS IN CARDIAC ARREST ADMINISTER CPR.

CONTINUE LIFE SUPPORTING MEASURES UNTIL MEDICAL ASSISTANCE HAS ARRIVED.

GET MEDICAL ATTENTION IF NECESSARY.

DO NOT WEAR SHOES OR CLOTHING UNTIL ABSOLUTELY FREE OF ALL CHEMICAL ODORS.

SECTION VII REACTIVITY DATA

FOR THE SOLVENT:

FLAMMABLE. HYGROSCOPIC. INCOMPATIBLE WITH STRONG ACIDS. REACTS WITH ACID

HALIDES AND ANHYDRIDES.

INCOMPATIBLE WITH STRONG OXIDIZING AGENTS. INCOMPATIBLE WITH STRONG REDUCING

AGENTS.

INCOMPATIBLE WITH ACTIVE METALS (E.G. SODIUM). DECOMPOSITION LIBERATES TOXIC

FUMES.

SECTION VIII SPILL OR LEAK PROCEDURES

SPILLS OR LEAKS: EVACUATE AREA. WEAR APPROPRIATE OSHA REGULATED EQUIPMENT. VENTILATE AREA. ABSORB ON VERMICULITE OR SIMILAR MATERIAL. SWEEP UP AND PLACE IN AN APPROPRIATE CONTAINER. HOLD FOR DISPOSAL. WASH CONTAMINATED SURFACES TO REMOVE ANY RESIDUES.

DISPOSAL: BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

THIS CHEMICAL SHOULD BE HANDLED ONLY IN A HOOD. EYE SHIELDS SHOULD BE WORN. USE APPROPRIATE OSHA/MSHA APPROVED SAFETY EQUIPMENT. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. KEEP TIGHTLY CLOSED IN A COOL DRY PLACE. STORE UNDER NITROGEN. STORE ONLY WITH COMPATIBLE CHEMICALS.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT ON THE DATE IT IS PUBLISHED AND MUST NOT BE CONSIDERED ALL INCLUSIVE. THE INFORMATION HAS BEEN OBTAINED ONLY BY A SEARCH OF AVAILABLE LITERATURE AND IS ONLY A GUIDE FOR HANDLING THE CHEMI-CALS. OSHA REGULATIONS REQUIRE THAT IF OTHER HAZARDS BECOME EVIDENT, AN UP-GRADED MSDS MUST BE MADE AVAILABLE TO THE EMPLOYEE WITHIN THREE MONTHS. RE-

SPONSIBILITY FOR UPDATES LIES WITH THE EMPLOYER AND NOT WITH CHEM SERVICE, INC. PERSONS NOT SPECIFICALLY AND PROPERLY TRAINED SHOULD NOT HANDLE THIS CHEMICAL OR ITS CONTAINER. THIS MSDS IS PROVIDED WITHOUT ANY WARRANTY EXPRESSED OR IMPLIED, INCLUDING MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

THIS PRODUCT IS FURNISHED FOR LABORATORY USE ONLY! OUR PRODUCTS MAY NOT BE USED AS DRUGS, COSMETICS, AGRICULTURAL OR PESTICIDAL PRODUCTS, FOOD ADDITIVES OR HOUSEHOLD CHEMICALS.

Burdick & Jackson

Material Safety Data Sheet

o-Xylene

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: o-Xylene

OTHER/GENERIC NAMES: Ortho-xylene, o- Dimethylbenzene

PRODUCT USE: Solvent

MANUFACTURER: Honeywell, Burdick & Jackson
1953 South Harvey Street
Muskegon, MI 49442

FOR MORE INFORMATION CALL:
(Monday-Friday, 8:00am-5:00pm)
1-800-368-0050

IN CASE OF EMERGENCY CALL:
(24 Hours/Day, 7 Days/Week)
1-800-707-4555 or Chemtrec 1-800-424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NUMBER	WEIGHT %
o-Xylene	95-47-6	100

Trace impurities and additional material names not listed above may also appear in Section 15 towards the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Flammable Liquid and Vapor. Can cause damage to the Central nervous system, liver, kidneys, lungs, skin, and eyes.

POTENTIAL HEALTH HAZARDS

SKIN: Irritant. Can cause dermatitis through defatting of tissue. Rash or blisters may occur.

EYES: Irritant. Symptoms may include tearing, bl.urring, and sensitivity to light.

INHALATION: Irritant. Can cause nausea, vomiting, headache, drowsiness, numbness, lung congestion and lowered body temperature.

INGESTION: Can cause digestive disorders, bloody vomit, intoxication, liver and kidney damage..

DELAYED EFFECTS: Prolonged or repeated exposure can cause liver and kidney damage and coma. Can be fatal.

Ingredients found on one of the OSHA designated carcinogen lists are listed below.

INGREDIENT NAME	NTP STATUS	IARC STATUS	OSHA LIST
No Ingredients listed in this section			

4. FIRST AID MEASURES

SKIN: Wash with soap and water and flush with water. Remove contaminated clothing and wash before reuse. Get medical attention.

EYES: Immediately flush eyes with plenty of water for a least 15 minutes. Get medical attention.

INHALATION: Remove from exposure area to fresh air. If victim is not breathing administer artificial respiration according to your level of training and obtain professional medical assistance immediately.

INGESTION: Do not induce vomiting. Contact physician immediately.

ADVICE TO PHYSICIAN: Treat symptomatically.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT:	63° F (17° C)
FLASH POINT METHOD:	Closed Cup
AUTOIGNITION TEMPERATURE:	867 °F
UPPER FLAME LIMIT (volume % in air):	6.7%
LOWER FLAME LIMIT (volume % in air):	0.9%
FLAME PROPAGATION RATE (solids):	Not applicable
OSHA FLAMMABILITY CLASS:	IB

EXTINGUISHING MEDIA:
Dry Chemical, foam, or Carbon Dioxide

UNUSUAL FIRE AND EXPLOSION HAZARDS:
Vapors are heavier than air, and may migrate to a low area and flashback in a fire or remote ignition condition.

SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:
Do not release runoff from fire control measures into waterways or sewers.
Water will not be effective in extinguishing a fire. Use water spray to cool fire-exposed containers and to reduce rate of burning, taking care not to spread the fire. Heat will build pressure and rupture closed storage containers.
Wear NIOSH approved self-contained breathing apparatus, and full protective clothing.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE: (Always wear recommended personal protective equipment.)
Eliminate sources of ignition. Isolate the spill area. Stop leak in a safe and practical manner. (If leak cannot be stopped easily and safely, advise trained emergency response personnel of the situation.) Using inert material (such as ground corncobs) dike the spilled solvent to prevent it from running into drains or waterways.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

7. HANDLING AND STORAGE

NORMAL HANDLING: (Always wear recommended personal protective equipment.)
Ground containers for transfer of contents. Keep away from sparks, open flames and ignition sources, Do not get in eyes, on skin or clothing. Use with adequate ventilation. No smoking in areas of use.

STORAGE RECOMMENDATIONS:
Store in an area designed for storage of flammable liquids. (OSHA 29 CFR 1910.106)
Store in a cool, well-ventilated area away from oxidizers and ignition sources. Protect against physical damage. Outside or detached storage is preferable. Inside storage should be in a standard flammable liquids storage room or cabinet. No smoking in storage areas. Once liquid solvent has been completely dispensed, containers which appear "empty" should be handled in the same manner as when they were "full" of liquid solvent.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS:
Provide general or local exhaust ventilation systems to maintain airborne concentrations below exposure levels. Regularly inspect all electrical and mechanical equipment used with or near toluene. Ground and bond metal containers to minimize static sparks.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION: Protective gloves and clothing are recommended. Viton or nitrile rubber offers acceptable chemical resistance. Clothing should be static free.

EYE PROTECTION: Wear safety glasses with non-perforated sideshields for normal handling. Goggles or a full face shield may be necessary depending on quantity of material and conditions of use.

RESPIRATORY PROTECTION: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (*29 CFR 1910.134*) and, if necessary, wear a MSHA/NIOSH-approved respirator. For emergency or non-routine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

ADDITIONAL RECOMMENDATIONS: Emergency eyewash fountains and safety showers should be available in the vicinity of any potential exposure.

MATERIAL SAFETY DATA SHEET

o-Xylene

EXPOSURE GUIDELINES

INGREDIENT NAME	ACGIH TLV	OSHA PEL	OTHER LIMIT
o-Xylene	100 ppm	100 ppm	None

* = Limit established by Honeywell International, Inc.
** = Workplace Environmental Exposure Level (AIHA).
*** = Biological Exposure Index (ACGIH).

OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:
None

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Clear		
PHYSICAL STATE:	Liquid		
MOLECULAR WEIGHT:	106.17		
CHEMICAL FORMULA:	C_8H_{10}		
ODOR:	Threshold = < 1ppm		
SPECIFIC GRAVITY (water = 1.0):	0.8802		
SOLUBILITY IN WATER (weight %):	0.175% @ 20° C		
pH:	Not Applicable		
BOILING POINT:	144.41° C		
MELTING POINT:	-25.18°C		
VAPOR PRESSURE:	5.2mm Hg @ 25° C		
VAPOR DENSITY (air = 1.0):	3.7		
EVAPORATION RATE:	0.7	COMPARED TO:	Butyl Acetate = 1
% VOLATILES:			
FLASH POINT:	63°F		

(Flash point method and additional flammability data are found in Section 5.)

10. STABILITY AND REACTIVITY

NORMALLY STABLE? (CONDITIONS TO AVOID):
Stable under normal storage and handling conditions.

INCOMPATIBILITIES:
Strong acids, oxidizers and bases.

HAZARDOUS DECOMPOSITION PRODUCTS:
Thermal oxidation can produce toxic fumes of carbon monoxide.

HAZARDOUS POLYMERIZATION:
Not expected to occur.

11. TOXICOLOGICAL INFORMATION

IMMEDIATE (ACUTE) EFFECTS:
Intraperitoneal-Mouse LD_{50}:1364 mg/kg

DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:
Liver or kidney damage may occur.

OTHER DATA:
None.

12. ECOLOGICAL INFORMATION

guppy (Poecilia reticulata) 7d GLNK0069 LC50 35 mg/l
fathead minnows (n.s.i.) (1; 24; 48; 72; 96h) GLNK0069 LC_{50},S 46; 42; 42; 42; 42 mg/l

goldfish (Carassius auratus) 96h GLNK0069 LC_{50} 17 mg/l (n.s.i.)

13. DISPOSAL CONSIDERATIONS

RCRA

Is the unused product a RCRA hazardous waste if discarded? Yes
If yes, the RCRA ID number is: D001, U239

OTHER DISPOSAL CONSIDERATIONS:

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

14. TRANSPORT INFORMATION

US DOT PROPER SHIPPING NAME:	Xylene
US DOT HAZARD CLASS:	3, Flammable Liquid
US DOT ID NUMBER:	UN1307
US DOT PACKING GROUP:	II
NA EMERGENCY RESPONSE GUIDE:	130

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA)

TSCA INVENTORY STATUS: Listed on Inventory
OTHER TSCA ISSUES: None

SARA TITLE III/CERCLA

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

INGREDIENT NAME	SARA/CERCLA RQ (lb)	SARA EHS TPQ (lb)
o-Xylene	1000 lbs	

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

SECTION 311 HAZARD CLASS: Acute, Fire

SARA 313 TOXIC CHEMICALS:
The following ingredients are SARA 313 "Toxic Chemicals". CAS numbers and weight percents are found in Section 2.

INGREDIENT NAME	COMMENT
o-Xylene	

STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

INGREDIENT NAME	WEIGHT %	COMMENT
No Ingredients listed in this section.		

ADDITIONAL REGULATORY INFORMATION:
RTECS = ZE2450000

WHMIS CLASSIFICATION (CANADA):
Class B, Division 2

FOREIGN INVENTORY STATUS:
EC No: 202-422-2

16. OTHER INFORMATION

OTHER INFORMATION:

CURRENT ISSUE DATE: June, 2000
PREVIOUS ISSUE DATE: January, 1995 January, 1998 Reformat Header, December, 1998

CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:
New Format. New header and footer information.

NFPA Classification	
Health:	2
Flammability:	3
Reactivity:	0

RdH Laborchemikalien GmbH & Co. KG
P.O.Box 10 02 62, D-30918 Seelze, Germany
Tel: +49-(0)5137-999 0   Fax +49-(0)5137-999 120

M A T E R I A L   S A F E T Y   D A T A   S H E E T

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -
CATALOG #: 36666
NAME: ALDRIN
(PESTANAL)

SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -
CAS #: 309-00-2
EC NO: 206-215-8
SYNONYMS
ALDREX * ALDREX 30 * ALDREX 30 E.C. * ALDRIN (ACGIH:OSHA) * ALDRINE (FRENCH) * ALDRITE * ALDROSOL * ALTOX * COMPOUND 118 * ENT 15,949 * HEXACHLOROHEXAHYDRO-ENDO-EXO-DIMETHANONAPHTHALENE * 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4,5,8-DIMETHANONAPHTHALENE * 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-EXO-1,4-ENDO-5,8-DIMETHANONAPHTHALENE * 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4-ENDO-EXO-5,8-DIMETHANONAPHTHALENE * HHDN * KORTOFIN * LATKA 118 (CZECH) * NCI-C00044 * OCTALENE * RCRA WASTE NUMBER P004 * SD 2794 * SEEDRIN * TATUZINHO *

SECTION 3. - - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -
LABEL PRECAUTIONARY STATEMENTS
HIGHLY TOXIC (USA)
TOXIC (EU)
DANGEROUS FOR THE ENVIRONMENT
TOXIC IN CONTACT WITH SKIN AND IF SWALLOWED.
LIMITED EVIDENCE OF CARCINOGENIC EFFECT.
TOXIC: DANGER OF SERIOUS DAMAGE TO HEALTH BY PROLONGED EXPOSURE IN CONTACT WITH SKIN AND IF SWALLOWED.
VERY TOXIC TO AQUATIC ORGANISMS, MAY CAUSE LONG-TERM ADVERSE EFFECTS IN THE AQUATIC ENVIRONMENT.
PROBABLE CARCINOGEN (US)
READILY ABSORBED THROUGH SKIN.
TARGET ORGAN(S):
CENTRAL NERVOUS SYSTEM
REPRODUCTIVE SYSTEM
DO NOT BREATHE DUST.
WEAR SUITABLE PROTECTIVE CLOTHING AND GLOVES.
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
THIS MATERIAL AND ITS CONTAINER MUST BE DISPOSED OF AS HAZARDOUS WASTE.
AVOID RELEASE TO THE ENVIRONMENT. REFER TO SPECIAL INSTRUCTIONS/ SAFETY DATA SHEETS.

SECTION 4. - - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN IMMEDIATELY.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF SKIN CONTACT, FLUSH WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND SHOES. CALL A PHYSICIAN.
IN CASE OF CONTACT WITH EYES, FLUSH WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. ASSURE ADEQUATE FLUSHING BY SEPARATING THE EYELIDS WITH FINGERS. CALL A PHYSICIAN.

SECTION 5. - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -
EXTINGUISHING MEDIA
WATER SPRAY.
CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
EVACUATE AREA.

SECTION 7. - - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -
REFER TO SECTION 8.

SECTION 8. - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
WASH THOROUGHLY AFTER HANDLING.
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
NIOSH/MSHA-APPROVED RESPIRATOR.
COMPATIBLE CHEMICAL-RESISTANT GLOVES.
CHEMICAL SAFETY GOGGLES.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -
APPEARANCE AND ODOR
SOLID.

SECTION 10. - - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -
STABILITY
STABLE.
INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS
HAZARDOUS POLYMERIZATION
WILL NOT OCCUR.

SECTION 11. - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -
ACUTE EFFECTS
MAY CAUSE SKIN IRRITATION.
TOXIC IF ABSORBED THROUGH SKIN.
READILY ABSORBED THROUGH SKIN.
MAY CAUSE EYE IRRITATION.
MAY BE HARMFUL IF INHALED.
MATERIAL MAY BE IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
TOXIC IF SWALLOWED.
EXPOSURE CAN CAUSE:
NAUSEA
VOMITING
HEADACHE
TREMORS
INCOORDINATION
DIZZINESS
CYANOSIS
SEIZURES
UNCONSCIOUSNESS
CHRONIC EFFECTS

Valid 11/2002 - 01/2003

RdH Laborchemikalien GmbH & Co. KG
P.O.Box 10 02 62, D-30918 Seelze, Germany
Tel: +49-(0)5137-999 0 Fax +49-(0)5137-999 120

M A T E R I A L S A F E T Y D A T A S H E E T

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -
CATALOG #: 36666
NAME: ALDRIN
(PESTANAL)
SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -
CAS #: 309-00-2
EC NO: 206-215-8
SYNONYMS
ALDREX * ALDREX 30 * ALDREX 30 E.C. * ALDRIN (ACGIH:OSHA) * ALDRINE (FRENCH) * ALDRITE * ALDROSOL * ALTOX * COMPOUND 118 * ENT 15,949 * HEXACHLOROHEXAHYDRO-ENDO-EXO-DIMETHANONAPHTHALENE * 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4,5,8-DIMETHANONAPHTHALENE * 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-EXO-1,4-ENDO-5,8-DIMETHANONAPHTHALENE * 1,2,3,4,10,10-HEXACHLORO-1,4,4A,5,8,8A-HEXAHYDRO-1,4-ENDO-EXO-5,8-DIMETHANONAPHTHALENE * HHDN * KORTOFIN * LATKA 118 (CZECH) * NCI-C00044 * OCTALENE * RCRA WASTE NUMBER P004 * SD 2794 * SEEDRIN * TATUZINHO *
SECTION 3. - - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - -
LABEL PRECAUTIONARY STATEMENTS
HIGHLY TOXIC (USA)
TOXIC (EU)
DANGEROUS FOR THE ENVIRONMENT
TOXIC IN CONTACT WITH SKIN AND IF SWALLOWED.
LIMITED EVIDENCE OF CARCINOGENIC EFFECT.
TOXIC: DANGER OF SERIOUS DAMAGE TO HEALTH BY PROLONGED EXPOSURE IN CONTACT WITH SKIN AND IF SWALLOWED.
VERY TOXIC TO AQUATIC ORGANISMS, MAY CAUSE LONG-TERM ADVERSE EFFECTS IN THE AQUATIC ENVIRONMENT.
PROBABLE CARCINOGEN (US)
READILY ABSORBED THROUGH SKIN.
TARGET ORGAN(S):
CENTRAL NERVOUS SYSTEM
REPRODUCTIVE SYSTEM
DO NOT BREATHE DUST.
WEAR SUITABLE PROTECTIVE CLOTHING AND GLOVES.
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
THIS MATERIAL AND ITS CONTAINER MUST BE DISPOSED OF AS HAZARDOUS WASTE.
AVOID RELEASE TO THE ENVIRONMENT. REFER TO SPECIAL INSTRUCTIONS/ SAFETY DATA SHEETS.
SECTION 4. - - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN IMMEDIATELY.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF SKIN CONTACT, FLUSH WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND SHOES. CALL A PHYSICIAN.
IN CASE OF CONTACT WITH EYES, FLUSH WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. ASSURE ADEQUATE FLUSHING BY SEPARATING THE EYELIDS WITH FINGERS. CALL A PHYSICIAN.

SECTION 5. - - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -
EXTINGUISHING MEDIA
WATER SPRAY.
CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
EVACUATE AREA.

SECTION 7. - - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -
REFER TO SECTION 8.

SECTION 8. - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
WASH THOROUGHLY AFTER HANDLING.
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
NIOSH/MSHA-APPROVED RESPIRATOR.
COMPATIBLE CHEMICAL-RESISTANT GLOVES.
CHEMICAL SAFETY GOGGLES.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -
APPEARANCE AND ODOR
SOLID.

SECTION 10. - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -
STABILITY
STABLE.
INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS
HAZARDOUS POLYMERIZATION
WILL NOT OCCUR.

SECTION 11. - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -
ACUTE EFFECTS
MAY CAUSE SKIN IRRITATION.
TOXIC IF ABSORBED THROUGH SKIN.
READILY ABSORBED THROUGH SKIN.
MAY CAUSE EYE IRRITATION.
MAY BE HARMFUL IF INHALED.
MATERIAL MAY BE IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
TOXIC IF SWALLOWED.
EXPOSURE CAN CAUSE:
NAUSEA
VOMITING
HEADACHE
TREMORS
INCOORDINATION
DIZZINESS
CYANOSIS
SEIZURES
UNCONSCIOUSNESS
CHRONIC EFFECTS

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

CONTACT A LICENSED PROFESSIONAL WASTE DISPOSAL SERVICE TO DISPOSE OF THIS MATERIAL.
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT SIGMA CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - -

EUROPEAN INFORMATION

EC INDEX NO: 602-048-00-3
TOXIC
DANGEROUS FOR THE ENVIRONMENT
R 24/25
TOXIC IN CONTACT WITH SKIN AND IF SWALLOWED.
R 40
LIMITED EVIDENCE OF CARCINOGENIC EFFECT.
R 48/24/25
TOXIC: DANGER OF SERIOUS DAMAGE TO HEALTH BY PROLONGED EXPOSURE IN CONTACT WITH SKIN AND IF SWALLOWED.
R 50/53
VERY TOXIC TO AQUATIC ORGANISMS, MAY CAUSE LONG-TERM ADVERSE EFFECTS IN THE AQUATIC ENVIRONMENT.
S 22
DO NOT BREATHE DUST.
S 36/37
WEAR SUITABLE PROTECTIVE CLOTHING AND GLOVES.
S 45
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
S 60
THIS MATERIAL AND ITS CONTAINER MUST BE DISPOSED OF AS HAZARDOUS WASTE.
S 61
AVOID RELEASE TO THE ENVIRONMENT. REFER TO SPECIAL INSTRUCTIONS/ SAFETY DATA SHEETS.

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK

ACGIH TLV-CONFIRMED ANIMAL CARCINOGEN	DTLVS* TLV/BEI,1999
ACGIH TLV-TWA 0.25 MG/M3 (SKIN)	DTLVS* TLV/BEI,1999
IARC CANCER REVIEW:ANIMAL LIMITED EVIDENCE	IMSUDL 7,88,1987
IARC CANCER REVIEW:HUMAN INADEQUATE EVIDENCE	IMEMDT 5,25,1974
IARC CANCER REVIEW:GROUP 3	IMSUDL 7,88,1987

EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION
FEREAC 54,7740,1989
MSHA STANDARD-AIR:TWA 0.25 MG/M3 (SKIN)
DTLVS* 3,7,1971
OSHA PEL (GEN INDU):8H TWA 0.25 MG/M3 (SKIN)
CFRGBR 29,1910.1000,1994
OSHA PEL (CONSTRUC):8H TWA 0.25 MG/M3 (SKIN)
CFRGBR 29,1926.55,1994
OSHA PEL (SHIPYARD):8H TWA 0.25 MG/M3 (SKIN)
CFRGBR 29,1915.1000,1993
OSHA PEL (FED CONT):8H TWA 0.25 MG/M3 (SKIN)
CFRGBR 41,50-204.50,1994
OEL-AUSTRALIA: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-AUSTRIA: MAK 0.25 MG/M3, SKIN, JAN1999
OEL-BELGIUM: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-DENMARK: 0.25 MG/M3, SKIN, JAN1999
OEL-FINLAND: TWA 0.25 MG/M3, STEL 0.75 MG/M3, SKIN, JAN1999

OEL-FRANCE: VME 0.25 MG/M3, SKIN, C3 CARCINOGEN, JAN1999
OEL-GERMANY: MAK 0.25 MG/M3, SKIN, JAN1999
OEL-INDIA: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-THE NETHERLANDS: MAC-TGG 0.25 MG/M3, SKIN, JAN1999
OEL-NORWAY: TWA 0.25 MG/M3, JAN1999
OEL-THE PHILIPPINES: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-POLAND: MAC(TWA) 0.5 MG/M3, STEL 1.5 MG/M3, JAN1999
OEL-RUSSIA: STEL 0.01 MG/M3, SKIN, JAN1993
OEL-SWITZERLAND: MAK-W 0.25 MG/M3, SKIN, JAN1999
OEL-THAILAND: TWA 0.25 MG/M3, JAN1993
OEL-TURKEY: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-UNITED KINGDOM: TWA 0.25 MG/M3, STEL 0.75 MG/M3, SKIN, SEP2000
OEL IN ARGENTINA, BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV;
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NIOSH REL TO ALDRIN-AIR:10H CA TWA 0.25 MG/M3 (SK) (0.15 MG/M3 LOQ)
NIOSH* DHHS #92-100,1992
NOHS 1974: HZD 04260; NIS 1; TNF 43; NOS 8; TNE 605
NOES 1983: HZD 04260; NIS 1; TNF 7; NOS 2; TNE 42; TFE 7
ATSDR TOXICOLOGY PROFILE (NTIS** PB/89/214514/AS)
EPA GENETOX PROGRAM 1988, POSITIVE/LIMITED: CARCINOGENICITY-MOUSE/RAT
EPA GENETOX PROGRAM 1988, NEGATIVE: HISTIDINE REVERSION-AMES TEST; S CEREVISIAE-HOMOZYGOSIS
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: D MELANOGASTER SEX-LINKED LETHAL
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES
ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 2001
NIOSH ANALYTICAL METHOD, 1994: ALDRIN, 5502
NCI CARCINOGENESIS BIOASSAY (FEED);CLEAR EVIDENCE:MOUSE
NCITR* NCI-TR-21,1978
NCI CARCINOGENESIS BIOASSAY (FEED);EQUIVOCAL EVIDENCE:RAT
NCITR* NCI-TR-21,1978

U.S. INFORMATION

THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.
THIS PRODUCT IS OR CONTAINS CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH, FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

MERCK
eurolab

SAFETY DATA SHEET

1. Identification of the substance/preparation and of the company/undertaking

Identification of the product

Catalogue No: 12390 ID No.: 1218100

Product name: **p,p' - DDT, pesticide standard**

Manufacturer/supplier identification

Company: Merck Eurolab Ltd, Merck House, Poole, Dorset, BH15 1TD, England
Telephone : 01202 669700 Telefax : 01202 665599

Emergency telephone No.: 01202 669700

2. Composition/information on ingredients

Chemical characterization

Chlorinated pesticide

Product name: p,p'-DDT

CAS number: 50-29-3 EC-No.: 200-024-3

3. Hazards identification

Toxic if swallowed. Possible risk of irreversible effects. Toxic: damage of serious damage to health by prolonged exposure if swallowed. Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

4. First aid measures

Eye contact: Irrigate thoroughly with water for at least 10 minutes. If discomfort persists obtain medical attention.
Inhalation: Remove from exposure, rest and keep warm. In severe cases obtain medical attention.
Skin contact: Wash off skin thoroughly with water. Remove contaminated clothing and wash before

re-use. In severe cases, OBTAIN MEDICAL ATTENTION.
Ingestion: Wash out mouth thoroughly with water and give plenty of water to drink. OBTAIN MEDICAL ATTENTION.

5. Fire-fighting measures

Special risks:

Not combustible. May evolve toxic fumes in fire. (phosgene)

Suitable extinguishing media:

Not applicable

6. Accidental release measures

Wear appropriate protective clothing. Inform others to keep at a safe distance.
Mix with sand, transfer carefully to container and arrange removal by disposal company. Wash site of spillage thoroughly with water and detergent.
For large spillages liquids should be contained with sand or earth and both liquids and solids transferred to salvage containers. Any residues should be treated as for small spillages.

7. Handling and storage

Handling:

Avoid generation of dusts. Under no circumstances eat, drink or smoke while handling this material. Wash hands and face thoroughly after working with material. Contaminated clothing should be removed and washed before re-use.

Storage:

Store at room temperature (15 to 25°C recommended). Keep well closed and protected from direct sunlight and moisture.

8. Exposure controls/personal protection

As appropriate to the situation and the quantity handled.
Respirator: Self-contained breathing apparatus
Ventilation: Fume cupboard
Gloves: Neoprene
Eye Protection: Goggles or face-shield
Other Precautions: Plastic apron, sleeves, boots - if handling large quantities

Engineering methods to control or prevent exposure are preferred. Methods could include process enclosure or mechanical ventilation.

9. Physical and chemical properties

Form:	solid
Colour:	white
Odour:	almost odourless
Melting temperature	108 - 109°C
Boiling temperature	260°C
Density(g/ml)	0.98 - 0.99
Vapour pressure	0.000025 Pa
Log P(o/w):	6.2
Solubility in water	0.003 mg/l

10. Stability and reactivity

Stable.

Substances to be avoided: bases, strong oxidizing agents, aluminium.

11. Toxicological information

Possible effects:
After skin contact: Irritation. Danger of skin absorption.
After eye contact: Irritation.
After ingestion and inhalation: toxic. Possible effects: headache, nausea, agitation, spasms, dyspnoea, respiratory arrest, vomiting, CNS disorders.

Further hazardous properties cannot be excluded. The product should be handled with the care usual when dealing with chemicals.

Further data

LD50 87 mg/kg oral, rat.

Has been found to cause cancer in laboratory animals. Evidence of reproductive effects. Evidence of teratogenic effects.

12. Ecological information

HLC: 3 Pa m3/mol Koc: 0.00002

Toxic for aquatic organisms Toxic for lower aquatic organisms. Insecticidal effect.

Bioaccumulation potential: high (Log Pow >4). Biological degradability: poor. May be an endocrine active substance.

Do not allow to enter drinking water supplies, waste water, or soil!

13. Disposal considerations

Chemical residues are generally classified as special waste, and as such are covered by regulations which vary according to location. Contact your local waste disposal authority for advice, or pass to a chemical disposal company. Rinse out empty containers thoroughly before returning for recycling.

14. Transport information

UN-No.: 2761	IMDG class: 6.1
IMO: 6.1/2761	Packaging group: III
IATA: 2761	Packaging group: III

Correct technical name: ORGANOCHLORINE PESTICIDE, SOLID, TOXIC, (P,P'-DDT)
ADR/RID: 6.1,73'(c)

15. Regulatory information

Labelling according to EC directives

Symbol: T N Toxic. Dangerous for the environment.

R-phrases: R25-40-48/25-50/53
Toxic if swallowed. Possible risk of irreversible effects. Toxic: damage of serious damage to health by prolonged exposure if swallowed. Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

S-phrases: S22-36/37-45-60-61
Do not breathe dust. Wear suitable protective clothing and gloves. In case of accident or if you feel unwell, seek medical advice immediately(show the label where possible). This material and its container must be disposed of as hazardous waste. Avoid release to the environment. Refer to special instructions/Safety data sheets.

EC-No.: 200-024-3
Carcinogen, Category 3

Local Regulations

U.K. Transport Category 3

Within the UK, the use of this material must be assessed under the Control of Substances Hazardous to Health (COSHH) regulations.

The Stockholm Convention classifies this substance as a Perisistent Organic Pollutant (POP). Its use is strictly controlled and must be phased out.

Within the UK, this material is subject to statutory control as a prescribed substance due its endocrine disruption potential (category 1)

UK Exposure Limits: OES - 1,1,1-Trichlorobis(chlorophenyl)ethane(DDT):
Long-term: 1 mg/m3 Short term: 3 mg/m3

16. Other information

Revised.
Supersedes edition of: 09/02/98
Reason for alteration: Changes in Section : 15

Date of issue:	22/06/01
Date of print:	02/10/01

Valid 11/2002 - 01/2003

Sigma Chemical Co.
P.O. Box 14508
St. Louis, MO 63178 USA
Phone: 314-771-5765

M A T E R I A L S A F E T Y D A T A S H E E T

SECTION 1. - - - - - - - - - - CHEMICAL IDENTIFICATION- - - - - - - - - -
CATALOG #: D7519
NAME: DIELDRIN

SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - - -
CAS #: 60-57-1
MF: C12H8CL6O
EC NO: 200-484-5

SYNONYMS
ALDRIN EPOXIDE * ALVIT 55 * COMPOUND 497 * DIELDREX * DIELDRIN (ACGIH:) Tj ET BT /PjCo

16,225 * HEOD * HEXACHLOROEPOXYOCTAHYDRO-ENDO,EXO-DIMETHANONAPHTHALENE * ILLOXOL * INSECTICIDE NO. 497 * INSECTLACK * KOMBI-ALBERTAN * LATKA 497 (CZECH) * MOTH SNUB D * NCI-C00124 * OCTALOX * PANORAM D-31 * RED SHIELD * RCRA WASTE NUMBER P037 * SD 3417 * TERMITOX *

SECTION 3. - - - - - - - - - - - HAZARDS IDENTIFICATION - - - - - - - - - -
LABEL PRECAUTIONARY STATEMENTS
HIGHLY TOXIC (USA)
VERY TOXIC (EU)
TOXIC BY INHALATION AND IF SWALLOWED.
VERY TOXIC IN CONTACT WITH SKIN.
LIMITED EVIDENCE OF CARCINOGENIC EFFECT.
TOXIC: DANGER OF SERIOUS DAMAGE TO HEALTH BY PROLONGED EXPOSURE IF SWALLOWED.
VERY TOXIC TO AQUATIC ORGANISMS, MAY CAUSE LONG-TERM ADVERSE EFFECTS IN THE AQUATIC ENVIRONMENT.
READILY ABSORBED THROUGH SKIN.
POSSIBLE CARCINOGEN (US)
CALIF. PROP. 65 CARCINOGEN.
TARGET ORGAN(S):
LIVER
CENTRAL NERVOUS SYSTEM
TOXIC IF INHALED.
DO NOT BREATHE DUST.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
THIS MATERIAL AND ITS CONTAINER MUST BE DISPOSED OF AS HAZARDOUS WASTE.
AVOID RELEASE TO THE ENVIRONMENT. REFER TO SPECIAL INSTRUCTIONS/ SAFETY DATA SHEETS.

SECTION 4. - - - - - - - - - - - FIRST-AID MEASURES- - - - - - - - - - -
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN IMMEDIATELY.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF SKIN CONTACT, FLUSH WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND SHOES. CALL A PHYSICIAN.
IN CASE OF CONTACT WITH EYES, FLUSH WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. ASSURE ADEQUATE FLUSHING BY SEPARATING

THE EYELIDS WITH FINGERS. CALL A PHYSICIAN.

SECTION 5. - - - - - - - - - FIRE FIGHTING MEASURES - - - - - - - - - -

EXTINGUISHING MEDIA

CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.

SPECIAL FIREFIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS

EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - - - - - ACCIDENTAL RELEASE MEASURES- - - - - - - - -

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.

SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.

AVOID RAISING DUST.

VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

EVACUATE AREA.

SECTION 7. - - - - - - - - - - - HANDLING AND STORAGE- - - - - - - - - - -

REFER TO SECTION 8.

SECTION 8. - - - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION- - - - - -

SAFETY SHOWER AND EYE BATH.

USE ONLY IN A CHEMICAL FUME HOOD.

WASH CONTAMINATED CLOTHING BEFORE REUSE.

WASH THOROUGHLY AFTER HANDLING.

DO NOT BREATHE DUST.

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.

AVOID PROLONGED OR REPEATED EXPOSURE.

NIOSH/MSHA-APPROVED RESPIRATOR.

COMPATIBLE CHEMICAL-RESISTANT GLOVES.

CHEMICAL SAFETY GOGGLES.

KEEP TIGHTLY CLOSED.

STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - - - -

APPEARANCE AND ODOR

SOLID.

PHYSICAL PROPERTIES

MELTING POINT: 143 - 144 C

VAPOR DENSITY: 13.2 G/L

SWISS POISON CLASS: 2

SECTION 10. - - - - - - - - - -STABILITY AND REACTIVITY - - - - - - - - -

STABILITY

STABLE.

INCOMPATIBILITIES

STRONG OXIDIZING AGENTS

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

CARBON MONOXIDE, CARBON DIOXIDE

HAZARDOUS POLYMERIZATION

WILL NOT OCCUR.

SECTION 11. - - - - - - - - - - TOXICOLOGICAL INFORMATION - - - - - - - -

ACUTE EFFECTS

MAY CAUSE SKIN IRRITATION.

TOXIC IF ABSORBED THROUGH SKIN.

MAY CAUSE EYE IRRITATION.

TOXIC IF INHALED.

MATERIAL MAY BE IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.

TOXIC IF SWALLOWED.

OVEREXPOSURE CAN CAUSE: MALAISE, HEADACHE, NAUSEA, VOMITING, DIZZINESS, TREMORS, CLONIC AND TONIC CONVULSIONS, COMA, RESPIRATORY FAILURE.

TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

CHRONIC EFFECTS

THIS PRODUCT IS OR CONTAINS A COMPONENT THAT HAS BEEN REPORTED TO BE POSSIBLY CARCINOGENIC BASED ON ITS IARC, ACGIH, NTP OR EPA CLASSIFICATION.

TARGET ORGAN(S):

CENTRAL NERVOUS SYSTEM
LIVER
BLOOD
LABORATORY EXPERIMENTS HAVE SHOWN MUTAGENIC EFFECTS.

RTECS #: IO1750000
1,4:5,8-DIMETHANONAPHTHALENE,
1,2,3,4,10,10-HEXACHLORO-6,7-EPOXY-1,4,4A,5,6,7,8,8A-
OCTAHYDRO, ENDO,EXO-

TOXICITY DATA

ORL-MAN LDLO:65 MG/KG	34ZIAG -,215,1969
UNR-HMN LDLO:28 MG/KG	ATXKA8 22,115,1966
ORL-RAT LD50:38300 UG/KG	JAFCAU 3,402,1955
IHL-RAT LC50:13 MG/M3/4H	85GMAT -,73,1982
SKN-RAT LD50:56 MG/KG	RPZHAW 18,161,1967
IPR-RAT LD50:35 MG/KG	CBPCEE 85,437,1986
SCU-RAT LD50:49 MG/KG	85GMAT -,73,1982
IVN-RAT LD50:9 MG/KG	BJIMAG 21,269,1964
ORL-MUS LD50:38 MG/KG	SPEADM 78-1,13,1978
IVN-MUS LD50:10500 UG/KG	TXAPA9 23,408,1972
ICE-MUS LD50:3 MG/KG	TOLED5 60,289,1992
ORL-DOG LD50:65 MG/KG	GUCHAZ 6,198,1973
ORL-MKY LD50:3 MG/KG	32ZDAL -,79,1970
IHL-CAT LC50:80 MG/M3/4H	GTPZAB 8(4),30,1964
ORL-RBT LD50:45 MG/KG	PCOC** -,377,1966
SKN-RBT LD50:250 MG/KG	SPEADM 78-1,13,1978
ORL-PIG LD50:38 MG/KG	EJTXAZ 7,159,1974
ORL-GPG LD50:49 MG/KG	PCOC** -,377,1966
ORL-HAM LD50:60 MG/KG	TJADAB 9,11,1974
ORL-PGN LD50:23700 UG/KG	ASTTA8 (680),157,1979
IVN-PGN LD50:1200 MG/KG	32ZDAL -,79,1970
ORL-CKN LD50:20 MG/KG	JEENAI 44,1013,1951
ORL-QAL LD50:10780 UG/KG	ETOCDK 1,157,1982
ORL-DCK LD50:381 MG/KG	TXAPA9 20,57,1971
ORL-MAM LD50:94 MG/KG	NTIS** PB288-416
UNR-MAM LD50:25 MG/KG	30ZDA9 -,63,1971
ORL-BWD LD50:13300 UG/KG	ASTTA8 (680),157,1979

TARGET ORGAN DATA
PERIPHERAL NERVE AND SENSATION (FLACCID PARALYSIS WITHOUT ANESTHESIA)
SENSE ORGANS AND SPECIAL SENSES (MIOSIS)
BEHAVIORAL (ALTERED SLEEP TIME)
BEHAVIORAL (SOMNOLENCE)
BEHAVIORAL (TREMOR)
BEHAVIORAL (CONVULSIONS OR EFFECT ON SEIZURE THRESHOLD)
BEHAVIORAL (EXCITEMENT)
BEHAVIORAL (FOOD INTAKE)
BEHAVIORAL (WITHDRAWAL)
BEHAVIORAL (IRRITABILITY)
CARDIAC (OTHER CHANGES)
LUNGS, THORAX OR RESPIRATION (ACUTE PULMONARY EDEMA)
LUNGS, THORAX OR RESPIRATION (CHRONIC PULMONARY EDEMA OR CONGESTION)
LUNGS, THORAX OR RESPIRATION (TUMORS)
GASTROINTESTINAL (NAUSEA OR VOMITING)
LIVER (FATTY LIVER DEGENERATION)
LIVER (TUMORS)
KIDNEY, URETER, BLADDER (OTHER CHANGES)
SKIN AND APPENDAGES (TUMORS)
PATERNAL EFFECTS (OTHER EFFECTS ON MALE)
EFFECTS ON FERTILITY (PRE-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
EFFECTS ON EMBRYO OR FETUS (FETAL DEATH)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (CENTRAL NERVOUS SYSTEM)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (EYE, EAR)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (CRANIOFACIAL)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (BODY WALL)

SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
EFFECTS ON NEWBORN (LIVE BIRTH INDEX)
EFFECTS ON NEWBORN (BEHAVIORAL)
TUMORIGENIC (CARCINOGENIC BY RTECS CRITERIA)
TUMORIGENIC (NEOPLASTIC BY RTECS CRITERIA)
TUMORIGENIC (EQUIVOCAL TUMORIGENIC AGENT BY RTECS CRITERIA)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

SECTION 12. - - - - - - - - - - ECOLOGICAL INFORMATION - - - - - - - - - -

DATA NOT YET AVAILABLE.

SECTION 13. - - - - - - - - - - DISPOSAL CONSIDERATIONS - - - - - - - - -

CONTACT A LICENSED PROFESSIONAL WASTE DISPOSAL SERVICE TO DISPOSE OF THIS MATERIAL.
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - - - - - - - TRANSPORT INFORMATION - - - - - - - - -

CONTACT SIGMA CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - - - - - - REGULATORY INFORMATION - - - - - - - - - -

EUROPEAN INFORMATION
EC INDEX NO: 602-049-00-9
VERY TOXIC
R 25
TOXIC IF SWALLOWED.
R 27
VERY TOXIC IN CONTACT WITH SKIN.
R 40
LIMITED EVIDENCE OF CARCINOGENIC EFFECT.
R 50/53
VERY TOXIC TO AQUATIC ORGANISMS, MAY CAUSE LONG-TERM ADVERSE EFFECTS IN THE AQUATIC ENVIRONMENT.
S 22
DO NOT BREATHE DUST.
S 36/37
WEAR SUITABLE PROTECTIVE CLOTHING AND GLOVES.
S 45
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).
S 61
AVOID RELEASE TO THE ENVIRONMENT. REFER TO SPECIAL INSTRUCTIONS/ SAFETY DATA SHEETS.

REVIEWS, STANDARDS, AND REGULATIONS
OEL=MAK
ACGIH TLV-NOT CLASSIFIABLE AS A HUMAN CARCINOGEN DTLVS* TLV/BEI,1999
ACGIH TLV-TWA 0.25 MG/M3 (SKIN) DTLVS* TLV/BEI,1999
IARC CANCER REVIEW:ANIMAL LIMITED EVIDENCE IMEMDT 5,125,1974
IARC CANCER REVIEW:HUMAN INADEQUATE EVIDENCE IMEMDT 5,125,1974
IARC CANCER REVIEW:GROUP 3 IMSUDL 7,196,1987
MSHA STANDARD-AIR:TWA 0.25 MG/M3 (SKIN)
DTLVS* 3,84,1971
OSHA PEL (GEN INDU):8H TWA 0.25 MG/M3 (SKIN)
CFRGBR 29,1910.1000,1994
OSHA PEL (CONSTRUC):8H TWA 0.25 MG/M3 (SKIN)
CFRGBR 29,1926.55,1994
OSHA PEL (SHIPYARD):8H TWA 0.25 MG/M3 (SKIN)
CFRGBR 29,1915.1000,1993
OSHA PEL (FED CONT):8H TWA 0.25 MG/M3 (SKIN)
CFRGBR 41,50-204.50,1994
OEL-AUSTRALIA: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-AUSTRIA: MAK 0.25 MG/M3, SKIN, JAN1999
OEL-BELGIUM: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-DENMARK: 0.25 MG/M3, SKIN, JAN1999
OEL-FINLAND: TWA 0.25 MG/M3, STEL 0.75 MG/M3, SKIN, CARCINOGEN, JAN1999
OEL-FRANCE: VME 0.25 MG/M3, SKIN, C3 CARCINOGEN, JAN1999

OEL-GERMANY: MAK 0.25 MG/M3 (TOTAL DUST), SKIN, JAN1999
OEL-INDIA: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-THE NETHERLANDS: MAC-TGG 0.25 MG/M3, SKIN, JAN1999
OEL-NORWAY: TWA 0.25 MG/M3, JAN1999
OEL-THE PHILIPPINES: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-POLAND: MAC(TWA) 0.5 MG/M3, STEL 1.5 MG/M3, JAN1999
OEL-RUSSIA: STEL 0.01 MG/M3, JAN1993
OEL-SWITZERLAND: MAK-W 0.25 MG/M3, SKIN, JAN1999
OEL-THAILAND: TWA 0.25 MG/M3, JAN1993
OEL-TURKEY: TWA 0.25 MG/M3, SKIN, JAN1993
OEL-UNITED KINGDOM: TWA 0.25 MG/M3, STEL 0.75 MG/M3, SKIN, SEP2000
OEL IN ARGENTINA, BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV;
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NIOSH REL TO DIELDRIN-AIR:CA TWA 0.25 MG/M3 (SK) (0.15 MG/M3 LOQ)
NIOSH* DHHS #92-100,1992
NOHS 1974: HZD M2830; NIS 2; TNF 56; NOS 3; TNE 760
ATSDR TOXICOLOGY PROFILE (NTIS** PB/89/214514/AS)
EPA GENETOX PROGRAM 1988, POSITIVE: V79 CELL CULTURE-GENE MUTATION
EPA GENETOX PROGRAM 1988, NEGATIVE: RODENT DOMINANT LETHAL; HOST-MEDIATED ASSAY
EPA GENETOX PROGRAM 1988, NEGATIVE: HISTIDINE REVERSION-AMES TEST; S CEREVISIAE-HOMOZYGOSIS
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: D MELANOGASTER SEX-LINKED LETHAL
EPA TSCA SECTION 8(D) UNPUBLISHED HEALTH/SAFETY STUDIES
ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 2001
NCI CARCINOGENESIS BIOASSAY (FEED);EQUIVOCAL EVIDENCE:MOUSE
NCITR* NCI-TR-21,1978
NCI CARCINOGENESIS BIOASSAY (FEED);NO EVIDENCE:RAT
NCITR* NCI-TR-22,1978
NCI CARCINOGENESIS BIOASSAY (FEED);NO EVIDENCE:RAT
NCITR* NCI-TR-21,1978

U.S. INFORMATION

THIS PRODUCT IS OR CONTAINS CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

SECTION 16. - - - - - - - - - - - OTHER INFORMATION- - - - - - - - - - - -

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH, FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Trichloroethylene
PRODUCT ID: 0085
SYNONYMS: Trichloroethene; Trichlorethylene; Trichlor; C_2HCl_3
ISSUE DATE: 11/26/2002
EDITION NO.: 17

PPG Industries, Inc.
One PPG Place, Pittsburgh, PA 15272, USA
24-hour Emergency Telephone Number: 1-304-843-1300
For Product Information (8am-5pm Eastern time):
1-800-243-6774 (C/A)

PREPARER: Product Safety, Chemicals

2. COMPOSITION/INFORMATION ON INGREDIENTS

Material/CAS Number	Percent
Trichloroethylene (Stabilized) 79-01-6	>99

Note: Tested Mixture

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

WARNING! May cause irritation to eyes and skin. Vapor harmful. Harmful if swallowed. Possible cancer hazard based on tests with laboratory animals -- overexposure may create cancer risk. Do not ship lightly stabilized grades in aluminum trailers.

Precautions: Avoid contact with eyes. Avoid prolonged or repeated contact with the skin. Use only with adequate ventilation. Do not breathe vapors. High vapor concentrations can cause dizziness, unconsciousness, central nervous system depression or death. Long-term overexposure may cause liver/kidney injury. Do not use in poorly ventilated or confined spaces without proper respiratory protection. Ventilation must be sufficient to limit employee exposure to this product below permissible exposure limits. Eye irritation, dizziness and/or drunkenness are signs of overexposure. Do not swallow. Wash thoroughly every day after work. Do not eat, drink or smoke in work area.

4. FIRST AID MEASURES

INHALATION: Move person to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult. If breathing is difficult, give oxygen. Call a physician.

EYE/SKIN CONTACT: In case of contact, immediately flush eyes and skin with plenty of water (soap and water for skin) for at least 15 minutes, while removing contaminated clothing and shoes. Get medical attention if irritation persists. Thoroughly clean contaminated clothing and shoes before reuse or discard.

INGESTION: If swallowed, give at least 3-4 glasses of water, but do not induce vomiting. Do not give anything by mouth to an unconscious or convulsing person. Get medical attention.

NOTES TO PHYSICIAN:
Only administer adrenaline after careful consideration following overexposure. Increased sensitivity of the heart to adrenaline may be caused by overexposure to this product.

5. FIRE FIGHTING MEASURES

FLASH POINT: None (by DOT test method).

FLAMMABLE LIMITS IN AIR - LOWER (%): 7.8%

FLAMMABLE LIMITS IN AIR - UPPER (%): 52%

EXTINGUISHING MEDIA: Carbon dioxide. Dry chemical. Water.

SPECIAL FIREFIGHTING PROCEDURES: Emits toxic fumes under fire conditions. When this product is involved in fires, it can decompose to toxic, corrosive hydrogen chloride and possible traces of phosgene. Fire-fighters must wear NIOSH approved pressure demand, self-contained breathing apparatus and full protective clothing when fighting chemical fires. Vapor concentration in a confined or poorly ventilated area can be ignited upon contact with a high energy spark, flame, or high intensity source of heat. This can occur at concentrations ranging between the lower and upper limits (by volume) listed above.

6. ACCIDENTAL RELEASE MEASURES

ACTION TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Immediately evacuate the area. Provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and eye/skin protection should be permitted in the area. Dike area to contain spill. Take precautions as necessary to prevent contamination of ground and surface waters. Recover spilled material on adsorbents, such as sawdust or vermiculite, and sweep into closed containers for disposal. After all visible traces, including ignitable vapors, have been removed, thoroughly wet vacuum the area. Do not flush to sewer. If area of spill is porous, remove as much earth and gravel, etc. as necessary and place in closed containers for disposal.

7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORAGE:
Vapors are heavier than air and will collect in low areas. Keep container closed when not in use. Store only in closed, properly labeled containers. This material or its vapors when in contact with flames, hot glowing surfaces or electric arcs can decompose to form hydrogen chloride gas and possible traces of phosgene. Avoid contamination of water supplies. Handling, storage and use procedures must be carefully monitored to avoid spills or leaks. Any spill or leak has the potential to cause underground water contamination which may, if sufficiently severe, render a drinking water source unfit for human consumption. Contamination that does occur cannot be easily corrected. A chlorinated solvent used as a flashpoint suppressant must be added in sufficient quantity or the resultant mixture may have a flashpoint lower than the flammable component. Do not use cutting or welding torches on drums that contained this product unless properly purged and cleaned. Do not ship lightly stabilized grades in aluminum trailers. The only exception is Type 145 vapor degreasing grade. Liquid oxygen or other strong oxidants may form explosive mixtures with this product.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits:
8-hour Time Weighted Average (TWA); 15-minute Short-Term Exposure Limit (STEL)

OSHA: 50 ppm TWA. 200 ppm STEL.

ACGIH: 50 ppm TWA. 100 ppm STEL.

RESPIRATORY PROTECTION: Airborne concentrations should be maintained below the exposure limits. When respiratory protection is required for certain operations (<10x exposure limit), use an air purifying respirator. The effectiveness of an air purifying respirator is limited. Use only for a single short-term exposure. Use self-contained breathing apparatus (SCBA) or full facepiece airline respirator with auxiliary SCBA operated in the pressure demand mode for emergencies and for all work performed in storage vessels, poorly ventilated rooms, and other confined areas. Overexposure to vapors may be prevented by ensuring proper ventilation controls, vapor exhaust or fresh air entry. A NIOSH-approved air purifying respirator with the appropriate chemical cartridges or a positive-pressure air-supplied respirator may also reduce exposure. Read the respirator manufacturer's instructions and literature carefully to determine the type of airborne contaminants against which the respirator is effective, its limitations, and how it is to be properly fitted and used.

VENTILATION: Use local exhaust or general room/dilution ventilation sufficient to maintain employee exposure below permissible exposure limits.

EYE AND FACE PROTECTION: Splashproof goggles.

PROTECTIVE GLOVES: Viton®. Silver Shield®. Polyvinyl alcohol (degrades in water).

OTHER PROTECTIVE EQUIPMENT: Boots, aprons, or chemical suits should be used when necessary to prevent skin contact.

9. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT:	86-88 C
VAPOR DENSITY (Air=1):	4.54
SPECIFIC GRAVITY (Water=1):	1.465 @ 20/20 C
pH:	6.7 to 7.5
FREEZING/MELTING POINT:	-86.4 C
SOLUBILITY (wt.% in water):	0.11
BULK DENSITY:	12.2 lbs/gal @ 20 C
VOLUME % VOLATILE:	100
VAPOR PRESSURE:	57.8 mm Hg @ 20 C
EVAPORATION RATE:	0.28 (ethyl ether=1)
HEAT OF SOLUTION:	NA
PHYSICAL STATE:	Liquid
ODOR:	Ether-like
COLOR:	Clear/Colorless

10. STABILITY AND REACTIVITY

STABILITY: Stable.

HAZARDOUS POLYMERIZATION: Will not occur.

INCOMPATIBILITY (CONDITIONS/MATERIALS TO AVOID):
Open flames, hot glowing surfaces or electric arcs. Avoid contamination with caustic soda, caustic potash or oxidizing materials. Shock sensitive compounds may be formed.

HAZARDOUS THERMAL DECOMPOSITION/COMBUSTION PRODUCTS:
Hydrogen chloride gas. Possible traces of phosgene.

11. TOXICOLOGICAL INFORMATION

ACUTE INHALATION LC50:	(mouse) 8450 ppm (4 hours). Slight to very low toxicity.
ACUTE DERMAL LD50:	(rabbit) >2000 mg/kg Slight to very low toxicity.
SKIN IRRITATION:	Mildly irritating.
EYE IRRITATION:	Moderately irritating.
ACUTE ORAL LD50:	(rat) 5650 mg/kg. Slight to very low toxicity.

CHRONIC EFFECTS/CARCINOGENICITY: Trichloroethylene is listed by NTP as a suspect carcinogen, and by IARC as a Group 2A carcinogen.

MEDICAL CONDITIONS AGGRAVATED: Prolonged exposure above the OSHA permissible exposure limit may complicate existing liver and kidney diseases.

EFFECTS OF OVEREXPOSURE:

ACUTE:

Inhalation: This product is primarily a central nervous system depressant. Inhalation can cause irritation of the respiratory tract, dizziness, nausea, headache, loss of coordination and equilibrium, unconsciousness and even death in confined or poorly ventilated areas. Fatalities following severe acute exposure to various chlorinated solvents have been attributed to ventricular fibrillation.

Eye/Skin: Liquid splashed in the eye can result in discomfort, pain and irritation. Prolonged or repeated contact with liquid on the skin can cause irritation and dermatitis. The problem may be accentuated by liquid becoming trapped against the skin by contaminated clothing and shoes. Skin absorption is not expected to be of toxicological significance under normal industrial use.

Ingestion: Swallowing of this material may result in irritation of the mouth and GI tract along with other effects as listed above for inhalation. Vomiting and subsequent aspiration into the lungs may lead to chemical pneumonia and pulmonary edema which is a potentially fatal condition.

CHRONIC: Prolonged exposure above the OSHA permissible exposure limits may result in liver and kidney damage. Prudent handling practices should be followed to minimize human exposure.

CARCINOGENICITY: In a National Cancer Institute bioassay, little if any effect was observed in rats but hepatocellular carcinomas were quite common in both sexes of mice fed high doses. A subsequent study investigating the possible differences in metabolism found that mice metabolized trichloroethylene to a much greater extent than other species. Additionally, data from this study showed that tumor formation occurred via a nongenetic mechanism. The Science Advisory Board of the EPA has suggested caution in concluding from animal studies that trichloroethylene presents a risk of human cancer because of the negative epidemiology studies and also because of metabolism studies showing differences between the human and mouse response.

MUTAGENESIS: When activated with microsomal enzymes, trichloroethylene has been shown to be weakly positive in certain microbial mutagen test systems.

EPIDEMIOLOGY: In a retrospective cohort study of 14,457 people followed for at least 26 years, the investigators concluded that employees occupationally exposed to trichloroethylene did not show any significant association between several measures of exposure to trichloroethylene and any excess of cancer.

REPRODUCTIVE/DEVELOPMENTAL: Trichloroethylene was not embryotoxic or teratogenic in rats or mice inhaling the compound. In a teratology-reproduction study conducted by NTP, rats and mice fed microencapsulated trichloroethylene at doses as high as 300 mg/kg/day (rats) and 750 mg/kg/day (mice) showed little effect.

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION:
Slightly toxic to aquatic life.

Sheepshead Minnows - 96-hour LC50 - 52 mg/l
Mysid Shrimp - 96-hour LC50 - 14 mg/l

Marine Alga - 96-hour EC50 - 95 mg/l

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD:
Contaminated sand, sawdust, vermiculite, soil or porous surface must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be reprocessed or incinerated or must be treated in a permitted hazardous waste management facility. Waste material must be disposed of in accordance with federal, state, provincial, and local environmental control regulations. Empty containers should be recycled or disposed of through an approved waste management facility.

14. TRANSPORT INFORMATION

Proper Shipping Name: .... Trichloroethylene
Hazard Class: .... 6.1 (Toxic)
UN Number: UN1710
Packing Group: III
USA-RQ, Hazardous Substance and Quantity: .... 100 lbs./45.4 kg.
Marine Pollutant: .... None

15. REGULATORY INFORMATION

USA TSCA: All components of this product are listed on the TSCA Inventory.
EUROPE EINECS: All components in this product are listed on EINECS.
CANADA DOMESTIC SUBSTANCES LIST (DSL): This product and/or all of its components are listed on the Canadian DSL.
AUSTRALIA AICS: All components of this product are listed on AICS.
KOREA ECL: All components in this product are listed on the Korean Existing Chemicals Inventory (KECI).
JAPAN MITI (ENCS): All components in this product are listed on the Japanese Existing and New Chemical Substances (ENCS) chemical inventory.
PHILIPPINES PICCS: All of the components in this product are listed on the Philippines Inventory of Chemicals and Chemical Substances (PICCS).

SARA TITLE III:
SARA (311, 312) Hazard Class:
Acute Health Hazard. Chronic Health Hazard.
SARA (313) Chemicals:
Listed.
SARA Extremely Hazardous Substance:
Not listed.

CERCLA Hazardous Substance:
Listed in Table 302.4 of 40 CFR Part 302 as a hazardous substance with a reportable quantity of 100 pounds. Releases to air, land or water which exceed the RQ must be reported to the National Response Center, 800-424-8802.

RCRA:
Waste trichloroethylene and contaminated soils/materials from spill cleanup are U228 hazardous

waste as per 40 CFR 261.33 and must be disposed of accordingly under RCRA.

CALIFORNIA PROPOSITION 65: This product is a chemical known to the State of California to cause cancer.

NJ RIGHT-TO-KNOW LIST: Also contains butylene oxide (CAS No. 106-88-7).

CANADA REGULATIONS (WHMIS): Class D1B - Toxic Materials. Sensitization to product: None known. Odor threshold: Approx. 80 ppm. Product use: degreasing solvent.

16. OTHER INFORMATION

The following has been revised since the last issue of this MSDS:
Date. Edition. Section 3 has been updated. Section 8 has been updated. Section 13 has been updated. Section 14 has been updated. Section 15 has been updated.

Previous revision date: 09/27/2001
Previous edition number: 16

NA = Not Available

MERCK
eurolab

SAFETY DATA SHEET

1. Identification of the substance/preparation and of the company/undertaking

Identification of the product

Catalogue No: P26217 ID No.: 1040700

Product name: **Tetrachloroethylene**

Manufacturer/supplier identification

Company: Merck Eurolab Ltd, Merck House, Poole, Dorset, BH15 1TD, England
Telephone : 01202 669700 Telefax : 01202 665599

Emergency telephone No.: 01202 669700

2. Composition/information on ingredients

Chemical characterization

Halogenated solvent

Product name: Tetrachloroethylene

CAS number: 127-18-4 EC-No.: 204-825-9

3. Hazards identification

Possible risk of irreversible effects. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

4. First aid measures

Eye contact: Irrigate thoroughly with water for at least 10 minutes. OBTAIN MEDICAL ATTENTION.
Inhalation: Remove from exposure, rest and keep warm. In severe cases obtain medical attention.
Skin contact: Wash off skin thoroughly with water. Remove contaminated clothing and wash before re-use. In severe cases, OBTAIN MEDICAL ATTENTION.

Ingestion: Wash out mouth thoroughly with water and give plenty of water to drink. OBTAIN MEDICAL ATTENTION.

5. Fire-fighting measures

Special risks:

May evolve toxic fumes in fire.

Suitable extinguishing media:

Not applicable

6. Accidental release measures

Wear appropriate protective clothing. Inform others to keep at a safe distance.
Absorb on an inert absorbent, (e.g. BDH Spillage absorption granules), transfer to a suitable container and arrange removal by disposal company. Wash site of spillage thoroughly with water and detergent.
For large spillages liquids should be contained with sand or earth and both liquids and solids transferred to salvage containers. Any residues should be treated as for small spillages.

7. Handling and storage

Handling:

Under no circumstances eat, drink or smoke while handling this material. Wash hands and face thoroughly after working with material. Contaminated clothing should be removed and washed before re-use. Do not empty into drains.

Storage:

Store at room temperature (15 to 25°C recommended). Keep well closed and protected from direct sunlight and moisture.

8. Exposure controls/personal protection

As appropriate to the situation and the quantity handled.
Respirator: Self-contained breathing apparatus
Ventilation: Fume cupboard, flameproof
Gloves: Nitrile
Eye Protection: Goggles or face-shield
Other Precautions: Plastic apron, sleeves, boots - if handling large quantities

9. Physical and chemical properties

Form:	liquid
Colour:	colourless
Odour:	ether-like
Melting temperature	-22°C
Boiling temperature	121°C
Density(g/ml)	1.62
Vapour pressure	20mmHg, 26°C
-Density	5.83
Log P(o/w):	2.6
Solubility in water	Practically insoluble

10. Stability and reactivity

Stable.
Unsuitable working materials: various plastics.

Substances to be avoided
alkali metals, alkaline earth metals, metals in powder form, alkali hydroxides, oxygen, nitrogen oxides.

Hazardous decomposition products
phosgene, hydrochloric acid, chlorine.

11. Toxicological information

After contact with substance: Severe irritations of: eyes, mucous membranes. Danger of skin absorption.
After long-term exposure to the chemical: dermatitis.
After absorption: headache, nausea, vomiting, narcosis. Absorption can result in damage of: liver, kidneys. The carcinogenic potential is awaiting further clarification.

Further data

LD50 2629 mg/kg oral, rat.
LC50 34 mg/l inhalation, rat.
Has been found to cause cancer in laboratory animals. Evidence of reproductive effects.
Carcinogen, Category 3

12. Ecological information

Henry constant 2700 Pa m3/mol   Koc: 209-238
Ecotoxic effects:

aquatic organisms LC: 10 mg/l/96h
P.promelas LC: 18.4 mg/l/96h
Daphnia magna LC: 3.3 - 18.0 mg/l

Bioaccumulation potential: low (Log Pow <2).
Toxic for aquatic organisms. May cause long term adverse effects in the aquatic environment.+

Do not allow to enter drinking water supplies, waste water, or soil!

13. Disposal considerations

Chemical residues are generally classified as special waste, and as such are covered by regulations which vary according to location. Contact your local waste disposal authority for advice, or pass to a chemical disposal company. Rinse out empty containers thoroughly before returning for recycling.

14. Transport information

UN-No.: 1897 IMDG class: 6.1
IMO: 6.1/1897 Packaging group: III
IATA: 1897 Packaging group: III
Correct technical name: TETRACHLOROETHYLENE
ADR/RID: 6.1,15'(c)

15. Regulatory information

Labelling according to EC directives

Symbol: Xn N Harmful. Dangerous for the environment.

R-phrases: R40-51/53
Possible risk of irreversible effects. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

S-phrases: S23-36/37-61
Do not breathe gas. Wear suitable protective clothing and gloves. Avoid release to the environment. Refer to special instructions/Safety data sheets.

EC-No.: 204-825-9
Carcinogen, Category 3

Local Regulations

U.K. Transport Category 3

UK Exposure Limits: OES - Tetrachloroethylene
Long term: 345 mg/m3 (50 ppm) Short term: 689 mg/m3 (100 ppm)

16. Other information

Reason for alteration: Changes in Section : 12, 15
Revised.
Supersedes edition of: 18/08/94

Date of issue:	10/12/97
Date of print:	02/10/01

GARDENA, CA
NEW BRUNSWICK, NJ

SPECTRUM®

Material Safety Data Sheet

NFPA	HMIS	Personal Protective Equipment
1 / 3 / 2	Health Hazard 3 Fire Hazard 1 Reactivity 2	See Section 15.

Section 1. Chemical Product and Company Identification

Common Name/ Trade Name	**Arsenic**	Code	A5860
		CAS#	7440-38-2
Manufacturer	SPECTRUM QUALITY PRODUCTS INC. 14422 S. SAN PEDRO STREET GARDENA, CA 90248	RTECS	CG0525000
		TSCA	TSCA 8(b) inventory: Arsenic
Commercial Name(s)	Not available.	CI#	Not applicable.
Synonym	Not available.	IN CASE OF EMERGENCY CHEMTREC (24hr) 800-424-9300 CALL (310) 516-8000	
Chemical Name	Arsenic		
Chemical Family	Element. (Inert material.)		
Chemical Formula	As		
Supplier	SPECTRUM QUALITY PRODUCTS INC. 14422 S. SAN PEDRO STREET GARDENA, CA 90248		

Section 2.Composition and Information on Ingredients

		Exposure Limits			
Name	CAS #	TWA (mg/m³)	STEL (mg/m³)	CEIL (mg/m³)	% by Weight
1) Arsenic	7440-38-2	0.01			100

Toxicological Data on Ingredients	Arsenic: ORAL (LD50):	Acute: 763 mg/kg [Rat]. 145 mg/kg [Mouse].

Section 3. Hazards Identification

Potential Acute Health Effects	Very hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant).
Potential Chronic Health Effects	CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys, lungs, the nervous system, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage.

Continued on Next Page

Section 4. First Aid Measures

Eye Contact	Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.
Skin Contact	Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.
Serious Skin Contact	Not available.
Inhalation	If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Serious Inhalation	Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
Ingestion	Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.
Serious Ingestion	Not available.

Section 5. Fire and Explosion Data

Flammability of the Product	May be combustible at high temperature.
Auto-Ignition Temperature	Not available.
Flash Points	Not available.
Flammable Limits	Not available.
Products of Combustion	Some metallic oxides.
Fire Hazards in Presence of Various Substances	Flammable in presence of open flames and sparks, of heat, of oxidizing materials.
Explosion Hazards in Presence of Various Substances	Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.
Fire Fighting Media and Instructions	SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.
Special Remarks on Fire Hazards	Material in powder form, capable of creating a dust explosion. When heated to decomposition it emits highly toxic fumes.
Special Remarks on Explosion Hazards	Not available.

Section 6. Accidental Release Measures

Small Spill	Use appropriate tools to put the spilled solid in a convenient waste disposal container.
Large Spill	Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Continued on Next Page

Section 7. Handling and Storage

Precautions	Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids, moisture.
Storage	Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8. Exposure Controls/Personal Protection

Engineering Controls	Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.
Personal Protection	Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.
Personal Protection in Case of a Large Spill	Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Exposure Limits	TWA: 0.01 from ACGIH (TLV) [United States] [1995] Consult local authorities for acceptable exposure limits.

Section 9. Physical and Chemical Properties

Physical state and appearance	Solid. (Lustrous solid.)	Odor	Not available.
Molecular Weight	74.92 g/mole	Taste	Not available.
pH (1% soln/water)	Not applicable.	Color	Silvery.

Boiling Point	Not available.
Melting Point	Sublimation temperature: 615°C (1139°F)
Critical Temperature	Not available.
Specific Gravity	5.72 (Water = 1)
Vapor Pressure	Not applicable.
Vapor Density	Not available.
Volatility	Not available.
Odor Threshold	Not available.
Water/Oil Dist. Coeff.	Not available.
Ionicity (in Water)	Not available.
Dispersion Properties	Not available.
Solubility	Insoluble in cold water, hot water.

Continued on Next Page

Section 10. Stability and Reactivity Data

Stability	The product is stable.
Instability Temperature	Not available.
Conditions of Instability	Not available.
Incompatibility with various substances	Reactive with oxidizing agents, acids, moisture.
Corrosivity	Non-corrosive in presence of glass.
Special Remarks on Reactivity	Not available.
Special Remarks on Corrosivity	Not available.
Polymerization	Will not occur.

Section 11. Toxicological Information

Routes of Entry	Inhalation. Ingestion.
Toxicity to Animals	Acute oral toxicity (LD50): 145 mg/kg [Mouse].
Chronic Effects on Humans	CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH. Causes damage to the following organs: kidneys, lungs, the nervous system, mucous membranes.
Other Toxic Effects on Humans	Very hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant).
Special Remarks on Toxicity to Animals	Not available.
Special Remarks on Chronic Effects on Humans	Not available.
Special Remarks on other Toxic Effects on Humans	Not available.

Section 12. Ecological Information

Ecotoxicity	Not available.
BOD5 and COD	Not available.
Products of Biodegradation	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation	The products of degradation are as toxic as the original product.
Special Remarks on the Products of Biodegradation	Not available.

Continued on Next Page

Section 13. Disposal Considerations

Waste Disposal	Recycle, if possible. Consult your local or regional authorities.

Section 14. Transport Information

DOT Classification	CLASS 6.1: Poisonous material.
Identification	: Arsenic UNNA: UN1558 PG: II
Special Provisions for Transport	Not available.
DOT (Pictograms)	

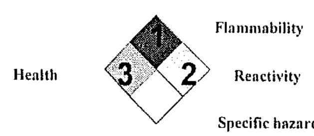
Section 15. Other Regulatory Information and Pictograms

Federal and State Regulations	California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Arsenic California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Arsenic Pennsylvania RTK: Arsenic Massachusetts RTK: Arsenic TSCA 8(b) inventory: Arsenic
California Proposition 65 Warnings	California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Arsenic
Other Regulations	OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
Other Classifications	WHMIS (Canada): CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). DSCL (EEC): R22- Harmful if swallowed. R45- May cause cancer.

HMIS (U.S.A.)

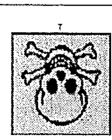
Health Hazard	3
Fire Hazard	1
Reactivity	2
Personal Protection	E

National Fire Protection Association (U.S.A.)



WHMIS (Canada) (Pictograms)

DSCL (Europe) (Pictograms)



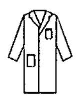
TDG (Canada) (Pictograms)

Continued on Next Page

ADR (Europe) (Pictograms)

Protective Equipment

Gloves.



Lab coat.

Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

Safety glasses.

Section 16. Other Information

Catalog Number(s) A1335

References

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Liste des produits purs tératogènes, mutagènes, cancérogènes. Répertoire toxicologique de la Commission de la Santé et de la Sécurité du Travail du Québec.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations Not available.

Validated by G. A. Binas on 3/30/2000.	Verified by G. A. Binas. Printed 2/7/2001.

CALL (310) 516-8000

ARCONIUM

MATERIAL SAFETY DATA SHEET

SECTION 1 – MANUFACTURER INFORMATION

MANUFACTURER: ARCONIUM ALLOYS 401-456-0800
50 SIMS AVENUE
PROVIDENCE, R.I. 02909
PREPARER/CONTACT: ARCONIUM ALLOYS
EMERGENCY PHONE: CHEMTREC 800-424-9300 PREPARATION/REVISION DATE: 09-18-1998

MSDS GROUP NUMBER: GROUP #2
PRODUCT NAME(S): LEAD, OSTALLOY 255, OSTALLOY 620
CHEMICAL FAMILY: ALLOY
CONDITION: SOLID

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH...............2
FLAMMABILITY....1
REACTIVITY.........0
PROTECTION.........2

SECTION 2 – HAZARDOUS INGREDIENTS

THIS PRODUCT CONTAINS HAZARDOUS INGREDIENTS: YES

CHEMICAL/COMMON NAME	CAS-NUMBER	PEL-OSHA	TLV-ACGIH
LEAD	7439-92-1	0.2mg/m3	0.2mg/m3

THIS PRODUCT MAY CONTAIN ONE OR MORE CHEMICALS SUBJECT TO TOXIC CHEMICAL RELEASE REPORTING REQUIREMENTS OF SECTION 313 OF TITLE III OF SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) OF 1986 AND CFR PART 372.

THIS PRODUCT CONTAINS CARCINOGENS (NTP, IARC, OR OSHA): YES

CHEMICAL/COMMON NAME	CAS-NUMBER	NTP	IARC	OSHA
LEAD	7439-92-1		XXX	

SECTION 3 – HEALTH HAZARD DATA

HEALTH EFFECTS (ACUTE AND CHRONIC) –
LEAD: DEPENDING UPON INDIVIDUAL SUSCEPTIBILITY AND DEGREE OF OVEREXPOSURE, EFFECTS ARE GENERALLY ONLY SEEN AFTER LONG-TURM EXPOSURE. EARLY SYMPTONS OF LEAD INTOXICATION INCLUDE CONSTIPATION, INSOMNIA, GASTOINTESTINAL DISORDERS, ANEMIA, WEAKNESS AND JOINT PAIN. OVEREXPOSURE TO LEAD MAY HAVE EFFECTS ON THE REPRODUCTIVE SYSTEM OF BOTH MEN AND WOMEN. PERSONS THAT INTEND TO HAVE CHILDREN AND PREGNANT WOMEN IN PARTICULAR SHOULD MAINTAIN A BLOOD LEVEL OF LESS THAN 30mg/100g OF BLOOD.

PRIMARY ROUTES OF ENTRY –
NOSE, MOUTH, EYES AND SKIN.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE –
SEE HEALTH EFFECTS – ACUTE AND CHRONIC

EMERGENCY FIRST AID PROCEDURES –
IF MOLTEN METAL CONTACTS SKIN OR EYE, IRRIGATE IMMEDIATELY WITH COLD WATER, SEEK MEDICAL ASSISTANCE.

SECTION 4 – CHEMICAL DATA

BOILING POINT (F)	3164	SPECIFIC GRAVITY (WATER=1)	11.3
VAPOR PRESSURE (mmHg)	N/A	PERCENT VOLATILE BY VOLUME (%)	N/A
VAPOR DENSITY (AIR=1)	N/A	EVAPORATION RATE (BUTYL ACETATE =1)	N/A

SOLUBILITY IN WATER – NEGLIGIBLE

APPEARANCE AND ODOR INFORMATION – SILVER GRAY METAL

SECTION 5 – PHYSICAL HAZARD DATA

FLASH POINT (METHOD USED): NON-FLAMMAB   FLAMMABLE LIMITS: Lel=N/A UEL=N/A

EXTINGUISHER MEDIA – N/A

SPECIAL FIRE FIGHTING PROCEDURES –
DO NOT USE WATER ON MOLTEN ALLOY – DANGER OF EXPLOSION

UNUSUAL FIRE OR EXPLOSION HAZARDS – N/A

INCOMPATIBILITY (MATERIALS TO AVOID) –
OXIDIZERS, ACIDS, HALOGENATED ACIDS. KEEP WATER AWAY FROM MOLTEN ALLOY.

HAZARDOUS DECOMPOSITION PRODUCTS – N/A

WILL HAZARDOUS POLYMERIZATION OCCUR – WILL NOT OCCUR.

CONDITIONS TO AVOID FOR POLYMERIZATION – N/A

IS THE PRODUCT STABLE – STABLE

CONDITIONS TO AVOID FOR STABILITY – LEAD CAN REACT VIOLENTLY WITH OXIDIZING MATERIALS. WATER MAY BECOME TRAPPED WITHIN THE SURFACE CRACKS WHICH MAY CAUSE AN EXPLOSUIN WHEN THE METAL IS MOLTEN.

SECTION 6 – SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SIPLLED – NORMAL SOLID CLEAN UP PROCEDURES. AVOID MAKING DUST.

WASTE DISPOSAL METHODS – DISPOSE OF ACCORDING TO LOCAL, STATE, OR FEDERAL HAZARDOUS WASTE REGULATIONS OR RETURN TO MANUFACTURER FOR DISPOSAL.

SECTION 7 – EXPOSURE CONTROL INFORMATION

VENTILATION –
LOCAL EXHAUST: RECOMMENDED
MECHANICAL (GENERAL): RECOMMENDED
SPECIAL: AVOID INGESTION
OTHER: N/A

RESPIRATORY PROTECTION – BUREAU OF MINES APPROVED RESPIRATOR.

PROTECTIVE GLOVES – HEAT RESISTANT

OTHER PROTECTIVE EQUIPMENT –
EYE PROTECTION – RECOMMENDED, SAFETY SHOES – WHILE GRINDING, POLISHING, OR MELTING STATES, LOCAL EXHAUST VENTILATION RECOMMENDED.

OTHER ENGINEERING CONTROLS – N/A

WORK PRACTICES –
DO NOT SMOKE, EAT, DRINK OR APPLY COSMETICS IN WORK AREA. DO NOT USE NEAR FOOD OR EATING AREAS. AVOID MAKING DUST.

HYGIENIC PRACTICES –
WASH HANDS BEFORE EATING OR DRINKING, DO NOT SMOKE, DRINK, EAT OR APPLY COSMETICS IN WORK AREA. DO NOT USE NEAR FOOD OR EATING AREA. AVOID MAKING DUST.

SECTION 8 – SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE –
DO NOT SMOKE, EAT, DRINK OR APPLY COSMETICS IN WORK AREA. DO NOT USE NEAR FOOD OR EATING AREAS. AVOID MAKING DUST.

MAINTENANCE PRECAUTIONS – N/A

OTHER PRECAUTIONS –
WHEN OSHA PERMISSIBLE EXPOSURE LIMITS (PEL) IS EXCEEDED, THEN SPECIAL CLOTHING, VENTILATION, RESPIRATORS, SAMPLING, ETC., MAY BE REQUIRED.

ADDITIONAL COMMENTS –
WHILE THE INFORMATION AND RECOMMENDATIONS SET FORTH ABOVE ARE BELIEVED TO BE ACCURATE AS OF THE DATE HEREOF, ARCONIUM ALLOYS MAKES NO WARRENTY WITH RESPECT THERETO AND DISCLAIMS ALL LIABILITY OR ACTION BASED THEREON.

Material Safety Data Sheet

Chromium

ACC# 05000

Section 1 - Chemical Product and Company Identification

MSDS Name: Chromium
Catalog Numbers: S79965-1, S79965, S79965-2, S799651, S799652
Synonyms: Chrome
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7440-47-3	CHROMIUM	>=99%	231-157-5

Hazard Symbols: XN
Risk Phrases: 40

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: silver-gray. Causes eye and skin irritation. Causes severe respiratory tract irritation. May cause kidney damage. May cause lung damage. Causes digestive tract irritation. May cause liver damage. May cause allergic skin reaction. **Warning!**
Target Organs: Liver.

Potential Health Effects
Eye: Causes eye irritation. May cause conjunctivitis.
Skin: Causes skin irritation. Prolonged and/or repeated contact may cause irritation and/or dermatitis. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material.
Ingestion: May cause irritation of the digestive tract. May cause liver damage.
Inhalation: Causes respiratory tract irritation. Inhalation of fumes may cause metal fume fever, which is characterized by flu-like symptoms with metallic taste, fever, chills, cough, weakness, chest pain, muscle pain and increased white blood cell count. May cause asthma and shortness of

breath. May cause headache, coughing, fever, weight loss, and pneumoconiosis.
Chronic: Prolonged inhalation may cause respiratory tract inflammation and lung damage.

Section 4 - First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.
Skin: Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse.
Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid. Do NOT use mouth-to-mouth resuscitation.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: Evacuate area and fight fire from a safe distance. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. May burn with invisible flame. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Dust can be an explosion hazard when exposed to heat or flame.
Extinguishing Media: Use dry sand or earth to smother fire. Use dry chemical to fight fire. Contact professional fire-fighters immediately.

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up or absorb material, then place into a suitable clean, dry, closed container for disposal. Avoid generating dusty conditions. Remove all sources of ignition. Isolate area and deny entry. Place under an inert atmosphere. Do not use combustible materials such as paper towels to clean up spill.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Minimize dust generation and accumulation. Use spark-proof tools and explosion proof equipment. Avoid contact with skin and eyes. Keep container tightly closed. Avoid contact with heat, sparks and flame. Avoid ingestion and inhalation. Handle under an inert atmosphere.
Storage: Keep away from heat, sparks, and flame. Store in a tightly closed container. Keep from

contact with oxidizing materials. Store in a cool, dry, well-ventilated area away from incompatible substances. Keep away from acids. Keep containers tightly closed. Do not expose to air. Store under an inert atmosphere.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
CHROMIUM	0.5 mg/m3 TWA	as Cr: 0.5 mg/m3 TWA; see Appendix C for supplementary exposure limits as Cr: 250 mg/m3 IDLH	1 mg/m3 TWA

OSHA Vacated PELs: CHROMIUM: (as Cr): 1 mg/m3 TWA

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: silver-gray
Odor: odorless
pH: Not available.
Vapor Pressure: Not applicable.
Vapor Density: Not available.
Evaporation Rate: Not applicable.
Viscosity: Not applicable.
Boiling Point: 4784 deg F
Freezing/Melting Point:3375 deg F
Autoignition Temperature: 752 deg F (400.00 deg C)
Flash Point: Not applicable.
Decomposition Temperature: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 1; Reactivity: 1
Explosion Limits, Lower:.0230oz/ft3
Upper: Not available.
Solubility: Insoluble in water.
Specific Gravity/Density:7.2 @28C

Molecular Formula: Cr
Molecular Weight:51.996

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures. Powder or liquid is pyrophoric.
Conditions to Avoid: Incompatible materials, ignition sources, dust generation, exposure to air, acids, strong oxidants.
Incompatibilities with Other Materials: Ammonium nitrate, hydrogen peroxide, lithium, nitric oxiode, potassium chlorate, sulfuri dioxide, strong oxidizers, hydrochloric acid, sulfuric acid, nitrogen oxide,
Hazardous Decomposition Products: Toxic chromium oxide fumes.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 7440-47-3: GB4200000
LD50/LC50:
Not available.

Carcinogenicity:
CAS# 7440-47-3:
ACGIH: A4 - Not Classifiable as a Human Carcinogen
IARC: Group 3 carcinogen
Epidemiology: Certain hexavalent chromium compounds have been demonstrate d to be carcinogenic on the basis of epidemiologic investi gations on workers and experimental studies in animals. In creased incidences of respiratory cancer has been fo und in chromium (VI) workers. There is an increased incide nce of lung cancer in industrial workers exposed to chromi um (VI) compounds. Please refer to IARC volume 23 for a more detailed discussion.
Teratogenicity: No information found.
Reproductive Effects: No information found.
Neurotoxicity: No information found.
Mutagenicity: No information found.
Other Studies: See actual entry in RTECS for complete information.

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts

261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	No information available.				No information available.
Hazard Class:					
UN Number:					
Packing Group:					

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 7440-47-3 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA

Section 302 (RQ)
CAS# 7440-47-3: final RQ = 5000 pounds (2270 kg) (no reporting of releases of this hazardou
Section 302 (TPQ)
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 7440-47-3: acute, chronic, flammable.
Section 313
This material contains CHROMIUM (CAS# 7440-47-3, 99%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA. CAS# 7440-47-3 is listed as a Priority Pollutant under the Clean Water Act. CAS# 7440-47-3 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 7440-47-3 can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
XN
Risk Phrases:
R 40 Possible risks of irreversible effects.

Safety Phrases:

WGK (Water Danger/Protection)
CAS# 7440-47-3: No information available.
Canada
CAS# 7440-47-3 is listed on Canada's DSL List. CAS# 7440-47-3 is listed on Canada's DSL List.
This product has a WHMIS classification of D2A, D2B.
CAS# 7440-47-3 is listed on Canada's Ingredient Disclosure List.
Exposure Limits
CAS# 7440-47-3: OEL-ARAB Republic of Egypt:TWA 0.05 mg/m3 OEL-AUSTRALIA:TWA 0.05 mg/m3 OEL-BELGIUM:TWA 0.5 mg/m3 OEL-DENMARK:TWA 0.5 mg/m3 OEL-FINLAND:TWA 0.01 mg/m3 OEL-FRANCE:TWA 0.5 mg/m3 OEL-JAPAN:TWA 0.5 mg/m3 OEL-THE NETHERLANDS:TWA 0.5 mg/m3 OEL-THE PHILIPPINES:TWA 1 mg/m3 OEL-SWEDEN:TWA 0.5 mg/m3 OEL-UNITED KINGDOM:TWA 0.5 mg/m3 OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

Section 16 - Additional Information

MSDS Creation Date: 3/01/1999
Revision #4 Date: 8/02/2000

MERCK
eurolab

SAFETY DATA SHEET

1. Identification of the substance/preparation and of the company/undertaking

Identification of the product

Catalogue No: 12426 ID No.: 6619900

Product name: **gamma BHC (HCH, lindane)**

Manufacturer/supplier identification

Company: Merck Eurolab Ltd, Merck House, Poole, Dorset, BH15 1TD, England
Telephone : 01202 669700 Telefax : 01202 665599

Emergency telephone No.: 01202 669700

2. Composition/information on ingredients

Chemical characterization

Organic solid

Product name: 1,2,3,4,5,6-γ-Hexachlorocyclohexane

CAS number: 58-89-9 EC-No.: 200-401-2

3. Hazards identification

Toxic by inhalation, in contact with skin and if swallowed. Irritating to eyes and skin. Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

4. First aid measures

Eye contact: Irrigate thoroughly with water for at least 10 minutes. If discomfort persists obtain medical attention.
Inhalation: Remove from exposure, rest and keep warm. In severe cases obtain medical attention.
Skin contact: Wash off skin thoroughly with water. Remove contaminated clothing and wash before re-use. In severe cases, OBTAIN MEDICAL ATTENTION.

Ingestion: Wash out mouth thoroughly with water and give plenty of water to drink. OBTAIN MEDICAL ATTENTION.

5. Fire-fighting measures

Special risks:

Not combustible. May evolve toxic fumes in fire. (phosgene)

Suitable extinguishing media:

Water spray, foam, dry powder or carbon dioxide

6. Accidental release measures

Wear appropriate protective clothing.
Mix with sand, transfer carefully to container and arrange removal by disposal company. Wash site of spillage thoroughly with water and detergent.
For large spillages liquids should be contained with sand or earth and both liquids and solids transferred to salvage containers. Any residues should be treated as for small spillages.

7. Handling and storage

Handling:

Avoid generation of dusts. Under no circumstances eat, drink or smoke while handling this material. Wash hands and face thoroughly after working with material. Contaminated clothing should be removed and washed before re-use.

Storage:

Store at room temperature (15 to 25°C recommended). Keep well closed and protected from direct sunlight and moisture.

8. Exposure controls/personal protection

As appropriate to the situation and the quantity handled. Engineering methods to control or prevent exposure are preferred. Methods could include process enclosure or mechanical ventilation.

Ventilation: Extraction hood
Respirator: Dust respirator
Gloves: Neoprene
Eye Protection: Goggles or face-shield
Other Precautions: Plastic apron, sleeves, boots - if handling large quantities

See section 15 for UK exposure limits.

9. Physical and chemical properties

Form:	fine crystals
Colour:	white
Odour:	almost odourless
Melting temperature	112-114°C
Boiling temperature	288°C
Density(g/ml)	Not available
Vapour pressure	0.23 hPa (40°C)
Log P(o/w):	3.9
Solubility in water	Immiscible or insoluble

10. Stability and reactivity

Stable.

No data

11. Toxicological information

After inhalation: toxic
After skin contact: Irritation. Danger of skin absorption.
After eye contact: Irritation.
After ingestion: toxic
Possible effects: headache, nausea, agitation, spasms, dyspnoea, respiratory arrest, CNS disorders, death.

Further hazardous properties cannot be excluded. The product should be handled with the care usual when dealing with chemicals.

Further data

LD50 76 mg/kg oral, rat.

Has been found to cause cancer in laboratory animals. Evidence of reproductive effects.

12. Ecological information

Toxic for aquatic organisms Toxic for lower aquatic organisms. Insecticidal effect.
Bioaccumulation potential: high (Log Pow >4).
Do not allow to enter drinking water supplies, waste water, or soil!

13. Disposal considerations

Chemical residues are generally classified as special waste, and as such are covered by regulations which vary according to location. Contact your local waste disposal authority for advice, or pass to a chemical disposal company. Rinse out empty containers thoroughly before returning for recycling.

14. Transport information

UN-No.: 2811	IMDG class: 6.1
IMO: 6.1/2811	Packaging group: II
IATA: 2811	Packaging group: II

Correct technical name: TOXIC SOLID, ORGANIC, N.O.S. (1, 2, 3, 4, 5, 6, gamma HEXACHLOROCYCLOHEXANE)
ADR/RID: 6.1,25'(b)

15. Regulatory information

Labelling according to EC directives

Symbol: T N   Toxic. Dangerous for the environment.

R-phrases: R23/24/25-36/38-50/53
Toxic by inhalation, in contact with skin and if swallowed. Irritating to eyes and skin. Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

S-phrases: S13-45-60-61
Keep away from food, drink and animal feeding stuffs. In case of accident or if you feel unwell, seek medical advice immediately(show the label where possible). This material and its container must be disposed of as hazardous waste. Avoid release to the environment. Refer to special instructions/Safety data sheets.

EC-No.: 200-401-2

Local Regulations

U.K. Transport Category 2

Within the UK, the use of this material must be assessed under the Control of Substances Hazardous to Health (COSHH) regulations.

Within the UK, this material is subject to statutory control as a prescribed substance due its endocrine disruption potential (category 1)

UK Exposure Limits: OES - y-Hexachlorocyclohexane(lindane):
Long term: 0.1 mg/m3 (Sk, Bmgv)

16. Other information

Revised.
Supersedes edition of: 11/11/97
Reason for alteration: General update.

Date of issue:	13/09/01
Date of print:	02/10/01

MATERIAL SAFETY DATA SHEET

F-120

07/13/89 LAST REVISED JUNE 1989

SECTION I PRODUCT SPECIFICATIONS

CAT. NO. F103 BHC (B-ISOMER) OTHER NAME:

CAS. NO. 319-85-7 1.2.3.4.5.6-HEXACHLOROCYCLOHEXANE (BETA ISOMER)

SUPPLIED BY CHEM SERVICE, INC. PO BOX 3108, WEST CHESTER, PA, 19381

(215) 692-3026

EMERGENCY PHONE #: 215-386-2100

SECITON II TOXICITY DATA

RAT OR MOUSE LD50	RTECS#	OSHA PEL	ACGIH TLV
6000MG/KG	GV4375000	NA	NA

THIS COMPOUND IS GENERALLY CONSIDERED TO BE NON-TOXIC.

SECTION III PHYSICAL DATA

MELTING POINT	BOILING POINT	DENSITY	VAPOR PRESSURE	VAPOR DENSITY

312 C	NA	NA	0.17 MM@40 C	NA

EVAPORATION RATE (BUTYL ACETATE=1)	ODOR	COLOR	PHASE	SOLUBILITY IN WATER
NA	STENCH	OFF-WHITE TO BROWN	CRYSTALLINE SOLID	VERY SLIGHTLY SOLUBLE

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: DATA NOT AVAILABLE.

EXTINGUISHING MEDIA: CARBON DIOXIDE, DRY CHEMICAL POWDER OR SPRAY.

NO EXPLOSION LIMITS ARE AVAILABLE FOR THIS COMPOUND.

SECTION V HEALTH HAZARD DATA

CONTACT LENSES SHOULD NOT BE WORN IN THE LABORATORY.

ALL CHEMICALS SHOULD BE CONSIDERED HAZARDOUS - AVOID DIRECT PHYSICAL CONTACT!

SUSPECTED CARCINOGEN - MAY PRODUCE CANCER.

CAN CAUSE DELAYED ADVERSE HEALTH EFFECTS.

POSSIBLE CUMULATIVE POISON.

SECTION VI   FIRST AID

AN ANTIDOTE IS A SUBSTANCE INTENDED TO COUNTERACT THE EFFECT OF A POISON. IT SHOULD BE ADMINISTERED ONLY BY A PHYSICIAN OR TRAINED EMERGENCY PERSONNEL. MEDICAL ADVICE CAN BE OBTAINED FROM A POISON CONTROL CENTER.

IN CASE OF CONTACT: FLUSH EYES CONTINUOUSLY WITH WATER FOR 15-20 MINUTES. FLUSH SKIN WITH WATER FOR 15-20 MINUTES. IF NO BURNS HAVE OCCURRED, USE SOAP AND WATER TO CLEANSE SKIN. IF INHALED REMOVE PATIENT TO FRESH AIR. ADMINISTER OXYGEN IF PATIENT IS HAVING DIFFICULTY BREATHING. IF PATIENT HAS STOPPED BREATHING ADMINISTER ARTIFICIAL RESPIRATION. IF PATIENT IS IN CARDIAC ARREST ADMINISTER CPR. CONTINUE LIFE SUPPORTING MEASURES UNTIL MEDICAL ASSISTANCE HAS ARRIVED. REMOVE AND WASH CONTAMINATED CLOTHING. IF PATIENT IS EX-HIBITING SIGNS OF SHOCK - KEEP WARM AND QUIET. CONTACT POISON CONTROL CENTER IMMEDIATELY IF NECESSARY. DO NOT ADMINISTER LIQUIDS OR INDUCE VOMITING TO AN

UNCONSCIOUS OR CONVSULSING PERSON.

IF PATIENT IS VOMITING - WATCH CLOSELY TO MAKE SURE AIRWAY DOES NOT BECOME OBSTRUCTED BY VOMIT.

GET MEDICAL ATTENTION IF NECESSARY.

SECTION VII REACTIVITY DATA

REACTS WITH ACID HALIDES AND ANHYDRIDES.

SECTION VIII SPILL OR LEAK PROCEDURES

SPILLS OR LEAKS: EVACUATE AREA. WEAR APPROPRIATE OSHA REGULATED EQUIPMENT. VENTILATE AREA. SWEEP UP AND PLACE IN AN APPROPRIATE CONTAINER. HOLD FOR DISPOSAL. WASH CONTAMINATED SURFACES TO REMOVE ANY RESIDUES.

DISPOSAL: BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.

SECTION IX PRECAUTIONS TO BE TAKEN IN HANDLING

THIS CHEMICAL SHOULD BE HANDLED ONLY IN A HOOD. EYE SHIELDS SHOULD BE WORN. USE APPROPRIATE OSHA/MSHA APPROVED SAFETY EQUIPMENT. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. KEEP TIGHTLY CLOSED IN A COOL DRY PLACE. STORE ONLY WITH COMPATIBLE CHEMICALS.

SECTION X SPECIAL PRECAUTIONS AND COMMENTS

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT ON THE DATE IT IS PUBLISHED AND MUST NOT BE CONSIDERED ALL INCLUSIVE. THE INFORMATION HAS BEEN OBTAINED ONLY BY A SEARCH OF AVAILABLE LITERATURE AND IS ONLY A GUIDE FOR HANDLING THE CHEMICALS. OSHA REGULATIONS REQUIRE THAT IF OTHER HAZARDS BECOME EVIDENT, AN UPGRADED MSDS MUST BE MADE AVAILABLE TO THE EMPLOYEE WITHIN THREE MONTHS. RESPONSIBILITY FOR UPDATES LIES WITH THE EMPLOYER AND NOT WITH CHEM SERVICE, INC. PERSONS NOT SPECIFICALLY AND PROPERLY TRAINED SHOULD NOT HANDLE THIS CHEMICAL OR ITS CONTAINER. THIS MSDS IS PROVIDED WITHOUT ANY WARRANTY EXPRESSED OR IMPLIED, INCLUDING MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

THIS PRODUCT IS FURNISHED FOR LABORATORY USE ONLY! OUR PRODUCT MAY NOT BE USED AS DRUGS, COSMETICS, AGRICULTURAL OR PESTICIDAL PRODUCTS, FOOD ADDITIVES OR AS HOUSEHOLD CHEMICALS.

Appendix H

EHS Field Forms

Air Quality Monitoring Record

Client:____________________________
Location: Yakima, WA______________
Project Mgr.: Michael Byers__________

Project No.: DWT40-16457-300_______
Site Eng.: Winston Chen_____________
Site H&S Ofcr.: Winston Chen________

Date	Initial	Time	Location	PID/FID PPM	O_2%	LEL%	Dräeger Tubes			Other
							_____	_____	_____	

Field Equipment Calibration/Maintenance Log

Client:____________________________
Location: Yakima, WA______________
Project Mgr.: Michael Byers__________

Project No.: DWT40-16457-300______
Site Eng.: Winston Chen____________
Site EHS Off.: Winston Chen_________

Date	Type of Equipment[1]	Equipment ID Number	Procedure[2]	Reference Standards[3]	Initials of Individual	Company	Calibration OK Yes/No

Maintenance Required/Procedures:____

[1]Certifications or statements of manufacturer calibration can be obtained from RETEC office files.

[2] Use space below if necessary

[3] Type of calibration gas used and concentration; buffer solutions, etc.

Confined Space Entry Permit

Client:	Project Number:
Location:	Date:
Project Manger:	Site Engineer:
Site EHS Officer:	
Location and Description of Confined Space:	
Purpose of Entry:	
Date of Entry:	Termination Date:
Description of Hazards of the Permit Space:	
Authorized Entrants:	
Authorized Attendants:	
Rescue Team Personnel/Outside Agency (Name and Address):	

Special Requirements	Yes	No
Lockout/Tagout		
Lines Broken-Capped or Blanked		
Purge-Flush or Vent		
Ventilation		
Secure Area		
SCBA or APRs		
Escape Harness		
Tripod Emergency Escape Harness		
Lifelines		
Fire Extinguishers		
Lighting		
PPE		
• Level A, B, C, or D		
• Modifications		
• Communication System		

Required Air Monitoring	PEL	Yes	No	Frequency (times/day)
% Oxygen	19.5 to 21%			
% LEL	0 to 10%			
Benzene	1 ppm			
Carbon Monoxide	50 ppm			
Aromatic Hydrocarbon	10 ppm			
Other:				
Note: If any reading exceeds the PEL designated, appropriated actions must be implemented before allowing anyone to enter the confined space.				
Name of Person Conducting Monitoring:				

***Note**: Continuous/periodic tests shall be established prior to initiation of site activities. Any questions pertaining to testing, contact Jim Colbert, Corp. EHS Manager (970) 493-3700.*

Instruments Used	Type	Yes	No	Calibration Date
PID	Photoionization			
Portable GC	Flame ionization			
LEL	Explosimeter			
Oxygen	% Oxygen			
Combustible Gas Indicator	LEL/O_2/H_2S/CO			
Sampling Tubes	Dräeger or equivalent			NA

Immediately prior to entry, conduct these tests three times at five-minute intervals at all levels of the confined space:			
	Test 1 Time	**Test 2 Time**	**Test 3 Time**
Oxygen Content (%)			
Flammability (% LEL)			
Toxic Gases (ppm)			

Describe in detail any ventilation systems to be used:______________________________

____

____

Onsite individual responsible for authorizing entry:
Name (please type):
Signature:

Confined Space Entry Permit Approval:	
Name (please type):	
Signature:	
Date of Approval:	
Duration of Permit Validity:	

EHS Incident Report

Section One: Background Information

Your Name	________________	Today's Date	________________
Project Name	________________	Site Name	________________
Project Manager	________________	Project Number	________________

Were there any witnesses to the incident? ☐Yes ☐No

If yes, list name(s)/office locations (including subcontractors):

____

____

Was weather a factor? ☐Yes ☐No

If yes, please describe weather conditions:

____

____

____

Section Two: Injury, Illness and Exposure

Was there an injury, illness or exposure associated with this incident?

☐ Yes ☐ No

If yes, please complete this section.
If no, please proceed to Section Three.

Name of Injured:	____________	Job Title:	____________
Male/Female:	____________	Date of Hire:	____________
Date of Birth:	____________	SSN:	____________
Date/Time of Injury/Exposure:	____________	Time Employee Began Work:	____________
Supervisor:	____________	H&S Coordinator:	____________
Log Number:	____________	SSN:	____________

Employee's Home Address: ____

____

____

NOTE: the Occupational Safety and Health Administration requires the above information for regulatory reporting.

Where did the incident occur (place name, address)?

____

____

____

____

Please describe the incident:

____

____

____

____

____

____

____

Was injured person/persons using required PPE? ☐Yes ☐No

Were there any unsafe conditions at the time of the incident? ☐Yes ☐No

If yes, please describe:

____

____

____

____

Please describe what the employee was doing just before the incident (was there an unsafe act involved?):

What was the severity of the injury / exposure:

☐First Aid Only ☐Medical Treatment- Only ☐Fatality ☐Non-Occupational

What was the nature of the injury / exposure (please check):

☐Fractures	☐Blisters	☐Heat Exhaustion	☐Dislocations
☐Respiratory Allergy	☐Toxic Respiratory	☐ Exposure	☐Concussion
☐Heat Burns	☐Toxic Ingestion	☐Faint/Dizziness	☐Abrasions
☐Chemical Burns	☐Cold Exposure	☐Toxic Respiratory	☐Lacerations
☐Radiation Burns	☐Frostbite	☐Dermal Allergy	☐Punctures
☐Bruises	☐Heatstroke	☐Ergonomic	☐Sprains
☐Bites	☐Other:		

Parts of Body Affected (Specify Right/Left): ______

Date medical care was received: ______

Was employee taken to the emergency room? ☐Yes ☐ No

Was employee hospitalized overnight as an in-patient? ☐Yes ☐ No

Facility Where Medical Care Was Received:

Clinic/Hospital Name: ______
Name of Attending Physician: ______
Clinic/Hospital Address: ______
Clinic/Hospital Telephone Number: ______

Section Three: Environmental Incident

Did one of the following occur: a spill to land over one quart, any spill to surface water, a significant release to the air, a violation of permit conditions, receipt of Notice of Violation, or an event that causes potentially significant damage to the environment?

☐ *Yes* ☐*No*

Did a RETEC employee directly contribute to the incident?

☐ *Yes* ☐ *No*

If yes to both, please complete this section.
If no to either, the incident is not required to be reported to the RETEC EHS Department. Continue to Section Four

What type of environmental incident occurred?

☐Spill to Land ☐Spill to Water ☐Release to Air ☐Permit Violation ☐Notice of Violation ☐Other

If other, specify:

Please describe the incident in detail:

If the incident was a spill or release, what material was involved and what amount?

Was there a violation of permit limits associated with the incident? ☐Yes ☐No

If yes, list permits and issuing agencies:

Were the required regulatory agencies notified? ☐Yes ☐No

If yes, which agencies were notified?

Section Four: Property Damage / Loss

Did the damage exceed $500.00?
☐ Yes ☐ No

If yes, please complete this section.
If no, the incident is not required to be reported to the RETEC EHS Department. Continue to Section Five.

What type of loss and/or property damage occurred?

☐Equipment Failure ☐Collision ☐Contamination ☐Weather ☐Fire ☐Vandalism/Theft ☐Other

If other, specify:

Describe the incident of loss or damaged property in detail (RETEC):

Describe the incident of loss or damage of property in detail (3^{rd} Party):

Was a RETEC insurance representative contacted? ☐Yes ☐No

If yes, list name of agent and time

What was the approximate cost of the loss / property damage?

Section Five: Analysis and Corrective Action

Were there any behavioral factors that contributed to the incident? (Check one) ☐Yes ☐No

If yes, please describe (describe any unsafe acts or conditions):

What can be done to prevent a recurrence of this type of incident?

List corrective actions that were taken to prevent this type of incident in the future:

Person Responsible for taking corrective action:

Forward this form within 24 hours to the following:

- ☐Health and Safety Department - Monroeville
- ☐Regional Manager - Local
- ☐Operations Manager – Local
- ☐Health and Safety Coordinator – Local

Employee's Signature Date

Employee's Supervisor Signature Date

PROJECT MANAGERS ARE REQUIRED TO SUBMIT A ROOT CAUSE ANALYSIS FOR ALL INCIDENTS.

Near-Miss Incident Report

Name:________________________ **Date of Near Miss:**__________________

Client:________________________ **Project Number:**__________________

Did this incident involve an Environmental Near-Miss? ☐ Yes ☐ No

I witnessed a near-accident this day at:______________________________

Was appropriate PPE being worn? ☐ Yes ☐ No

The following is an account of what happened:__________________________

I believe this could have resulted in injury and/or damage to: (check all that pertain)

☐ Personnel ☐ Property ☐ Equipment

If these circumstances occurred:______________________________

I recommend the following actions to prevent this from occurring in the future:______________

Note: Use additional paper if required

Hot Work Permit

Permit Valid
For 1 Work Day

Site Name:________________ **Project Number:**________________

EHS Officer:________________ **Client:**________________

Hot Work Description:________________________________

____

____

Workers/Welders Conducting Hot Work:________________________

Permits MUST be completed in its Entirety Before Hot Work Begins

	Yes	**No**
Has project supervisor been notified of intended Hot Work?		
Does client representative need to be notified of the intended Hot Work?		
Will Hot Work impact the general public, clients, or operation employees?		
Will the intended Hot Work need to be coordinated with other contractors who may be working on the site to make them aware of any hazards and the scope of work to be performed?		
Have hazardous energy sources been identified, isolated, and locked out/tagged out before the start of the project?		
Will Hot Work be conducted within a confined space?		
All testing equipment (i.e., CGI, oxygen meter, etc.) and firefighting equipment (i.e., extinguisher, etc.) have been checked to ensure proper operation and calibration before the start of this project?		
Has a fire watch been designated and on station?		
Have coatings on metal surfaces been tested for ignitability and flame spread?		
Has the area been cleared of all flammable materials?		
Have all fuel sources been identified and protected?		
Has the area been restricted with proper barriers and signs?		
Has the area been tested to be certain that atmosphere is 0% LEL before starting Hot Work?		
Have flame sensitive areas and equipment (including cylinders and gas delivery lines) exposed to slag and sparks been protected by flame resistant blankets or removed from the area?		
Have all equipment and hoses been protected from falling metal structures and debris?		
Have escape routes been identified before starting work?		
Is ventilation equipment needed? Type needed:		

The Following Protective Equipment Will be Required:

	Yes	No		Yes	No
Welding Goggles/Shield Tint			Supplied Air Respirator		
Safety Boots			Head Protection		
Leather gloves			Safety Harness		
Hearing Protection			Welding Leathers – Top		
APR Cartridge			Welding Leathers - Bottom		

Permit Valid for 1 Work Day

The following procedures will be applicable prior to Hot Work on tanks or other types of enclosed structures. (Check all that apply and fill in appropriate information)

- ☐ Ventilate to 0% LEL
- ☐ Confined Space Entry Permit
- ☐ Mechanical Ventilation Required
- ☐ Cold Cut Only Method Allowed:______________________________
- ☐ Hot Cutting Permitted Method Allowed:______________________________

Inert to <____________% Oxygen

Approvals:

____
Date

____
Client Representative

____
RETEC Site Safety Officer

____
Fire Watch

____
Performed Hot Work Employee

File Permit in Project Work File and Health and Department

Drill Rig Inspection Log

Project Name:____________________ **Project Number:**____________________

Date:____________________ **Subcontractor Audited:**____________________

Auditor:____

General Safety		
Safety Officer Designated for Job:	☐ Yes	☐ No
Name:		
Safety Meeting Performed (Daily)	☐ Yes	☐ No
Personal Protective Equipment (PPE)		
Hard Hats	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No
Steel Toed Boots	☐ Yes	☐ No
Hearing Protection	☐ Yes	☐ No
Work Gloves	☐ Yes	☐ No
Orange Work Vests	☐ Yes	☐ No
Traffic Cones and Signs	☐ Yes	☐ No
Other	☐ Yes	☐ No
Disposal of PPE in Proper Waste Containers (if applicable)	☐ Yes	☐ No
Comments:		
Daily Inspections of Drill Rig:		
Structural Damage, Loose Bolts	☐ Yes	☐ No
Proper Tension in Chain Drives	☐ Yes	☐ No
Loose or Missing Guards, Fluid Leaks	☐ Yes	☐ No
Damaged Hoses and/or Damaged Pressure	☐ Yes	☐ No
Gages and Pressure Relief Valves	☐ Yes	☐ No
Comments:		

Check and test all safety devices such as:		
Emergency shutdown switches, at least daily	☐ Yes	☐ No
All gages and warning lights and ensure control levers are functioning properly	☐ Yes	☐ No
First Aid and fire extinguishers on drill rig	☐ Yes	☐ No
Back up alarm functioning properly	☐ Yes	☐ No
Comments:		

Drill Crew Training Requirements:		
40-hour OSHA Training	☐ Yes	☐ No
8-hour Annual Refresher Training	☐ Yes	☐ No
Drill Rig Training/Safe Operating Practices	☐ Yes	☐ No
First Aid/CPR	☐ Yes	☐ No
Emergency Procedures	☐ Yes	☐ No
Emergency Phone Numbers Posted	☐ Yes	☐ No
Site Orientation	☐ Yes	☐ No
Health and Safety Plan Review	☐ Yes	☐ No
Comments:		

Housekeeping:		
Suitable storage for tools, materials, and supplies	☐ Yes	☐ No
Pipes, drill rods, casing, and augers stacked on racks to prevent rolling and sliding	☐ Yes	☐ No
Platforms and other work areas free of debris materials and obstructions	☐ Yes	☐ No
Comments:		

Hand Tools:		
Tools in good condition	☐ Yes	☐ No
Broken tools discarded and replaced	☐ Yes	☐ No
Right tool used for the right job	☐ Yes	☐ No
Comments:		

Drilling Operations:		
Mast or derrick down when moving rig	☐ Yes	☐ No
Overhead obstructions identified before mast is raised	☐ Yes	☐ No
Drill rig stabilized using leveling jacks or solid cribbing	☐ Yes	☐ No
Secure and lock derrick	☐ Yes	☐ No
Comments:		

Overhead and Buried Utilities:		
Buried utilities identified and marked	☐ Yes	☐ No
Safe distance of drill rig from overhead power lines	☐ Yes	☐ No
Comments:		

Wire Line Hoists Wire Rope and Hardware:		
Inspection for broken wires where reduction in rope diameter, wire diameter, fatigue, corrosion, damage from gear jamming, crushing, bird caging, kinking	☐ Yes	☐ No
Inspect and lubricate parts daily	☐ Yes	☐ No
Comments:		

Auger Operations: What to look for:

- A system of responsibility between the operator and the tool handler when connecting and disconnecting auger sections and inserting and removing auger fork.
- During connecting and disconnecting auger sections and inserting auger for the tool, handler should position himself away from the auger column while it is rotating.
- When securing the auger to the power coupling, pin should be inserted and tapped into place using a hammer or other similar device.
- Tool hoist should be used to lower second section of auger into place.
- Both operators should be clear of auger as it is being lifted into place.
- Long-handled shovel should be used to move dirt away from auger.

Overall Summary:____

Identify Potential Hazards

☐ Abrasions
☐ Biological Hazards (plants, animals, insects)
☐ Cave-in (trench/excavation work)
☐ Chemical/Thermal Burn
☐ Cuts
☐ Dermatitis
☐ Dropping Materials/Tools to lower level
☐ Drowning/Flowing water
☐ Dust
☐ Electrical Shock
☐ Elevated/Overhead Work
☐ Energized Equipment
☐ Fire
☐ Flammability
☐ Foreign body in eye
☐ Hazardous materials (exposure or release)
☐ Heat or Cold Stress
☐ Heavy Equipment Operation
☐ Heavy Lifting
☐ High Noise Levels
☐ Impact Noise
☐ Inability to maintain communication
☐ Inclement weather
☐ Overhead work
☐ Overhead utilities
☐ Underground Utilities
☐ Pinch points
☐ Pressurized lines
☐ Slips, Trips, Falls
☐ Sprains/Strains
☐ Traffic
☐ Underground Utilities
☐ Confined Space
☐ New or Rental Equipment
☐ Surface Water Run-On/Run-Off
☐ Odor/VOC Emissions
☐ Compressed Gas Cylinders
☐ Generated Wastes (solids/liquids)
☐ Known/Unknown Visitors
☐ Visibility
☐ New Personnel
☐ Hoists/Rigging/Slings/Wire Rope
☐ Special Operations/Instructions (attach)
☐ Ergonomics

Identify Controls

☐ Air Monitoring
☐ Barricades/Fencing/Silt Fencing
☐ Buddy System
☐ Appropriate Clothing/Monitoring of Weather
☐ Confined Space Procedures
☐ Decontamination
☐ Drinking Water/Fluids
☐ Dust abatement Measures
☐ Equipment inspection
☐ Exclusion zones
☐ Exhaust ventilation
☐ Fall Protection
☐ Fire extinguisher/Fire watch
☐ Flotation Devices/Lifelines
☐ Grounds on Equipment/Tanks
☐ Ground Fault Interrupter
☐ Ground Hydraulic Attachments
☐ Hand signal communication
☐ Hazardous/Flammable material storage
☐ Hazardous Plant/Animal Training
☐ Hearing Protection (Specify)
☐ Hoses, Access to water
☐ Hot Work Procedures
☐ Insect Repellent or Precautions
☐ Isolation of Equipment or Process (LO/TO)
☐ Stormwater Control Procedures/Methods
☐ Machine/Equipment Guarding
☐ Manual Lifting Equipment (Chain Falls)
☐ Protective Equipment (specify)
☐ Proper lifting techniques
☐ Proper tool for Job
☐ Radio Communication
☐ Respirator, (specify type)
☐ Safety Harness/Lanyard/Scaffold
☐ Sloping,, Shoring, Trench Box
☐ Vehicle Inspection
☐ Spill Prevention Measures/Spill Kits
☐ Equipment Manuals/Training
☐ Emergency Procedures/Incident Management Plan
☐ Appropriate Labels/Signage
☐ Derived Waste Management Plan
☐ Visitor Escort/Orientation/Security
☐ Window Cleaning/Defrost
☐ Proper Work Position/Tools

Pre-Task Review (Yes/No/NA)

1. Has Job Hazard Analysis been completed and reviewed? ______
2. Is Job Scope understood by all Personnel? ______
3. Proper Safety Equipment on job site? ____
4. Permit Issues?
   What type? ☐ Hot Work
   ☐ Confined Space ☐ Excavation
   ☐ Other:____________________________
5. Proper Tools for Job on site? ______
6. Oxygen/Flammability checked? ________
7. Reviewed MSDSs for any hazardous substance that might be present? ______
8. Proper training for all personnel? ________
9. Are there any planned deviations from set procedures for equipment modifications? ___ If so, contact supervisor to check applicability of MOC procedures.
10. Is there any work planned that could cause activation of emergency procedures? ___ If so, have these procedures been discussed and communicated?

Post-Task Review

1. Work area cleaned up?_________
2. All locks and tags removed and signed off by individuals?______________
3. Have Permits been turned in? ______
4. STAR submitted to EHS Department?
5. Were there any unplanned deviations from set procedures or equipment modifications? _______________
   If so, contact supervisor to check applicability of MOC procedures.

The RETEC Group, Inc. Safety Task Analysis Review (STAR)

Task Description:______________________

____

List Tasks:

____

Company: ______________________

Completed By: ______________________

Date: ______________________

Job Location:______________________

List Additional Hazards (Hazards Not Shown with Check Box)

____

List Additional Contorls (Controls Not Shown with Check Box)

____

Tailgate Meeting Topic

____

Signatures of Personnel on Task Analysis Review/Tailgate Meeting:

____

Mentor Assigned to Work

____

Lessons Learned (Based on changes in conditions (EHS Near-Incidents/Observations, Potential Emergencies)

Is there a better/safer way to perform the work/task?

____

Supervisor Review (date/Time): ______________

EHS Review (date/time):______________

Comments:

Job Hazard Analysis Form

Job/Operation	JSHA No.	JSHA Status	Page_________of____	☐ New Revision No.:_____

Analysis by:	Reviewed & Approved by:	Process/Machine Equipment:
Employee Position Title:	Approval Date:	Recommended/Required PPE:
Department/Division:	Annual Review Date:	Special Hazards:

Sequence of Basic Job Steps		Potential Hazards/Accidents		Recommended Safe Job Procedures	
Step #		Step #		Step #	

Field Equipment/Tool Inspection Checklist

Equipment/Tool Inspected: ______________________

Site: ______________________ **Inspected by:** ______________________

Date: ______________________ **Title:** ______________________

Item #	Item Inspected	Description	Pass	Fail	N/A
1	Equipment Operator	Equipment operator has had proper training and is familiar with equipment and operational features.			
1	Hydraulic Lines	Hydraulic lines are secure and no leaks. Hoses are in good condition with no cracks or breaks.			
2	Pipe, Hoses and Fittings	Discharge hoses and pipes are secure and no leaks. Fittings are tight, secure, and not leaking.			
3	Power/Extension Cords	Power/extension cords are in one piece with no frays or breaks. Plug ends are in good working order.			
4	GFI and Grounding	A ground fault interrupter is in place for electrical equipment and is in good working order. Grounding cable in place and operable for drilling or liquids transfer.			
5	Safety Guards	All equipment/tool safety guards are in place and in operation. Rotating and thermal guards.			
6	Windows and Mirrors	Equipment windows and mirrors are in good in good condition to ensure operator visibility.			
7	Wheels and Tires	Equipment wheels and tires are in good working order. Proper inflation.			
8	Engine Oil Fluids	Engines or motors are properly lubricated and cooled. No leaks are present. Oil and coolant levels full.			
9	Tools Handles	Tool handles are secure and not broken. Grips are not worn or missing.			
10	Blades	Cutting blades are sharp and securely fastened to the equipment or tool.			

Item #	Item Inspected	Description	Pass	Fail	N/A
11	Fall Protection	Harnesses and lifelines are secure and in good condition. Buckles and fasteners in good condition.			
12	Ingress and Egress to Equipment	Steps, handrails, etc. are secured and functioning properly. Steps are free of ice and mud.			
13	Lights and Signals, Alarms	Lights and signals operate properly. Backup alarm working properly.			
14	Lock Out/Tag Out	Battery disconnect switch in place to prevent unauthorized use. Lock out/tag out system in place to prevent energizing.			
15	Fire Extinguishers	Fire Extinguisher in place, or available close by, for emergency fire protection.			
16	Ignition and Controls	Ignition and controls intact with no loose wiring.			

Notes (Reference Item#)

Appendix I
Complete Site Specific Job Safety Analysis (JHA)

Complete Site Specific Job Safety Analysis (JHA)

As detailed Job Hazard Analysis (JHA) will be completed as part of the HASP preparation for the scope of work covered described in Table 1-1 of the HASP. Instruction for the completion of the JHA is outlined in Section 2.1.1 of the HASP. Previously completed JHAs are available for use on this project on the RETEC EHS Forum Database at "T-EHS\Job Hazard Analysis\Completed Example JHAs\. If the scope of work expands following field mobilization, JHAs for these additional tasks must be completed in the field using the JHA form included in Appendix H-9.

Job Safety and Hazard Analysis

Job/Operation	JSHA No.	JSHA Status		
Building Survey, Building Demolition, Excavation, Well Installation			Page 1 of 3	☒ New Revision No.:____

Analysis by:	Reviewed & Approved by:	Process/Machine Equipment:
Winston Chen, Sarah Albano		
Employee Position Title: Project Engineer, Staff Engineer	Approval Date:	Recommended/Required PPE: Level D
Department/Division:	Annual Review Date:	Special Hazards:

Sequence of Basic Job Steps		Potential Hazards/Accidents		Recommended Safe Job Procedures	
Step #		Step #		Step #	
1	Building Survey	1	Dusty conditions Air quality Bird Droppings Overhead Hazards	1	-Wear safety glasses, or goggles if necessary -Follow air monitoring program and take appropriate actions -Wear hard hat -No entering above ground-level floor -Be aware of overhead hazards
2	Building Demolition	2	Hit by heavy equipment and on-site vehicles Dusty conditions Air quality Bird Droppings	2	- Set up traffic control, barricades, signs, etc. around work areas. Remain aware of heavy equipment movement - Wear safety glasses, or goggles if necessary - Follow air monitoring program and take appropriate actions - Maintain eye contact and request permission prior to approaching heavy equipment. Do not walk behind heavy equipment

3	Excavation and Backfilling	3	Hit by heavy equipment and on-site vehicles Dusty conditions Air quality Trip/fall into pits/trenches	3	- Set up traffic control, barricades, signs, etc. around work areas. Remain aware of heavy equipment movement - Wear safety glasses, or goggles if necessary - Follow air monitoring program and take appropriate actions - Water down surface soils when dry and windy - Maintain eye contact and request permission prior to approaching heavy equipment. Do not walk behind heavy equipment.
4	Soil Sampling	4	Contact with contaminants Fall/Trip into pits/trenches Dusty conditions Air quality	4	- Wear appropriate PPE as identified in Section 3 of HASP. - Follow air monitoring program and take appropriate actions. - Water down surface soils when dry and windy - Wear safety glasses, or goggles if necessary
5	Backfill and Grading	5	Hit by heavy equipment and on-site vehicles Dusty conditions	5	- Remain aware of heavy equipment/vehicle movement - Water down surface soils when dry and windy - Wear safety glasses, or goggles if necessary - Maintain eye contact and request permission prior to approaching heavy equipment. Do not walk behind heavy equipment.

6	Well Installation	6	Hit by heavy equipment and on-site vehicles Dusty conditions	6	- Remain aware of heavy equipment/vehicle movement - Water down surface soils when dry and windy -Wear safety glasses, or goggles if necessary - Maintain eye contact and request permission prior to approaching heavy equipment. Do not walk behind heavy equipment.

Appendix J

Roadway Worker Protection

Requirements for On-Track Safety/Roadway Worker Protection on Railroad Sites

This appendix describes the implementation plan The RETEC Group, Inc. (RETEC) has established to achieve and maintain compliance with On-Track Safety/Roadway Worker Protection requirements established by the Federal Railroad Administration (FRA). RETEC has adopted the BNSF Maintenance of Way (MOW) Safety Rules, Maintenance of Way Operating Rules and BNSF Engineering Instruction No. 1.1 but the intent of this document is to use these requirements on all client railroad sites.

This document constitutes the track safety standards which RETEC and its subcontractors will adhere to while performing projects activities for all our railroad clients. RETEC recognizes the importance of and accepts the responsibility for On-Track Safety/Roadway Worker Protection for its employees and subcontractors. All railroad project employees are required to read this document annually and know how to obtain On-Track Safety/Roadway Worker Protection information from the documents referenced above (see the Summary in Attachment 1).

RETEC understands that these requirements must be followed throughout all of our regional offices when conducting work on railroad property. As discussed below, this document should always be used as a supplement and appendix to a site-specific Health and Safety Plan (HASP) for each individual site. As such, health and safety procedures and the training specified in this document will be utilized in addition to those procedures specified in the site-specific HASP at every site. This document does not represent a stand-alone health and safety program or document. Further, all office, regional, and corporate responsibilities existing at RETEC remain in-place.

Specific requirements of the implementation On-Track Safety/Roadway Worker Protection plan include the following:

1. These requirements are appended to all railroad project site-specific HASPs.

2. All RETEC employees and subcontractors are required to successfully receive orientation training on the railroad-sponsored website www.contractororientation.com.

3. Upon successful completion of website training, a wallet card will be issued to certify that the training has been received. This is **orientation** training only and is the first step in being in compliance with the RETEC On Track safety training program and must be completed *annually*.

4. No employee, either RETEC or RETEC subcontractor, will be permitted to work on a railroad site without a current (within the last year) wallet card or a print out of the training roster off the website during the interim period when the employee is waiting for their wallet card.

5. RETEC employees and subcontractors must be registered by the Corporate EHS Secretary or the Corporate Administrative Manager in RETEC's Monroeville office at 412-380-0140 ext. 29 or ext. 28 from Monday to Friday 8 a.m. to 3 p.m. EDT/EST. From Monday to Friday, 3 p.m. to 8 p.m. EDT/EST, registration may be obtained by calling 412-370-7458. Registration is not available at any other time. *Note that if you do not register and take the website training, it will not be valid and you will be required to re-take the website training again after obtaining authorized registration.*

6. RETEC personnel who have completed the course and have received a wallet card are tracked on the Health and Safety Medical Surveillance and Training Database in the Monroeville office.

7. All RETEC employees and subcontractors must also read "Requirements for On-Track Safety/Road Worker Protection on Railroad Sites" as the second part of the On-Track safety training program. You will have attested that you understand and will abide by these requirements when you sign the acknowledgement form of this site specific HASP. Prior to work on a railroad site and *annually at a minimum*, RETEC employees and subcontractors working at railroad sites must receive this training.

8. A Lotus Notes-based application is available for RETEC employees only, which includes a copy of these requirements, a short quiz to verify that the training has been received and understood, and a tracking database.

9. Other methods of providing this training will include a module at the annual 8-hour HAZWOPER refresher-training course.

10. RETEC subcontractors who have received the website orientation training but have not received this part of the On-Track Safety/Roadway Worker Training will be briefed on the job site by the designated health and safety officer and required to sign an acknowledgement form.

11. In addition, all RETEC employees and subcontractors must be generally familiar with the following four (4) documents as part of the On-Track Safety/Roadway Worker Training Program:

    - FRA Railroad Administration Regulations
    - BNSF Engineering Instruction No. 1.1
    - BNSF Maintenance of Way Operating Rules
    - BNSF Maintenance of Way Safety Rules

12. A summary of these documents is attached for use in becoming generally familiar with them. Consult this summary for requirements that are specific to your project or for any Roadway Worker Protection information you may require. Complete copies of these documents for any section you find specifically

applicable to your site work can then be obtained under the reference section of the railroad training website www.contractororientation.com.

Federal Railroad Administration Regulations

In December 1996, FRA codified rules and regulations for work at railroad sites in the Federal Register (49 CFR 214). The rule became effective January 15, 1997. The FRA regulations address Roadway Worker Protection, a term which will be used interchangeably with On-Track Safety. The requirements outlined in this document specifically address the requirements of the FRA regulations. Note that BNSF has published the requirements for On-Track safety in BNSF Engineering Instruction No. 1.1 (See Attachment 1).

In an effort to promote uniformity and safety and to minimize the burden on contractors, the FRA concluded that contractors would be expected to comply with compliance programs established by the railroads. To this end, this document reviews the requirements established by FRA and BNSF, as presented to RETEC and our contractors on the BNSF website (www.contractororientation.com).

In summary, the Roadway Worker Protection regulation requires that each railroad devise and adopt a program of on-track safety to provide employees working along the railroad with protection from the hazards of being struck by a train or other on-track equipment. As previously stated, RETEC has adopted BNSF's program documentation. Elements of the on-track program include this document and the summary of references, a clear delineation of RETEC's responsibilities for providing on-track safety (including employee rights), well-defined procedures for communication and protection, and annual on-track safety training.

Basic On-Track Safety Program Requirements

The On-Track Safety Program must be in place when work is to be performed within 25 feet of active tracks, siding, or spurs. As such, the following requirements apply:

- Complete a Contractor Safety Action Plan (see Contractor Safety Action Plan section below) and *submit a copy to the website Webmaste*r and a hard copy to the appropriate BNSF Representative.

- The primary purpose of this document is to establish and document the contact information necessary for responding to emergency situations. Those contacts include medical, police, and fire. An online form is available for use, which may be modified for site-specific requirements. The plan should be developed taking into account the following information:

    - Recent Accident History/Goals
    - Employee Training
    - Emergency Preparedness Plan
    - Job Safety Briefings

- Work Practices/Facility Assessments
- Safety Communications Plan
- Process for Addressing Safety Issues

- Notify the Roadmaster, facility manager, or designee in advance of your visit and your plans for work to be conducted, and provide a copy of the Contractor Safety Action Plan to the on-site contact. A copy of the plan should also be maintained by all work groups (notification requirements are clearly identified below). The Roadmaster, or designee, shall be notified prior to performing work within 25 feet of any active tracks, sidings, or spurs.

- In the Contractor Safety Action Plan, establish a protection method within a 25-foot zone (within 25 feet from centerline of the tracks). The method of protection must be approved by the Roadmaster, documented, and carried with the crew performing the work. The established roadway worker protection method may consist of one of the following:

  - No protection
  - Lookout protection (may not be a Contractor or RETEC employee)
  - Lone Worker (may not be a Contractor or RETEC employee)
  - Flagman
  - Derail
  - Flag

- The following types of protection establish a roadway worker protection method if work is to be completed in the foul zone (within 4 feet of the near rail). The method of protection must be approved by the Roadmaster, documented, and carried with the crew performing the work.

  - Derail
  - Flag
  - Flagman
  - Authority

- Personnel on the property must be able to produce a Certificate of Safety Training Card demonstrating that they are current in the Contractor Safety Orientation and that they have read and are familiar with the requirements specified in this document.

- Personnel must participate in a Job Safety Briefing.

- Personnel must follow applicable MOW Safety Rules.

- Personnel must follow applicable MOW Operating Rules.

- Personnel must comply with the Contractor General Safety Requirements.

- Personnel must comply with OSHA and FRA regulations.
- Personnel must obey all traffic control signs, including stop signs (All RETEC and subcontractor personnel must come to a complete stop at ALL STOP SIGNS) and comply with posted speed limits.
- Personnel must operate all vehicles with headlights on and seat belts fastened.
- Personnel must wear hard hats (6-point suspension preferred) for any activities outside the office or vehicles. It is recommended that contractor's supervisory personnel wear hard hats with orange retro-reflective strips to distinguish them from other contractor employees.
- Personnel must wear safety glasses meeting ANSI-Z87.1 standards with side protection, no amber/yellow lenses, no mirrored lenses, and only clear lenses inside buildings. Wrap-around glasses meeting ANSI-Z87.1 standards are permitted.
- Safety-toe boots must be worn at all times while onsite. Boots must be Class 75, 6-inch, over the ankle, lace-up, safety toe boots with a defined heel, meeting ANSI Z41 PT91 standard.
- Personnel must wear high-visibility orange retro-reflective vests for any activities outside the office or vehicles (excluding walking to and from vehicles in an established parking lot). Only orange is permitted within 25feet of the centerline of any active tracks, sidings, or spurs.
- Finger rings, hoop type earrings, and loose jewelry are not permitted on-site.

Any questions regarding On-Track Safety/Roadway Worker Protection may be directed to the RETEC EHS Department (978-371-1422 or 412-380-0140) or your local EHS coordinator.

ATTACHMENT 1: Summary of Maintenance of Way (MOW) Engineering Instruction 1.1 and FRA Regulations

Reference:	Safety Topic:	Requirement:	Section:
MOW	**Core Rules**	Job Safety Briefing	1.1
MOW		Aware of Rights And Responsibilities	1.2
MOW		PPE understood	1.3
MOW		Tools Inspected	1.4.1
MOW		Familiar with tools	1.4.2
MOW		Vehicle trained	1.4.8-9
MOW		Work Environment clean, orderly and inspected	1.5.1-2
MOW		Personnel aware of Track right of way	1.6
MOW	**Chem. Safety**	Prevention of spills, discharges to environment	2.1-2
MOW		Chemical Spill and Release Emergency Procedures, and Reporting	2.1-2
MOW		Chemical Containers labeled	2.3
MOW		Safe Atmosphere Ventilation	2.4
MOW		Proper Cleansing equipment	2.5
MOW		Spill containment and prevention measures	2.6
MOW		Protection from Lead, Asbestos, Manganese, and Silica Dust	2.7-10
MOW		All chemicals brought onsite approved	2.11
MOW	**Electrical Safety**	Electrical Safety followed	3.0
MOW		Clearing and Jumping Batteries	3.3
MOW	**Fire**	Area emergency plans and special instructions understood	5.1
MOW		Notification of all personnel effected	5.1
MOW		Aisles, exits, and fire doors clear	5.1
MOW		Fire extinguishers up-to-date and easily accessible	5.3
MOW		Open flames, gasoline/oil-burning devices always attended with extinguisher on hand	5.3.3-4
MOW		Use of highly flammable liquids to start or intensity fire prohibited	5.4
MOW		Fueling only done in safe manner	5.5
MOW		Electrical circuits handled only by those that are experienced	5.6
MOW		HazMat Storage and Dispensing to be done in groups or by distance using grounding and bonding as needed	5.7
MOW		Use and Handling Liquefied Petroleum Gas	5.8
MOW	**Hot Work**	Welding, Cutting, Heating, & Arc Welding done safely	6.0
MOW	**Hand Tools**	Personnel using Hand Tools understand use and care	7.0
MOW	**Aerial Work**	Personnel working aerially understand specific dangers and how to avoid them	9.0
MOW	**Material Handling**	Storage set up safely, equip used wisely, regulations and BNSF policies followed	11.1
MOW	**Motor Vehicles and Trailers**	Know and obey local, state, and fed laws and regulations on and off company property	12.1.1
MOW	**On or near tracks**	Personnel aware of Track right of way, and working with the RR equipment they will work with	13.0

Reference:	Safety Topic:	Requirement:	Section:
MOW	**On-Track Machines or Vehicles**	Personnel aware of how to use the On-Track equipment they will work with	14.0
MOW	**Oxygen and fuel gas**	Gas cylinders must be tested, handled, and transported safely	15.0
MOW	**Power Tools and Machinery**	Only authorized personnel who have inspected, insulated, grounded and understand the equipment may use it	16.0
MOW	**Rigging, Cranes, & Hoists**	Those working with the equip understand operation and maintenance	17.0
MOW	**Thermite Welding**	Only those that are qualified or under the direct supervision of a qualified thermite welder may assist in the process	19.0
MOW	**Work Environment**	Make certain that all openings in the ground are covered or guarded, do not step or walk over openings	20.1
MOW		Work place clear of obstructions	20.2
MOW		Unauthorized persons must not be on hoists, machines, or any shop machinery, or distract personnel operating those.	20.4
MOW		Offices are neat, and equip not in the way	20.5
MOW		Trenching and Shoring must be done under direct supervision of a competent person	20.6
MOW		When working on a tower personnel follow BNSF rules	20.7-9
MOW		Fall protection equipment should be inspected cleaned and stored according to BNSF rules	20.10-11
MOW		Tool and equipment are set up in a secure manner	20.12
MOW		Personnel working in rigging & installation know 3 knots	20.13
MOW	**PPE and clothing**	All PPE follows BNSF criteria	21.0
MOW	**Train and Engine movement**	Inspect passing trains	22.0
MOW	**Job Tools**	Job Safety Briefing, and stretching done by personnel	25.0
MOW	**Policies**	BNSF policies followed for personnel interactions, and work practices	26.0
MOW	**Programs**	Personnel understand programs that pertain to their work	27.0
MOW	**Glossary**	Personnel understand those RR words that they may need	40.0
Eng 1.1	**Fouling the Track**	All personnel must determine if on-track safety is provided when track may be fouled	1.1.1
Eng 1.1	**MOW Operating Rules Training**	Personnel working <= 25 feet must have received on-track safety training	1.1.2 C. Contractors
Eng 1.1		Personnel working >25 ft. away must have received on-track safety training if:	1.1.2 C. Contractors
Eng 1.1		Excavation activities could affect the integrity of the track structure	1.1.2 C. Contractors
Eng 1.1		Equipment, such as cranes, could cause fouling of track	1.1.2 C. Contractors
Eng 1.1		Overhead actives, such as stringing power lines, could result in material being dropped on or across the track	1.1.2 C. Contractors
Eng 1.1		When specifically authorized by the BNSF Project Rep. Personnel may perform a routing inspection or minor worker without a railroad employee present when:	1.1.2 C. Contractors

Reference:	Safety Topic:	Requirement:	Section:
Eng 1.1		Personnel working alone & is trained/qualified as a lone worker*	1.1.2 C. Contractors
Eng 1.1		Personnel are protected by a qualified lookout*	1.1.2 C. Contractors
Eng 1.1		Although not preferred & must not be done on a routine basis, job safety briefing may be considered as roadway worker protection/on-track safety training when approved by the BNSF Project. Rep.	1.1.2 C. Contractors
Eng 1.1		Personnel must attend a BNSF Eng./MOW Contractor Safety Orientation class prior to beginning on-site work	1.1.2 C. Contractors
Eng 1.1		Contractor must meet with BNSF Project. Rep. & establish a project-specific protection/safety strategy	1.1.2 C. Contractors
Eng 1.1	**Job Briefing**	A briefing must be conducted before anyone fouls a track, when working conditions or procedures change, or when the method of on-track safety is changed, extended, or about to be released	1.1.3
Eng 1.1		Minimum on-track safety info. must include:	1.1.3
Eng 1.1		Designation of the employee in charge	1.1.3
Eng 1.1		Method of on-track safety being applied	1.1.3
Eng 1.1		track limits & time limits of authority	1.1.3
Eng 1.1		track(s) that may be fouled	1.1.3
Eng 1.1		Operational controls of movements on adjacent tracks, if any	1.1.3
Eng 1.1		Procedure to arrange for on-track safety on adjacent tracks, if necessary	1.1.3
Eng 1.1		Means of providing a warning when a lookout is used	1.1.3
Eng 1.1		Designated place of safety where workers will be clear for trains	1.1.3
Eng 1.1		Designated work zones around machines	1.1.3
Eng 1.1		Safe working & traveling distances between machines	1.1.3
Eng 1.1		There are briefing specifics for Lone workers as well	1.1.3
Eng 1.1	**ON-Track Safety Procedures**	MWOR Rules 6.3.1-5 cover authority, responsibilities, & protection for Main Tracks, Controlled Sidings, & Other Tracks.	1.1.4 A-C
Eng 1.1		Lone worker & lookouts must use the "Statement of On-Track Safety" as described in MWOR Rule 6.3.3, "Visual Detection of Trains."	1.1.4 D
Eng 1.1		When large-scale maintenance & construction crews are track within <25 ft. from another live track this section must be reviewed	1.1.4 E
Eng 1.1	**Audible Warning From Trains**	General Code of Operating Rules (GCOR) Rule 5.8.2, "Sounding Whistle," requires trains & engines to sound whistle & ring bell approaching roadway workers	1.1.5
Eng 1.1	**On-Track Safety Procedures in Effect**	Management & individual roadway workers share the responsibility for ensuring that proper on-track safety procedures are followed when workers are fouling the track	1.1.6
Eng 1.1		Contractors must create & implement procedures as stringent as the BNSF Program	1.1.6 C Responsibilities of Contractors
Eng 1.1		All roadway workers have the right to challenge in good faith the on-track safety procedures applied at their work location	1.1.6 D Challenges to Procedures

Reference:	Safety Topic:	Requirement:	Section:
Eng 1.1	**Requirement for Operating Roadway Machines**	Personnel operating roadway machines must understand & comply with requirements	1.1.7
Eng 1.1	**Spacing of On-Track Equipment**	If on-track equipment is used, workers & machine operators must follow the guidelines for maintaining safe distances	1.1.8
Eng 1.1	**Traveling On-Track Equipment**	Personnel operating roadway machines must understand & comply with requirements	1.1.9
Eng 1.1	**On-Track Safety Program Documentation**	All employees subject to these rules are required to have a current copy they can refer to while on duty	1.1.10
Eng 1.1		All MWOR-qualified employees shall be provided with & must maintain copy of Eng. Instruction 1 Safety	1.1.10
Eng 1.1		MWOR qualified employees will take annual written exams to help monitor their compliance with the program	1.1.10
49 CFR 214	**RR On-Track Safety Programs generally**	RRs shall adopt & implement their own program for on-track safety, which meets Fed min. standards	214.303
49 CFR 214	**On-Track Safety Program Documents**	RR must have all on-track safety rules in one place, easily accessible to roadway workers	214.309
49 CFR 214		Contractors must provide a manual to its employees, & know its employees are knowledgeable about its contents	214.309
49 CFR 214		The manual must be at the work site available for ref by all roadway workers	214.309
49 CFR 214	**Responsibility of Employers**	Personnel must be trained & supervised to work w/ the on-track safety rules at the work site	214.311
49 CFR 214		Personnel may challenge in good faith on-track safety rules compliance, without censure, punishment, harm or loss	214.311
49 CFR 214	**Responsibility of Individual Roadway Workers**	Personnel may not foul a track unless necessary to accomplish their duties	214.313
49 CFR 214		Personnel must know that on-track safety is being provided before fouling a track, remain clear of the track, & inform the employer when their required level of protection is not provided	214.313
49 CFR 214		Personnel must inform employer of good faith concerns they may have w/ on-track safety	214.313
49 CFR 214	**Supervision & Communication**	Personnel must know & acknowledge understanding of on-track safety methods prior to commencing duties on or near the track	214.315
49 CFR 214		A job briefing must occur at the begin inning of each work period, where personnel acknowledge understanding	214.315
49 CFR 214		At least one roadway worker must provide on-track safety while a group is working together, either for the job or the specific work condition	214.315
49 CFR 214		The on-track safety responsible worker must conduct a safety briefing prior to the beginning of work, near track, or before changing on-track methods during a work period	214.315

Reference:	Safety Topic:	Requirement:	Section:
49 CFR 214		Personnel must also be briefed to immediately leave the fouling space & not return until on-track safety is reestablished	214.315
49 CFR 214		Lone workers must also have a safety briefing w/ a supervisor or another designated employee to advise them of their itinerary & the means by which they plan to protect themselves.	214.315
49 CFR 214		The lone worker briefing must include geographical location, period of time at that location, different locations planned that day, & planned method of protection	214.315
49 CFR 214		The lone worker must be capable of determining their proper means to achieve their safety	214.315
49 CFR 214		If channels of communication are disabled the briefing must be conducted as soon as possible after communication is restored	214.315
49 CFR 214	**On-track Safety Procedures Generally**	One or more of these types of procedures should be used when personnel foul a track	214.317
49 CFR 214		Fouling: distance limit of 4 ft. from the outer side of the running rail nearest to the roadway worker, or outside of that distance if expected or potential activities or surroundings could cause movement into the space that would be occupied by a train, or if components of a moving train could extend outside the 4 ft zone	214.317
49 CFR 214	**On-track Safety Procedure: Working Limits**	Procedure described in subpart	214.319
49 CFR 214	**On-track Safety Procedure: Exclusive Track Occupancy**	Procedure described in subpart	214.321
49 CFR 214	**On-track Safety Procedure: Foul Time**	Procedure described in subpart	214.323
49 CFR 214	**On-track Safety Procedure: Train Coordination**	Procedure described in subpart	214.325
49 CFR 214	**On-track Safety Procedure: Inaccessible Track**	Procedure described in subpart	214.327
49 CFR 214	**On-track Safety Procedure: Train Approach Warning Provided by Watchmen/lookouts**	Procedure described in subpart	214.329
49 CFR 214	**On-track Safety Procedure: Definite Train Location**	Procedure described in subpart	214.331
49 CFR 214	**On-track Safety Procedure: Informational Lineups of Trains**	Procedure described in subpart	214.333

Reference:	Safety Topic:	Requirement:	Section:
49 CFR 214	**On-track Safety Procedures for Roadway Work Groups**	Employers shall not require or permit roadway work groups may not foul a track unless they have established on-track safety through working limits, train approach warning, or definite train location	214.335
49 CFR 214		Personnel should not foul a track without having been informed by the roadway worker in charge that on-track safety is being provided	214.335
49 CFR 214		When risk of distraction is significant & there is a need to provide on-track safety on adjacent tracks train approach warning must be used on adjacent tracks that are not within working limits	214.335
49 CFR 214		Adjacent track: <25 ft between track centers, those tracks at 25 ft are not	214.335
49 CFR 214	**On-track Safety Procedures for Lone Workers**	The decision to not use individual train detection should rest solely w/ the lone worker, & may not be reversed by any other person	214.337
49 CFR 214		There is a method where the lone worker is capable of visually detecting the approach of a train & moving to a previously determined location of safety at least 15 seconds before the train arrives, but this method is only used under strict circumstances	214.337
49 CFR 214	**Roadway Maintenance Machines**	There is a general requirement for on-track safety around roadway maintenance machines that requires that the details be provided by RR management, conferring w/ their employees, & industry suppliers	214.341
49 CFR 214	**Training & Qualification, General**	Personnel must be given on-track safety training once every calendar year, w/ the designation of personnel determining what training that entails, this training must be documented written or electronically	214.341
49 CFR 214		Personnel must be able to show sufficient understanding of the subject, & that they can perform their duties	214.341
49 CFR 214	**Training for All Roadway Workers**	Personnel must have the basic training set forth in this rule, as well as specialized training required for particular functions called for in 214.347-214.355	214.345
49 CFR 214	**Training for Lone Workers**	This section requires a higher degree of qualification, as the worker is fully responsible for their own safety	214.347
49 CFR 214	**Training for Watchmen/Lookouts**	This section details the standards for qualification of a lookout, who is responsible for the protection of others	214.349
49 CFR 214	**Training for Flagmen**	This section requires that flagmen be qualified on the operating rules of the RR on which they are working	214.351
49 CFR 214	**Training & Qualification of Roadway Workers who provide on-track safety for Roadway Work Groups**	Individual must be able to apply the proper on-track safety rules & procedures in various circumstances, to communicate w/ other RR employees regarding on-track safety procedures, & to supervise other roadway workers in the performance of their on-track safety responsibilities	214.353
49 CFR 214		A recorded examination is also part of the qualification process for providing on-track safety for roadway work groups	214.353
49 CFR 214	**Training & Qualification in On-track safety for operators of roadway maintenance machines**	Operators of roadway maintenance machines must have been trained w/ the type of machine to be operated, & their circumstances & conditions under which it is to be operated	214.355

ATTACHMENT 2: Additional On-Track Safety Information

On-track safety is an important part of our work as it relates to all railroads throughout the U.S. The following sections will outline some general topics of discussion and a synopsis of the different forms of protection offered by the railroad to its employs and contractors.

When working on railroad property, it is important to determine the following information.

General Topics

Where are you going to be working on the railroad? The following information needs to be determined:

- Line Segment
- Mile Post (MP)
- Track Segment
- Nearest Crossing
- Railroad name for the location
- Track designation (Track One is mainline etc.)
- Railroad direction (North, South, East, and West in railroad terms does not necessarily correspond to compass points)
- Nearest two switch points in both directions
- If in a switchyard (flat or hump), determine specific track number designations
- What Valuation Map numbers cover the segment of track you are working on (this may be difficult to determine and may have to be determined in follow up conversations)

You have now arrived at a point where you know where you are on the railroad. Why is this important?

- Communication with railroad personnel
- Standardizes communication

- Pinpoints your location such that the railroad can now protect you while on the property. (THIS IS FOR YOUR SAFETY)
- Reduces potential liability for inappropriate actions that can interfere with railroad operations

Communication with railroad employees is the one of the single most important and compelling needs to be accomplished while working on railroad property. **Documentation in "field notes" and Record of Communications are VERY important**. Prior to departure to a railroad job site, know whom you are working for, their phone numbers, cell numbers, and specific title at the railroad. This information may be critical if you are questioned by other railroad employees as to why you are on the property and for whom you are working. Upon arrival at a job site identify yourself to the designated contact and exchange communication information. Every situation will be different. If your contact is a Roadmaster, find out his/her specific office location; ask what his/her territory limits are. Ask him/her to identify any other railroad employee that you will be working with and how you can communicate with them. Log in your "field notes" these introductions, time, and date. Always alert railroad employees as to when you are on the property and when you are leaving, even for lunch. Ask the railroad employees what their normal scheduled start and stop times are for work. Ask who their replacement will be, if you are scheduled to work past their shut-off time. Make sure, through some form of general conversation, that multiple departments within the railroad know you are on the property. Railroads are compartmentalized similar to other companies and some times the right hand does not know what the left is doing. Knowledge of the general operating structure of the railroad is important and can keep you safe.

Protection Offered by the Railroad

Now that you know where you are on the railroad property and you have established lines of communication with "in-field" railroad employees, you need to tell them exactly what you are going to do and the duration.

"I will be excavating within 25 feet of centerline of the track between milepost 165.1 and 165 on the High Line at various locations. This location is railroad east of Blacktail Mountain and railroad west of East Glacier. I understand that this is dual line main track with DTC (Direct Terminal Control). The nearest crossing is approximately 11.5 miles railroad east at East Glacier. I will be excavating small test pits approximately 6 feet in depth and 10 feet long to take samples. I will not excavate any closer than the end of the tie. We will not cross any tracks, all excavation activities will occur on the geographic south side of the track. Upon completion of sampling, the hole will be backfilled and field compacted. We will work from 7.00 am MST and finish at 5.00 pm MST. There will be four employees involved with the work, one will operate a Case 560 backhoe, two will be taking samples and the other employee will provide safety watch. I am under contract to BNSF for Mr. Mike Perridone, Manager of Environmental Remediation with BNSF at Havre, MT.; we anticipate this work will take 3 days. Now you have established the, who, what, when, where and why. First you are on dual main line track, this line handles not only 30 general commodities train units per day, but 6 high-speed Amtrak trains. This is a remote location, depending on the time of year; weather conditions access and communications will be difficult. The railroad now has to take the information you provided and will determine what level of protection you will need.

General Code of Operating Rules
Fourth Edition, Effective April 2, 2000
General Code of Operating Rules Committee

This section provides a overview of the specific sections of the General Code of Operating Rules that explain the different levels of protection offered for accepting railroads. It does not evaluate the specific forms of protection offered by BNSF that may vary from this General Code. Some sections may contradict, overlap and amplify other sections. The most important information to extract from this, are the various forms of protection. As an individual contractor/consultant, you will have little if any input on the form of protection that the railroad provides. Many factors have to go into this decision, which include traffic patterns, work schedules, manpower, union operating rules and other financial considerations. Use this as a general level of guidance to educate and protect you (crews) from potential safety related issues while on railroad property.

Section 5.4 Flags for Temporary Track Conditions

This section outlines the specific flagging protection offered for "Temporary Track Conditions". In general this can be a Yellow Flag or Yellow/Red Flag which is a not specified by track bulletin, track warrant or general order. In essence once a train crew observes the flags they must precede under caution and/or stop. This means trains will still move although slower, and must visually watch out for your work areas.

Section 5.13 Blue Signal Protection of Workmen

This rule outlines the requirements for protecting railroad workmen (and contractors) who are inspecting, testing, repairing, and servicing rolling equipment. In particular, because these tasks require the workmen to work on, under, or between rolling equipment, workmen are exposed to potential injury from moving equipment. In most railroads this can be a blue light or flag. The railroad employee locks out the switch points leading to this section of track. In most cases you will find this applied in a yard, industrial track or siding.

Section 6.31. Train Coordination

Employees may use a train's authority to establish working limits for track maintenance. To establish the working limits, the train must be in view and stopped. The employee in charge of working limits will communicate with a member of the train crew and determine, its movement and authority to be released.

In essence the track section is protected by the fact that there is a train on the track and it is stopped in view, the train crew and its train effectively protect this section. Sub-section B effectively creates a track permit authority within the train's limits.

Section 7.13 Protection of Employees in Bowl Tracks

During humping operations, before a train or yard crew member goes between engines or cars on a bowl track to couple air hoses, adjust coupling devices, or maintenance protection must be provided against cars released from the hump into the tracks.

This is a very dangerous situation in railroad work. Working in a hump yard can be deadly. Cars released into a bowl will be silent as they move and can strike without a sound. Notification must be made to the Yardmaster, follow up with the Terminal Superintendent and most importantly the Tower Operator. Make sure tracks are taken out of service and lined against a movement.

Section 9.15 Track Permits

On track designated in the timetable, a track permit will authorize a train, track car, machine or employee to occupy the main tracks between specific points. The track permit must be issued by a designated control operator under the direction of the train dispatcher. Within these limits, movements may be made in either direction.

This may be the highest level of track protection, insofar as it is a scheduled occupancy of the track and no movement will take place without specific instructions. Note that even with the permit some movements could occur.

Section 10.3 Track and Time

The control operator may authorize a train (equipment and/or people) to occupy a track or tracks within specified limits for a certain time period. Authority must include track designation, track limits, and time limit. The train (equipment and/or people) may use the track in either direction within the specified limits, until the limits are verbally released. This is a high end of protection; it gives you a specified time and duration. Remember the railroad is a dynamic world and situations change; keep in close contact with your flagman.

Section 14.0 Rules Applicable Only Within Track Warrant Control (TWC) Limits

Where designated by the timetable, a track warrant will authorize use under the direction of the train dispatcher or as prescribed by Rule 6.13 (Yard Limits) or Rule 6.14(Restricted Limits). Track warrant instructions must be followed where yard limits or restricted limits are in effect. A Track Warrant is a written form filled out and is posted notifying railroad employees of the conditions under which operations are to be/or not conducted on this track segment. Strict speed conditions are set for train traffic and the train crew must contact crews working in this area before entering the limits of the warrant.

Section 15.1 Track Bulletins

Contain information on all conditions that affect safe train or engine movement. A Track Bulletin is somewhat similar to a Track Warrant.

Section 15.2 Track Bulletin Form B

A Form B is a combination of Rule 5.4 and to a degree Section 10.3. It is a verbal radio message that protects the track and has very specific format for transmittal of information. It is a verbal form of communication and authorization, which although provides a good level of protection, train traffic is still permitted in the work area. The use of a Form B is prevalent and again close coordination with the flagman is paramount. In all these situations where permission, authorizations and/or changes are made to the operations by verbal communication, it is occurring on a railroad radio. Document in field notes communication with the flagman, and what his/her specific instructions are.

Appendix G

Groundwater Compliance Monitoring Plan

Groundwater Compliance Monitoring Plan

Yakima Valley Spray/U-Haul Site
Yakima, Washington

Prepared by:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162

RETEC Project Number: DWT40-16457-300

Prepared for:

Yakima Valley Spray Steering Committee

October 16, 2003

Table of Contents

List of Tables

List of Figures

List of Attachments

1 Introduction

This document details the groundwater compliance monitoring plan scope and schedule for the Yakima Valley Spray/U-Haul site (YVS site). Currently, portions of the soil and groundwater at the YVS site contain chemical concentrations above applicable cleanup levels. The Washington State Department of Ecology (Ecology) prepared a *Final Cleanup Action Plan* (Ecology, 2001a) detailing the scope of work required for final remedial action at the YVS site. The scope of work includes soil excavation above the water table to remove contaminants in soil above applicable cleanup levels, as well as installation and operation of a groundwater sparging/bioventing system to treat any remaining impacted groundwater, with an option to perform a complete excavation, with no groundwater sparging system. The details of the remedy implementation are included in the *Engineering Design Report* (RETEC, 2003). This compliance monitoring plan outlines the groundwater monitoring programs, including the well locations, sampling frequency, and analytical program. Methods for sampling and evaluating the data are also discussed. This plan was prepared in accordance with the Model Toxics Control Act (MTCA), WAC 173-340-410 and WAC 173-340-820. A Focused Groundwater Sampling and Analysis Plan is provided as an attachment to this document.

The overall remedial objective of the YVS cleanup is to decrease the volume of contaminated soil and groundwater such that the remaining conditions are protective of human health and the environment. Compliance monitoring will be conducted during and after remediation to assure that conditions remain protective. In accordance with WAC 173-340-410, monitoring will be completed in the following three phases:

- **Protection Monitoring** is intended to "confirm that human health and the environment are adequately protected during construction and the operation and maintenance period." Protection monitoring will therefore occur during excavation activities as well as during operation of the groundwater sparging system, if the groundwater system is installed and operated.

- **Performance Monitoring** will be conducted to "confirm that the … cleanup action has attained cleanup standards." Groundwater samples will be collected and analyzed to confirm that compliance with cleanup levels is maintained after the groundwater sparging/bioventing system is shut down, or after the excavation has been backfilled if no groundwater system is implemented.

- **Confirmational Monitoring** is performed after completion of performance monitoring to "confirm the long-term effectiveness of

> the… cleanup action." Periodic sampling of groundwater from selected wells will be conducted.

This compliance monitoring plan is for groundwater sampling activities only. Compliance monitoring for soil is included in other documents. The site-specific health and safety plan includes information on protection monitoring to protect workers, as well as best management practices for limiting off-site exposure to impacted soils during excavation activities. The *Engineering Design Report* (EDR, RETEC, 2003) includes provisions for performance monitoring to ensure the excavation is sufficient to meet cleanup standards. Longer term confirmational monitoring for the soil remedy will be achieved through the groundwater monitoring program described herein. In addition, the Sampling and Analysis Plan (attachment to EDR, RETEC 2003) provides additional information pertinent to the compliance monitoring program, and is incorporated in this document by reference. A more focused Sampling and Analysis Plan limited to groundwater sampling methods and analysis is attached to this Compliance Monitoring Plan.

This Compliance Monitoring Plan is organized as follows:

- Section 2 – monitoring well network;
- Section 3 – analytical methods and selection of indicator hazardous substances (IHS);
- Section 4 – sampling frequency for each of the monitoring stages;
- Section 5 – contingency plans; and
- Attachment 1 – Focused Groundwater Sampling and Analysis Plan.

2 Monitoring Well Network

The monitoring wells included in performance and compliance monitoring at the YVS site include wells that currently exist at the site, as well as new monitoring wells that will be installed following implementation of the excavation remedial action.

For purposes of discussing the rationale used to develop the monitoring schedule, three subsets of wells have been defined: Background Wells, Compliance Wells, and Sentry Wells. The well locations are shown in Figure 2-1. Each subset of wells serves a different purpose and will have its distinct monitoring program during each stage of compliance monitoring.

2.1 Background Wells

Background wells will provide data on background levels of indicator hazardous substances (IHS) that can be used to establish background concentrations of these compounds under WAC 173-340-709. The background wells are shown on Figure 2-1. Existing wells YS-3 and MW-12 will be monitored as background wells. It is likely that MW-4 will be damaged or removed during excavation activities; it will be replaced with two deeper background wells, BG-60 and BG-90, with depths of 60 and 90 feet, respectively. These two new wells may be placed in the northwest corner of the site, or near one of the other background wells, pending site access. The final location of these wells will be determined during implementation of the remedy, and will be confirmed with Ecology prior to well installation.

2.2 Compliance Wells

Monitoring wells MW-6, YS-1 and a new well designated as YVS-3 installed between these two wells would be used as point of compliance wells (Figure 2-1). Concentrations of IHSs must meet MTCA Method B cleanup levels or background levels established in accordance with WAC 173-340-709 using data from background wells, in order to achieve site cleanup and apply for site closure. Additionally, two deeper wells will be installed near YVS-3 as a clustered set of monitoring wells, with total depths of 60 (YVS-3-60) and 90 feet (YVS-3-90). These wells are designated compliance wells, but will be monitored for PCE only.

2.3 Sentry Wells

The sentry wells will be used to monitor the performance of the remedial action, and will be used to provide early warning in the event that contaminants are found to be moving towards the compliance wells. Therefore, these wells will be instrumental in determining if contingent actions may be warranted, but, as they are not located at the point of compliance, are not subject to attainment of cleanup levels.

Two sentry wells will be installed following the source removal excavation. One well (designated YVS-1) would be immediately downgradient of the source excavation area. The second well (designated YVS-2) would be installed immediately downgradient of the groundwater sparging zone. Note that existing well MW-7 will likely be removed during remedy implementation. YVS-1 will replace MW-7, as required by the Cleanup Action Plan.

In addition, a new well (YVS-4) installed in the air sparging area will serve as a sentry well to account for periodic southwesterly groundwater flow. If the sparging system is not implemented, YVS-4 will not be installed, and MW-10 will serve as the final sentry well.

2.4 Gauging Wells

In addition to the wells described above that serve as the compliance monitoring network, all wells existing at the site after remedy implementation will be gauged in conjunction with sampling activities, to provide ongoing information about groundwater flow direction.

3 Sample Analysis

Groundwater samples in the compliance monitoring program will be collected using low-flow sampling techniques. Only arsenic samples will be field-filtered. All samples will be collected using the procedures detailed in the *Focused Groundwater Sampling and Analysis Plan* attached to this document. In addition to the standard parameters monitoring during purging, dissolved oxygen (DO) will be measured using a down-hole measuring probe.

3.1 Indicator Hazardous Substances

Ecology's *Final Cleanup Action Plan* (Ecology, 2001a) details the scope of work required for final remedial action at the YVS site, and includes a list of IHSs to be used in compliance monitoring for the soil excavation, as well as for targeting the areas where a groundwater remedy must be implemented. These IHSs are:

- DDT
- Aldrin
- Dieldrin
- Beta BHC
- Gamma BHC (Lindane)
- Arsenic
- PCE
- TPH as gasoline
- TPH as diesel

Ecology has determined that remedial actions based on targeting these compounds will result in cleanup of soil and groundwater at the site. Site cleanup will be achieved by removing contaminants in soil that present a risk to human health through direct contact, as well as removing contaminants in soil and groundwater to be protective of groundwater beneficial uses.

The compounds identified as soil IHSs by Ecology will be monitored in groundwater as part of the compliance monitoring program. Benzene will also be included in the groundwater monitoring because it contributes the majority of risk associated with site groundwater. Groundwater samples submitted for arsenic analysis will be field-filtered to provide an accurate assessment of mobile arsenic in groundwater. Although Aldrin and Dieldrin were not detected in groundwater during the RI, they will be retained as part of the compliance monitoring program, as they comprise a large portion of the site risk in soil.

Groundwater samples will therefore be analyzed for the following compounds, hereafter referred to as IHSs for groundwater:

- Method 8080
    - DDT
    - Aldrin
    - Dieldrin
    - Beta BHC
    - Gamma BHC (Lindane)
- Method 8260
    - Benzene
    - PCE
- Method 6010/7000
    - Arsenic (field filtered)
- Method NWTPH-G
    - TPH as gasoline
- Method NWTPH-D
    - TPH as diesel

The laboratory will be instructed not to refilter samples submitted for arsenic analysis, and will further be instructed to include a digestion step prior to analysis, per Ecology's request. Sample handling and laboratory analysis are discussed in detail in the *Sampling and Analysis Plan* (attachment to EDR, RETEC, 2003) and the *Focused Groundwater Sampling and Analysis Plan* attached to this monitoring plan.

3.2 Cleanup Levels

Cleanup levels for IHSs in groundwater are based on MTCA Method A or B cleanup levels for residential properties (Ecology, 2001b) and are included in Table 3-1, below.

Note that PCE is detected area-wide in groundwater, so compliance with cleanup levels for PCE will be achieved as long as site wells contain PCE at concentrations less than background. Currently, PCE concentrations in wells at the downgradient edge of the site are lower than those at the upgradient edge of the site. Ongoing monitoring will verify that this situation does not change following remedy implementation. Procedures for calculating background concentrations are included in Section 3.3, below.

Table 3-1 Groundwater Cleanup Levels

Chemical	Cleanup Level (µg/L)
Benzene	5
DDT	0.30
Aldrin	NS[a]
Dieldrin	NS[a]
Beta BHC	0.2[b]
Gamma BHC (Lindane)	0.2
PCE	background[c]
Arsenic (field-filtered)	5
TPH-G	800
TPH-D	500

NOTES:

a) NS = Not specified; no previous detections of these compounds in groundwater during the RI

b) Beta BHC is an isomer of Lindane. The Lindane cleanup level will apply to each isomer.

c) Method for calculating background concentration is provided in Section 3.3.

3.3 Statistical Methods

3.3.1 Background Calculations

The procedure used to calculate levels of background PCE is based on guidance outlined in the Ecology document *Statistical Guidance for Ecology Site Managers*. Data collected from the background wells will be combined and evaluated using the statistical analysis package distributed by Ecology, MTCA STAT. The data will be tested for lognormality, and, if appropriate, 50th and 90th percentiles will be calculated for each constituent evaluated. The calculated Background Level will then be determined to be the lower of the 90th percentile or 4 times the 50th percentile PCE concentration.

3.3.2 95% UCL Calculations

In accordance with the Ecology document *Statistical Guidance for Ecology Site Managers*, 95 percent upper confidence limits (UCLs) will be estimated using MTCA STAT for each constituent for each compliance well. Only data sets with fewer than 15 percent censored (non-detect, or less than detection limit) data can be evaluated using this method. Further, UCLs will not be generated if the data are neither normally nor lognormally distributed. In those cases, the maximum detection may be used as a surrogate for the 95 percent UCL.

4 Compliance Monitoring Program

4.1 Summary of Program

Table 4-1 provides a summary of the sampling frequencies and analyses for each stage of compliance monitoring. In addition to the sampling for laboratory analysis of groundwater, all site wells will be gauged at each sampling event.

Prior to initiation of the compliance monitoring program, an additional two comprehensive rounds of sampling will be performed. The first will be a site-wide event to be completed prior to excavation at the site. The second will be a site-wide event to be completed after the excavation has been backfilled. In each event, all existing wells will be sampled and analyzed for the full suite of analytes using Methods 8260, 8080, 6010/7000, NWTPH-g and NWTPH-d.

For the compliance monitoring program, wells will be sampled quarterly through the protection and performance monitoring stages. Thereafter, the confirmational monitoring schedule will be developed in consultation with Ecology (TBD). During these three stages, samples will be analyzed for groundwater IHSs defined in Section 3 of this plan.

The specific monitoring program is described in more detail in Sections 4.2 through 4.4. Note that the Consent Decree (Section X, Paragraph C) allows for modification or termination of the compliance monitoring program at any time in the program, pending a request to Ecology and Ecology's subsequent approval of the request for modification/termination.

Table 4-1 Groundwater Sampling Frequency

	Background, Sentry and Compliance Wells Only		All Wells	
Monitoring Phase	**Frequency**	**Analytes**	**Frequency**	**Analytes**
Pre Excavation	--	--	one-time	full suite
Post Excavation	--	--	one-time	full suite
Protection	quarterly	IHS/PCE	quarterly	gauging only
Performance	quarterly	IHS/PCE	quarterly	gauging only
Confirmational	TBD	IHS/PCE	TBD	gauging only

IHS/PCE = Deep wells analyzed for PCE only, remaining wells analyzed for all IHS
TBD = To be determined in consultation with Ecology
Full suite = all analytes for methods 8080, 8260, 6010/7000 series, TPH-g, TPH-d

Protection monitoring begins with the groundwater sparging/bioventing system startup, and continues until cleanup levels are achieved in Compliance Wells. Note that if the complete excavation option is selected and no groundwater sparging system is installed, there will be no protection monitoring.

Performance monitoring will then be performed for two years following completion of the remedial actions to gather sufficient data to verify statistically that cleanup levels have been attained.

Confirmational monitoring will be performed thereafter to assess the long-term effectiveness of the remedy. The frequency and duration of this monitoring will be determined in consultation with Ecology. It is currently anticipated that this monitoring will consist of an additional 2 to 3 years of semiannual sampling at high and low water table seasons.

Figure 4-1 is a flow chart presenting the decision process for proceeding through the compliance monitoring process.

4.2 Protection Monitoring

The objective of protection monitoring is to "confirm that human health and the environment are adequately protected during construction and the operation and maintenance period" (WAC 173-340-410) and to evaluate the operation of the groundwater sparging system.

During construction as well as active operation and maintenance of the groundwater system (if installed), worker protection monitoring will be performed in accordance with the site health and safety plan. This may include such measures as vapor or dust monitoring, as well as best management practices for system operation to provide worker protection.

If applicable, during operation of the groundwater system, all wells included in the compliance monitoring program (see Section 2 and Figure 2-1) will be sampled on a quarterly basis until cleanup criteria for IHSs in the groundwater system have been met. Cleanup criteria are based on meeting cleanup levels (Table 3-1) or background levels (See Section 3.3) in the compliance wells, for one year.

Once cleanup levels have been achieved in compliance wells, the groundwater sparging/bioventing system will be shut down. Following shut down of the extraction system, the performance monitoring phase will commence.

If at any time during operation of the groundwater sparging system, concentration increases are observed and confirmed in sentry wells, contingent actions may be triggered (see Section 5).

If the groundwater sparging system is not installed and operated because the complete excavation remedy is selected, the protection monitoring phase of the compliance monitoring program will consist only of worker safety monitoring during excavation activities, and performance monitoring will begin immediately following backfill of the excavation areas.

4.3 Performance Monitoring

Once implementation of the remedy is completed (either the groundwater system is shut down or the complete excavation is backfilled), performance monitoring will begin. The goal of performance monitoring is to "confirm that the interim action or cleanup action has attained cleanup standards" (WAC 173-340-410). The performance monitoring schedule includes two years of quarterly sampling for background, sentry and compliance wells at the YVS site.

"The decision on whether cleanup levels are met is based on the comparison of the upper 95% confidence limit (UCL) on the mean, calculated from the sampling data, with the cleanup level" (Ecology, 1995). Because WAC 173-340-720(8)(c) states that compliance with a cleanup level must be determined for each well or monitoring point, separate 95% UCLs will be calculated using each set of data points obtained from each compliance monitoring well. Ecology's MTCA STAT statistical package will be used to calculate the UCLs (See Section 3.3). Further, Ecology requires that "no sample concentration can exceed twice the cleanup level, and that less than 10% of the samples can exceed the cleanup level." Following this evaluation, and assuming that achievement of cleanup levels has been demonstrated, the performance monitoring phase will be considered complete, and confirmational monitoring can begin.

Performance monitoring will be performed for a period of at least two years and will cease when data show that cleanup levels have been maintained at the site. If, at any time during the performance monitoring period, concentrations of IHSs resulting in 95% UCLs greater than cleanup levels are observed and confirmed in compliance wells, contingent actions may be triggered (see Section 5).

4.4 Confirmational Monitoring

The objective of confirmational monitoring is "to confirm the long-term effectiveness of the interim action or cleanup action" (WAC 173-340-410). Because the travel time of groundwater across the entire site is approximately one year (based on groundwater velocities reported in the RI – RETEC, 1995), two years of periodic monitoring should be sufficient to prove that the remedy has achieved cleanup levels that are permanent. The frequency and duration of the confirmational monitoring stage will be determined in consultation with Ecology. It is currently anticipated that this phase will involve 2 to 3 years of semiannual sampling of the wells in the compliance monitoring program. Statistical methods used during performance monitoring will also be used to prove continued compliance with cleanup levels in the compliance wells. At the end of confirmational monitoring demonstrating that cleanup levels are maintained in compliance wells, a letter will be submitted to Ecology to request site closure. In the event that concentrations in the compliance wells increase above cleanup levels (as determined by 95% UCL evaluation), contingent actions may be triggered (see Section 5).

4.5 Reporting and Data Analysis

Raw, unvalidated data will be provided to Ecology within 30 days of the conclusion of each groundwater sampling event. Groundwater monitoring results will be reported on a quarterly basis, and will include a comparison to previous results and an evaluation of conditions at the YVS site. During performance and confirmational monitoring, reports will also include a statistical summary of the data, as appropriate. In the event that contingent actions are triggered (see Section 5), Ecology will be notified within 30 days of receipt of data confirming that contingent actions may be required.

5 Contingent Measures

Contingent measures may be implemented if constituent concentrations increase in sentry wells during groundwater sparging system operation, or rebound above cleanup levels during performance or confirmational monitoring.

Contingent measures will be triggered by the following occurrences:

- During protection monitoring, if concentrations in sentry wells increase by an order of magnitude;
- During performance or confirmational monitoring, if concentrations in compliance wells rebound above cleanup levels with no corresponding increase in background wells, AND increase results in 95% UCL exceedance of cleanup levels OR increase is greater than 2 times cleanup level.

In all cases, the first step in a contingent action will be to verify the increase. Resampling for the IHS will be performed within 60 days of the original sampling to confirm the elevated concentration. If the increase in concentration does not persist during the subsequent event, compliance monitoring will return to the normal schedule. If, however, the additional sampling confirms the increase, contingent measures will be implemented.

Depending on the stage of compliance monitoring during which an increase is confirmed, contingent measures may be implemented, following consultation with Ecology to determine the appropriate action. Contingent measures may include any or all of the following actions:

- Additional monitoring to statistically verify a rebound and/or the magnitude of the rebound;
- Evaluation of data from background and/or sentry wells to determine the source of the concentration increase;
- Collection of additional data to determine if natural attenuation is sufficient to manage the rebound;
- Restarting or modification of the groundwater sparging system; and/or
- Additional remedial action, in consultation with Ecology.

In the event that contingent actions include restarting the groundwater sparging system or implementation of a new groundwater remedy, the compliance monitoring schedule will revert back to the protection monitoring stage.

6 References

RETEC, 1995. *Remedial Investigation Report for the Yakima Valley Spray Company (U-Haul) Facility, Yakima, Washington.* Prepared for U-Haul of Inland Northwest, Yakima, Washington. Remediation Technologies, Inc., Seattle, Washington. March.

RETEC, 1995. *Draft Feasibility Study for the Yakima Valley Spray (U-Haul) Facility, Yakima, Washington.* Prepared for U-Haul of Inland Northwest. March.

RETEC, 2003. *Engineering Design Report.* Prepared for the Yakima Valley Spray Steering Committee. The RETEC Group, Inc.

Washington State Department of Ecology, 1992. *Statistical Guidance for Ecology Site Managers.* Washington State Department of Ecology Toxics Cleanup Program. Publication No. 92-54. August.

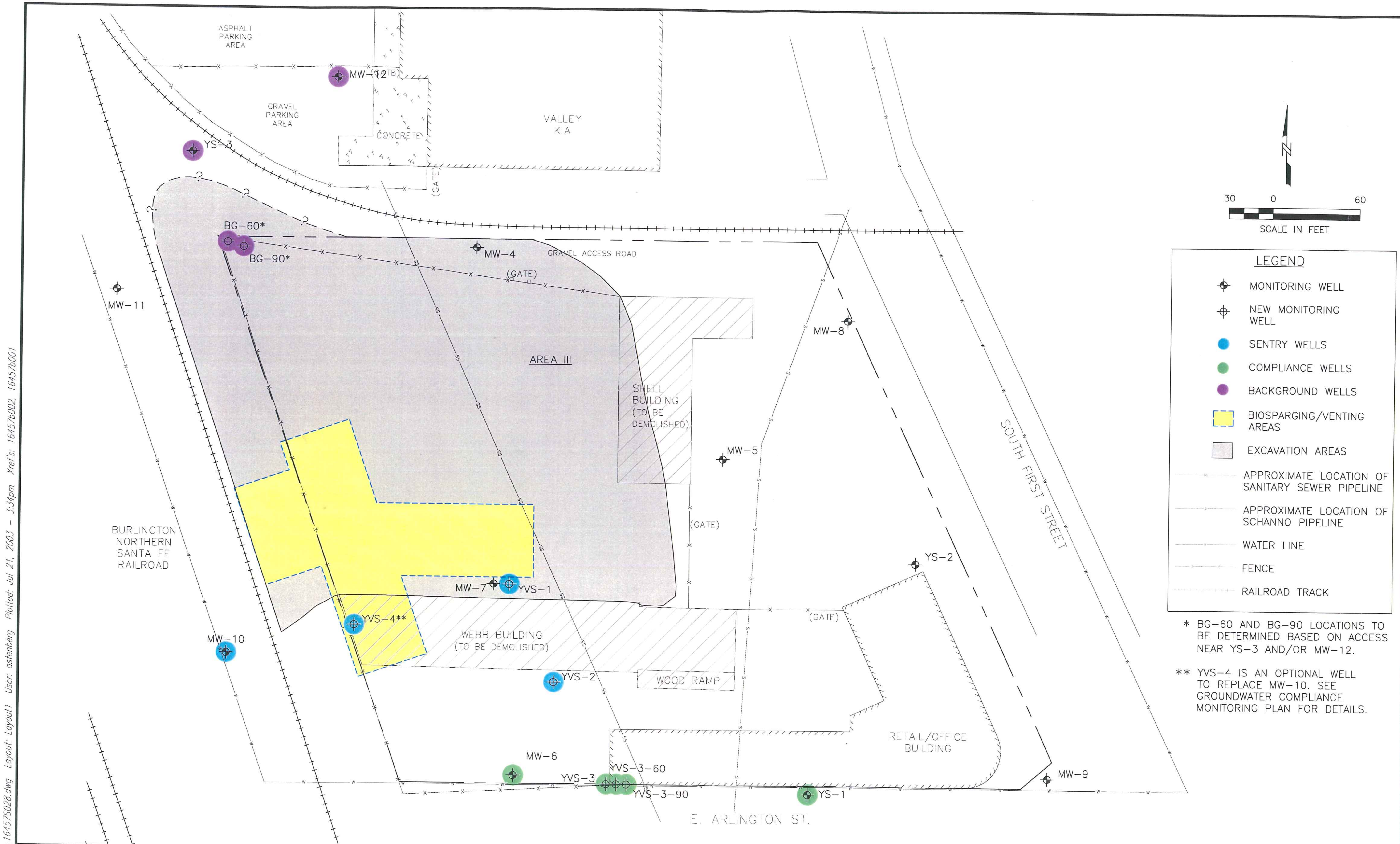
Washington State Department of Ecology, 1993. *Supplement S-6 to Statistical Guidance for Ecology Site Managers.* August.

Washington State Department of Ecology Toxics Cleanup Program, 1995. *Guidance on Sampling and Data Analysis Methods.* Publication No. 94-49. January.

Washington State Department of Ecology , 2001a. *Final Cleanup Action Plan.* Prepared by Richard Bassett. Yakima. August.

Washington State Department of Ecology Toxics Cleanup Program, 2001b. *Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC.* Publication No. 94-06. February.

Figures



File: H:\16457\16457S028.dwg Layout: Layout1 User: astenberg Plotted: Jul 21, 2003 - 3:34pm Xref's: 16457b002, 16457b001

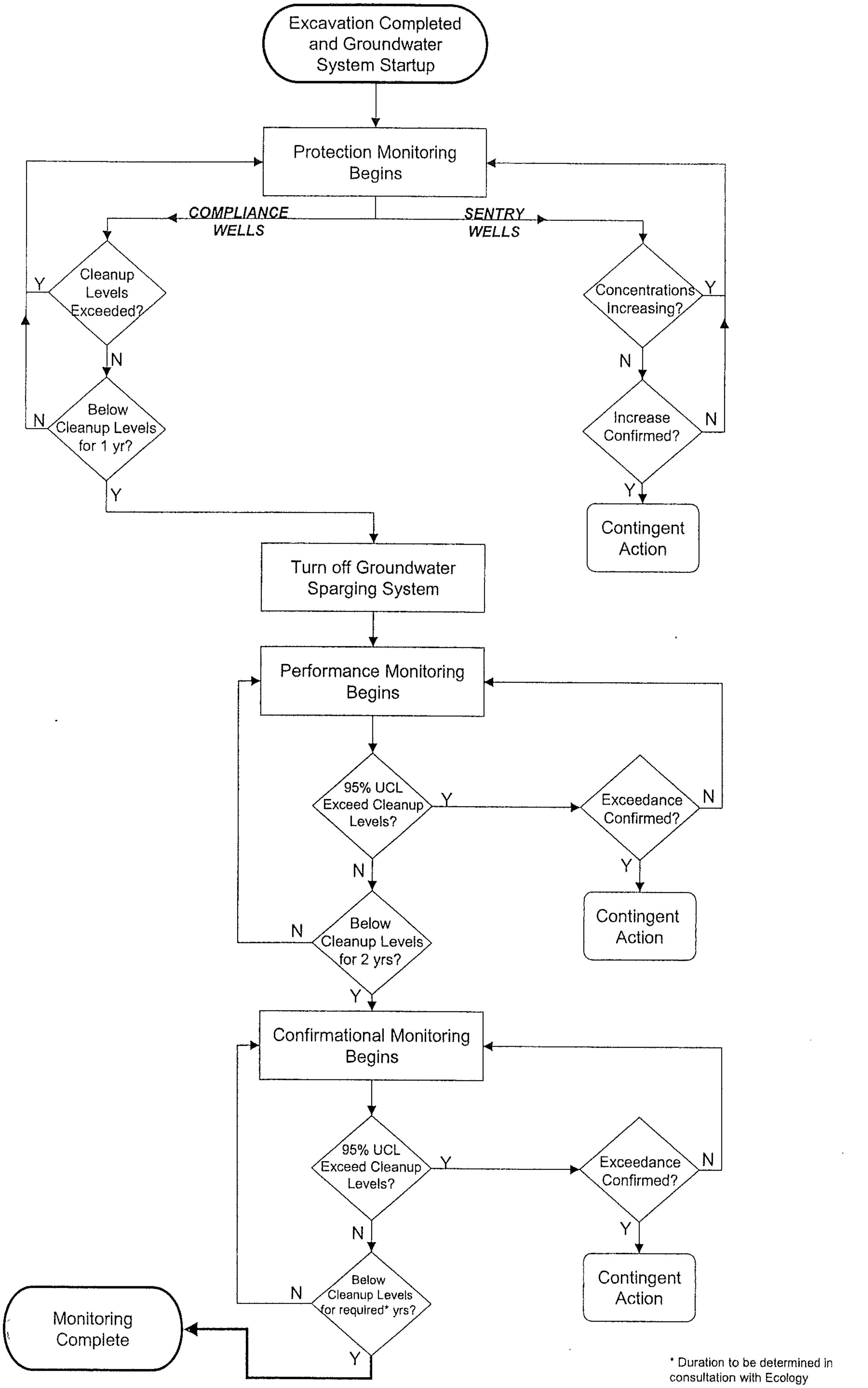
RETEC

YAKIMA VALLEY SPRAY (U-HAUL) SITE
YAKIMA, WASHINGTON
DWT40-16457-300

DATE: 07/21/03 | DRWN: A.S./SEA

LONG TERM GROUNDWATER MONITORING WELLS

FIGURE 2-1



* Duration to be determined in consultation with Ecology

RETEC

Compliance Monitoring Program Flow Chart

Figure 4-1

Attachment 1

Focused Groundwater Sampling and Analysis Plan

Focused Groundwater Sampling and Analysis Plan

Yakima Valley Spray (U-Haul) Site
Yakima, Washington

Prepared by:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162

RETEC Project Number: DWT40-16457-300

Prepared for:

Yakima Valley Spray Steering Committee

October 2003

Table of Contents

Table of Contents

List of Tables

1 Introduction

This sampling and analysis plan (SAP) presents the project organization, objectives, and specific Quality Assurance (QA) and Quality Control (QC) activities associated with the collection of groundwater samples at the Yakima Valley Spray (U-Haul) Site in Yakima, Washington. This SAP meets the requirements of the Model Toxics Control Act (WAC 173-340-820). All QA/QC procedures detailed in this SAP are in accordance with applicable professional technical standards, Washington Department of Ecology guidelines (Ecology, 1991, 1995), and project-specific goals. This SAP describes the procedures that will be implemented to ensure that the precision, accuracy, representativeness and completeness of the project data are sufficient to satisfy the project objectives.

2 Quality Assurance Objectives

Groundwater samples will be collected for laboratory analysis as described in Section 3 in order to meet the objectives described in project specific work plans. To help achieve the data quality requirements, the following quality-control parameters will be evaluated throughout the course of this project:

- Detection limits;
- Data precision;
- Data accuracy;
- Representativeness;
- Comparability and completeness.

These quality-assessment parameters are described in greater detail in the following paragraphs.

2.1 Detection Limits

The method detection limit for a given parameter is determined by procedures specified in the analytical method. Detection limits will be observed for all laboratory analyses performed during this project, except where matrix interferences and high concentrations of target and non-target compounds increase the reporting detection limits.

2.2 Precision

Precision will be determined for field duplicate samples by examining sample results for degree of variance and determining if sampling error has occurred.

Precision is a measure of agreement among individual measurements of the same parameter, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. The relative percent difference (RPD) parameter will be calculated to define the precision between duplicate analyses.

The RPD for each component is calculated using the following equation:

$$\%\,\mathrm{RPD} = \frac{(X_2 - X_1)}{[(X_1 + X_2)/2]} \times 100$$

where:

X_1 = first duplicate sample value

X_2 = second duplicate sample value

The laboratory objective for precision is to generate RPD values that fall within the established control limits for the method employed. The field objective for precision is to generate RPD values that are between 0 and 50 percent for soil samples and 0 to 30 percent for groundwater samples. If the criteria are not met, the data reviewer will examine other quality-control criteria to determine the need for some qualification of the data.

2.3 Accuracy

Accuracy is defined as the degree of agreement between a measurement and an accepted reference of true concentration. Accuracy is determined by spiking samples with a known concentration of standard compounds and comparing the analytical results with the known value. Data accuracy will be assessed by determining the percent recovery of a spiked compound. Percent recovery (%R) is determined by the equation:

$$\%R = \frac{(C_1 - C_0)}{C_S} \times 100$$

where:

C_1 = measured concentration in the spiked sample

Co = measured concentration in the unspiked sample

C_s = concentration at which the sample was spiked

The concentration at which the sample was spiked (C_s) is calculated, using the following equation:

$$C_S = \frac{(C_{spike} \times V_{spike})}{V_{sample} + V_{spike}}$$

where:

C_s = concentration at which the sample was spiked

C_{spike} = spike concentration

V_{spike} = volume of spike

V_{sample} = volume of sample

The laboratory objective for accuracy is to generate $\%R_s$ that fall within established control limits for the method employed.

Surrogate and matrix spiking compounds and sample selection for spiking are determined by current SW-846 methodologies. Percent recoveries indicate the actual performance of the analytical method on real world samples. Surrogate spikes, matrix spikes, matrix spike duplicates, and QC spikes will be conducted using standard laboratory methods.

2.4 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic population, a process control or an environmental condition. Appropriate sampling procedures will be implemented so that the samples are representative of the environmental matrices from which they were obtained.

2.5 Comparability and Completeness

Comparability is achieved through the use of the same analytical methods that were used previously, through use of trained personnel and through following procedures in this SAP. Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The completeness goal will be at least 90 percent.

3 Groundwater Sampling Procedures

This section describes standard procedures for collection of groundwater samples. Specific procedures included in project-specific work plans supercede the procedures presented in this section. Sampling scope (including locations and depths of samples) is defined in the Groundwater Compliance Monitoring Plan.

3.1 Water Level Measurement

Water level data are used to indicate the direction of groundwater flow and areas of recharge and discharge, to evaluate the effects of manmade and natural stresses on the groundwater system, to define the hydraulic characteristics of aquifers, and to evaluate stream-aquifer relations. Measurements of the static-water level are also needed to estimate the amount of water to be purged from a well prior to sample collection when purge volumes are based on well volumes, rather than stabilization of parameters (i.e., for samples collected by bailing, rather than using low flow techniques). Well volumes are calculated from the length of the water column and the well casing diameter.

When taking a series of fluid-level measurements at a number of monitoring wells, it is generally good practice to go in order from the least- to most-contaminated well. Additionally, the measurement of all site wells should be done consecutively and before any sampling activities begin. This will ensure the data are representative of aquifer conditions. All pertinent data will be entered in the fluid-level monitoring log sheet or the project field book.

3.1.1 Well Evaluation

Upon arrival at a monitoring well, the surface seal and well protective casing should be examined for any evidence of frost heaving, cracking or vandalism. All observations should be recorded in the fluid-level monitoring log or the project field book, and repairs scheduled as necessary.

3.1.2 Measuring Point Location

The measuring point location for the well should be clearly marked on the inner casing (PVC riser) or identified in previous sample collection records. This point is usually established on the well casing itself, but may be marked on the protective steel casing in some cases. In either case, it is important that the marked point coincide with the same point of measurement used by the surveyor. If not marked from previous investigations, the water level measuring point should be marked on the north side of the well casing and noted in the fluid-level monitoring log or the project field book. Monitoring well measurements for total depth and water level should be consistently measured from one reference point so that these data can be used for assessing trends in the groundwater.

3.1.3 Water Level Measurement

Water level measurements shall be made using an electronic or mechanical device. Many types of electrical instruments are available for water level measurement; most operate on the principle that a circuit is completed when two electrodes are immersed in water. Electrodes are generally contained in a weighted probe that keeps the tape taut while providing some shielding of the electrodes against false indications as the probe is being lowered into the well. Before lowering the probe in the well, the circuitry can be checked by dipping the probe in water and observing the indicator (a light, sound, and/or meter).

To obtain a water level measurement, slowly lower the decontaminated probe into the monitoring well until the indicator (light, sound, and/or meter) shows water contact. At this time the precise measurement should be determined by repeatedly raising and lowering the tape or cable to converge on the exact measurement.

Water level measurement should be entered in the fluid-level monitoring log or the project field book. The water level measurement device shall be decontaminated immediately after use following the procedures described in at the end of this section.

3.1.4 Measurement of Total Depth

During water level measurement, the total depth of the well may also be measured periodically. This measurement gives an indication of possible sediment buildup within the well that may significantly reduce the screened depth. If total depth is to be measured, the same methods used for measuring water levels (e.g., steel tape or electrical probes) may be used to measure the total well depth. The most convenient time to measure the total well depth is immediately following measurement of the water level and prior to removing the measurement device completely from the well. The measurement device (steel tape or electrical probe) is lowered down the well until the measurement tape becomes slack indicating the weighted end of the tape or probe has reached the bottom of the well. The total well depth shall be recorded in the field book.

Total depth will not be routinely measured in wells containing in-well, dedicated pumps. If sediment buildup is suspected, in-well equipment may be removed so that total depth can be measured.

3.2 Sample Collection Using a Bailer

3.2.1 Water Level Measurement

After unlocking and/or opening a monitoring well, the first task will be to obtain a water level measurement. A static water level will be measured in the well prior to the purging and collection of any samples. The water level is needed for estimating the purge volume and may also be used for mapping the potentiometric surface of the groundwater. Water level measurements will be made using an electronic or mechanical device following the methods described above.

3.2.2 Purging

Well purging is the activity of removing some volume of water from a monitoring well in order to induce "fresh" groundwater to flow into the well prior to sampling. Under most well construction and hydrogeologic conditions, this provides water that is more representative of the groundwater in saturated materials adjoining the well.

For wells that will be sampled using a bailer, the volume of water to be removed, referred to as the purge volume, is a function of the water yielding capacity of the well, the well diameter and depth. The depth to water should be measured just prior to purging. The purge volume should equal at least three well volumes when bailing.

According to the EPA, the well should be purged until measurements of turbidity, redox potential, and dissolved oxygen in in-line or down hole analyses have stabilized within about 10% over at least two measurements (EPA, 1992). During purging, pH, specific conductance and temperature will be monitored. Field parameter values will be entered on the groundwater sampling form along with the corresponding purge volume.

Purging generally will be performed for all groundwater monitoring wells prior to sample collection. Purge water is removed from the well using a bailer, using the bailing techniques described above. Purge water should be placed in appropriate storage containers pending disposal. After purging a groundwater sample may be collected.

3.2.3 Sample Collection

Obtain a clean decontaminated bailer and new, clean length of polypropylene rope or equivalent bailer cord. Tie a knot to secure the bailer cord to the bailer. Test the knot for effectiveness. Tie an additional knot, if necessary.

If bailer cord is from a spool, the sampler may lower the bailer to the bottom of the monitoring well, remove an additional five feet of cord from the spool and cut the cord at the spool.

Raise the bailer by grasping a section of cord using each hand alternately. This bailer lift method is used so that the bailer cord will not come into contact with the ground or other potentially contaminated surfaces.

Samples collected by bailing will be poured directly into sample containers from bailers that are full of fresh groundwater. Samples will be collected in the following order for those methods specified in the work plan:

- Volatile organic compounds;
- Semivolatile organic compounds;
- Pesticides/Herbicides/PCBs/Dioxins;
- Organic indicator compounds;
- Metals (total and/or dissolved);
- Miscellaneous inorganic compounds;
- Radiometric compounds; and
- Microbial analyses.

During sample collection, bailers will not be allowed to contact the sample containers.

3.3 Sample Collection Using Low Flow Methods

Groundwater withdrawal using pumps is commonly performed with centrifugal, peristaltic, submersible, or bladder pumps. Peristaltic and centrifugal pumps are limited to conditions where groundwater need only be raised through approximately 20 to 25 feet of vertical distance. Submersible or bladder pumps can be used when groundwater is greater than 25 feet below grade. Specific methods for pumps will be discussed in the project specific sampling plan.

3.3.1 Purging

Purging is required prior to sample collection when using low flow techniques, however, three well volumes are not required. Instead, purging is considered complete when consecutive measurements of turbidity, dissolved oxygen, oxidation-reduction potential, pH, specific conductance, and temperature are within 10 percent of the previous measurement, and when consecutive measurements of conductivity are within 3 percent.

3.3.2 Sample Collection

Samples may be collected using dedicated pumps or a single pump. If a single pump is used, new, clean tubing will be used at each well, and equipment that contacts water directly will be decontaminated as appropriate.

Upon stabilization of parameters, the purge rate is reduced to approximately 100-200 mL/min. Samples are collected from the discharge tube of the pump into appropriate sample containers. Samples collected for analysis of dissolved metals will be filtered in the field with a 0.45-micron filter prior to filling the sample container.

3.4 Quality Control of Groundwater Sample Collection

At least one duplicate sample shall be collected for every 10 investigation samples. Duplicate water samples will be collected by filling two containers (or sets of containers) simultaneously from the sampling device.

Trip blanks will be carried each day that more than one well is sampled for volatile constituents. The laboratory will prepare trip blanks by filling representative glassware with known deionized water. These samples will be transported with the sample collection glassware and analyzed for evidence of systematic contamination from sample transport, glassware cleaning and laboratory storage. Trip blanks will be shipped with each day's samples. If samples are hand-delivered, trip blanks will be submitted for analysis with each batch of samples delivered.

Field blanks and field duplicates will not be labeled as such on the sample labels or chain-or-custody forms, but they will be identified as such in the field notebook and on the sample logs. A summary of the QA samples to be collected is provided in Table 4-1.

Table 3-1 Summary of Quality-Assurance Samples for Water

Matrix	Parameter	Trip Blank	Field Duplicates	Matrix Spikes
Water	A	1 per shipment when samples require volatile analysis	1 per 10 samples	1 per 20

Notes:
A – The field duplicate and equipment blank will be analyzed for the same parameters as the investigative samples.

3.5 Documentation

Various documents will be completed and maintained as a part of groundwater sample collection. These documents will provide a summary of the sample collection procedures and conditions, shipment method, analyses requested, and the custody history. These documents may include:

- Field books;
- Groundwater sampling forms;
- Sample labels;
- Chain-of-custody forms; and

- Shipping receipts.

All documentation will be stored in the project files.

3.6 Decontamination

Decontamination is performed as a quality assurance measure and as a safety precaution. It prevents cross-contamination between samples and also helps maintain a clean working environment. Equipment requiring decontamination may include hand tools, monitoring and testing equipment, personal protective equipment, or heavy equipment (e.g., loaders, backhoes, drill rigs, etc.).

Decontamination is achieved mainly by rinsing with liquids that may include: soap and/or detergent solutions, tap water, distilled water and methanol. Equipment may be allowed to air dry after being cleaned or may be wiped dry with paper towels or chemical-free cloths.

All sampling equipment will be decontaminated prior to use and between each sample collection point. Waste products produced by the decontamination procedures such as rinse liquids, solids, rags, gloves, etc. will be collected and disposed of properly based on the nature of site impact and site protocols. Any materials and equipment that will be reused must be decontaminated or properly protected before being taken off-site.

Duplicate and equipment rinseate samples will be analyzed for the same constituents as the environmental samples.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

The following are decontamination procedures for sampling equipment:

1) Remove gross visible solids from the equipment by brushing and then rinse with tap water.

2) Wash with detergent or soap solution (e.g., Alconox® and tap water).

3) Rinse with tap or distilled water.

4) Repeat entire procedure or any parts of the procedure as necessary.

5) Rinse with distilled water.

6) After decontamination procedure is completed, avoid placing equipment directly on ground surface.

Downhole drilling equipment, such as augers, split spoons, Shelby tubes, and sandlines may also be decontaminated with pressurized hot water or steam wash, followed by a fresh water rinse. No additional decontamination procedures will be required if the equipment appears to be visually clean. If impacts are visible after hot water/steam cleaning, then a detergent wash solution with brushes (if necessary) will be used.

4 Sample Handling

4.1 Sample Handling

Analytical methods and requirements for water are summarized in Table 4-1. Some or all of these methods may be used in investigation work. Actual analytical methods will be specified in work plans. Groundwater samples will be analyzed for some or all of the following constituents:

- Volatiles (Benzene and PCE);
- Metals (arsenic, total and/or dissolved);
- Pesticides (DDT, Aldrin, Dieldrin, Beta BHC, Gamma BHC [Lindane]); and
- Petroleum Hydrocarbons (TPH-gas and TPH-diesel).

Table 4-1 Sample Handling and Preservation Requirements for Water

Parameter	Method	Container Water	Preservation	Holding Time
Pesticides	8081	2- 500 mL AG	Cool to 4° C	7 days
Gasoline	8015 (mod)	40 ml vial (2)*	Cool to 4° C & (b)	14 days (7 if unpreserved)
Diesel Extended	8015 (mod)	1 Liter AG	Cool to 4° C	7 days
Volatile Organic Compounds (VOCs)	8260	40 ml vial (3)*	Cool to 4° C & (b)	14 days (7 if unpreserved)
Metals	6010/7000 series	1 Liter HDPE	Cool to 4° C & 5 ml (f)+	6 months

Notes:

Container
WMG = wide mouth glass
HDPE = high-density polyurethane

Preservation
(b) HCl to pH<2
(f) 1:1 HNO_3

* No headspace
\+ Total/field filtered only

The laboratory will be instructed not to refilter samples submitted for arsenic analysis, and will further be instructed to include a digestion step prior to analysis, per Ecology's request.

4.2 Procedures

Chain-of-custody procedures are intended to document sample possession from the time of collection to disposal. Chain-of-custody procedures are detailed below.

All samples must be packaged so that they do not leak, break, vaporize or cause cross-contamination of other samples. Waste samples and environmental samples (e.g., groundwater, soil, etc.) should not be placed in the same container. Each individual sample must be properly labeled and identified. A chain-of-custody record must accompany each shipping container. When refrigeration is required for sample preservation, samples must be kept cool during the time between collection and final packaging.

All samples must be clearly identified immediately upon collection. Each sample bottle label will include the following information:

- Client or project name, or unique identifier, if confidential;
- A unique sample description;
- Sample collection date and time;
- Sampler's name or initials;
- Indication of filtering or addition of preservative, if applicable; and
- Analyses to be performed.

After collection, identification and preservation (if necessary), the samples will be maintained under chain-of-custody procedures as described below.

4.3 Chain of Custody

A sample is considered to be under custody if it is in one's possession, view, or in a designated secure area. Chain-of-custody forms must document transfers of sample custody. The chain-of-custody record will include, at a minimum, the following information:

- Client or project name, or unique identifier, if confidential;
- Sample collector's name;
- Company's (RETEC) mailing address and telephone number;
- Designated recipient of data (name and telephone number);
- Analytical laboratory's name and city;
- Description of each sample (i.e., unique identifier and matrix);
- Date and time of collection;
- Quantity of each sample or number of containers;
- Type of analysis required; and
- Date and method of shipment.

Additional information may include type of sample containers, shipping identification air bill numbers, etc.

When transferring custody, both the individual(s) relinquishing custody of samples and the individual(s) receiving custody of samples will sign, date, and note the time on the form. If samples are to leave the collector's possession for shipment to the laboratory, the subsequent packaging procedures will be followed.

4.3.1 Packing for Shipment

To prepare a cooler for shipment, the sample bottles will be inventoried and logged on the chain-of-custody form. At least one layer of protective material will be placed in the bottom of the container. As each sample bottle is logged on the chain-of-custody form, it should be wrapped with protective material (e.g., bubble wrap, matting, plastic gridding, or similar material) to prevent breakage. Each sample bottle should be placed upright in the shipping container. Each sample bottle cap should be checked during wrapping and tightened if needed. Avoid over tightening, which may cause bottle cap to crack and allow leakage. Additional packaging material such as bubble wrap or Styrofoam pellets should be spread throughout the voids between the sample bottles.

Most samples require refrigeration as a minimum preservative. If needed, reusable cold packs or ice placed in heavy-duty zip-lock type bags should be distributed over the top of the samples. Two or more cold packs or bags should be used. Additional packing material should then be placed to fill the balance of the cooler or container.

Place the original completed chain-of-custody record in a zip-lock type plastic bag and place the bag on the top of the contents within the cooler or shipping container. Alternatively, the bag may be taped to the underside of the container lid. Retain a copy of the chain-of-custody record with the field records.

Close the top or lid of the cooler or shipping container and rotate/shake the container to verify that the contents are packed so that they do not move. Add additional packaging if needed and reseal. Place signed and dated chain-of-custody seal at two different locations (front and back) on the cooler or container lid and overlap with transparent packaging tape. The chain-of-custody tape should be placed on the container in such a way that opening the container will destroy the tape. Packaging tape should encircle each end of the cooler at the hinges.

Sample shipment should be sent via courier or an overnight express service that can guarantee 24-hour delivery. Retain copies of all shipment records as provided by the shipper.

Chain-of-custody records will be maintained in an appropriate file with the Project Manager. Copies of these records will be submitted in an appendix to the final report. Chain-of-custody information will also be recorded in field notebooks.

4.4 Sample Log-In

Upon receipt of samples (which will be accompanied by a completed chain-of-custody record detailing requested analyses), the Laboratory Coordinator(s) or his/her delegate will:

- Verify all paperwork, chain-of-custody records, and similar documentation;
- Log-in samples, assign unique laboratory sample numbers, and attach the numbers to the sample container(s);
- Store samples in a refrigerated sample bank.

5 Calibration Procedures and Frequency

This section establishes the procedures for maintaining the accuracy of instruments and measuring equipment to conduct field measurements and tests.

5.1 Responsibilities

The field sampler is responsible for the calibration of field equipment following the equipment manufacturer's instructions for calibration. The responsibility for the calibration of laboratory equipment lies with the Laboratory Coordinator(s). For discussion of laboratory equipment calibration, see the laboratory QA manual.

5.2 General Calibration Procedures

Field-testing equipment used for analytical determinations falls into two categories: those calibrated prior to each use and those calibrated on a scheduled periodic basis. Frequency of calibration will be based on the type of equipment, inherent stability, manufacturer's recommendations, values given in national standards and the intended use and experience. Table 5-1 presents the calibration frequency of the field sampling equipment.

Table 5-1 Field Sampling Equipment Calibration Frequency

Instrument	Calibration Procedure	Calibration Frequency
pH meter	Two-point calibration with pH buffers 7 and 4, or 10, as appropriate	Daily
Conductivity meter	None	Not Applicable
DO meter	Two-point calibration	Daily
Redox meter	None	Not Applicable
Thermometer	Check with ohm meter or standard thermometer	Annually
Photoionization detector	Isobutylene gas standard;	Daily
Electric water level probe	Test probe in tap water; check tape against known length	Probe; as needed if malfunctions; tape length: annually
Turbidity Meter	3-point calibration	Daily

Equipment will be calibrated using reference standards (i.e., National Bureau of Standards (NBS) or accepted values of natural physical constants). If national standards do not exist, the basis for calibration will be documented in the daily field activity log. Field equipment calibration will be performed, as described by the equipment manufacturer.

Calibrated equipment will be uniquely identified by using the manufacturer's serial number or other means. A label with the identification number and the date when the next calibration is due will be physically attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference.

Scheduled periodic calibration of testing equipment will not relieve field personnel of the responsibility to verify that equipment is functioning properly. If an individual suspects an equipment malfunction, she/he will remove the device from service, tag it so that it is not inadvertently used, and see that recalibration is performed or substitute equipment is obtained. Instruments past due for calibration will be immediately removed from service either physically or, if this is impractical, by tagging, sealing, labeling, or other means.

5.3 Calibration Failures

Equipment that fails calibration or becomes inoperable during use will be removed from service, tagged to indicate that it is out of calibration and segregated to prevent inadvertent use. Such equipment will be repaired and recalibrated or replaced as appropriate.

The Project Engineer will evaluate results of activities performed using equipment that has failed recalibration. If the activity results are adversely affected, the results of the evaluation will be documented, and the appropriate personnel notified. If water level measurements are found to be in error due to recalibration failure of the water level probe, the appropriate modifications will be made to the measurement according to the recalibration data and recorded in the data logbook. If pH, conductivity or temperature meters fail recalibration, the data will be reviewed to determine whether alternate parameter data are sufficient to accept the groundwater sampling results. For instance, if the conductivity meter fails recalibration, pH and temperature readings will be used to verify that the purge water has stabilized. Since these parameters are calibrated prior to each use, it is unlikely that the data will be unacceptable.

5.4 Calibration Records

Calibration records will be maintained in daily field activity logs or on appropriate forms.

5.5 Maintenance

Each piece of equipment used in activities affecting data quality will be maintained according to specifications provided by the manufacturer. The Project Engineer will be responsible for performing routine maintenance and will have available tools and spare parts to conduct routine maintenance. If the equipment or instrument cannot be maintained to manufacturer's specifications or cannot be properly calibrated, it will be returned to the manufacturer or other repair facility for proper maintenance and repair. Once received back from the manufacturer, the instrument will be checked for compliance to project specifications before being returned to routine field use.

6 Analytical Procedures

The laboratories utilized for analysis of samples collected under the SAP shall perform all analysis according to EPA-accepted methods. Accepted EPA methods consist of those methods that are documented in the "Contract Lab Program Statement of Work for Organic Analysis" or any alternative method that has been approved by EPA for use during this project. The specific analytical methods to be used during the investigation will be specified in work plans. The analytical method procedures are detailed in the laboratory QA manual.

6.1 Analytical Laboratories

A laboratory accredited by Ecology will perform analysis on all water samples collected as described the Groundwater Compliance Monitoring Plan.

6.2 General Requirements

In general, the laboratory will adhere to those recommendations as promulgated in 21 CFR Part 58, "Good Laboratory Practices," criteria described in Methods for Chemical Analysis of Water and Wastes, 1979 (EPA-600/4-79-020); procedures described in SW-846 Test Methods for Evaluating Solid Waste-Physical/Chemical Methods, Third Edition, 1994; and those criteria presented in 40 CFR 136, "Guidelines Establishing Test Procedures for Analysis of Pollutants Under the Clean Water Act."

6.3 Analytical Data Review

The QA Officer will perform a review of the data received from the analytical laboratory to ensure that all of the project QC criteria have been met. Every component of the data package will be inspected. A series of QC forms will be supplied by the laboratory with the analytical data package and will be used as part of the data review process.

The results of all environmental sampling will be sent to the Data Validator for validation. A report containing the results of the validation will be submitted to the QA Officer.

7 Review and Reporting

Data quality and utility depends on many factors, including sampling methods, sample preparation, analytical methods, quality control and documentation. Physical and chemical data have been divided into five categories (EPA Region V Model Quality Assurance Project Plan, 1991), as follows:

- **Level V B Nonstandard Methods.** Analyses by nonstandard protocols, such as ultra-low detection limits or analysis of an unusual chemical compound. These analyses often require method modification and/or development. CLP (Contract Laboratory Program) Special Analytical Services (SAS) projects are considered Level V.

- **Level IV B CLP Routine Analytical Services (RAS).** This level is characterized by rigorous QA/QC protocols and documentation, and it provides qualitative and quantitative analytical data. Some EPA regions have obtained similar support via their own regional laboratories, university laboratories or other commercial laboratories.

- **Level III B Laboratory Analysis (using methods other than the CLP RAS).** This level is used primarily in support of engineering studies, using standard EPA-approved procedures. Some procedures may be equivalent to CLP RAS, without the CLP document requirements.

- **Level II B Field Analysis.** This level is characterized by the use of portable analytical instruments that can be used on-site or in mobile laboratories stationed near a site (close-support labs). Depending upon the types of impacts, sample matrix and personnel skills, qualitative and quantitative data can be obtained.

- **Level I B Field Screening.** This level is characterized by the use of portable instruments that can provide real-time data to assist in the optimization of sampling point locations and for health and safety support. The types of data included are those generated on site through the use of PID, pH, conductivity, or other real-time monitoring equipment. Data can be generated regarding the presence or absence of certain materials (especially volatiles) at sampling locations.

The data generated in this project will be prepared and reviewed for Level III validation. The laboratory will use EPA methods to identify analytical values that do not meet the required ranges for surrogate recoveries and matrix spike recoveries. If such values are identified, then the analysis must be repeated. If the re-analyzed values are within required limits and holding times, they will be reported as true values. If, in the repeated analysis, the values are still outside required limits, the data are considered to be invalid, and matrix effects are considered to have caused the values to be outside of the acceptable recovery limits.

7.1 Analytical Data

The laboratory will submit results that are supported by sufficient backup data and QA/QC results to enable the quality of the data to be determined conclusively. Prior to release of data, the laboratory coordinator(s) will: review the data package for reasonableness; review QC data results; verify that calculation checks were properly performed; review chain-of-custody record(s), sample preservation, and holding-time requirements; and write a project narrative. Data that are not acceptable will be held until the problems are resolved. This SAP describes the procedures that are employed to evaluate the precision, accuracy, representativeness, and completeness of the analytical test data generated during this project. It is the responsibility of the QA Officer to review these parameters. Validity of all data will be determined based on the criteria described in this SAP.

7.2 Final Reporting and Archiving of Documents

Upon successful completion of the data validation process, all data generated at the site will be tabulated and stored on computer disk. Data summaries and results will be submitted in final report form. This report will consist of all pertinent sample and project information. It will also identify analytical procedures.

Copies of all analytical data and/or final reports will be retained in the laboratory files, and at the discretion of the Laboratory Coordinator(s), the data will be stored on computer disks for a minimum of 1 year.

After one year, or whenever the data become inactive, the files will be transferred to archives in accordance with standard laboratory procedure. Data may be retrieved from archives upon request.

8 Data Management and Assessment

The data collected and validated as part of the project scope of work will be combined with the data already compiled for the facility. This section discusses the management of data generated as part the field effort.

8.1 Data Management

8.1.1 Reporting

After receipt of the analytical results, the QA Officer will review all raw data, including QA/QC data from the sample analyses.

Periodic reports will include a summary of data reduction results and a discussion of any inconsistencies that exist from a data-use standpoint. All field data sheets will be included as an appendix in the reports. All raw data will be appropriately identified in reports and included in a separate appendix of the report. Raw data will be submitted to Ecology following the schedule and format specified in the Consent Decree for this project.

8.1.2 Representativeness

The determination of the representativeness of the data will be performed by:

- Comparing actual sampling procedures to those delineated in this plan;
- Examining the results of QC blanks for evidence of external contamination or cross-contamination; such evidence may be cause for invalidations or qualification of the affected samples;
- Invalidating non-representative data or identifying data to be classified as questionable or qualitative. Only representative data will be used in subsequent data reduction, validation activities and facility characterization.

The analytical results of the equipment blank samples (cross-contamination) and trip blank samples (external contamination) will be compared to the results of the field samples to determine if the level of impact is significant. The rule of 5x will be used when chemicals are measured in a blank sample. This rule states that if a sample concentration is less than five times (5x) the blank, the sample should be qualified as non-detectable (EPA, 1988).

8.1.3 Data Review

The objective of the data review is to identify any qualitative, unreliable or invalid laboratory measurements. Data review entails a review of the laboratory-provided QC data to verify that the laboratory is properly performing the QC program and is operating within the required control limits. As a result, it will be possible to determine which samples, if any, are related to out-of-control laboratory QC samples. Laboratory data will be screened for inclusion of and frequency of the necessary QC supporting information, such as detection limit verification, duplicates, spikes and method blanks. QC supporting information will be screened to determine whether any data are outside established control limits. Any out-of-control data without appropriate corrective action will be cause to qualify the affected measurement data. Missing or infrequent QC information will be cause to contact the laboratory concerning affected measurement data and to request additional QC supporting information for re-analysis.

8.2 Data Assessment

8.2.1 Field Procedures

Quality control procedures for field instruments will be limited to periodic instrument calibration as described in Section 5.

8.2.2 Laboratory Procedures

Following the assessment of laboratory data for the inclusion of required QC data, the QC data will be analyzed for accuracy and precision. If quality control audits result in the detection of unacceptable data, the QA Officer will be responsible for initiating corrective action, which may include:

- Reanalyzing samples if holding-time criteria permit;
- Resampling and analyzing;
- Evaluating and amending sampling and analytical procedures; and
- Accepting data and acknowledging the level of uncertainty.

8.2.3 Accuracy

The accuracy of the data will be determined as follows:

- Computing percent recoveries for spiked samples;
- Calculating the standard deviation in the overall average recovery value; and
- Determining the range of uncertainty at a given level of confidence.

The accuracy of the data will be used to determine any bias in the analytical methods. The field sample results will not be adjusted for bias, but the bias will be considered in the interpretation of the data.

8.2.4 Precision

The determination of the precision of the data will be performed by examining duplicate samples for degree of variance and by determining if sampling error has occurred by the variance of duplicates. The precision values calculated from the field duplicates will be used in the data interpretations to determine how sensitive the site characterizations are to the variances in the data.

Specific precision targets cannot be formulated without baseline precision data. However, the precision data will be summarized into the following categories. For each compound or element, the number of field duplicates with variance in the following ranges will be evaluated:

- Less than 10 percent;
- 10 to 25 percent;
- 25 to 50 percent; and
- Greater than 50 percent.

This will provide qualitative information to the individuals interpreting the data as to the range of variances and will also allow the proper planning for QC samples in future sampling episodes.

8.3 Data Validation

After reviewing the laboratory analytical data, the QA officer will provide the Data Validator with the data and field notes from the applicable sampling activities. The Data Validator will compare the actual sampling and laboratory procedures to those explained in this plan, identify any questionable or qualitative data, and report the validation results to the QA Officer.

9 References

Ecology, 1991. *Guidance and Specifications for Preparing Quality Assurance Project Plans.* Washington State Department of Ecology.

Ecology, 1995. *Guidance on Sampling and Data Analysis Methods.* Washington State Department of Ecology Toxics Cleanup Program.

EPA, 1979. 21 CFR, Part 58. *Good Laboratory Practices*. In: Methods for Chemical Analysis of Water and Wastes. U.S. Environmental Protection Agency, EPA-600/4-79-020.

EPA, 1988. *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses.* U.S. Environmental Protection Agency, Region I.

EPA, 1991. *EPA Region V Model Quality Assurance Project Plan.* U.S. Environmental Protection Agency, Region V, Office of Superfund.

EPA, 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance.* U.S. Environmental Protection Agency, Office of Solid Waste.

EPA, 1994. *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods.* Third Edition. U.S. Environmental Protection Agency. SW-846.

Guidelines Establishing Test Procedures for Analysis of Pollutants Under the Clean Water Act. In: 40 CFR, Part 136.

Appendix H

Minor File Modification Form

Engineering Design Report (or other report name)
MINOR SITE MODIFICATION

Site: Yakima Valley Spray – INW
Modification Number:
Relevant EDR/SAP Section and Page Number:

Date:

Issue:
Describe problem resulting from current plan or document vs. field or other encountered conditions.

Recommended Resolution:

Resolution Approved by Ecology:

Requested by: ____________________ ____________________
RETEC or GeoEngineers personnel P.E. License No. and Seal

Approved by: ____________________
Dick Bassett
Site Manager
Department of Ecology

See other side for instructions regarding use of this form.

Instructions for Use

1. Use this form to document and obtain approval for approval for significant changes to the EDR or SAP. Significant changes constitute changes in remedial goals, sampling protocol, schedule, deviations from the Consent Decree (CD) or any issues that arise that are not resolved by agreement between PLP representatives and Ecology.

2. In the case of significant changes, described above, the form on the other side should be completed. The issue section should include a specific reference to the section of the CD, EDR or document that is in dispute. If the issue requires rapid resolution, the requestor may call Dick Bassett or his designated representative before completing and FAXing the form.

3. After the form is filled out and signed by the requestor, FAX the completed form to Dick Bassett at _______.

4. All completed forms should be copied in duplicate, with one copy remaining with the EDR/SAP and one copy sent to Dick Bassett.