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FINAL REPORT ON

CITY OF MOSES LAKE MAINTENANCE FACILITY

MOSES LAKE, WASHINGTON

REMEDIAL INVESTIGATION
FEASIBILITY STUDY

Submitted to:

City of Moses Lake, Washington

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1897
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EXECUTIVE SUMMARY

The City of Moses Lake entered into an Agreed Order (NO. 02-TCPER-4648) with the Washington State Department of Ecology (Ecology) to complete a Remedial Investigation/Feasibility Study (RI/FS) for chemical impacts at the City of Moses Lake Maintenance Facility (Site). The Site is located at 819 E Penn Street, Moses Lake, Washington. The Site is a designated Model Toxics Control Act (MTCA), Washington Administrative Code (WAC) 173-340 (Ecology, 2001a) listed site. The RI/FS has been conducted according to the MTCA cleanup regulations, specifically WAC 173-340 (Ecology, 2001a).

The purpose of the RI/FS is to collect, develop and evaluate sufficient information regarding the City of Moses Lake Maintenance Facility to determine the nature and extent of releases of hazardous substances to support the FS and identify a recommended cleanup action alternative under the MTCA cleanup regulation Chapter 173-340 WAC, specifically Sections WAC 173-340-360 through WAC 173-340-390.

The entire Site is situated on a 7.2-acre rectangular city block that is about 900 feet in an east-west direction by 350 feet in a north-south direction. The Site is the location of the City of Moses Lake Maintenance Facility and supports the City's Department of Water and Streets projects. The RI/FS focuses on the three areas of the maintenance facility:

- The East Portion of the Site, near the maintenance shop, which is the location of previous petroleum hydrocarbon soil and groundwater remediation activities associated with UST closures;
- The Central Portion of the Site where oil impacted soils were encountered during a 2002 geotechnical/environmental investigation (Golder, 2002); and
- The West Portion of the maintenance facility, formerly known as the Mansfield parcel that may have been impacted by potential historic releases of petroleum hydrocarbons or other chemicals.

The RI field work was conducted from March 27, 2003 through May 2, 2003, with supplemental investigations conducted on September 26, 2003 and December 9, 2003. During the RI field investigation samples were collected for chemical analysis from a total of 30 GeoProbe borings, four hollow stem auger borings, (which were completed as monitoring wells), two hand auger holes and six test pits. In addition, groundwater samples were collected and analyzed from ten Site monitoring wells and six GeoProbe locations. The information obtained through the RI was used to supplement existing Site information and previous environmental investigations.

The general groundwater flow direction is towards the northwest and follows the general surface topography. Based on aquifer slug testing, the groundwater flow velocity over the Central Portion of the Site is approximately 0.2 feet per day. The nearest down-gradient use of groundwater is approximately 0.4 miles from the Site and is not at risk of being impacted from contaminated Site soils.

The analytical results for soil and groundwater samples collected for the various sample locations during the RI were evaluated to assess the risk posed by the Site to human health and the environment. The assessment was conducted by evaluating the concentration of constituents of potential concern (COPC) with respect to various State and Federal regulatory soil, groundwater or surface water cleanup or quality criteria. Following an analysis of all relevant and applicable

(ARAR) regulations and laws, MTCA Method A and Method B cleanup levels for unrestricted use were selected to assess human health and environmental concerns related to soil issues. MTCA Method A and Method B cleanup levels for potable water were selected to assess human health related to groundwater and surface water potential exposures. To evaluate the risk associated with terrestrial wildlife, a simplified terrestrial ecological evaluation was conducted in accordance with WAC 173-340-7490 through WAC 173-340-7494. Chapter 173-201A 040 WAC surface water criteria and National Water Quality Criteria (EPA, 2002) for surface water were used to assess the potential off-site impacts to aquatic wetland habitat adjacent to the Site. Those constituents detected in soil or groundwater samples that exceed their respective cleanup or quality criteria were identified as constituents of concern (COCs).

The following summarizes the findings of the RI:

- The nature of the soil and groundwater impacts observed on Site above cleanup or quality criteria appear to be related to petroleum hydrocarbons releases.
- Diesel through lube oil range petroleum hydrocarbons are identified as a COCs for soil and groundwater on the East Portion of the Site. Free product was identified in a Site monitoring well (MW-11), the South end of the Maintenance Shop. The impacted soil and groundwater appear to be limited to a relatively small area nearby MW-11.
- Gasoline through lube oil range petroleum hydrocarbons, xylenes, and lead were identified as COCs for soil in the source area in the Central Portion of the Site. No COCs were identified for groundwater in the Central Portion of the Site.
- No COCs were identified for soil or groundwater on the West Portion of the Site.
- The RI data indicate that COCs have not migrated off-site and there is minimal potential for off-site impacts to occur in the future in association with the Site.
- The ecological risk (to wildlife) under the industrial site scenario is minimal, as bird and small mammal use of the area is minimized by the industrial characteristics of the Site, including the compacted nature of the asphalt or compact soil and gravel covering the sub-surface soil, the lack of plant cover in the area, and the general industrial activity of human and vehicle traffic and noise.

The remedial action objectives (RAOs) were identified for the Site. RAOs are essentially site-specific goals based on acceptable exposure levels that are protective of human health and the environment. RAOs combine consideration of applicable or relevant and appropriate requirements (ARARs) and the specific constituents, affected media, and potential exposure pathways of the site.

Considering the information collected in the RI, the potential risk of identified COCs, and potential migration pathways of materials disposed at the site, the remedial action objectives for this site are identified as:

- Reducing the potential for exposure of human or ecological receptors to petroleum products at the Site via direct contact with contaminated soils or exposure to potentially hazardous constituents in groundwater; and
- Reducing the potential for migration of petroleum from soil to groundwater.

Cleanup goals were identified for Site COCs, including gasoline through lube oil petroleum hydrocarbons xylenes and lead for Site soils and diesel through lube oil range petroleum hydrocarbons for groundwater. Cleanup goals are numeric expressions of RAOs. Cleanup goals are generally established for COCs as the lower of a numeric chemical-specific ARAR or a risk-based cleanup concentration. Cleanup goals are presented as preliminary in the FS because the final remediation goals, or cleanup levels, are set in the Cleanup Action Plan (CAP).

Cleanup goals for remedial action involving soil excavation are set at the appropriate MTCA Method A or Method B concentrations of ecological concern criteria for Site COCs. Similarly the cleanup goals for groundwater at MW-11 will be set as the appropriate MTCA Method A for Site COCs. These cleanup goals are established for the list of analytes found to exceed their respective MTCA Method A or Method B cleanup criteria or terrestrial ecological evaluation concern criteria and are protective by multiple pathways and for multiple hazardous substances according to WAC 173-340-708 (5).

Based on the RAO and cleanup goals, potential remediation technologies that may be used in association with Site remediation were identified. The candidate technologies were screened based on Site characteristics and RI data to obtain a list of technologies feasible for use in assembling remediation alternatives. The remediation technologies retained through the screening process were incorporated into the following remediation alternatives.

Alternative 1: No Action
Alternative 2 Institutional Control and Monitoring
Alternative 3: Capping - Monitoring and Institutional Controls
Alternative 4: Excavation and Off-Site Landfill
Alternative 5: Excavation and On-Site Treatment
Alternative 6: Excavation and Off-Site Treatment

Alternative 1 (No Action) was included as a baseline. A preliminary evaluation was conducted in accordance with WAC 173-340-350(8)(b), which resulted in eliminating Alternative 1 (No Action) and Alternative 2 (Institutional Control and Monitoring) from further evaluation, because neither alternative meets the threshold requirements for this Site under WAC-173-340-360 (2)(a). Using a comparative methodology, Alternatives 3 through 6 were evaluated for protectiveness, permanence, effectiveness over the long-term, management of short term risk, technical and administrative implementability, public concern and determining whether the alternative uses permanent solutions to the maximum extent practicable to determine a comparative net benefit for each alternative. The cost benefit for each alternative was then calculated for the four remaining alternatives. The net benefit and cost benefit were compared for each alternative. Alternative 4 (Excavation and Off-Site Landfill) had the highest degree of both net benefit and cost benefit and is therefore the recommended remediation alternative.

Alternative 4 (Excavation and Off-Site Landfill) would protect human health and the environment by locating, excavating and removing affected soil from the contaminated area for off-site landfill disposal. This alternative would involve excavation to achieve remediation goals and cleanup levels established in the CAP. Removal of COC to the cleanup goals identified would require excavating soil in the Central Portion of the Site and near MW-11. Transporting impacted soils to a landfill would require importing replacement fill materials for backfill. The source of groundwater impacts at MW-11 will be removed by excavation and the groundwater subsequently tested.

TABLE OF CONTENTS

VOLUME I

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

VOLUME II

1.0 INTRODUCTION

The City of Moses Lake entered into an Agreed Order (NO. 02-TCPER-4648) with the Washington State Department of Ecology (Ecology) to complete a Remedial Investigation/Feasibility Study (RI/FS) for chemical impacts at the City of Moses Lake Maintenance Facility (Site). The Site is located at 819 E Penn Street, Moses Lake, Washington (Figure 1-1) and bounded by Block Street and Wheeler Road on the west and south, respectively, and an unnamed gravel road bounds the Site to the east (See Figure 1-2). Figure 1-3 provides a schematic of the Site and surrounding area. This report documents the results of the RI and presents FS as required under the Agreed Order.

1.1 Statement of Purpose

The Site is a designated Model Toxics Control Act (MTCA), Washington Administrative Code (WAC) 173-340 (Ecology, 2001a) listed site. The RI/FS has been conducted according to the MTCA cleanup regulations, specifically WAC 173-340 (Ecology, 2001a).

The purpose of the RI/FS is to collect, develop and evaluate sufficient information regarding the City of Moses Lake Maintenance Facility to determine the nature and extent of releases of hazardous substances to support the FS and identify a recommended cleanup action alternative under the MTCA cleanup regulation Chapter 173-340 of the Washington State Administrative Code (WAC) Sections WAC 173-340-360 through WAC 173-340-390. Hazardous substances are defined by Revised Code of Washington (RCW) 70.105D.020 (5).

The RI provides a list of constituents of concern (COCs) for the site, the nature and extent of contamination, a conceptual site model for exposure, and risk-based remedial action objectives that are protective of human health and the environment. Information and data collected during the RI supplements the existing Site information and facilitates completion of the RI/FS.

The FS provides a comprehensive evaluation of likely remediation alternatives and selects one that provides the most practical and achievable results for the City's Maintenance Facility.

1.2 Statement of Objectives

The overall objective of the RI is to clearly establish the nature, and vertical and lateral extent of chemical impacts to Site soil and groundwater, and to develop a conceptual site model for exposure that identifies any potential human health or environmental risks associated with the Site. Completion of the RI will provide the necessary data to support the FS, and evaluate applicable remedial alternatives for the Site to support the recommendation of a remedy that meets all regulatory requirements and will protect human health and the environment.

The objectives of the remedial investigation as identified in the Agreed Order include:

1. An assessment of historical uses and operations at the Site and surrounding area;
2. A comprehensive evaluation of previous investigations and remediation conducted at the Site;
3. A classification of soil types and characteristics at the Site and the discussion of the Site geology and hydrogeology;
4. An evaluation of groundwater use in the area near the Site;
5. An update of the known extent of chemical/petroleum impacted soils at the Site;

6. Installation of appropriately located monitoring wells;
7. Testing of soils and groundwater for petroleum and other potential hazardous substances used/disposed at the Site, if any;
8. Verification sampling around removed/abandoned underground storage tanks (USTs) and previous remediation areas as required by Ecology;
9. A simplified ecological evaluation of the Site and potential impact on adjacent habitat areas; and
10. A survey of the Site and groundwater-monitoring wells installed to determine the groundwater gradient at the Site.

The FS was conducted according to the MTCA cleanup regulations, specifically WAC 173-340-350 through 360 and the Agreed Order.

The objective of the FS is to provide the following:

1. A comprehensive evaluation of likely remediation alternatives; and
2. Presents the recommended remedial alternative that provides the most practical and achievable results for the City of Moses Lake Maintenance Facility.

The remedy recommended in the FS is protective of human health and the environment, effective, achievable in a practical manner and will be able to be implemented within a reasonable time frame.

1.3 RI/FS Approach

Work for the RI/FS was conducted in accordance with Ecology's Agreed Order with the City of Moses Lake, Washington, No. 02-TCPER 4684 and the Remedial Investigation/Feasibility Study Work Plan for the City of Moses Lake Maintenance Facility, Moses Lake, Washington Revision II (Golder, 2003). The RI/FS focuses on the three areas of the maintenance facility, which are included in the following list. A plan of the Site is presented as Figure 1-2.

- The East Portion of the Site, in the vicinity of the maintenance shop, which is the location of previous petroleum hydrocarbon soil and groundwater remediation activities associated with UST closures;
- The Central Portion of the Site where oil impacted soils were encountered during a 2002 geotechnical/environmental investigation (Golder, 2002); and
- The West Portion of the maintenance facility, formerly known as the Mansfield parcel that may have been impacted by potential historic releases of petroleum hydrocarbons or other chemicals.

The RI was conducted to meet the requirements of WAC 173-340-350 and those outlined in Exhibit B of the Agreed Order and include the following elements:

- Site Characterization – provides a characterization of the regional and site-specific geology, hydrogeology and Site soils;

- Source and Contamination Characterization – provides a list of chemicals of concern, identifies the nature and extent of impacted Site soil and groundwater sufficient to support the FS; and,
- Potential Receptors Information – develops a conceptual site model that identifies human and ecological populations that may be in contact with contaminants and potential routes of exposure for those populations; and estimate the current risks to humans and the environment.

The RI it was conducted in a phased approach to achieve the stated purpose and objectives. The overall RI/FS approach was developed to be comprehensive yet streamlined. Prior to conducting the initial phases of the RI, a significant amount of knowledge about the Site existed from previous investigations and the approach accounted for that information. The RI/FS extended the base of Site knowledge by meeting the objectives stated in Section 1.2. The first RI/FS activities involved reviewing background information and existing information associated with previous investigations to identify data gaps. The review was used to develop a list of potential chemicals of concern for the RI. Based on the list, the nature of chemical impacts was characterized prior to delineating its horizontal and vertical extent.

A preliminary evaluation of the potential applicable or relevant and appropriate regulations (ARARs) for the list of potential chemicals of concern was conducted in association with development of the Quality Assurance Project Plan (QAPP) for this RI/FS work plan. The preliminary ARAR evaluation was used to determine the appropriate method of analysis and detection limits for the list of potential chemicals of concern in anticipation of the eventual needs of the FS.

The data generated by the RI scope of work presented in Section 4.0 of the work plan was reviewed to ensure the FS could be completed and a remedy identified that would provide protection of human health and the environment. A supplemental investigation was conducted as data generated during the initial phase of the RI was insufficient to support completion of the FS. The FS evaluates likely remediation alternatives and recommends a selected remedial alternative that is protective of human health and the environment and provides the most practical and achievable results for the Site. The proposed remedy is based on the nature and extent of the affects to the Site soil and groundwater.

1.4 RI/FS Organization

We have structured this RI/FS report to facilitate a clear understanding of all the elements conducted. It is organized as follows:

1.4.1 Remediation Investigation

- Section 1 – Introduction, this section
- Section 2 – Location and Site History
- Section 3 – Physical Setting
- Section 4 – Soil and Groundwater Sampling Method
- Section 5 – Nature and Extent of Chemical Constituents Exceeding Regulatory Criteria
- Section 6 – Potential Applicable Relevant and Appropriate Requirements (ARARs)
- Section 7 – Remedial Action Objectives

1.4.2 Feasibility Study

- Section 8 – Identification and Screening of Remedial Technologies
- Section 9 – Development of Alternatives
- Section 10 – Evaluation of Alternatives
- Section 11 – References

2.0 LOCATION AND SITE HISTORY

The following sections describe the City of Moses Lake Maintenance Facility, surrounding area and the history of operations at the Site. Figure 1-1 shows the location of the Site. Figure 1-2 illustrates the Site's features. Figure 1-3 presents a schematic of the properties and land use in the vicinity of the Site, Figure 1-3a presents a schematic of Figure 1-3 overlaid on an aerial photograph to provide additional detail of the Site and surrounding area. Site photographs are provided in Appendix D.

2.1 Site Location

The Site is located within the City block north of Wheeler Road, south of Penn Street and east of Block Street (Figure 1-2) in Moses Lake, Grant County, Washington. The address for the facility is 819 East Penn Street. The Site is in the SW quarter of the SE quarter of Section 14, Township 19 North, Range 28 East, Willamette Meridian.

The legal descriptions for the Site are described as follows:

- **East Portion:** Lot 1 of Municipal Tract #2, Grant County Assessor's parcel number 11-0480-000.
- **Central Portion:** Tax #3678, Grant County Assessor's parcel number 11-0309-000.
- **West Portion:** Lot 5 Commercial Plat, Grant County Assessor's parcel number 09-1184-000 and Lot 6 Commercial Plat, Grant County Assessor's parcel number 09-1185-000.

Grant County Assessor's parcel number 11-0480-000 incorporates the established 4.7-acre Moses Lake Maintenance Facility. Grant County Assessor's parcel number 11-0309-000 includes a strip of land in the Central Portion of the site to the west of the established maintenance facility area. Grant County Assessor's parcel numbers 09-1184-000 and 09-1185-000 include the land east of Block Street. Figure 1-2 shows the approximate boundaries of the East, Central and West Portions of the Property.

2.2 Site Description

The entire Site is situated on a 7.2-acre rectangular city block, about 900 feet in an east-west direction by 350 feet in a north-south direction (Figure 1-2). A chain-link fence has been constructed around the perimeter of the Site.

The current established portion of the maintenance facility is on the eastern 4.7-acre portion of the property (580 feet in an east-west direction by 350 feet in a north-south direction). The established portion of the facility purchased in 2001 is separated from the property to the west by a chain-link fence that runs north-south. Buildings on the eastern 4.7-acre portion of the property (Figure 1-2) include:

- A maintenance shop on the east side of the property
- A Cascade Natural Gas building on the southeast corner of the property
- A parks department shop building to the south of the maintenance shop
- A secure chemical storage area to the south of the maintenance shop
- An office building and asphalt parking area on the north central portion of the property

In addition, there is a material stockpile area (including pieces of pipe, fencing, small storage sheds, sand and bricks) and a concrete wash area in the center of the facility, storage of tires, paint, toluene and oil drums along the fence line on the West Portion of the facility and a large gravel stockpile on the southwest portion of the facility (Figure 1-2). The ground surface east of the maintenance shop and the parking areas north and south of the office building are covered with asphalt. The remainder of the ground is bare sand and gravel.

The Site area west of the established maintenance facility was purchased by the City in 2001 and covers 2.5 acres (320 feet in an east-west direction by 350 feet in a north-south direction). All but the northeast and southwest corners of the area are surfaced with asphalt. Buildings on the West Portion of the property (Figure 1-2) include:

- Three warehouse buildings located on the southwest, northwest and south sides of the property.
- An office and shop building, previously occupied by Northwest Irrigation on the northeast side of the (West Portion) property.

2.3 Description of Adjacent Properties

A schematic showing the land use in the vicinity of the Site is presented in Figures 1-3 and 1-3a.

The Site is bounded on the north by Penn Street. The land immediately north of Penn Street and the existing maintenance facility is owned by the City of Moses Lake and had been filled for a distance of about 100 feet north of Penn Street to form a level gravel surfaced area now used for parking vehicles. The land north of the fill area is undeveloped. The land north of Penn Street and the West Portion of the Site comprises commercial and light industrial buildings including automobile repair and storage facilities.

The Site is bounded on the east by a gravel road running north-south between Wheeler Road and Penn Street. A loading bay and office is east of this gravel road.

The Site is bounded on the south by Wheeler Road, a busy road that connects the eastern side of the City to the downtown area. The East Columbia Basin Irrigation Project facility and the Samaritan Hospital are south of Wheeler Road and the existing maintenance facility. A strip mall including a Safeway store and parking lot is on the land to the southwest of the Site. Low-lying undeveloped wetlands are south of Wheeler Road between the hospital and the strip mall. Additional wetlands are north of the parking area on Penn Street.

The west of the Site is bounded by Block Street. Commercial and light industrial buildings including automobile repair and storage facilities are on the west side of Block Street.

2.4 Site History

The City of Moses Lake has owned and operated the established maintenance facility on the eastern 4.7-acre portion of the Site since the 1950s. Current activities at the maintenance facility include:

- Repair of vehicles and equipment within the maintenance shop building;
- Washing of vehicles and equipment in the wash bay on the south side of the maintenance shop building and in the sweeper pit in the Central Portion of the facility;

- Gravel storage;
- Storage of pesticides and herbicides for roadway maintenance; and,
- Small quantity storage of materials (pieces of pipe, fencing, small storage sheds, sand, bricks, tires, paints, solvents, lubricants, antifreeze, empty drums).

Gasoline and diesel fueling of vehicles occurred at the Site prior to 1992. In 1992, gasoline and diesel storage tanks were removed from the Site. Since 1992, all vehicles have been fueled off site.

Based on discussions with City personnel, prior to development of the maintenance facility, there was a shallow drainage channel that ran approximately north-south between the established maintenance facility property and the newly purchased property to the west. During development of the established maintenance facility, 55-gallon drums and other waste materials were removed from the old drainage channel prior to the channel being in filled and graded. Impacted soils were not removed at this time. City personnel also indicated that waste oil was disposed at the Site in this vicinity. City personnel were not aware of the disposal of any other waste products, but could not rule out the possibility that other products associated with the maintenance shop, such as degreasing solvents, transmission fluid, mineral oils and gasoline, may have been disposed of in this area.

City personnel also indicated that an unlined sweeper pit was previously located in the vicinity of the existing concrete lined sweeper pit. The unlined pit was constructed of drain rock infilling an unlined excavation. Vehicles to be cleaned were driven on to the drain rock and washed. Wash water infiltrated into the drain rock and into the ground beneath the pit. This sweeper pit was replaced with the concrete lined sweeper pit in the mid 1990s.

One 500-gallon diesel underground storage tank (UST), one 1,000-gallon diesel UST, one 6000-gallon regular gasoline UST, one 8,000-gallon unleaded gasoline UST, one 500-gallon used oil UST and one unknown capacity (less than 6,000 gallons) regular gasoline UST were previously located at the maintenance facility. The approximate locations of these USTs are shown on Figure 2-1. A summary of the USTs is presented in Table 2-1. Between 1970 and 1992, all of the USTs were decommissioned and removed (see Section 2.5). Currently, only a 500-gallon waste oil above ground storage tank and several 55 gallon drums of motor oil are maintained on-site. The 500- gallon tank is approved by the manufacturer for waste oil. The Waste oil tank is located on a concrete dock in the shop and the 55-gallon drums are stored in the maintenance shop on a concrete surface.

According to City personnel, activities on the western 2.5-acre portion of the Site have included metal fabrication and welding and a short-term janitorial service.

The Site has poor drainage characteristics. Drainage was improved over the established maintenance facility area and over the portion of the property to the west by installation of perforated pipe bedded in drain rock. Although plans showing the location of the piping system were not available, the City believes that the drainage system over the established maintenance facility area flows into the storm drain that runs north on the west side of the Site (Figure 2-1). Based on communication between City personnel and the previous owner of the West Portion of the property, perforated pipe bedded in drain rock was also used to drain this part of the Site. This system drains into a catch basin with an open grill (Figure 2-1) that is believed to drain northward into the storm sewer. Figure 2-1 also provides the location of the Site underground utilities.

2.4.1 Prior Owners

The City of Moses Lake purchased the original property from Grant County in 1955. The City has owned and operated the maintenance facility on the eastern 4.7-acre portion of the Site since the 1950s. City records indicate that utilities were installed to the property in 1956 and the County issued the first building permit for the property in 1957. Although there are no direct records establishing it, it is accepted that the East and Central Portion of the subject property were undeveloped prior to 1956.

The western 2.5-acre portion of the Site was purchased by the City of Moses Lake from Busby International, Inc. (Busby) of Moses Lake in September 2001. According to the Grant County parcel database and communication with City personnel, Busby purchased Commercial Plat Lots 5 and 6 (Grant County Assessor's parcel numbers 09-1184-000 and 09-1185-000, respectively) from Meco, Inc. in 1995. Meco owned the property from about 1964 to 1995. Both Busby and Meco were fabricating/welding companies. Busby continues to operate in the Moses Lake area. Meco is no longer in business. According to City personnel, prior to 1964 the property was used by a company called Grant County Tractor as a tractor sales and repair facility. Busby also purchased Grant County Assessor's parcel number 11-0309-000 in the Central Portion of the property (the land between the municipal and commercial plats) in 1994. Prior to this the land was owned by Mr. Sid Eland. Based on communication with City personnel, Mr. Eland ran a metal fabrication business on the property.

2.5 Previous Environmental Investigations

The following paragraphs summarize the environmental investigations that are recorded for the established maintenance facility on the eastern 4.7-acre portion of the Site. Figure 2-2 presents the locations of the test pits and monitoring wells associated with these previous investigations. Table 2-1 presents a summary of the USTs that were previously located at the Site.

The regular gasoline UST of unknown capacity was removed at the maintenance facility in the early 1970s (Groundwater Technology, 1994). During removal of the tank, leaks were noted. Remedial action and cleanup is reported to have occurred but no written records have been found.

In 1986 petroleum impacted soils were noted during replacement of the 500-gallon diesel UST with the 1,000-gallon diesel UST (Century West Engineering Corporation, 1992). Remedial action is reported to have occurred but no written records have been found.

In 1990, the City collected a soil sample from a test pit dug in the vicinity of the former 500-gallon diesel UST. Analyses indicated TPH concentrations in the soil greater than the 200 part per million (ppm) 1990 MTCA Method A Cleanup Levels. In September 1990, the City notified Ecology of a petroleum hydrocarbon release at the Site.

In March 1992, the City contracted Century West Engineering Corporation (Century West) to complete a remedial investigation on the East Portion of the Site. The investigation involved digging eight test pits, (designated CW-TP-1 through -8) and installing four groundwater monitoring wells (designated MW-01, MW-02, MW-03 and MW-04). The location of the monitoring wells is presented on Figure 2-2. Construction details for the monitoring wells are summarized on Table 2-2. The soil samples collected during the investigation were analyzed for hydrocarbon identification (HCID) and total petroleum hydrocarbons (TPH). The groundwater samples were analyzed for benzene, toluene, ethyl benzene and xylenes (BTEX), hydrocarbon identification (HCID) and TPH. Soil samples collected from CW-TP-1 and CW-TP-2 (Figure 2-2) indicated TPH levels between 2,100 to 24,000 ppm at depths of 2 and 4 feet below ground surface (bgs). The source of the petroleum hydrocarbons were reported as parked vehicles for the CW-TP-1 sample and the former 500-gallon diesel UST for the CW-TP-2 sample. HCID analyses indicated no detectable petroleum hydrocarbons were present in groundwater. Therefore, BTEX analysis was not conducted on the groundwater samples. The study recommended excavating the impacted soils and removing the soils to an off-site location for treatment or disposal.

In November 1992, the City contracted Royal Excavation, Inc. (REI) and Sage Earth Sciences, Inc. (Sage) to remove the 6,000-gallon regular gasoline UST, the 8,000-gallon unleaded gasoline UST, the 1,000-gallon diesel UST and the 500-gallon used oil UST (Sage, 1993). The approximate locations of these tanks are shown in Figures 2-1 and 2-2. About 425 cubic yards of gasoline impacted soils were removed from the excavations around the two gasoline tanks. In addition, aged petroleum, diesel and oil impacted soils were found in the diesel tank excavation and oil impacted soils were found in the waste oil tank excavation. Eight test pits were subsequently dug around the maintenance shop area (Figure 2-2). Soil and groundwater sampled from the test pits indicated aged gasoline and lead in the soil and groundwater extending northwest from the maintenance shop. A water sample collected from a storm sewer manhole northeast of the property contained aged gasoline, oil and lead. In addition, petroleum odors were noted in the stormwater discharge to a tributary of the Milwaukee drain, north of Penn Street.

In February 1993, the impacted soils in the vicinity of the waste oil tank were excavated. Soil sampling indicated that impacted soils were removed (City of Moses Lake, 1993).

In 1993 and 1994, the City contracted Groundwater Technology, Inc. (Groundwater Technology, 1994) to complete a Remedial Investigation/Feasibility Study (RI/FS) to characterize Site conditions and obtain Site information to support a feasibility study of remedial alternatives associated with the petroleum impacted soils and groundwater found during the 1992 decommissioning of the USTs. The specific areas of concern investigated during the RI were operations associated with: former UST storage of gasoline, diesel and waste oil; vehicle parking on the property; and, a stormwater / groundwater collection system that discharges to a tributary of the Milwaukee drain, north of Penn Street. Eighteen soil borings were drilled and 10 groundwater monitoring wells (MW-05 though MW-14) were installed (Figure 2-2). Construction details for the monitoring wells (MW-05 though MW-14) are summarized in Table 2-2. Soils and groundwater analyzed indicated two areas of impacted soil and one plume of impacted groundwater:

- Diesel contaminated soils were encountered beneath the southwest portion of the maintenance shop;
- Gasoline contaminated soils were encountered beneath the northern portion of the maintenance shop and northwest of the maintenance shop; and,
- A 150-200 ft plume of gasoline-impacted groundwater less than 50 feet wide was encountered from the Site of the former gasoline USTs in a northwesterly direction to MW-08 about 90 feet north of the office building on Penn Street (Figure 2-2).

A remediation system comprising soil venting, air sparging system and in-situ bioremediation was recommended to remediate the Site. In summer 1994, the soil and groundwater remediation system recommended by Groundwater Technology (1994) was installed. After four years of intermittent operation and monitoring, it was determined that the contaminants had been lowered to below action levels and in April 1997 the system was shut down (Ecology, 2002).

In June 1995, during excavation of the sweeper pit, petroleum contaminated soil and waste oil filters were encountered. The contaminated soils and filters were removed (Ecology, 2002).

In late 2001, the City purchased the property west of the maintenance facility and east of Block Street. In February 2002, 10 test pits (Figure 2-2), designated as GA-TP-1 through -10, were excavated to support future development of the maintenance facility on the newly purchased land to the west (Golder, 2002). Diesel and heavy oil impacted soils containing levels exceeding the 2,000 ppm MTCA Method A Cleanup level for unrestricted land use were encountered in two test pits (GA-TP-10 and GA-TP-9) located in the center of the Site (See Figure 2-2). Although groundwater was not analyzed, visual observations made in the test pits indicated that groundwater was potentially impacted.

City personnel said they are unaware of any previous environmental investigations associated with the western 2.5-acre portion of the Site.

3.0 PHYSICAL SETTING

3.1 Topography

The Site is located on a west-facing slope just east of a low basin area occupied by the northern tip of Pelican Horn. The northern tip of Pelican Horn is about 2,000 feet southwest of the Site. Parker Horn is 2,500 feet northwest of the Site. The regional topography slopes gently west-northwest towards Parker Horn (Figure 1-1).

Site elevation ranges from approximately 1,100 feet at the southeast corner of the Site to about 1,055 feet along the west property line (Figure 3-1). The slope of ground surface on the Site ranges from 0 to 30 percent. The Site topography is generally flat in the Western Portion of the Site rising toward the eastern third of the property in the area of the existing operations and maintenance shop. There is an existing fill slope up to 10 feet high along Wheeler Road at the south property line.

3.2 Soils

The Site is located within two soil mapping units (USDA, 1984): Ephrata fine sandy loam, 0 to 2 percent slopes across the West Portion of the Site; and, Wiehl fine sandy loam, 15 to 35 percent slopes across the northeastern portion of the Site. Field observations (Sage, 1993) indicated that the soils comprise medium brown to dark brown sandy silt with silty sand. The upper one-foot is commonly blocky due to frost and/or partial cementation (Sage, 1993).

Century West (1992) reported that the Site soils more closely matched the Endicott series, soil inclusions that are not designated as a definable mapping unit. The Endicott series are described as grayish brown silt loams about 7 inches thick overlying 30 inches of brown silt loam. The subsoil is a white silt loam about 25 inches thick. At depths of approximately 60 inches bgs there is a hardpan that is cemented with lime and silica.

3.3 Geology

This section describes the regional geologic setting followed by site-specific geology encountered during subsurface investigations at the Site.

3.3.1 Regional Geology

The Site is located within the central portion of the Columbia Plateau. The geology of the Columbia Plateau comprises basalt flows overlain in places by sedimentary overburden. In Moses Lake, the sedimentary overburden comprises Pliocene sediments of the Ringold Formation overlain by varying thicknesses of late Pleistocene Missoula Flood deposits, which are in turn overlain by younger dune sand deposits.

3.3.2 Site Geology

The Site is about 2,000 feet northeast of the northern tip of Pelican Horn. The geologic map of Washington, southeast quadrant (Schuster et. al, 1997), indicates that the Site is on a narrow strip of Ringold Formation sediments bounded to the east and west by Missoula outburst flood deposits. Due to the proximity of the Site to Pelican Horn, it is likely that recent fine grained lacustrine/wetland type deposits overlie the Ringold and Missoula Flood deposits in this area. Schuster et. al. (1997) describe the Ringold Formation sediments in this area as interbedded fluvial and lacustrine sand, silt and clay beds with local pebble lenses containing indurated calcium carbonate or siliceous layers (also known as caliche). Schuster et. al (1997) describes the Missoula Flood deposits in this area as fluvial gravels with minor silts and clays and subordinate Ringold Formation sediments and caliche.

3.3.3 Groundwater Technology Investigation - 1993

Based on the RI work completed at the Site in 1993 (Groundwater Technology, 1994), the geology over the eastern part of the Site (in the vicinity of the maintenance shop and office building) comprises:

- 0 - 2 feet bgs: silty sand with gravel.
- 2 - 9 to 14 feet bgs: fine grained sand with up to 25% silt and clay with the silt/clay fraction increasing from southeast to northwest.
- 9 to 14 – 18 feet bgs: partially cemented fine sand, silt and clay.
- 18 - 22 feet bgs: silt and clay.

Sage (1993) noted that calcium carbonate cemented sandy silts and silty sands occur approximately one foot above the groundwater surface and extend downward to the bottom of all test pit excavations.

3.3.4 Golder Investigation, 2002

Geologic units encountered during Golder's 2002 geotechnical test pit exploration program are summarized below. The locations of the test pits are shown in Figure 2-2 and the test pit logs are included in Appendix A with the RI field logs.

- **Fill** – Fill was encountered in all the test pits extending to depths of between about 1 and 7 feet bgs (below ground surface). Fill soils generally consist of a varied mixture of loose to dense silt, sand and gravel with variable amounts of cobbles and boulders, and a trace of organics (roots, branches, and wood debris), asphalt, and concrete debris. Golder test pits GA-TP-1, GA-TP-4, GA-TP-5, GA-TP-6, and GA-TP-10 (Figure 2-2) encountered cobbles and boulders (clasts of native rock, asphalt, concrete) and trash (rubber, wood, cardboard, rebar, carpet, and brick debris). Golder test pit GA-TP-9 about 20 feet south of the concrete lined sweeper pit (Figure 2-2) encountered an unmarked drain pipe bedded in washed rock backfill. The upper 0.5 feet of the fill in the roadway areas consisted of a crushed rock. Petroleum odor and staining during excavation of several of the test pits were observed.
- **Wetland Deposit** - The wetland deposit underlies the fill throughout the lower areas west of the existing operations building. This unit was observed in Golder test pits GA-TP-1, GA-TP-2, GA-TP-4 through GA-TP-8, and GA-TP-10 (Figure 2-2) extending to depths of greater than 14 feet bgs. This unit generally consists of very loose to compact, interbedded, massive to laminated silt with some fine to coarse sand and a trace of fine gravel ranging to fine to medium sand, with a trace ranging to some silt, a trace of organics (roots and rootlets) throughout. Moderate to severe caving and flowing soils were observed while excavating in this unit.
- **Fluvial Deposit** - Fluvial deposits were encountered in Golder test pits GA-TP-2, GA-TP-5, GA-TP-6, and GA-TP-8 (Figure 2-2) at depths of between 5 and 9 feet bgs underlying the wetland deposits. In some areas due to caving conditions, the bottom of the test pits did not extend beyond the wetland deposits and it was not determined if

underlying fluvial deposits were present. When encountered the fluvial deposits consisted of compact to dense, fine to coarse gravel and cobble with a little to some sand and a trace of silt ranging to fine to coarse sand with a trace of silt.

- **Ringold Formation** – The Ringold Formation was encountered (3.5 feet bgs) in test pit GA-TP-3 located on the up slope side of the existing soil stock pile adjacent to the north side of Wheeler Road (Figure 2-2). The Ringold Formation as observed in GA-TP-3 consists of very dense, massive, calcified, tuffaceous silt with a little fine sand.

3.3.5 Remedial Investigation, 2003

During the RI field investigation a total of 30 GeoProbe (designated GP-), four hollow stem auger completed and monitoring wells (designated MW-), and two hand auger holes (designated HA-) were drilled, six test pits (designated TP-) were excavated and groundwater samples collected and analyzed from nine Site monitoring wells (new and previously existing) and six GeoProbes. A Golder geologist examined and logged the soil conditions observed in the GeoProbe and hollow stem auger borings, hand auger borings and test pits. Pertinent information including depths, stratigraphy, and soil engineering characteristics were recorded. The stratigraphic contacts indicated on the summary logs represent the approximate boundaries between soil types. The soil samples were classified in accordance with Golder Associates Inc. Technical Procedure for Field Identification of Soil (TP 1.2-6), which was presented in the RI/FS Study Work Plan (Golder, 2003). The detailed boring and test pit logs are included in Appendix A. The locations of the borings and test pits are shown on Figure 3-2. The soil and groundwater conditions were those recorded for the locations and dates indicated and may not necessarily represent those of other times and locations.

Based on the subsurface conditions encountered during the RI in test pits, GeoProbe borings and well borings, the project site is underlain by some or all of the following units: fill, wetland deposits, fluvial deposits and Ringold Formation sediments. The general description of these soils units are the same as the 2002 investigation. Table 3-1 summarizes the subsurface stratigraphy encountered during the RI.

Fill was encountered at ground surface in all test pits and boreholes (Figure 3-3). The thickness of fill encountered ranged from:

- 1.5 to 8 feet below ground surface in the eastern investigation area
- 1.4 to 6.7 feet below ground surface in the central investigation area
- 2.5 to 4 feet below ground surface in the western investigation area

Fill soils generally consist of a varied mixture of loose to dense sand with varying amounts of silt, gravel and occasional cobbles with trace of organics (roots, branches, and wood debris), asphalt, concrete and small chips of paint. The fill soils in TP-01 extended to the bottom of the test pit at 8 feet bgs, significantly deeper than the 2.2 and 3 feet of fill soils encountered in nearby TP-02 and TP-03. This suggests that TP-01 may be located in the area of soils excavated for the previous diesel tank soil removal.

Over the eastern investigation area, the fill soils directly overlie Ringold Formation sediments. The Ringold Formation sediments generally comprise dense, brown and reddish brown sands and silts with very dense calcified layers, often referred to as caliche.

Over the central and western investigation areas, varying thicknesses of wetland deposits and/or fluvial deposits underlie the fill and overlie the Ringold Formation. The wetland deposits comprise gray-brown fine sands and silt with rootlets. The fluvial deposits comprise gray-brown sand and gravel with occasional cobbles.

Soil physical tests were conducted on soil samples collected to characterize the soil properties of the subsurface materials. Soil testing included grain size analysis, moisture content and specific gravity on a total of three samples described as fill, wetland deposits and Ringold Formation units. In addition, porosity and dry density were determined for the Ringold Formation sample. Due to issues with the volume and/or the disturbed nature of the fill and wetland deposit samples, it was determined that laboratory testing for porosity and dry density in these soil units would yield inaccurate results and therefore was not performed. Table 3-2 summarizes the soil properties evaluated from samples collected during the RI. The physical parameter soil data reports are provided in Appendix B.

3.4 Hydrogeology

Based on our understanding of the Site geology, the generalized conceptual hydrogeologic model for the Site comprises:

- A surficial unconfined aquifer in the fill, wetland deposits and fluvial deposits.
- A laterally discontinuous semi-confining unit (aquitard) corresponding to the Ringold sediments.

Previous and current studies indicate that groundwater is relatively shallow at the Site (between 2 and 9 feet bgs).

Century West (1992) and Groundwater Technology (1995) encountered groundwater over the East Portion of the Site at depths ranging from 2 to 6 feet bgs. Sage (1993) encountered groundwater over the East Portion of the Site at depths ranging from 3.5 to 9 feet bgs. In the remedial investigations for this study, Golder encountered groundwater over the eastern investigation area in GeoProbe (GP-01, GP-02 and GP-03) and test pit (TP-01, TP-02 and TP-03) explorations between about 2 and 5 feet bgs and within existing monitoring wells at between 2.2 and 6.9 feet bgs (Table 3-3).

Golder (2002) encountered groundwater over the central investigation between 3 to 8 feet bgs. In the remedial investigations for this study, Golder encountered groundwater over the central investigation area in GeoProbe borings (GP-04 through GP-16) at between 2.7 and 4 feet bgs and in test pit excavations (TP-04, TP-05 and TP-06) between about 4 and 4.5 feet bgs. Groundwater was measured within the new monitoring wells within the central investigation area (MW-15, MW-16, MW-17 and MW-18) between 3.3 and 3.9 feet bgs (Table 3-3).

In the remedial investigations for this study, Golder encountered groundwater over the western investigation area in GeoProbe borings (GP-17 through GP-23) at about 2 feet bgs. It was noted during drilling that groundwater in the borings rose from between 2.7 to 4 feet bgs to about 2 feet bgs in all borings. This suggests that the dense surficial fill material may have a low permeability.

A full round of groundwater level measurements was made by Golder on April 1, 2003 at existing and new monitoring wells. Based on a survey of the well measuring points (top of casing) completed by the City of Moses Lake between April 1 and 2, 2003, the groundwater elevations at the wells are summarized in Table 3-3. Figure 3-4 presents the groundwater elevations in plan for the Site, groundwater table contours and inferred groundwater flow directions. Based on the April 1, 2003 groundwater elevations, the general groundwater flow direction beneath the East and Central Portions of the Site is northwest as depicted in Figure 3-4.

The general groundwater flow direction is towards the northwest and follows the general surface topography. For the eastern investigation area, where groundwater monitoring has been conducted in the past, the horizontal hydraulic gradient based on the April 1, 2003 monitoring event was 0.07 ft/ft between MW-12 and MW-10, 0.05 ft/ft between MW-02 and MW-05, 0.3 ft/ft between MW-04 and MW-06 and 0.08 ft/ft between MW-02 and MW-08. This indicates that the horizontal hydraulic gradient is higher where the ground surface slope is steeper. For the central investigation area where the four new wells are located, the horizontal hydraulic gradient is significantly lower than the eastern area. The horizontal hydraulic gradient based on the April 1, 2003 monitoring event was 0.01 ft/ft between MW-15 and MW-16, MW-15 and MW-17 and between MW-18 and MW-17. Based on groundwater level monitoring completed for previous studies (Groundwater Technology, 1995), seasonal fluctuations of the groundwater elevation over the eastern investigation area are one foot or less, with no distinct time of the year having higher groundwater level for all wells. Based on communication with City personnel, groundwater sometimes reaches ground surface over the central investigation area, in particular at the base of the gravel storage area slope (next to GP-04, GP-09 and MW-15).

Four slug tests completed in 1993 at four separate wells on the East Portion of the Site (Groundwater Technology, 1994) indicate that the hydraulic conductivity of the silt and sand unit between 3 and 14 feet bgs ranges between 5.0×10^{-4} and 1.6×10^{-3} cm/s (1.6×10^{-5} and 5.2×10^{-5} ft/s). Based on the interpretation of the geologic units presented in this study, this is most likely to be representative of the Ringold Formation sediments. Groundwater flow rates over the East Portion of the Site were estimated at 0.5 to 1.5 feet per day in a northwest direction.

Slug tests were completed by Golder for this RI study on April 1, 2003 in MW-15 and MW-17 within the Central Portion of the site. A summary of the test results is included in Table 3-4. Details of the test analyses are included in Appendix B. Using both the rising head and falling head test results, the hydraulic conductivity of the screened geologic units from the water table to about 15 feet bgs in MW15 and MW17 (i.e. fill, overlying wetland / fluvial deposits overlying Ringold Formation sediments) ranges between 6.9×10^{-5} and 2.4×10^{-4} ft/s. Using the results of the rising head slug tests as most representative of the shallow aquifer in surficial geologic materials that include the three geologic units encountered by the wells, the hydraulic conductivity ranges between 2.1×10^{-4} and 2.4×10^{-4} ft/s (or 18.1 to 20.7 ft/day).

Using the equation,

$$V = K / I \qquad \text{(Equation 1)}$$

Where,

V = groundwater velocity (ft/day)

K = hydraulic conductivity (ft/day)

I = calculated hydraulic gradient, based on measured water levels in Site wells (ft/ft)

And, assuming a hydraulic gradient of 0.01 ft/ft (based on the April 1, 2003 groundwater levels in the new wells), the groundwater flow velocity over the Central Portion of the Site is approximately 0.2 feet per day.

3.5 Meteorology

The Site is located in the central Columbia Plateau in the rain shadow of the Cascade Range. The climate of the region is classified as semi-arid, with hot dry summers and abundant sunshine. In the summer, large diurnal temperature variations are common as a result of intense solar radiation and night-time cooling. Winters are cool, with occasional precipitation, overcast skies and fog.

According to historical information from the Western Regional Climate Center for the Moses Lake 3 E climate station from 1943 to 1979, average annual mean temperature is 49.0 degrees Fahrenheit (F) with monthly mean temperatures ranging from 26.1 degrees F in January and 70.4 degrees F in July. Highest daily temperatures (up to 113 degrees F) are experienced in August. Lowest daily temperatures (down to -33 degrees F) are experienced in February.

The mean annual total precipitation is 7.87 inches with a range of 4.17 to 12.07 inches for the period of record. Precipitation is generally highest in winter (on average about 1-inch per month during November, December and January) and lowest during summer (between 0.3 and 0.4 inches in July, August and September). A portion of the precipitation falls as snow between October and March.

3.6 Demographics

The population of Grant County in 2000 was 74,698. This represents a 36.3% growth from 1990. The population of the City of Moses Lake in 1990 and 2000 were 11,235 and 14,953, respectively. Agriculture is the principal economic activity, especially fruit and vegetable production. Tourism is also a significant and rapidly growing part of the local economy, particularly for outdoor recreation.

3.7 Water Supply

Water is supplied to the Site and immediate surrounding area by the City of Moses Lake public pressurized system. An evaluation of groundwater use in the Site vicinity is provided in Section 4.2.

3.8 Ecology

The local ecology is a function of topography, climate, and hydrology. The Columbia Plateau area around Moses Lake is a high desert ecosystem, which is classified as steppe or shrub-steppe. Bunchgrass and sagebrush comprise the majority of the vegetation in this ecosystem. However, in the more immediate area of the maintenance facility there are wetlands with mostly emergent vegetation, and some scrub-shrub and tree vegetation. The wetland areas are a result of the Site's proximity to Moses Lake (approximately 0.4 miles from the Parker Horn branch of the lake, Figure 1-1); the water table is relatively high. In addition, the areas north and south of the Site are lower in elevation relative to the surrounding developed areas, and can receive surface water runoff from those areas.

Species listed under the Endangered Species Act include Pygmy rabbit (*Brachylagus idahoensis*), Bald eagle (*Haliaeetus Leucocephalus*), Bull trout (*Salvelinus confluentus*), and Ute ladies'-tresses (*Spiranthes diluvialis*). The bald eagles are considered a transient visitor to the area surrounding the Site and the adjacent wetland areas are not considered Bull Trout habitat. There are a variety of birds that can be observed in the general vicinity of the Site including but not limited to songbirds, waterfowl, and raptors. Additional details regarding wildlife present in the Site vicinity are provided in Appendix C.

4.0 REMEDIAL INVESTIGATION ACTIVITES

This section describes the field activities that were completed at the Moses Lake Maintenance Facility in fulfillment of the remedial investigation/feasibility study Work Plan (Golder, 2003).

The field investigation as described in this document involved 11 data collection activities. These tasks are intended to support the characterization of the Site hydrogeology and nature and extent of impacts to Site soil and groundwater, as well as the risk assessment. The data collection activities included the following:

1. Review of background and existing Site information;
2. Identification of subsurface utilities to avoid damage of the utilities during RI field activities and to assess the impact that the utility lines may have on Site groundwater flow;
3. Sampling of source area soils to characterize the nature of the chemical impacts;
4. Sampling of source area subsurface soils to define the vertical and lateral extent of the source and to investigate the potential for additional sources on the West Portion of the Site;
5. Installation of groundwater monitoring wells for investigation of groundwater quality up-gradient, down-gradient and in the petroleum hydrocarbon impacted central source area and to help determine Site groundwater flow characteristics;
6. Groundwater sampling at temporary locations associated with the West Portion of the Site to investigate impacts to groundwater and the potential for other sources;
7. Groundwater quality sampling of selected existing monitoring wells in the UST closure remediation area on the east side of the Site and new monitoring wells installed during the RI;
8. Groundwater level monitoring in Site wells;
9. Hydraulic and physical aquifer testing of new monitoring wells installed during the RI and selected existing wells on the east side of the Site;
10. Performance of a simplified terrestrial ecological evaluation for the Site; and,
11. Geodetic control and surveying of existing and new Phase 1 RI monitoring wells.

4.1 Background and Existing Information Review

4.1.1 Topographic Map Review

Golder reviewed the historic United States Geological Survey 1956 and 1978 7.5 minute quadrangle topographic maps covering the Site and surrounding vicinity. Copies of these maps are included in Appendix D. The 1978 map shows very little change from the current topographic map and notes an oil tank next to the former Basin Oil Company property east of the Site. The 1956 map shows more detailed topography and highlights the location of the Site on the toe of a northwest facing slope. The oil tank is also noted on this 1956 map. In addition, the mall south of the Site and the northern continuation of Block Street to Broadway Avenue are not shown (since they did not exist when the 1956 map was published).

4.1.2 Fire Insurance Maps

Golder contracted Environmental Data Resources, Inc. (EDR) to identify historical fire insurance maps for the established maintenance facility. EDR maintains the largest and most complete archive of fire insurance mapping. No historical maps were located for the facility, which indicates that the facility has not been used as commercial property in the past.

4.1.3 Environmental Database Search

An environmental database search was conducted by Environmental Data Resources, Inc. (EDR) in accordance with ASTM E 1527 – 00 "Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Assessments," which included a search of 27 federal, state and local databases. Any sites with the same zip code as the Site are flagged and if they fall within the ASTM-designated search distance from the Site, are located on a base map. Details of the search results and search distances from the Site for the various databases are shown on the Map Findings Summary in the EDR report, which is included as Appendix E.

Results of the search indicated that the Site was listed in the following databases:

- RCRIS-SQG (federal Resource Conservation and Recovery Information – Small Quantity Generator)
- FINDS (federal Facility Index System)
- UST (state Underground Storage Tank list)
- LUST (state Leaking Underground Storage Tank list)
- CSCSL (state Confirmed and Suspected Contaminated Sites list),
- WA ICR (Washington Independent Cleanup Record)
- CERC-NFRAP (CERCLIS No Further Action Planned)

The Site is recorded on the federal RCRIS and FINDS databases since small quantities of hazardous chemicals are stored at the Site and since it is the City Maintenance Facility. The state listings reflect the confirmation of petroleum impacted soils and groundwater on the East Portion of the Site and removal and remediation activities associated with these impacts.

The database search also highlighted the following sites that are located hydraulically up-gradient from the maintenance facility. The approximate locations of the sites are shown on the overview and detailed radius maps presented with the EDR report in Appendix E.

- Basin Oil Company at 901 E Wheeler Road (a RCRIS-SQG site) located within 0.125 miles from the Site;
- Grant County Hospital District 1 at 801 E Wheeler Road (a RCRIS-SQG, FINDS and UST site) located within 0.125 miles from the Site;
- Swartz Electric at 934 E Wheeler Road (a UST site) located within 0.125 and 0.25 miles from the Site;
- East Columbia Basin Irrigation District at 514 Buchanan Street (a RCRIS-SQG, UST, LUST and WA ICR site) located within 0.125 and 0.25 miles from the Site;

- Moses Lake SOC at 418 N Clover Drive (a UST and LUST site) located within 0.25 and 0.5 miles from the Site; and,
- International Titanium at 1320 Road 3 NE (a RCRIS-SQG, FINDS, CSCSL and CERC-NFRAP site) located within 0.25 and 0.5 miles from the Site.

In terms of environmental concern, the following sites have had or still have the highest potential to impact groundwater at the Site:

- The site of the previous Basin Oil Company at 901 E Wheeler Road (a RCRIS-SQG site) is immediately east (about 150 feet) of the Site. According to City personnel, a leaking diesel UST was found on the site that was associated with diesel contamination of soils on the east side of the unnamed road that runs along the east side of the maintenance facility Site (Figure 1-2). When the City improved this road, they encountered diesel impacted soils within the ditch along the east side of the road.
- The East Columbia Basin Irrigation District at 514 Buchanan Street (a RCRIS-SQG, UST, LUST and WA ICR site) is located within 300 feet up-gradient of the Site (Figure 1-3). The EDR search results indicate that a leaking underground storage tank containing petroleum products had contaminated soils at the site and was removed in late 1993. A cleanup report was filed with Ecology in February 1994. In addition, three USTs containing leaded and unleaded gasoline were removed from the site.

In addition to known sites, the EDR database search identified 39 orphan sites that were insufficiently addressed to be plotted on the base map but had the same zip code as the maintenance facility Site.

4.1.4 Site Reconnaissance

A visual reconnaissance of the Site and nearby vicinity was conducted on March 7, 2003, prior to initiating drilling and sampling activities. Additional reconnaissance of the adjacent properties was completed during the field activities. During the reconnaissance, the Site was checked for previously unidentified physical evidence of potentially hazardous substances or petroleum products that may impact the subject property. At this time a Golder scientist observed the condition of the Site and adjacent properties, making note of geologic, topographic, and hydrologic features. While observing adjacent properties trespass laws were respected. Photographic documentation is provided in Appendix D.

Evidence of potential Site contamination was noted during the reconnaissance of the property, including:

- Evidence of storage or use of hazardous chemicals;
- Evidence of aboveground and underground fuel storage tanks;
- Evidence of surface leaks or spills of petroleum products or other hazardous materials;
- Evidence of hazardous material or waste storage/disposal areas including sumps, floor drains; and
- Hydraulic systems and electrical transformers or capacitors potentially containing PCBs.

4.1.4.1 Eastern Investigation Area

The eastern investigation area (Figure 1-2) is composed of the following (referenced photographs are provided in Appendix D):

- A maintenance shop on the east side of the property (Photograph 1);
- A Cascade Natural Gas building on the southeast corner of the property (Photograph 1);
- A parks department shop building south of the maintenance shop (Photograph 2);
- A secure chemical storage area south of the maintenance shop (Photograph 3); and,
- An office building and asphalt parking area on the north central portion of the property (Photograph 4).

The maintenance shop on the East Portion of the site (Figure 1-2) is divided into two areas: a concrete floored shop area on the east side (Photograph 5) and a covered gravel parking area on the west side (Photograph 6).

There is concrete floored wash rack on the south side of the shop area (Photograph 7) used to wash vehicles and parts. Communication with City personnel and review of Site plans (Figure 1-2) indicates that drainage from the wash rack flows west from the drain to just west of existing monitoring well MW-11 (Photograph 7) prior to the drain line turning north. The drain line flows through an oil-water separator located on the north side of Penn Street prior to flowing west along Penn Street (Figure 1-2). Four floor drains were also noted in the concrete floored shop area on the east side of the site. One of the drains is located about 10 feet northeast of existing monitoring well MW-05. It is assumed from the Site plan (Figure 1-2) that water that collects with the floor drains, flows in a northwest direction and joins the flow from the wash rack drain prior to flowing into the oil-water separator on the north side of Penn Street.

Activities that occur within the shop area include vehicle repair and maintenance involving use of hydraulic lifts. Tools and fluids (antifreeze, motor oils, lubricants, solvents and paints) associated with these activities were noted within the building. No evidence of improper storage of chemicals nor surface leaks or spills that would pose an environmental risk was noted while conducting the RI.

4.1.4.2 Central Investigation Area

The main features of the central investigation area (Figure 1-2) include:

- A material stockpile area (including pieces of pipe, fencing, small storage sheds, sand and bricks) (Photograph 8);
- A concrete lined sweeper wash pit (Photograph 8);
- Storage of tires, paint, toluene drums and oil drums along the fence line;
- A large gravel stockpile on the southwest portion of the facility (Figure 1-2 and Photograph 8); and,
- An office building and warehouse area located at 717 E Penn Street (Photograph 9).

The existing sweeper pit (Photograph 8) is used to wash down vehicles that are used by the City to clean streets. The sweeper pit drains into the oil-water separator located within the northwestern corner of the established maintenance facility area (just south of the police impound lot and east of the central fence line). From the oil-water separator (Figure 2-1), the drain flows northwards into the storm drain line that runs in a westerly direction along Penn Street.

Communication with City personnel indicates that there was a historic sweeper pit located immediately south and in the vicinity of the existing sweeper pit. The previous sweeper pit was constructed of drain gravel within an unlined excavation. Vehicles drove on to the gravel and were cleaned out by washing the waste materials into the gravel and allowing the wash water to infiltrate. Since the previous pit was not lined, wash water infiltrated into the ground.

During the March 7, 2003 Site visit, the office at 717 East Penn Street was being used to store geotechnical equipment and building maintenance equipment (Photograph 9). Chemicals including paints, solvents, herbicides, pesticides, and chlorodifluromethane were noted in small containers. No floor drains were noted in the building, or any evidence of improper storage of chemicals nor surface leaks or spills that would pose an environmental risk.

City personnel said there is a shallow groundwater collection system beneath the Central Portion of the site that comprises a 6-inch perforated and corrugated pipe bedded with drain gravel. Although there are no site plans showing the locations of the drains, the collection system is believed to convey groundwater west into the storm drain that runs north about 40 feet west of the sweeper pit (Figure 2-1). This storm drain runs through an oil-water separator located within the northwest corner of the established maintenance facility area (just south of the police impound lot and east of the central fence line) prior to flowing northwards into the storm drain line that runs west along Penn Street (Figure 2-1).

The ground surface over the central investigation area is bare except for the southwestern portion to the west of the fence line, which is covered in asphalt.

4.1.4.3 Western Investigation Area

The main features of the western investigation area (Figure 1-2) include:

- A concrete floored and metal sided office and warehouse building on the northwest (Photograph 10);
- A concrete floored, cinder block storage room and warehouse building on the southwest (Photograph 11);
- A concrete floored and metal sided warehouse building on the southeast (Photograph 12); and,
- A catch basin equipped with a grate cover on the west-central side of the area (Photograph 13).

During the March 7, 2003 site visit: the northwestern warehouse was being used to store a road marking vehicle and sewer tank trailer (Photograph 10); the southwestern warehouse building was being used by the City to store pipe, rope, metal, light bulbs, lawn mowers and office equipment (Photograph 11); and, the southeastern warehouse was being used to store two snow plow trucks, a de-icing truck, a scraper and motor home (Photograph 12). No floor drains were noted in any of the buildings, or any evidence of improper storage of chemicals nor surface leaks or spills that would pose an environmental risk.

Based on communication with City personnel, there is also a shallow groundwater collection system beneath ground surface west of the established maintenance facility area and central fence line (which includes portions of both the central and western investigation areas shown in Figure 1-2). The collection system comprises a 6-inch perforated and corrugated pipe bedded within drain gravel. Although there are no plans, the City (based on communication with the previous owner) indicated that the lines are likely to run north and south, conveying groundwater into the Central Portion of the site and then westwards into a catch basin. The approximate locations of the lines and the catch basin (which is covered by an open grill as shown in Photograph 13) are shown on Figure 2-1. The City believes that the water flows from the catch basin in a northerly direction into the storm drain located at the southeastern corner of Penn and Block Streets (Figure 2-1).

All but the northeast and southwest corners of the area are surfaced with asphalt.

4.1.4.4 Adjacent Land

Figure 1-3 presents a schematic of the land and properties surrounding the Site. This schematic was prepared based on observations made on March 26, 2003 The following paragraphs describe the land and properties surrounding the Site, noting any conditions that may pose an environmental risk. Photographs supporting the descriptions are provided in Appendix D.

The Site is bounded on the north by Penn Street. The land immediately north of Penn Street and the Eastern and Central Portions of the Site is owned by the City of Moses Lake and has been partially filled for a distance of about 100 feet north of Penn Street to form a level gravel surfaced area, now used for parking vehicles (Figure 1-3). The land north of the fill area is undeveloped land, currently owned by Desert Investment Corporation and previously owned by the Milwaukee Railroad Company. The land is low-lying land and has a small surface water drainage flowing southwest. The drainage was originally constructed by the Milwaukee Railroad as an interception drainage ditch and is sometimes referred to as the Milwaukee Drain. Approximately 200 feet north of the northeast corner of Penn and Block Streets, the drainage flows into a storm drain (Photograph 14). Based on communication with City personnel, the storm drain runs west along the south side of Penn Street and then turns southwards, and runs south beneath Wheeler Road and beneath the Safeway parking lot (Figure 1-3).

The land north of Penn Street and the West Portion of the Site comprises commercial and light industrial buildings including 706 Penn Street, which is a concrete block building currently under repair and for sale, plus an automobile storage facility east of 706 Penn Street. A frame and axle shop is on the property northwest of the Site.

The Site is bounded on the east by a gravel road running north-south between Wheeler Road and Penn Street. The land northeast of the Site is currently undeveloped (Figure 1-3). The land east of the Site is divided into two pieces. The northern piece was owned by Basin Oil. The southern piece comprises a warehouse, loading bay and office used by USF Reddaway and American Linen. Columbia Paint and Coatings is in Lovins Business Park, on Wheeler Road, just east of the loading bay. In terms of potential contamination sources, evidence of previous above ground and underground storage tanks and fuel conveyance piping was noted at the previous Basin Oil facility immediately east and up-gradient of the Site (Photograph 15).

The south of the Site is bounded by Wheeler Road, a busy road that connects the eastern side of the City to the downtown area. The Samaritan Hospital is located south of Wheeler Road and the existing maintenance facility. Low-lying undeveloped land is located to the south of Wheeler Road and the West Portion of the Site. A Safeway store is located on the land south of Wheeler Road and the southwest of the Site. The East Columbia Irrigation Project facility and residential land is south of Wheeler Road and southeast of the Site. In terms of potential contamination sources, a number of large aboveground storage tanks were noted at the East Columbia Irrigation Project facility that is immediately southeast and up-gradient of the Site (Photograph 16).

The west of the Site is bounded by Block Street. Commercial and light industrial buildings including automobile repair, storage and towing facilities are on the west side of Block Street.

4.1.5 Historical Aerial Photograph Review

Golder reviewed the following low altitude aerial photographs:

- 1962 Black and White Photograph of the 5 corners (B-41-5-82)
- 1974 Black and White Photograph of the intersection between Wheeler Road and SR17
- 1996 USGS Black and White Photograph of the 5 corners

Copies of the photographs are included in Appendix D.

1962 Black and White Photograph of the 5 corners (B-41-5-82)

The Site appears similar to current conditions with the administration building, maintenance shop and Park's building to the south of the maintenance shop in place and a gravel storage area on the south side of the Site. The covered gravel garage on the west side of the maintenance shop has not yet been constructed. A vegetated area runs north-south along the boundary between the currently established maintenance facility and the property purchased by the City in 2001. There also appears to be a vegetated drainage that runs in a northwest-southeast direction across the property purchased by the City in 2001, from the western property line, north of the warehouse on the southwest of the property, to Wheeler Road at the western boundary of the established maintenance facility property.. The drainage appears to run beneath Wheeler Road and into the wetland to the south of the Site. This is most likely the drainage referred to by City personnel that is a continuation of the Milwaukee Drain prior to the drainage being routed into the storm drain system. Buildings on the western property include the warehouse on the southwest and a building in the existing concrete block building on the northeast of the property.

The area surrounding the Site is similar to current conditions with a few exceptions. There is a ball park in the location of the current cinema building located about 0.25 miles northwest of the Site. The mall (where Safeway is currently located) and the parking lot south of the Site have not yet been developed. The area north of the Site, which has been filled and is currently used by the City as a parking area, is vegetated, undeveloped land. There are buildings on the site of the former Basin Oil Company property east of the Site. The Lovins Business Park has not yet been constructed on Wheeler Road. The residential area to the southeast of the Site, on the south side of Wheeler Road, is less developed than at present.

1974 Black and White Photograph of the intersection between Wheeler Road and SR17

This photograph shows the intersection between Wheeler Road and SR17 and the land to the north of the intersection. The Site is not shown in the photograph. In comparison to the 1962 photograph, the only change to this intersection appears to be some additional commercial development on the north side of Wheeler Road, just west of the SR17 intersection.

1996 USGS Black and White Photograph of the 5 corners

The Site and surrounding area appear very similar to current conditions with the exception that the cinema, located about 0.25 miles northwest of the Site has not yet been constructed. The wetlands are apparent to the north and south of the Site. The drainage channel to the north of the site is apparent, running along the east side of the wetland area. There are no buildings in the vicinity of the Basin Oil Company property immediately to the east of the Site.

4.2 Area Groundwater Evaluation

Washington State water well records were searched to identify groundwater supply wells and evaluate groundwater usage in the area of the site. The search identified all water wells in Ecology's records in the SW ¼ of the SE ¼ of Section 14, SE ¼ of the SW ¼ of Section 14, NW ¼ of the NE ¼ of Section 23, NE ¼ of the NW ¼ of Section 23, 19 North, Range 28 East, Willamette Meridian. The search identified numerous resource protection wells, the majority of which were related to the Site. Water supply wells were identified in the following three locations within the search area.

- United Concrete Pipe Corporation water well (well log ID 173768) is located in the NW ¼ Section of the NE ¼ Section of Section 14 (no street address is available). The well is approximately 0.4 miles hydraulically down-gradient of the Site, based on the direction of groundwater flow on the Site. Well log records maintained by Ecology (see Appendix A) identify the depth of this well as 47 ft bgs. The wetland area on the north side of Penn Street lies between the Site and the water well location.
- City of Moses Lake Water supply wells (well log IDs 164496, 164497 and 164491) are located at 321 South Balsam approximately 0.4 miles hydraulically cross-gradient to the Site based on the direction of groundwater flow on the Site. Well log records maintained by Ecology (see Appendix A) identify the depth of the well as 950 ft bgs.
- James B Thoren water well (well log ID 168437) is located at 1003 South Ash over 0.6 miles hydraulically cross-gradient to the Site based on the direction of groundwater flow on the Site. Well log records maintained by Ecology (see Appendix A) identify the depth of this well as 69 ft bgs.

The search results and water supply well logs are provided in Appendix A. Based on the nature and extent of impacts defined by the RI, the above listed water supply wells are not at risk of being impacted from contaminated Site soils.

4.3 Utility Locate

Prior to invasive work onsite, Golder contracted with utility locator services to mark all known utilities in the sampling areas. Utilities including electrical power, water, sewage, natural gas and phone lines were marked. Golder field staff reviewed the marked utilities and confirmed the locations of the utilities with City personnel prior to confirming the locations of the subsurface investigation sites. All excavating and drilling activities were conducted in a manner that avoided disrupting these underground utilities.

4.4 Site Survey

A Site survey was completed between April 1 and 2, 2003 by the City of Moses Lake Engineering Department after RI field activities were complete. The City located all test pit, GeoProbe and monitoring well locations using a GPS with a horizontal accuracy of 0.02 feet. In addition, the ground surface and top of casing (the measuring point for water level readings) for the existing and new monitoring wells were surveyed using a total station to an accuracy of 0.01 foot. Due to the modifications made to the monitoring well monuments at MW-15 through MW-18, the wells were re-surveyed on May 13, 2003. All RI sample locations were plotted on the Site Plan and are presented on Figure 3-2. A copy of the survey points is provided in Appendix F. Sample locations GP-24 through GP-30 were measured in the field and transferred to the Site Plan and were not surveyed.

4.5 Soil and Groundwater Sampling

The RI field sampling was conducted by Golder between March 7 and December 9, 2003. The following sections describe the methods and sampling activities conducted during the RI. Tables 4-1 through 4-9 provide an overview of soil and groundwater sampling in each sampling zone. A full description of all sampling methods, QA procedures, etc. is described in the SAP and QAPP, Appendices A and B of the approved RIFS Work Plan.

To understand conditions on-site, we divided the site into three sampling zones: the eastern investigation area; the central investigation area and the western investigation area (Figure 1-2). The three zones are described briefly below:

- The East Portion of the Site, in the vicinity of the maintenance shop, is the location of previous petroleum hydrocarbon soil and groundwater remediation activities associated with UST closures;
- The Central Portion of the Site is where oil impacted soils were encountered during a 2002 geotechnical/environmental investigation (Golder, 2002); and,
- The West Portion of the Site was purchased by the City in 2001 and has been used mainly for metal fabrication. There is a potential that releases of petroleum hydrocarbons or other chemicals may have occurred at the site.

Four subsurface investigation techniques were employed: test pitting in the eastern and central investigation areas; drilling and installation of groundwater monitoring wells within the central investigation area; GeoProbe boring in the eastern, central and western investigation areas and two hand auger borings. The total number of samples, sample intervals, and frequency of analytical methods for samples vary for soils and groundwater collected in these zones. The surveyed locations for the investigation sites are shown in Figure 3-2.

The soil sampling program (test pit excavations, GeoProbe, well borings and hand auger borings) was subject to controls and strict QA protocols and procedures specified in the relevant technical procedures referenced in the Work Plan (Golder, 2003). These technical procedures include the following:

- TP 1.2-5 "Drilling, Sampling, and Logging Soils".
- TP 1.2-6 "Field Identification of Soil".
- TP 1.2-18 "Sampling Surface Soil for Chemical Analysis".
- TP 1.2-23 "Chain-of-Custody".

Drilling, installation, sampling and testing of the new groundwater monitoring wells, groundwater sampling of the existing groundwater monitoring wells and groundwater sampling of the GeoProbe borings within the western investigation area were subject to controls and strict QA protocols and procedures specified in the relevant technical procedures referenced in the Work Plan (Golder, 2003). These technical procedures include the following:

- TP 1.2-12 "Monitoring Well Drilling and Installation".
- TP 1.2-20 "Collection of Groundwater Quality Samples".
- QP 11.1 "Calibration and Maintenance of Measuring and Test Equipment".
- TP 1.2-23 "Chain-of-Custody".
- TP 1.4-11 "Technical Procedure for Single Borehole Drawdown and Recovery Pump Test".

4.5.1 Test Pit Investigations

Six test pits (denoted as TP-01 through TP-06 on Figure 3-2) were excavated in the eastern and central investigation areas on March 18, 2003 using a backhoe. The test pit was initially excavated to about four feet below ground surface. The excavation was then entered by the onsite hydrogeologist and the soils logged and sampled from the walls and floor of the excavation using a clean stainless steel spoon. The excavation was then continued with samples logged and collected from the backhoe bucket. When all sampling activities were complete, the excavated soils were replaced in the hole and compacted in place.

The soil was visually evaluated and described on a field test pit log. Soil was carefully transferred from the excavation into appropriate sample containers to minimize volatilization. An aliquot of soil was immediately placed into a sample container for chemical analysis before any field screening or visual evaluation occurred. The depth interval for each sample was recorded. Soil samples were collected at discrete intervals, with additional samples collected based on lithology, visual identification of contamination, and field screening. Each sample depth interval was a discrete sample that varied from 6 inches to 1 foot in length depending on the volume of soil needed to fill the sample containers. Disturbance of soil samples and exposure to air was minimized to the extent practicable to prevent volatilization.

Soil samples were field-screened for visual indications of contamination and unusual odors. A Photoionization Detector (PID) was used to measure volatile organic compounds emanating from the soil being screened. The purpose of the field screening was to provide a relative indication of any potential contamination. Visibly contaminated soils were retained for laboratory analysis where the nature and degree of contamination was measured according to standard laboratory methods.

Soils were logged according to the Unified Soil Classification System (USCS). Soil samples were collected to define the geology and hydrogeology on-site and to characterize the soil impacts, if any. Samples taken for laboratory analyses were collected in 4-oz glass jars. Samples taken for on-site assessment of volatiles were collected in Ziploc bags and tested with a PID (equipped with a 10.6 eV lamp) about 5 minutes after sampling using headspace techniques. Test pit logs providing details of the soils encountered in each test pit are included in Appendix A.

All sampling equipment was decontaminated prior to the start of sampling activities and between each use. The sampling equipment was washed with a non-phosphate detergent (Alconox) solution using brushes to remove all visible dirt and grit. An organic free distilled/deionized water rinse was used to thoroughly remove all detergent solution followed by a rinse with purge-and-trap-grade methanol. The final rinse was organic free distilled/deionized water. A methanol-soaked towel was used to remove material and the full-complement of decontamination procedures repeated when oil or other visible organic matter remained on the sampling equipment after the detergent/water wash.

Samples were collected in containers of appropriate volume and type as detailed in the QAPP (Golder, 2003). After filling, the containers were immediately sealed, labeled and placed in a cooler maintained at 4°C. Samples were transported to OnSite Environmental in Redmond, WA with chain-of-custody documentation in sufficient time to perform the requested analyses within the applicable holding times.

4.5.1.1 Eastern Investigation Area Test Pits

Three test pits (TP-01, TP-02 and TP-03) were excavated in the eastern investigation area in the area of the former diesel UST on the south side of the maintenance shop (Figure 3-2) to verify that impacted soils were excavated and removed during the UST closure. The test pits were excavated to depths ranging between 8 and 10 feet bgs. Samples were taken from TP-01, TP-02 and TP-03 from the soils in the vicinity of the water table to investigate the presence of petroleum hydrocarbons floating on the water table. Samples were also taken from the bottom of the test pit, at a depth corresponding to the soils below the previous diesel UST. The samples taken and laboratory analyses are summarized in Table 4-1. Equipment, field and trip blanks are not included on this table. An Ecology representative was present on-site for split sampling during the test pit excavations and collected a split sample in TP-03 at 9 ft bgs (Table 4-1). No evidence of soil impacts in the three eastern test pits were noted at the time of excavation.

4.5.1.2 Central Investigation Area Test Pits

Three test pits (TP-04, TP-05 and TP-06) were excavated in the waste oil source area (Figure 3-2) encountered during the 2002 Site geotechnical and environmental investigation (Golder, 2002) to characterize the nature of the contamination in this source area. Oil was noted in TP-04 soils at depths of 2.2, 3.0, 4.2 and 4.5 ft bgs and in TP-05 soils at depths of 3.0 and 3.9 ft bgs (Photograph 17). Perforated pipe bedded in rounded drain gravel was encountered at 4 ft bgs in TP-04 (on the north side of the test pit) and at 4.5 ft bgs in TP-06 (on the east side of the test pit) (Photograph 18). This is inferred to be the shallow groundwater drainage system that occurs within the central area of the site (Figure 2-1). The samples taken and laboratory analyses for the central area test pits are summarized in Table 4-2. Equipment, field and trip blanks are not included in this table. An Ecology representative was present on-site for split sampling during excavation of TP-04 and collected a split sample from TP-04 at between 2 to 3 ft bgs (Table 4-2).

4.5.2 <u>GeoProbe and Hand Auger Investigations</u>

A total of 30 GeoProbe borings (denoted as GP-01 through GP-30 on Figure 3-2) were completed within the eastern, central and western investigation areas on March 26 and 27, and May 1, 2003 using Cascade's direct push GeoProbe with a 4-foot long 1.5-inch ID sampler. The direct push technology involved the advancement of a sampler directly into the soil using hydraulic pressure and a hammer. A 1.5-inch ID steel sampling barrel fitted with clear PVC liners was driven into undisturbed soil to obtain individual soil samples from varying depths.

After being driven into the ground at 4-foot intervals, the steel sampling barrel was withdrawn and the liner extracted from the barrel sampler. The liner was cut length-wise and the exposed soil was field screened using the methods identified as those used for the test pit sampling in the preceding section. The soil was visually evaluated and described on a field boring log (Photograph 19). Borehole logs providing details of the soils encountered and the samples taken are included in Appendix A. The

GeoProbe soil samples collected for chemical analysis were selected based on field screening results. If field screening did not indicate the presence of petroleum hydrocarbons in any of the GeoProbe samples within the boring, the last sample collected from above the water table was submitted for analyses. Each sample depth interval was a discrete sample that will vary from 6 inches to 1-foot in length depending on the volume of soil needed to fill the sample containers. Disturbance of soil samples and exposure to air was minimized to the extent practical to prevent volatilization.

Two hand auger borings (denoted as HA-01 and HA-02 on Figure 3-2) were completed within the East Portion of the Site, May 2, 2003 using a 4-foot long hand auger with a 1.5-inch ID stainless steel sampler attachment. The auger was advanced by hand turning the tooling until soil moisture increased from dry/damp to moist. A stainless steel sampler was then attached to the rod and the sampler advance with a slide hammer. The sampler was removed and soil sampling continued as outline above for GeoProbe sampling. Borehole logs providing details of the soils encountered and the samples taken are included in Appendix A.

The GeoProbe and hand auger soil samples collected and submitted for chemical analyses were placed directly into 4-oz glass jars provided by the analytical laboratory and sealed with Teflon-lined lids. Soil was carefully transferred from the liners into appropriate sample containers to minimize volatilization. Any remaining soil material was placed in a Ziploc bag and sealed. The sample jars were labeled and placed in an ice chest for temporary storage at approximately 4°C until relinquished under chain of custody to OnSite Environmental in Redmond, WA with chain-of-custody documentation in sufficient time to perform the requested analyses within the applicable holding times.

All waste soils from the two day GeoProbe program were removed from the liners and placed into one labeled 5-gallon bucket for disposal once the contents of the soils have been determined.

4.5.2.1 Eastern Investigation Area GeoProbe and Hand Auger Borings

Three GeoProbe borings (GP-01, GP-02 and GP-03) were drilled in the eastern investigation area, down-gradient of the former waste oil UST (Figure 3-2) to verify that impacted soils were excavated and removed during the UST closure. Three additional GeoProbe (GP-24, GP-25 and GP-26) and two hand auger borings (HA-01 and HA-02) were advanced to below the water table at the southwest corner of the maintenance shop to delineate the extent of the petroleum hydrocarbons identified at MW-11. The East Portion GeoProbes were pushed to depths ranging between 7 and 8 feet bgs with refusal in GP-01 and GP-02 at 7 ft bgs on very dense, calcified Ringold Formation soils. Field screening did not indicate any petroleum hydrocarbon impacts to the soils and, as a result, the samples taken from the GeoProbes and hand auger borings were submitted for laboratory analysis represented the last sample collected from above the water table. Groundwater samples were collected from GP-24, GP-25, GP-26, HA-01 and HA-02. The groundwater samples collected from GP-25 and HA-02 were submitted for chemical analysis. Both the soil and groundwater samples submitted for chemical analyses are summarized in Table 4-3. Equipment, field and trip blanks are not included on this table.

4.5.2.2 Central Investigation Area GeoProbe Borings

Seventeen GeoProbe borings (GP-04 through GP-16, and GP-27 through GP-30) were drilled in the central investigation area (Figure 3-2) to characterize the soils and the nature and extent of the contamination in this source area. Field screening indicated the presence of petroleum hydrocarbon impacted soils in GP-08, GP-09 and GP-10 (Photograph 19 and Figure 3-2). Groundwater samples were collected from GP-27 and GP-28. The samples taken and laboratory analyses for the central area GeoProbe borings are summarized in Table 4-4. Equipment, field and trip blanks are not included on this table.

4.5.2.3 Western Investigation Area GeoProbe Borings

Seven GeoProbe borings (GP-17 through GP-23) were drilled in the western investigation area (Figure 3-2) to characterize the soils and the nature and extent of the contamination, if any, in this previously uninvestigated area of the Site. Field screening did not indicate any petroleum hydrocarbon impacts to the soils and, as a result, the soil samples that were collected from GP-17 through GP-23 and submitted for laboratory analysis represented the last sample collected from above the water table. Groundwater samples were collected at each of the GeoProbe borings and the groundwater sample from GP-19, GP-22 and GP-23 were submitted for chemical analysis. The samples taken and laboratory analyses are summarized in Table 4-5. An Ecology representative was present on-site for split sampling and collected a split sample from GP-19 (Table 4-9). Equipment, field and trip blanks are not included on this table.

4.5.3 Monitoring Well Drilling, Installation and Development

Four groundwater monitoring wells were drilled and installed in the Central Portion of the Site (Figure 3-2) using a 4.25-inch ID, 8-inch OD hollow stem auger (HSA). The monitoring wells were located as follows; one well (MW-15) was located up-gradient of the waste oil impacted source area in the Central Portion of the Site, two wells (MW-17 and MW-18) were located down-gradient and the fourth well (MW-16) was within the source area. The purpose of the wells was to investigate potential chemical impacts to the groundwater.

Soil samples were collected continuously during drilling with 24-inch and 18-inch long by 2.5-inch ID split spoon samplers. The sampler was placed at the top of the desired sampling interval and advanced 24 or 18 inches beyond the cutting edge of the lead auger (or until refusal was encountered) by a 300-pound hammer with a 30-inch drop. After driving the sampler to depth, or refusal if encountered, the sampler was removed from the augers and broken down. The soil within the sampler was lithologically logged and field screened using the same general procedures outlined for the test pit and GeoProbe programs in Sections 4.6.1 and 4.6.2. The soil sampler was decontaminated prior to each use in accordance with the decontamination procedures outlined in Sections 4.6.1 and 4.6.2.

Samples were collected from MW-15 between 10 and 11.5 feet bgs and from MW-17 between 12.5 to 13 feet bgs within 6 inch long brass liners (see Table 2-3). These samples were sealed and submitted for physical analyses.

Field screening was used to determine which soil samples to submit for chemical analyses. These soil samples were initially submitted for analysis of total petroleum hydrocarbons by the State Approved NWTPH-HCID method. If petroleum hydrocarbons were detected by the NWTPH-HCID analysis the results were quantified by either NWTPH-Dx and/or NWTPH-Gx as appropriate. A separate soil sample was collected from each monitoring well boring from below the water table and submitted to the analytical laboratory for total organic carbon (TOC) analysis by EPA Method 9060. The TOC samples were collected and analyzed to support groundwater contaminate transport modeling, if it were to be required. TOC results are provided in Appendix G. The samples taken and laboratory analyses are summarized in Table 4-6. Quality Assurance (QA) samples (e.g. duplicates, blanks) are not included on this table.

After drilling each boring, Golder installed a monitoring well in conformance with Washington State well construction regulations (WAC 173-160). All wells were completed with 2-inch diameter, schedule-80 PVC 0.010-inch slot well screens and casing with O-ring seals between joints. The well screens were 10 feet long in MW-15, MW-16 and MW-17 and 8-feet long in MW-18. An 8-foot long well screen was installed in MW-18 due to difficulties with soil sloughing into the borehole during installation. The 8-foot long screen was fabricated by cutting two feet off a full length 10 foot long well screen. All of the well screens were installed to straddle the water table surface by approximately 2 feet. A bottom cap was attached to the end of each well screen, and then the casing/screen string were centered in the hole.

Well installation was conducted inside the auger flights. A filter pack was installed from at least 6 inches below the well screen to about 6 inches to 1 foot above the topmost slot on the screen. The filter pack materials consisted of 10/20 Colorado silica sand. The sand pack was surged (as part of well development) to settle the sand before placing 2 to 2.5 feet of bentonite seal. Details of the new wells completed for this RI study are presented on the borehole logs included in Appendix A. A summary of the well construction details is presented on Table 2-2. Following completion of the borehole and well, drill cuttings were placed in labeled 55-gallon drums. Well completion diagrams are presented on the boring logs provided in Appendix A.

After surging and placement of the bentonite seal, an additional one foot of concrete was used to create a slightly domed pad, constructed to divert water runoff away from the well. All monitoring wells were completed with nominal 8-inch diameter protective steel flush-mount well monuments. About 1 inch of clearance was maintained between the well cap and the monument lid to allow placement of a data logger, if needed. The wells were capped using a plastic slip cap.

Following installation of the groundwater monitoring wells, the monitoring wells were developed to produce representative formation water that is free of drilling fluids, cutting, or other materials potentially introduced during drilling and well construction. Development was performed through a combination of surging and groundwater purging using a submersible pump. Groundwater produced during purging was captured in labeled 55-gallon drums.

4.5.4 Groundwater Sampling

Golder collected groundwater samples during the initial RI study from:

- Five existing monitoring wells (MW-04, MW-05, MW-08, MW-10 and MW-11) and two open hole hand auger borings (HA-01 and HA-02) within the eastern investigation area (Figure 3-2);
- The four new monitoring wells (MW-15, MW-16, MW-17 and MW-18) within the central investigation area (Figure 3-2); and,
- Twelve temporary well screens installed within GeoProbe borings (GP-17 through GP-28) within the Site investigation area (Figure 3-2), seven of the samples were submitted for chemical analyses.

Groundwater samples were collected from five of the existing monitoring wells on the East Portion of the Site (MW-04, MW-05, MW-08, MW-10 and MW-11 on Figure 3-2). These wells were preferentially selected for sampling based on previous groundwater monitoring results and the current condition of the well. Based on information collected by Groundwater Technology (1994 and 1995), the existing groundwater monitoring well samples, which have contained petroleum hydrocarbons and/or lead, include MW-05, MW-06, MW-08, MW-10 and MW-11. At the time of the initial round of groundwater level monitoring (March 17, 2003), Golder personnel noted petroleum hydrocarbon odors in MW-04 and not MW-06. As a result, groundwater was sampled from MW-04 instead of MW-06.

Golder collected additional groundwater samples during two subsequent sampling events conducted in association with the RI. The groundwater samples were specifically collected to resolve issues regarding the background concentration of arsenic in the shallow groundwater. A summary of the groundwater sampling activities are provided in Appendix A-1. Groundwater samples were collected from 10 Site monitoring wells including:

- Five existing monitoring wells (MW-02, MW-04, MW-05, MW-08, MW-10 and MW-11) within the East Portion of the Site and four new monitoring wells (MW-15, MW-16, MW-17 and MW-18) within the Central Portion of the Site (Figure 3-2).

MW-02 and MW-15 serve as the Site background wells.

Groundwater-sampling involved the following:

- Measurement of static water levels;
- Well purging using a Grundfos submersible pump for the monitoring wells and a peristaltic pump for the temporary locations (both with disposable tubing);
- Measurement of field parameters (pH, temperature, specific conductance, temperature, dissolved oxygen, and turbidity) during purging;
- Collection of all purge water was placed in labeled 55-gallon for temporary on-site storage prior to disposal; and,
- Collection of groundwater samples in appropriate containers.

The static water level was measured at each well prior to sampling. An electric well sounder was used for all manual water level measurements. The sounder was cleaned before and after each use by a process involving a detergent rinse, followed by an organic free distilled/deionized water rinse. The water level was measured from the elevation survey mark and was recorded to the nearest 0.01 feet. All recordings, dates, times and well designations are recorded on the Water Level Form included in Appendix A. A summary of the field parameter measurements, purge volumes and sample collection details are provided on the well purge forms and sample integrity data sheets in Appendix A.

During purging, field parameters were periodically measured. Purging was continued until the measured rate of change of the parameters was in accordance with TP-1.2-20 on consecutive readings. The instruments used in the field parameter measurements were field calibrated per the manufacturers' specifications and as described in the QAPP (Golder, 2003). Groundwater produced during purging was captured in labeled 55-gallon drums.

Samples were collected in bottles of appropriate volume and type, including preservatives as appropriate, as detailed in the QAPP. After filling, the bottles were immediately sealed, labeled and placed in a cooler maintained at 4° C. Samples were transported to the laboratory for analysis with chain-of-custody documentation in sufficient time to perform the requested analyses within the applicable holding times. The samples taken and laboratory analyses are summarized in Tables 4-7, 4-8 and 4-9. An Ecology representative was present on-site for split sampling and collected a split sample from MW-15 (Table 4-8).

Documentation for sampling included bottle labels, completion of Sample Integrity Data Sheets and chain-of-custody Records. The Sample Integrity Data Sheet was used to document groundwater sample collection information, as further described in the QAPP section of the approved RI/FS work plan (Golder, 2003).

4.5.5 Sampling of Soil and Water at the Western Catch Basin

During the RI activities, Golder personnel located the catch basin on the western central side of the western investigation area (Figure 2-1). Shallow groundwater that collects in the drainage system over the western investigation area (Figure 2-1) drains into this catch basin prior to flowing out to the sanitary sewer. To assess the general quality of the shallow groundwater as a whole and the sediment within the drainage system, water quality and sediment samples were taken from the catch basin. Sediment samples were collected from the catch basin on March 28, 2003. Water quality samples were collected from the catch basin on April 1, 2003.

Soil samples were taken from the bottom of the catch basin using a decontaminated stainless steel spade. Soil samples were collected in 4oz glass jars. The soil samples were submitted to OnSite for compositing and for analysis of NWTPH-HCID, semi-volatiles by EPA method 8270C, PCBs by 8082 and total RCRA metals. Water quality samples were taken by filling the appropriate containers directly from water contained in the catch basin. The water samples were submitted to OnSite for analysis of NWTPH-HCID, volatiles by EPA method 8260B and total RCRA metals.

4.6 Water Level Measurement and Product Removal at MW-11

Water levels were taken at all located, existing wells within the eastern investigation area and all new wells within the central investigation area on April 1, 2003 and again on September 26, 2003 according to the specifications of Golder Technical procedure TP-1.4-6 "Water Level Measurements." The water level measurements were collected as close to simultaneously as practicable in all wells in order to provide an accurate depiction of the water table. An electric well sounder was used for all manual water level measurements. The sounder was cleaned before and after each use by a process involving a detergent rinse, followed by an organic free distilled/deionized water rinse. The water level was measured from the elevation measuring point survey mark and was recorded to the nearest 0.01 feet. All recordings, dates, times and well designations are recorded on the Water Level Forms in Appendices A and A-1.

Floating product (petroleum) was discovered within the screened interval of MW-11 on April 1, 2003, while collecting groundwater measurements. The floating product was estimated to be approximately 6 inches thick.

While on site from September 25 through September 26, 2003, Golder personnel measured the floating product in MW11 using an interface probe and removed the floating product on three separate occasions, at 1500 on September 25, 2003 and at 0735 and 1600 on September 26, 2003. The thickness of the floating product in MW11 was measured at 2.4, 0.5 and 2.4 inches at these times respectively. After measurement, the product was pumped from the well.

4.7 Slug Testing

A series of three falling head and three rising head slug tests were conducted at MW-15 and MW-17 within the central investigation area on April 1, 2003. The tests were conducted in accordance with Golder technical procedure TP1.2-17 "Rising Head Slug Test". The falling head slug tests were performed by inserting a solid 6-foot long slug rod inside the well to displace the water in the well.

The rising head slug tests were performed by removing the slug rod from the well to displace the water in the well. The water level recovery after the slug is inserted (falling head test) and removed (rising head test) was monitored using automated pressure transducers and data loggers. The data was analyzed using the Hvorselv straight line method. The test analyses are included within Appendix B and the slug test results are summarized in Table 3-4.

4.8 Ecological Evaluation

The simplified terrestrial ecological evaluation was conducted in accordance with WAC 173-340-7492. This evaluation was initiated by obtaining a list of species for the site area protected under the Endangered Species Act, as well as the State list of Priority Habitats and Species. A site visit was conducted to observe species and habitat that could be affected if COCs (identified in Section 5) were to migrate off-site. With this information, a conceptual model was developed for ecological risk for an industrial site utilizing Table 749-2 of WAC 173-340-900. The model accounted for the nature and extent of contamination, exposure pathways, and possible receptors. The complete terrestrial ecological evaluation is provided in Appendix C.

4.9 Investigation Derived Wastes

Investigation derived waste (IDW) were generated on-site during boring, well development and well purging. All well development and purge water was contained in 55-gallon sealed drums and stored on the West Portion of the Site. The drums were labeled as outlined in the QAPP (Golder, 2003). Soil cuttings produced during drilling of the new monitoring wells were contained in 55-gallon sealed drums and stored on the West Portion of the Site. Waste soils produced during the GeoProbe program were contained within a sealed 5-gallon bucket and stored on the West Portion of the Site. All IDW containers were labeled as outlined in the QAPP (Golder, 2003).

Soil and groundwater quality data for the borings and wells will be used in the future to characterize the IDW prior to disposal. Additional IDW sampling may also be required prior to disposal at a licensed facility. Golder will work with the City of Moses Lake to manage IDW and will dispose of it during the remedial action, with Ecology approval.

4.10 Data Validation

All analytical data packages from each sample delivery group were validated by the detailed review and calculation validation processes described in *USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review* (EPA 1999), and *USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review* (EPA 2002). Data validation procedures were augmented in part by *"Data Validation Standard Operating Procedures for Contract Laboratory Program Routine Analytical Services"* (EPA, 1999). Data validation procedures were followed to ensure that the laboratory met all contractual requirements, all applicable reference method requirements, and the data quality objectives discussed in the RIFS Work Plan for the Moses Lake Facility and Appendix B (the Quality Assurance Project Plan), (Golder, 2003). The data review process provides information on analytical limitations of the data based on specific quality control (QC) criteria outlined in the referenced documents.

As part of data validation the split samples were collected by Ecology and analyzed at their Manchester Environmental Laboratory (Manchester) in Port Orchard, Washington. Ecology collected split samples from the following locations:

- Soil sampled from TP-03;

- Soil sampled from TP-04;
- Groundwater sampled from GeoProbe GP-19;
- Groundwater sampled from MW-15; and,
- Groundwater sampled from MW-11.

Split samples results are presented in the table notes on the appropriate analytical result tables presented and discussed in Section 5.

The copies of the annotated laboratory data reports are provided in Appendix G with the data validation report. Attachment 5 of the data validation report includes summary review tables of the sample holding times, a calculated comparison of duplicate and split samples and field blank samples.

5.0 NATURE AND EXTENT OF CHEMICAL CONSTITUENTS EXCEEDING REGULATORY CRITERIA

The following sections describe the analytical results for soil and groundwater samples collected during the RI field work conducted from March 27, 2003 through September 26, 2003. The results are organized by relative portion of the Site where samples were collected. Tables are provided that present the relevant soil and groundwater data and applicable Model Toxic Control Act (MTCA) cleanup criteria or National Water Quality Criteria, as appropriate. The complete analytical data reports for RI samples including the Ecology split samples are provided in Appendix H.

Method A and B cleanup criteria and ecological concern criteria (for simplified terrestrial ecological evaluations) are provided with the constituents or compounds results for soil samples, as appropriate. Method A and B cleanup criteria for groundwater and surface water with respect to human health are provided with the constituents or compounds results for groundwater samples, as appropriate. MTCA Method A criteria are conservative cleanup levels for sites undergoing routine cleanup actions or sites with relatively few hazardous substances. The Method A cleanup criteria are protective of human health and the environment for unrestrictive land use and potable water. MTCA Method B criteria presented are risk-based cleanup numbers that are protective of human health and the environment for unrestricted land use, potable water and surface water for a wide variety of hazardous substances. Chapter 173-201A 040 WAC surface water criteria and National Water Quality Criteria (EPA, 2002) for surface water are provided on groundwater tables for aquatic concerns, as appropriate. A more complete discussion of risk-based cleanup criteria and remedial action objectives is provided in Section 7.

Based on historical information those chemicals that may potentially have been contained in Site soils or groundwater and posed a risk to human health or the environment were considered as Constituents of Potential Concern (COPCs). Those constituents detected in soil or groundwater samples that were reported above their respective practical quantitation limit (PQL) and exceeded their respective cleanup criteria under MTCA or were not detected above their PQL, but the PQL exceeded the MTCA cleanup criteria were retained as COPCs. The list of COPCs was subsequently evaluated to determine the Constituents of Concern (COC) for soil and groundwater for each portion of the Site.

In general, COPCs were identified as COCs if the reported concentration for a constituent exceeded the applicable MTCA cleanup criteria. Uncertainties or exceptions that affected the determination of COCs from the list of COPC during the evaluation are presented in Section 5.6.2. Those constituents detected in soil or groundwater samples are identified in Section 5 tables. The tables also identify the constituents that exceeded MTCA cleanup criteria or had PQLs above the cleanup criteria (COCs). Figure 5-1 presents the concentrations of COCs and identifies the areas where Site soil is impacted with COCs above cleanup criteria.

5.1 East Portion Summary of Soil and Groundwater Sample Results

Tables 5-1.1 through 5-1.4 summarize the analytical results for soil and groundwater samples associated with the East Portion of the Site. Table 5-1 presents the analytical results for soil samples analyzed for total petroleum hydrocarbons and lead. Tables 5-1.2 through 5-1.4 present the groundwater sample analytical results for total petroleum hydrocarbons, lead, arsenic, polynuclear aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) detected above the respective VOC PQLs. Based on the results presented in the respective tables and following discussion diesel range petroleum hydrocarbons are identified as a COC for soil on the East Portion of the Site. Diesel and gasoline range petroleum hydrocarbons are identified as COCs for groundwater on the East Portion of the Site.

5.1.1 Soil

Table 5-1.1 summarizes the analytical soil results for the soils associated with potential releases from former diesel and waste oil USTs on the East Portion of the Site. The analytical results show that petroleum hydrocarbons were not present in the soil samples above their respective PQLs in RI samples with only one exception. Oil range petroleum hydrocarbons were detected (550 mg/kg) in one sample collected from GeoProbe sample location GP-01 at approximately 2.5 feet bgs, which at the reported concentration do not exceed the MTCA ecological concerns, or Method A or Method B cleanup criteria. However, diesel range petroleum hydrocarbons were detected (24,000 mg/kg) during the 1992 Century West investigation that exceeded the MTCA cleanup criteria in the sample that was colleted from CW-TP-2. The test pit was east of the maintenance shop wash rack as shown in Figure 5-1. The soils may have not been completely removed. Therefore, diesel through oil range petroleum hydrocarbons are identified as a COC for the East Portion of the Site soil.

5.1.2 Groundwater

Groundwater samples collected in East Portion of the Site showed little evidence of remaining impacts from historical UST releases of petroleum hydrocarbons with only one exception. A four to six inch floating petroleum product layer (diesel fuel) was discovered in MW-11 during the RI. The only groundwater sample collected on the East Portion of the Site that exhibited petroleum hydrocarbons concentrations above the MTCA Method A cleanup criteria was collected below the product layer at MW-11 Neither the product layer nor dissolved petroleum hydrocarbons were detected within 15 feet of MW-11 in hydraulically down-gradient or cross-gradient sample locations. Groundwater outside of the immediate area in the area of MW-11 does not appear to be impacted above cleanup criteria, however, only soil has been tested up-gradient of MW-11. The concentrations of diesel range petroleum hydrocarbons detected in MW-11 groundwater sample may be a function of intra well contamination between the floating product and groundwater or more closely associated with lowering the groundwater sampling pump through the product layer to collect the sample. Diesel through oil range petroleum hydrocarbons are identified as a COC for the East Portion of the Site groundwater. However, the floating product at MW-11 will essentially be addressed as a soil and source removal issue with subsequent groundwater testing. There are no surface water criteria for aquatic concerns available for petroleum hydrocarbons or associated VOC constituents from the noted sources.

PCBs were not detected above the individual aroclor PQLs (0.047 µg/L) and are not considered a COC. However, the PQL for PCBs does exceed the National Water Quality Criteria (0.014µg/L). A further discussion of PCB concentrations and National Water Quality Criteria is provided in Section 5.6.2.

Arsenic was detected in the five groundwater samples collected from the East Portion of the Site in March 2003. Concentrations ranged from 4.3 to 9.3 µg/L and exceeded the MTCA Method A cleanup criteria (5 µg/L) in four of the five samples. Arsenic was also detected in the six groundwater samples and one duplicate sample collected from the East Portion of the Site in September 2003. Concentrations ranged from 4.6 to 9.4 µg/L and exceed the MTCA Method A cleanup criteria (5 µg/L) in six of the seven samples. A final groundwater sample was collected from MW-02 on December 9, 2003 and had a concentration of 5.2 µg/L, which again exceeds the MTCA Method A cleanup criteria. However, based on statistical analysis conducted in accordance with WAC 173-340-709, the concentrations of arsenic detected in groundwater from two hydraulically upgradient well locations (MW-02 and MW-15) indicate the area background "upper 90" percentile concentration for arsenic in groundwater is 9.9 μg/L. Therefore, the arsenic concentrations detected in the East Portion of the Site groundwater samples are consistent with the calculated area background concentration.

Therefore, arsenic is not considered a COC in the East Portion of the Site. A further discussion of arsenic and background concentrations is provided in Section 5.6.2. Arsenic concentrations were below the surface water criteria for aquatic concerns.

Twelve of 18 PAHs were detected in the MW-11 groundwater sample. Two of the PAHs benzo(a)anthracene and chrysene are carcinogenic PAHs (cPAHs). The analytical results show that the concentrations of PAHs including the cPAHs are not above the MTCA Method A and B cleanup criteria. There are no surface water criteria for aquatic concerns available for PAHs from the noted sources. PAHs are not considered a COC in the groundwater in the East Portion of the Site.

A total of 12 VOCs were detected in RI groundwater samples collected from monitoring wells located on the East Portion of the Site. Ecology had a split sample from MW-11 analyzed for VOCs at their laboratory in Manchester, Washington. The analytical results from Ecology split samples produced results consistent with the RI samples. Four additional VOCs were detected above their respective PQLs in the Ecology split sample than the RI samples. No more than six individual compounds were detected in any one individual RI sample. A total of 16 VOCs were reported as detected in the split sample. The analytical results show that the concentrations of VOCs are not above the MTCA Method A or Method B cleanup criteria in either the RI or split samples. There are no surface water criteria for aquatic concerns available for the detected VOCs from the noted sources. Therefore, VOCs are not considered a COC for groundwater on the East Portion of the Site.

5.2 Central Portion Summary of Soil and Groundwater Sample Results

Tables 5-2.1 through 5-2.4 summarize the analytical results for soil samples associated with the source area in the Central Portion of the Site. Table 5-2.2 present the analytical results for total petroleum hydrocarbons used to delineate the extent of petroleum hydrocarbon impacts in the Central Portion of the Site. Table 5-2.5 present the analytical results for groundwater samples analyzed for total petroleum hydrocarbons, lead, arsenic, and PAHs. VOCs detected above the VOC PQLs are presented on Table 5-2.6. Table 5-2.7 present the analytical results for soil samples analyzed for total organic carbons. Based on the results presented in the respective tables and following discussion, diesel, oil and gasoline range petroleum hydrocarbons, xylenes and lead are identified as COCs for soil on the Central Portion of the Site.

5.2.1 Soil

Table 5-2.1 summarizes the petroleum hydrocarbon, BTEX, MTBE, PCB and lead results for the soils associated with the source area on the Central Portion of the Site. Table 5-2.2 summarizes the petroleum hydrocarbon, BTEX, MTBE results for soil samples collected and analyzed to delineate the extent of impacted soils.

Sample results from TP-04, and TP-05, show diesel, oil and gasoline range petroleum hydrocarbons were detected above both the MTCA Method A and ecological concern cleanup criteria in the source area and extended south-southeast to the area near GP-09 and GP-10. Ecology collected split samples from TP-04 and TP-05 that were analyzed at its Manchester laboratory. The analytical results from Ecology split samples produced results consistent with the RI samples. Diesel and or oil range petroleum hydrocarbons were also detected in soil samples collected from GP-07, GP-08, GP-11, GP-14, GP-15 and MW-15 but were below the MTCA Method A and ecological concerns cleanup criteria. Gasoline range petroleum hydrocarbons were only detected in samples collected from TP-04, TP-05, MW-16 and GP-09.

Lead was only detected in concentrations above the MTCA Method A cleanup criteria for unrestricted use in samples collected from TP-05. Lead was detected in concentrations ranging from 7.5 mg/kg to 330 mg/kg in the source area soil samples. The lead concentrations did not exceed the MTCA Method A cleanup criteria for industrial use (1,000 mg/kg) but did exceed the MTCA Method A cleanup criteria for unrestricted use (250 mg/kg), and exceeded the 220 mg/kg MTCA Ecological Concern Criteria (WAC 173-340 Table 749-2) in samples collected from TP-05. Therefore, lead is retained as a COC for some soil in the Central Portion of the Site.

Diesel and oil range petroleum hydrocarbons were detected in the Central Portion soil samples at concentrations that ranged between 170 mg/kg to 12,000 mg/kg and 67 mg to 8,700 mg/kg, respectively. Gasoline petroleum hydrocarbons were detected in soil samples at concentrations that ranged between 50 mg/kg to 5,800 mg/kg. Split sample results for diesel and oil range petroleum hydrocarbons were similar to the RI sample results. The Manchester laboratory also reported 84 mg/kg mineral spirits range petroleum hydrocarbons in the split sample.

Aroclor 1254 (PCBs) was detected from soil samples collected from TP-05 and MW-16 but did not exceed the MTCA Method A, Method B or ecological concerns cleanup criteria. PCBs are not considered a COC for soil in the Central Portion of the Site.

PAH results for the soils associated with the source area on this portion of the Site are summarized in Table 5-2.3 Fifteen of 18 PAHs were detected in one or more of the source area soil samples. The analytical results show that the concentrations of PAHs including cPAHs are not above the MTCA Method A, Method B or ecological concern cleanup criteria. However, due to interferences from elevated concentrations of petroleum hydrocarbons, the PQLs for the primary sample and duplicate (0TP05 – 3.0, 3.9 Comp and 1TP05 – 3.0, 3.9 Comp, respectively) samples collected at test pit TP-05 were above the cleanup criteria. PAHs were not analyzed for samples collected to delineate impacted soil as they were not identified as a COC in the source area.

VOC results for the soils associated with the source area are summarized in Table 5-2.4. Nineteen of 68 VOCs analyzed were detected in one or more of the source area soil samples analyzed by EPA Method 8260B. VOCs covered by the NWTPH-Gx method include BTEX and MTBE. The analytical results show that at the concentrations individual VOCs were detected only total xylenes were detected above the MTCA Method A, Method B or ecological concern cleanup criteria. Total xylenes (sum of m, p- xylene and o-xylene) were detected above the MTCA Method A cleanup criteria in the primary sample (10.4 mg/kg) and duplicate sample (43 mg/kg) collected from GP-09 at 3.5 to 4 feet bgs. Xylenes are a constituent of gasoline and diesel fuel and can be expected to be associated with the contamination at GP-09. Xylene is a COC for some soil in the Central Portion of the Site.

5.2.2 Groundwater

Table 5-2.5 summarizes results from the analyses conducted on groundwater samples collected from the Central Portion of the Site. The RI and Ecology split sample results show that MTBE and chloroform were the only organic constituents (including petroleum hydrocarbons and PCB analyses) detected above their respective PQLs. Neither of the compounds exceeded their respective MTCA Method A or Method B cleanup criteria. There are no surface water criteria for aquatic concerns available for petroleum hydrocarbons or detected VOC constituents available from the noted sources.

Based on the analytical results PCBs are also not considered a COC. However, the PQLs (0.048 µg/L) for PCBs exceeded the National Water Quality Criteria (0.014 µg/L). A further discussion of PCB concentrations and National Water Quality Criteria is provided in Section 5.6.2.

Arsenic was detected, in the groundwater sample and duplicate sample collected from MW-16 in March 2003, at concentrations (4.7 µg/L and 5.4 µg/L) consistent with Site background levels. However the concentration detected in the original sample (5.4 µg/L) is above the MTCA Method A cleanup criteria (5.0 µg/L).

Arsenic was also detected in the four groundwater samples collected from the Central Portion of the Site in September 2003. Concentrations ranged from 6.0 to 10.0 µg/L and exceed the MTCA Method A cleanup criteria (5 µg/L). A final groundwater sample was collected in the Central Portion of the Site from MW-15 on December 9, 2003, and had a concentration of 8.5 µg/L, which again exceeds the MTCA Method A cleanup criteria.

However, based on statistical analysis conducted in accordance with WAC 173-340-709, the concentrations of arsenic detected in groundwater from two hydraulically upgradient well locations (MW-02 and MW-15) indicate the area background "upper 90" percentile concentration for arsenic in groundwater is 9.9 µg/L. Therefore, the arsenic concentrations detected in the Central Portion of the Site groundwater samples are consistent with the calculated area background concentration.

Therefore arsenic is not considered a COC in the Central Portion of the Site. A further discussion of arsenic and area background concentrations is provided in Section 5.6.2. Arsenic concentrations were below the surface water criteria for aquatic concerns.

5.3 West Portion Summary of Soil and Groundwater Sample Results

Tables 5-3.1 and 5-3.2 summarize the analytical results for soil samples analyzed in association with the West Portion of the Site. Tables 5-3.3 presents the analytical results for total petroleum hydrocarbons, PCBs, EDB and detected VOCs, and Table 5-3.4 presents the metals results for groundwater samples collected on this portion of the Site. Based on the results presented in the respective tables and following discussion, no COCs were identified for the West Portion of the Site.

5.3.1 Soil

Table 5-3.1 summarizes the petroleum hydrocarbons, BTEX, and MTBE results for the West Portion soil samples. Oil range petroleum hydrocarbons were detected above PQLs in GP-17 through GP-20 soil samples. The concentration of oil range petroleum hydrocarbons detected on this portion of the Site ranged from 74 mg/kg to 920 mg/kg. Gasoline range petroleum hydrocarbons were only detected above PQLs in the soil samples collected from GP-17 at concentrations of 6.4 mg/kg. BTEX constituents and MTBE were not detected above their respective PQLs in the Western Portion soil samples submitted for chemical analysis. At the concentrations reported neither oil nor gasoline range petroleum hydrocarbons exceed MTCA Method A or Method B cleanup or ecological concern criteria.

Table 5-3.2 summarizes the results of the RCRA metals analysis for soil samples associated with this portion of the Site. Of the soil samples analyzed from this portion of the site barium, chromium and lead were the only metals detected above their respective PQLs. None of the metals were detected above MTCA Method A or Method B cleanup or ecological concern criteria. Selenium was included in the constituents that were not detected above its PQL and is not considered a COC. However, the

PQL for selenium exceeded the ecological concern criteria of 0.8 mg/kg. A further discussion of selenium concentrations and ecological concern criteria is provided in Section 5.6.2.

5.3.2 Groundwater

Results from analysis of organic constituents conducted on groundwater samples collected from the Central Portion of the Site are summarized in Table 5-3.3. Samples were analyzed for petroleum hydrocarbons, PCBs, VOCs, and PAHs. The results show that MTBE and chloroform were the only organic constituents/compounds detected above their respective PQLs in both the RI and Ecology split samples. Neither compound exceeded MTCA Method A or Method B cleanup criteria. There are no surface water criteria for aquatic concerns available for petroleum hydrocarbons, associated VOC constituents or PAHs from the noted sources.

Based on the analytical results PCBs are also not considered a COC. However, the PQLs (0.048 µg/L) for PCBs exceeded the National Water Quality Criteria (0.014 µg/L). A further discussion of PCB concentrations and National Water Quality Criteria is provided in Section 5.6.2.

Results from analysis of RCRA metals conducted on groundwater samples collected from the Central Portion of the Site are summarized in Table 5-3.4. The results show that arsenic was the only constituent detected above its PQLs. Concentrations of arsenic in groundwater collected from GP-19, GP-22 and GP-23 ranged from 5.8 to 11 mg/L and exceed the MTCA Method A cleanup criteria (5.0 µg/L). However, based on statistical analysis conducted in accordance with WAC 173-340-709 the concentrations of arsenic detected within these samples appear to generally be within the "upper 90th percentile" (9.9 µg/L) of the area background concentration, with one exception.

The concentration of arsenic detected in groundwater samples collected from the West Portion of the Site are samples are basically consistent with the calculated area background concentration. However, the groundwater sample collected from Geoprobe location GP-23 was reported with a concentration of 11 µg/L. This is the only location on the West Portion of the Site where arsenic was detected over the calculated area background concentration. However, the groundwater samples collected from GeoProbe samples are only considered as screening level samples, since GeoProbes are not viewed as proper groundwater quality monitoring locations (i.e. a formal monitoring well installed in accordance with the WAC 173-160 "Minimum Standards for Construction and Maintenance of Wells"). Therefore, arsenic is not considered a COC in the West Portion of the Site. A further discussion of arsenic and background concentrations is provided in Section 5.6.2. Arsenic concentrations were below the surface water criteria for aquatic concerns.

Selenium and silver were included in the constituents that were not detected above their PQLs (5.6 µg/L and 11.0 µg/L, respectively). Selenium and silver were also not detected above their Method Detection Limits (MDLs) (5 µg/L and 3.1 µg/L respectively). The PQLs for selenium and silver exceeded the National Water Quality Criteria 5 µg/L and 3.2 µg/L respectively. However the sample MDL did not exceed the National Water Quality Criteria for these two analytes, therefore selenium and silver are not considered COCs. Cadmium was also included in the constituents that were not detected above its PQL (4.4 µg/L). Cadmium was also not detected above its MDL (0.56 µg/L). Cadmium MDL is only slightly above the National Water Quality Criteria (0.25 µg/L). Cadmium is not considered a COC for the Site. A further discussion of cadmium concentrations and the National Water Quality is provided in Section 5.6.2.

5.4 West Portion Catch Basin Summary of Sediment Water Sample Results

Sediment and groundwater samples were collected from the catch basin of the West Portion of the Site (Figures 2-2 and 3-2). The catch basin receives water drained from the Central and West Portions of the Site. The sediment and water samples were collected and analyzed as a screening tool to identify COPCs potentially moving from Site soil to the Site surface water and/or groundwater. Tables 5-4.1 through 5-4.3 summarize the analytical results for the sediment sample analyzed in association with the West Portion of the Site catch basin. Tables 5-4.4 through 5-4.6 present the analytical results for the water sample collected from the catch basin. Based on the results presented in the respective tables and following discussion, arsenic, selenium, cadmium and lube oil range petroleum hydrocarbons were identified as COPCs. The evaluations for sediment samples used soil cleanup criteria for evaluating the potential of a constituent to be considered as a COC.

5.4.1 Catch Basin Sediment

Table 5-4.1 summarizes the petroleum hydrocarbons, and PCB results for the catch basin sediment sample. The results show that lube oil range petroleum hydrocarbons were the only constituent detected (13,000 mg/kg) above MTCA Method A cleanup criteria (2,000 mg/kg) for soil. The presence of lube oil in the catch basin sediment is expected and does not indicate any COPC or COC not already addressed on the Site. Lube oil was identified as a COC for the Central Portion of the Site. Lube oil was also detected in soil samples collected on the West Portion but were below the soil cleanup criteria.

PAH results for the soils associated with the catch basin are summarized in Table 5-4.2. Sixteen of 18 PAHs were detected in the sediment sample. The analytical results show that the concentrations of PAHs including cPAHs are not above the MTCA Method A, Method B or ecological concern cleanup criteria of soil.

Table 5-4.3 summarizes the results of the RCRA metals analysis for the catch basin. Barium, cadmium, chromium and lead were the only metals detected above their respective PQLs. None of the metals were detected above MTCA Method A or Method B cleanup or ecological concern criteria except cadmium. Cadmium was detected at 3.1 mg/kg, which is above the MTCA Method A cleanup level (2 mg/kg) for unrestricted use. Other analysis conducted for RCRA metals in soil failed to detect cadmium above cleanup criteria. Cadmium is not considered a Site COC, as the cadmium is limited to sediments contained in the catch basin and the cleanup level is based on the protection of groundwater. Due to the presence of cadmium above the MTCA Method A cleanup level (2 mg/kg) for soil, the catch basin will be cleaned out and documented under the Site remedial actions.

Selenium was included in the constituents that were not detected above its PQL and is not considered a COC. The PQL for selenium does exceed the ecological concern criteria of 0.8 mg/kg. A further discussion of selenium concentrations and ecological concern criteria is provided in Section 5.6.2.

5.4.2 Catch Basin Water

Table 5-4.4 summarizes the petroleum hydrocarbons results for the catch basin water sample. The results show that gasoline through lube oil range petroleum hydrocarbons were not detected above the MTCA Method A cleanup criteria for groundwater or the MTCA Method B criteria for Surface Water. The water results indicate that if the lube oil detected in the sediment sample is leaching out into the water it is below detectable levels. No surface water criteria for aquatic concerns are available for petroleum hydrocarbons.

Detected VOC results associated with the catch basin water sample are summarized in Table 5-4.5. Three VOCs MTBE (0.51 μg/L), 2-butanone (80.0 μg/L) and chloroform (0.58 μg/L) were detected above PQLs. The analytical results show that the concentrations detected none of the VOCs are above the MTCA Method A cleanup criteria for groundwater or MTCA Method B criteria for surface water. No surface water criteria for aquatic concerns are available for the detected VOC constituents.

Results from analysis of RCRA metals conducted on the catch basin water sample are summarized in Table 5-4.6. The results show that arsenic was the only constituent detected above its PQLs. The concentration of arsenic in the water was reported at 6.1 μg/L and exceeds the MTCA Method A cleanup criteria (5.0 μg/L). However, based on statistical analysis conducted in accordance with WAC 173-340-709 the concentrations of arsenic detected in this sample appears to be within the calculated area background concentrations. Therefore, arsenic is not considered a COC in the West Portion of the Site. A further discussion of arsenic and background concentrations is provided in Section 5.6.2. Arsenic concentrations were below the surface water criteria for aquatic concerns.

The same RCRA metals, cadmium, selenium and silver that were not detected in the West Portion groundwater samples were also not detected above their PQLs or MDLs in the catch basin sample. The MDLs for selenium and silver (5 μg/L and 3.1 μg/L, respectively) did not exceed the National Water Quality Criteria (5.0 μg/L and 3.2 μg/L, respectively) and they are not considered COCs. Although the MDL (0.56 μg/L) for cadmium slightly exceeded the National Water Quality Criteria (0.25 μg/L), it is not considered a COC.

5.5 Site Ecological Evaluation Results

A simplified terrestrial ecological risk assessment was conducted for the City of Moses Lake RI/FS per WAC 173-340-7490 through WAC 173-340-7494. The complete ecological risk assessment is provided in Appendix C. The primary conclusions reached by the ecological evaluation are as follows:

- Currently groundwater monitoring results indicate that COCs have not migrated off-site and there is minimal potential for off-site ecological impacts associated with the Site;
- The potential for future off-site ecological impacts is low and proposed remediation alternative will remove the source of contamination on-site to below MTCA soil cleanup levels for unrestricted use as well as reduce the potential for future offsite ecological impacts to occur;
- Currently the ecological risk (to wildlife) under the industrial site scenario is minimal, as bird and small mammal use of the area is minimized by the compacted nature of the asphalt or compact soil and the gravel covering the subsurface soil (making it less accessible for burrowing and foraging), the lack of plant cover in the area (making less shelter and other habitat available), and the general industrial activity of human and vehicle traffic and noise that make the immediate area unlikely habitat for birds or small mammals; and.
- The potential for future on-site ecological risk will be eliminated by the proposed remediation alternative by removing the source of contamination on-site to below MTCA soil cleanup levels for unrestricted use.
- Two COPCs, PCBs and cadmium were not detected above their respective PQLs or MDLs in groundwater or the catch basin water sample. The PQLs and MDLs exceed National Water Quality Criteria but neither analyte was considered a COC.

5.6 Remedial Investigation Conclusions

5.6.1 Summary of Remedial Investigation

Review of the data and Site information gathered during the RI and from previous investigations identified several COCs related to petroleum products. The COCs were discovered to be associated with the East and Central Portions of the Site related to petroleum products. Areas identified with COCs above regulatory levels are presented in Figure 5-2. The following summarizes the principal issues identified by the RI.

- Diesel through oil petroleum hydrocarbons are considered COCs for soil on the East (near MW-11) and Central Portions of the Site. Gasoline range petroleum hydrocarbons, xylenes and lead are considered COCs for some soils on the Central Portion of the Site;
- No COCs were identified for site groundwater except diesel through oil range petroleum hydrocarbons on the East Portion of the Site in the vicinity of MW-11;
- No COCs were identified for soil or groundwater on the West Portion of the Site;
- There was no off-site migration of COCs identified during the RI;
- There is no current exposure to off-site terrestrial ecological concerns including the adjacent wetlands.

5.6.2 Uncertainties Associated with the Data and Cleanup Criteria

The following uncertainties impact the quality of the data collected during the RI field activities. It is discussed here to describe its impact on the state of knowledge of soil and groundwater conditions onsite. However, none of these uncertainties create conditions where data was rejected or excluded from the RI/FS evaluation. They are discussed in this section for informational purposes only.

Arsenic was detected in groundwater samples across the Site at concentrations ranging from 4.3 µg/L to 11 µg/L. There was relatively little variation in the concentration of arsenic detected in groundwater samples collected on-site, which is not indicative of a source of arsenic other than from ubiquitous area background levels in the Site soils. However, the concentrations of arsenic detected in Site groundwater samples are generally above the MTCA Method A groundwater standard of 5 µg/L. Arsenic has been identified as naturally occurring in both soil and groundwater throughout eastern Washington.

WAC 173-340-709 provides a method for defining background concentrations for a constituent based on statistical analysis. WAC 173-340-709(3)(a) states that "for lognormally distributed data sets, background shall be defined as the true upper 90th percentile or four times the true 50th percentile whichever is lower". The background concentration of arsenic was determined based on the concentration of arsenic detected in groundwater samples collected from MW-02 and MW-15 as agreed to by Ecology (September 10, 2003 conference call).

The concentration of arsenic detected in groundwater samples collected on September 25, 2003 and December 9, 2003 from MW-02 (6.4 µg/L and 5.2 µg/L, respectively) and MW-15 (9.1 µg/L and 8.5 µg/L, respectively) were used to determine the true upper 90th and 50th percentile of arsenic in accordance with WAC 173-340-709. The true upper 90th and 50th percentiles of arsenic were calculated using the methods outlined in "Washington State Department of Ecology Toxics Cleanup Program Statistical Guidance for Ecology Site Managers" (Ecology 1992). Based on the assumption that the data are lognormally distributed, the 90th percentile of arsenic was determined to be 9.9 µg/L and four times the 50^{th} percentile (7.12 μg/L) was determined to be 28.5 μg/L. The assumption that the data are lognormally distributed was not disproved using the "W Test" as outlined in the Ecology (1992) Statistical Guidance Document. Therefore, the calculated area background concentration and cleanup criterion for groundwater to be used for arsenic at the Site is 9.9 μg/L. The statistical background calculation sheet is provided in Appendix A-1.

In situations where the cleanup levels are less than natural (area) background concentrations, WAC 173-340-700(6)(d) allows for the cleanup levels to be established at the background concentration. Given the fact that arsenic is a soluble metal that is commonly found in natural soils in Eastern Washington (Ecology, 1994), applying the background concentration as the cleanup levels is appropriate for the Site.

Soil samples submitted to the analytical laboratory from the West Portion of the Site were analyzed for RCRA metals by EPA Method 6010 in accordance with the Quality Assurance Project Plan (Appendix B of the RI/FS Work Plan). None of the metals were detected above their MTCA cleanup levels. However, the PQL for selenium was above the Ecological Concerns cleanup criteria of 0.8 mg/kg. The RI results indicate that the constituents impacting the Site are all related to petroleum releases. There is no process knowledge that indicates a release occurring on–site would lead to elevated levels of selenium. In addition, there were no other constituents reported above cleanup criteria on this portion of the Site that would indicate that any release of hazardous substances has occurred. Therefore, using the MTCA Method B concentration is appropriate for this Site.

Groundwater and catch basin water samples submitted to the analytical laboratory from the West Portion of the Site were analyzed for RCRA metals by EPA Method 6010 in accordance with the Quality Assurance Project Plan (Appendix B of the RI/FS Work Plan). None of the metals were detected above their PQLs except arsenic. However, the PQL (4.4 μg/L) for cadmium and the MDL (0.56 μg/L) were above the National Water Quality Criteria (0.25 μg/L). The cadmium MDL is only slightly above the National Water Quality Criteria. In addition, the RI data indicate that the constituents impacting the Site are all related to petroleum releases. There is no process knowledge indicating that a release occurring on–site would lead to elevated levels of the metals. In addition, there were no other constituents reported above cleanup criteria on this portion of the site that would indicate that any release of hazardous substances has occurred. Therefore, cadmium is not considered as COCs for the Site. The RI data indicates the COCs are not migrating with groundwater and more specifically are not migrating off-site and impacting adjacent wetlands for which the National Water Quality Criteria apply.

Similar conditions exist for PCBs analyzed for groundwater and catch basin samples on the East, Central and West Portions of the Site as the three RCRA metals. PCBs were not detected in any groundwater or water samples on Site. However, the PQLs for PCB analyses were above the National Water Quality Criteria (0.014 μg/L). The PQL for PCBs ranged from 0.047 to 0.048 μg/L, which is essentially the lowest reasonably achievable levels using standard analytical methods. WAC 173-340-707 states that "The Department recognizes that there may be situations where a hazardous substances is not detected or is detected at a concentration below the practical quantitation limit utilizing sampling and analytical procedures which comply with the requirements of WAC 173-340-830. If those situations arise and the practical quantitation limit is higher than the cleanup level for that substance, the cleanup level shall be considered to have been attained", which is subject to subsection (4) of the Section. The Site historical information, process knowledge and analytical data also indicate that the only substantial release(s) to occur on-site are associated petroleum releases. These analytes were therefore not considered as COCs.

The following section provides a description of laws and governmental regulations that apply to the chemical contamination found at the Moses Lake Maintenance Facility Site. It provides a context for developing cleanup standards in subsequent sections.

6.0 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

6.1 Introduction/Overview

This section identifies and evaluates federal and state requirements that are potentially applicable or relevant and appropriate (ARARs) for remedial actions at the City of Moses Lake Maintenance Facility. The ARAR identification process is based on criteria presented in WAC 173-340-710. Final ARARs will be determined in accordance with the requirements of the Agreed Order.

WAC 173-340-360(2) and 173-340-710(1) require that cleanup actions conducted under MTCA (RCW 70.105D) shall comply with applicable federal and state laws. Applicable laws are defined as those requirements that are legally applicable, as well as those that Ecology determines to be both relevant and appropriate.

In order to be defined as a "legally applicable" requirement, the requirement must be promulgated under state or federal law and must specifically address a hazardous substance, cleanup action, location or other circumstance at the site. "Relevant and appropriate" requirements are limited to those requirements promulgated under state and federal laws that, while not legally applicable, are determined by Ecology to address circumstances sufficiently similar to those encountered at the site such that the use of the requirements is well suited to particular site conditions. WAC 173-340-710(4) also includes a limited number of regulations that are automatically considered to be relevant and appropriate requirements.

Identification of ARARs must be made on a site-specific basis and involves a two-part analysis: first, a determination is made whether a given promulgated requirement is applicable; then, if it is not applicable, a determination is made whether it is both relevant and appropriate. A requirement may be either "applicable" or "relevant and appropriate," but not both.

The following discussion focuses on the most significant potential ARARs. The full list of potential ARARs is presented and discussed in Tables 6-1 and 6-2. The potential regulatory limits (cleanup criteria) for soil and groundwater in the East, Central and West Portion of the Site are presented in Tables 5-1.1 through 5-1.4, 5-2.1 through 5-2.6, and 5-3.1 through 5-3.4, respectively.

6.2 ARARs Based on Federal Laws

Resource Conservation and Recovery Act (RCRA) - 40 CFR 260-268

RCRA provides requirements that address the generation, transport, storage, treatment, and disposal of hazardous waste. In Washington, the majority of RCRA authority has been delegated to Ecology and is implemented through the Dangerous Waste Regulations (WAC 173-303).

6.3 ARARs Based on State Laws

Model Toxics Control Act - RCW 70.105D

MTCA is the key governmental regulation governing the conduct of the overall investigation and cleanup process for the site and is therefore applicable. MTCA describes the requirements for selecting cleanup actions, preferred technologies, policies for use of permanent solutions, the time frame for cleanup, and the process for making decisions. The regulation specifies that all cleanup actions be protective of human health and the environment, comply with cleanup standards (WAC

173-340-700 through WAC 173-340-760), comply with all applicable state and federal regulations, and provide for appropriate compliance monitoring. In addition, cleanup actions shall also use permanent solutions to the maximum extent practicable, provide for a reasonable restoration time frame and consider public concerns.

Specific criteria for the various cleanup methods are presented in the MTCA regulations. The MTCA regulations specify that cleanup actions utilize permanent solutions to the maximum extent practicable. Although MTCA identifies a hierarchy of preferred technologies that should be evaluated for use in the cleanup action, cost may also be a factor in determining points of compliance and selection of cleanup actions. For example, if the cost of cleanup action is substantial and disproportionate to the incremental increase in protection compared to a lesser preferred cleanup action, the less preferred action may be selected.

MTCA (RCW 70.105D.090) exempts remedial actions conducted pursuant to an Agreed Order or a Consent Decree from the procedural requirements of several state laws. These include the State Clean Air Act (RCW 70.94), Solid Waste Management - Reduction and Recycling Act (RCW 70.95), Hazardous Waste Management Act (RCW 70.105), Water Pollution Control Law (RCW 90.48), Shoreline Management Act (RCW 90.58), and Construction Projects in State Waters (RCW 75.20). In addition, the exemption also applies to the procedural requirements of any laws requiring or authorizing local governmental permits or approval for the remedial action. Therefore, while substantive compliance is necessary, permits and approvals are not required for remedial actions at the site. Substantive requirements are included in the Consent Decree, Agreed Order, or Enforcement Order implementing a cleanup action.

Model Toxics Control Act Cleanup Regulations - WAC 173-340

Regulations under Chapter 173-340 WAC, which implement the requirements of MTCA, are the primary regulatory vehicle under which the Moses Lake Maintenance Facility Site RI/FS process is being conducted and are therefore applicable. These regulations establish administrative processes and standards to identify, investigate and cleanup facilities where hazardous substances have been released.

WAC 173-340 Part VII establishes cleanup levels for environmental media, including groundwater, soil, and surface water. This regulation also contains standards for air emissions. Three methods are presented for determining cleanup levels: Method A (routine, using tables), Method B (universal), and Method C (conditional, primarily for industrial sites). All three MTCA methods for determining cleanup levels require compliance with other federal or state ARARs, and consideration of cross-media contamination. Method A is generally used for routine cleanups with relatively few contaminants. Method A standards are presented in tables in the MTCA rule.

Method B is the standard method for determining cleanup levels. Currently, Method B soil cleanup levels assume a residential use scenario, although Ecology could develop Method B industrial soil cleanup standards. Method B groundwater cleanup standards do not currently differentiate between residential and industrial use assumptions. Method B levels are determined using federal or state ARARs or are based on risk equations specified in MTCA regulations. For individual carcinogens, the cleanup levels are based on the upper bound of the excess lifetime cancer risk of one in one million (1×10^{-6}). Total excess cancer risk under Method B for multiple substances and pathways cannot exceed one in one hundred thousand (1×10^{-5}), and the total hazard index for substances with similar types of toxic response must be less than 1.

Method C cleanup levels are used where Method A and B are not appropriate. One of the following conditions must be met: Method A or Method B cleanup levels are below area background concentrations; cleanup to Method A or Method B levels has the potential for creating greater overall threat to human health and the environment than Method C; cleanup to Method A or Method B is not technically possible; or the site meets the definition of an industrial site. The requirements for qualification as a Method C industrial site are specified in WAC 173-340-740 and -745.

Method C cleanups must comply with applicable state and federal laws, must use all practicable levels of treatment and must incorporate institutional controls as specified in WAC 173-340-740 and 720. Risk-based equations for Method C cleanup levels for soil are specified in WAC 173-340-740 for residential and WAC 173-340-745 for industrial exposure assumptions. Method C cleanup standards for groundwater do not currently differentiate between residential and industrial use assumptions and are determined as specified in WAC 173-340-720. Total excess cancer risk for Method C, and the risk associated with individual compounds, cannot exceed 1 in one hundred thousand (1×10^{-5}), and the total hazard index for substances with similar types of toxic response must be less than 1. Method C cleanup levels that protect beneficial uses of groundwater other than drinking water are established by Ecology on a case-by-case basis. Method C cleanup criteria are not used for the Moses Lake Maintenance Facility Site.

For all three methods of establishing cleanup levels, Ecology must select a "point of compliance" for determining whether the cleanup level has been met. The point of compliance is defined as the point or points throughout the site where cleanup levels are established in accordance with the cleanup requirements for groundwater and soil specified in Sections 173-340-720 and -750. The point of compliance for soil cleanup levels based on the protection of groundwater is to be achieved in all soils throughout the site. For soil cleanup levels based on human exposure via direct contact, the point of compliance shall be established throughout the site from the ground surface to a depth of 15 feet. These depths represent the extent that soils may be potentially excavated or disturbed as a result of site development.

For cleanup alternatives that involve containment of hazardous substances, the soil cleanup levels are not required to be met at the points of compliance described above. WAC 173-340-720(8)(c) provides that where it can be demonstrated under WAC 173-340-350 through 173-340-390 that it is not practicable to meet the cleanup level throughout the site within a reasonable restoration time frame, Ecology may approve a conditional point of compliance for groundwater cleanup which shall be as close as practicable to the source of hazardous substances, and except as provided under (d) of the subsection, not to exceed the property boundary. Where a conditional point of compliance is proposed, the person performing the cleanup action must still demonstrate that all practicable methods of treatment are utilized. In these cases, compliance monitoring and other requirements identified in 173-340-740(6)(f) are required to ensure long-term integrity of the containment system.

State Environmental Policy Act (SEPA) – RCW 43.21C,

SEPA (RCW 43.21C) may be applicable to remedial actions at the Moses Lake Maintenance Facility Site. Ecology is the lead agency for MTCA remedial actions performed under a Consent Decree or an Agreed Order pursuant to WAC 197-11-253.

The SEPA process is triggered when a governmental action is taken on a public or private proposal. According to WAC 197-11-784, a proposal includes both regulatory decisions of agencies and actions proposed by applicants. If the proposal is not "exempt," Ecology will require the submission of a SEPA checklist, which solicits information regarding how the proposal will affect elements of the environment, such as air, water, etc.

If the proposal is determined by Ecology to have a "probable significant adverse environmental impact," an environmental impact statement (EIS) will be required, which examines potential environmental problems that would be caused by the proposal and options for mitigation. If in Ecology's opinion, there will be no significant adverse environmental impact, a Determination of Non-significance (DNS) will be issued and the SEPA process is completed without preparation of an EIS.

Any public comment period required under SEPA may be combined with any comment period associated with the MTCA process to expedite and streamline public input. According to WAC 197-11-259, if Ecology determines that the proposal will not have a probable significant adverse environmental impact, the DNS can be issued with the draft Cleanup Action Plan prepared pursuant to MTCA.

Dangerous Waste Regulations - WAC 173-303

The Washington State Dangerous Waste Regulations (WAC 173-303) are the state equivalent of the federal RCRA legislation, and contain a series of rules relating to the generation, handling, storage and disposal of dangerous waste. Recent MTCA amendments, as discussed above, exempt cleanup actions conducted under an Agreed Order or Consent Decree from the procedural requirements of several state laws, including the Hazardous Waste Management Act. Since implementation of the Act is afforded through the Dangerous Waste Regulations, this exemption also applies to the 173-303 rules. In addition, a recent amendment to the state Hazardous Waste Management Act (RCW 70.105) provides a conditional exemption to state-only dangerous wastes generated when a remedial action is conducted pursuant to a Consent Decree with Ecology. The exemption is not applicable to material that is a hazardous waste under Federal RCRA. The Consent Decree must provide management practices for the waste being generated, and must include a treatment or disposal location approved by Ecology.

Therefore, no WAC 173-303 procedural requirements will be applicable to remedial actions conducted at the site if the actions are conducted pursuant to a Consent Decree or Agreed Order. However, if non-exempt dangerous waste is generated and/or transported off the Site during cleanup, substantive requirements pertaining to dangerous waste generation, handling, storage, and disposal may be applicable under WAC 173-303.

The following section describes the specific cleanup level goals for the Moses Lake Maintenance Facility Site based on the COCs identified in Section 5.0 and the ARARs identified in Section 6.0.

7.0 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are site-specific goals based on acceptable exposure levels that are protective of human health and the environment. RAOs combine consideration of applicable or relevant and appropriate requirements (ARARs) and the specific constituents, affected media, and potential exposure pathways of the site. RAOs identify risk pathways that remedial actions should address and identify acceptable exposure levels for residual COCs.

The RI data indicated that groundwater is not impacted above MTCA cleanup criteria at the Moses Lake Maintenance Facility Site with the exception of the limited area near MW-11, where petroleum product was discovered in the well. Impacts to soils at the Site have been identified in the RI, based upon regulatory or screening levels. Adverse impacts attributable to the contamination at the Moses Lake Maintenance Facility include:

- Contamination of soils from historical operations and USTs previously located on Site that released petroleum hydrocarbons; and
- Potential contamination of groundwater by migration of constituents from contaminated soils; and the potential for petroleum impacts to groundwater at MW-11 to migrate off-site.

Considering the information collected in the RI, the potential risk of identified COCs, and potential migration pathways of materials disposed at the site, the remedial action objectives for this site are:

- Reduce the potential for exposure of human or ecological receptors to petroleum products at the Site via direct contact with contaminated soils or exposure to potentially hazardous constituents in groundwater;
- Reduce the potential for migration of petroleum from soil to groundwater, and
- Remove the potential for free petroleum product identified in MW-11 from migrating off site.

Remedial actions should be consistent with potential future land uses.

7.1 Cleanup Goals

Cleanup goals are numeric expressions of RAOs. A remediation goal is the maximum acceptable concentration of a COC to which the human or ecological receptors would be exposed via a specified exposure route (e.g., direct contact) under a specified exposure scenario (e.g., industrial land use). Cleanup goals are generally established for COCs as the lower of a numeric chemical-specific ARAR or a risk-based cleanup concentration. That is the cleanup levels at the lowest concentrations of cleanup criteria for protection of human health and ecological protection. Cleanup goals are presented as preliminary in the FS because the final remediation goals, or cleanup levels, are set in the Cleanup Action Plan (CAP).

The general framework that would be used to determine cleanup goals for any identified COC can be established according to MTCA acceptable exposure levels for carcinogens and non-carcinogens guidelines. Under MTCA, acceptable exposure levels for carcinogens are concentration levels that represent potential lifetime incremental cancer risk to an individual of 10^{-6} for individual constituents in a residential exposure scenario, 10^{-5} for individual constituents in an industrial exposure scenario, and 10^{-5} for combined constituent risks in both scenarios. For non-carcinogens, acceptable exposures levels are concentrations or multiple constituents that correspond to a hazard index less than 1.0.

Cleanup goals for remedial action involving soil are set at the appropriate MTCA Method A or Method B concentrations of ecological concern criteria for Site COCs. Similarly the cleanup goals for groundwater at MW-11 will be set as the appropriate MTCA Method A for Site COCs. Also, no ambient air quality standards are applicable to the site because it was not identified as an adverse impact attributable to the contamination at the site. Therefore, it is neither necessary nor appropriate to set remediation goals or cleanup standards for ambient air quality at the Site.

Table 7-1 presents the list of cleanup goals for the Moses Lake Maintenance Facility that is protective of human health and the environment. These cleanup goals are established for the list of analytes found to exceed their respective MTCA Method A or Method B cleanup criteria or terrestrial ecological evaluation concern criteria and are protective by multiple pathways and for multiple hazardous substances according to WAC 173-340-708 (5).

The following three sections comprise the feasibility study for the Moses Lake Maintenance Facility Site. The first (Section 8.0) identifies and screens remediation technologies; the second (Section 9.0) develops a list of remediation alternatives; and the third (Section 10.0) provides a detailed evaluation of alternatives and the selection of a remediation alternative for the Moses Lake Maintenance Facility.

8.0 IDENTIFICATION AND SCREENING OF REMEDIATION TECHNOLOGIES

This section presents the initial components of the Feasibility Study (FS) for the City of Moses Lake Maintenance Facility. It provides the identification and screening of remediation technologies where candidate technologies are screened on a site-specific basis to obtain a list of technologies feasible for use in assembling remediation alternatives.

These components are presented in the following sections.

8.1 Identification and Screening of Technologies

WAC 173-340-350(8)(b) affords the person conducting the FS the opportunity to screen alternatives or components from detailed evaluation. This section identifies and screens technologies or components that may be included as part of the remediation alternatives for the Site. A comprehensive list of technologies and process options that are potentially applicable to this Site is developed to cover all the applicable general response actions. The list of technologies is then screened to develop a refined list of potentially feasible technologies that can be used to develop remediation alternatives for the Site. The remediation alternatives/technologies are screened based on a preliminary analysis that first identifies those alternatives/technologies that clearly do not meet the threshold requirements identified in WAC 173-340-360(2)(a), which include:

- Protection of human health and the environment,
- Compliance with cleanup standards,
- Compliance with applicable state and federal laws, and
- Providing for compliance monitoring.

WAC 173-340-360(2)(b) requires that when selecting from cleanup actions that meet the minimum requirements, the action shall use permanent solutions to the maximum extent practicable and provide for a reasonable restoration time frame. The procedures for determining whether a cleanup action provides a reasonable restoration time frame are provided in WAC 173-340-360(4).

To determine if a cleanup action uses permanent solutions to the maximum extent practicable, the cleanup action is to be evaluated with respect to the following hierarchy of criteria presented in WAC 173-340-360(3)(f) as:

Protectiveness - Overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.

Permanence - The degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction of elimination of hazardous substances releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated.

Cost - The cost to implement the alternative, including the cost of construction, the net present value of any long-term costs, and agency oversight costs that are cost recoverable.

Long-term costs include operation and maintenance costs, monitoring costs, equipment replacement costs, and the cost of maintaining institutional controls. Cost estimates for treatment technologies shall describe pretreatment, analytical, labor, and waste management costs. The design life of the cleanup action shall be estimated and the cost of replacement or repair of major elements shall be included in the cost estimate.

Effectiveness over the long term - Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The following types of cleanup action components may be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: reuse or recycling; destruction or detoxification; immobilization or solidification; on-site or off-site disposal in an engineered, lined and monitored facility; on-site isolation or containment with attendant engineering controls; and institutional controls and monitoring.

Management of short-term risks - The risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.

Technical and administrative implementability - Ability to be implemented including consideration of whether the alternative is technically possible, availability of necessary off-site facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current or potential remedial actions.

Consideration of public concerns - Whether the community has concerns regarding the alternative and, if so, the extent to which the alternative addresses those concerns. This process includes concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the site.

Various technologies may only serve as one aspect or component of a cleanup action and may not solely meet all of the threshold requirements. However, the hierarchy of criteria identified above can be used for purposes of screening technologies (as a components of a cleanup action) from detailed analysis in a qualitative manner with the exception of consideration of public concern.

The technologies and process options are screened against the criteria hierarchy listed above using the "fatal flaw" approach. This approach ranks the criteria in order as listed above. Once a technology is rejected based on protectiveness, it is not further evaluated based on subsequent criteria. Similarly, if a technology is protective, but not permanent, the technology is rejected and evaluation of subsequent criteria is not undertaken. This approach streamlines the evaluation of technologies while maintaining the MTCA screening methodology.

Evaluation and screening of technologies are performed in a single step. The key criterion in selecting the screening level (technology class, individual technology, or process option) is whether there is a significant difference between the technologies or process options when evaluated against the screening criteria. Technologies and process options that are judged to have significant differences are screened separately, and the retained technologies or process options will be developed into separate remediation alternatives to allow full evaluation and comparison.

Process options that are screened together (i.e., not evaluated separately) and retained for any given technology are considered equally suitable (at the screening level of evaluation). Selection of representative process options is performed during the development of alternatives, so that best engineering judgment may be used to select and combine appropriate technologies and process options into cohesive, integrated remediation alternatives.

The potentially applicable remediation technologies considered for the Site are presented in Table 8-1 at the end of this section. The technology screening evaluations are also summarized in the table. Brief descriptions of the listed technologies and discussions of the screening evaluations are provided below. Technologies retained through this screening process are then incorporated into remediation alternatives in Section 9.

8.1.1 General Response Actions

General response actions are broad categories of remedial actions that can be combined to meet remedial goals at a site. The following general response actions are generally applicable to most sites, including the Moses Lake Maintenance Facility Site:

- No action
- Institutional controls (including monitoring)
- Containment
- Treatment (ex-situ or in-situ)
- Disposal (on-site or off-site)
- Removal.

Except for "no action," each of these response actions represents a category of technologies. The applicable technologies will vary depending on the media (e.g., soil or groundwater) and COCs (e.g., organic compounds or metals). The discussion of technologies is organized below by general response actions for groundwater and soil (the applicable media).

8.1.2 Institutional Controls And Monitoring

Institutional controls are legal and physical restrictions placed on a site to prevent exposure to COCs. Risk is mitigated by institutional controls to the extent that they prevent exposure to affected media including areas where elevated concentrations are present. However, institutional controls do not prevent off-site transport of constituents. Institutional controls include any maintenance required for ongoing effectiveness. Institutional controls are effective within their limitations, are easily implemented, and are low in cost. Institutional controls are typically included in any remedy where COCs will remain after completion of remediation. Institutional controls with monitoring alone are not protective of human health and the environment and do not meet the MTCA cleanup standard for this site, and therefore do not meet the threshold requirements of WAC 173-340-360 2(a)(i) through (iv).

Site Access Restrictions. Access restrictions involve preventing access by unauthorized persons. Fencing, combined with warning signs, is the most common means of restricting access. Security patrols are sometimes included for high-risk areas, but would not be warranted for this site. Fencing provides a physical barrier to site access. Warning signs discourage trespass by warning potential intruders of the hazards of entering the area. The maintenance facility is currently entirely fenced and access is limited to City personnel or personnel under the direction of the City. Fencing and warning signs are retained for further consideration.

Land Use Restrictions. Land use restrictions are legal controls such as deed restrictions and zoning that limit development or activities at a site. Deed restrictions are notices of land use restrictions that accompany the deed to the property in a manner that is legally binding and must be transferred to all subsequent owners of the property. The restrictions would include a description of the site and reasons for the limits on future activity. Such restrictions would prevent activities or development that could cause direct exposure to COCs, or that would compromise the integrity of the remedy. For example, deed restrictions would prohibit site development that could impair the effectiveness of a cap remedy. Land use restrictions are retained for further consideration.

Monitoring. Site monitoring may be a required component of any site remedy. Short-term monitoring is conducted to ensure that potential risks to human health and the environment are controlled while a site remedy is being implemented. Long-term monitoring is conducted to measure the effectiveness of the remedy and thereby ensure that the remedy continues to be protective of human health and the environment. Long-term monitoring would include periodic site inspections as necessary to determine maintenance needs (e.g., for fencing or a cap). A monitoring plan will be developed for the selected remedial action. The type of monitoring performed will depend on the nature of the remedy.

8.1.3 Containment

In-situ containment is a general response action used to prevent exposure to material affected by COCs that are left in place, and to control migration of constituents. Containment technologies are identified and screened in this section.

Capping.
Capping is a proven, effective technology for providing reliable long-term containment and preventing or minimizing off-site migration of constituents. Capping minimizes risk by preventing direct contact with hazardous substances in affected soil, and preventing off-site migration of constituents in surface water or airborne dust. Where infiltration through hazardous substances or affected soil is a concern, a low-permeability cap design is used to minimize the potential for constituent migration into groundwater by minimizing infiltration of precipitation.

Caps may be constructed of a variety of natural materials (i.e., clay, sand, and other soils), synthetic liners, geotextiles, other geomembranes, and other synthetic materials (e.g., asphalt or concrete). They may consist of a single layer or be a composite of several layers. Caps provide containment in three primary ways:

- A cap serves as a physical barrier to prevent humans, other animals, and vegetation from coming in contact with materials affected by COCs.
- A cap prevents erosion of soil by surface water and wind, thereby preventing off-site transport of COCs via surface water or wind.
- A low-permeability cap minimizes infiltration of surface water, decreasing the potential for transport of COCs in the soil to groundwater.

Caps can be designed to be compatible with many potential future site uses. Land use restrictions and other institutional controls are typically employed along with capping to prevent future site activities that could violate the integrity of the cap (e.g., excavation or support pilings for buildings). Long-term maintenance and monitoring are required.

Capping is readily implemented using standard design and construction techniques. It is relatively low cost, and thus highly cost-effective (i.e., high incremental protection relative to remediation cost). Capping technology is retained for further consideration.

Dust Control.
Dust control incorporates any measures to prevent wind dispersion of soil affected by COCs. Several approaches to dust control are available. Water is the most common method of short-term dust control. For long-term dust control, vegetation can be planted to hold the soil together and reduce wind velocity at the ground surface. Migration of site constituents via dust is not a problem at this site. However, excavation of the contaminated soil could generate dust from affected soil; therefore, dust controls are retained for possible use in conjunction with excavation.

Surface Water Controls.
Surface water management involves controlling surface water run-on and run-off at a site. The purpose of these controls is to minimize erosion that can entrain exposed soil affected by COCs, and expose underlying affected materials. Surface water controls by themselves are not generally effective as a permanent remedy. These controls may be used as short-term measures (e.g., during excavation), or as long-term measures (e.g., as part of capping). Surface water controls are proven technology, effective, easily implemented and inexpensive. They are therefore retained for use in conjunction with other remediation technologies.

8.1.4 Removal

Removal is a general response action for media affected by COCs prior to ex-situ treatment or disposal (on-site or off-site). Removal can be complete (i.e., all portions of soil with constituents above remediation goals), or partial (i.e., the highest concentrations of a constituent of concern). Removal by itself is not a complete remedial action, but must be combined with subsequent treatment and/or disposal of the removed media.

Excavation.
Removal of affected soil from the contaminated areas is technically feasible. Equipment that would be considered includes backhoes, loaders, bulldozers, clamshells, and draglines. The choice of equipment is typically made by the excavation contractor and is not normally part of design.

Excavation of affected soil would be necessary to allow ex-situ treatment or off-site disposal. Therefore, excavation is retained for use in conjunction with appropriate treatment or disposal technologies.

8.1.5 Ex-Situ Treatment

There are numerous technologies available for ex-situ soil treatment. The soils are treated with the intent of reducing the toxicity, mobility, or volume of material. However, all require the removal of affected soil and vary in the degree on implementability.

This section considers a wide range of technologies for ex-situ soil and waste treatment following excavation. A treatability study would be necessary to determine the appropriate treatment method, should excavation and treatment of contaminated material be selected as the recommended remediation action. Ex-situ soil treatment technologies are therefore identified and screened for this eventuality.

Treatment is intended to reduce the toxicity, mobility, or volume of material affected by COCs. Many treatment technologies convert COCs to less toxic forms. Destruction or degradation of organic compounds is possible (e.g., oxidation to carbon dioxide and water) although not always feasible or cost-effective. However, metals cannot be destroyed by treatment. Metal toxicity can be reduced via chemical conversion to a less toxic compound of the metal, and metals can be immobilized by fixation (stabilization).

Reuse/Recycling. The reuse and recycling of impacted soil can be accomplished if impacted soils are excavated and transported to a landfill. The impacted soil may be used as landfill cap material, although no other waste materials have been identified at this site with the potential for reuse or recycling. The reuse and recycling of impacted soils as landfill cover in general provides an effective permanent solution that is protective of human health and the environment and is easily implementable. This technology is therefore retained for use in conjunction with disposal technologies.

Dry Soil Sieving. Dry soil sieving is an ex-situ physical separation process that is performed without the addition of water. Soil is passed through one or more screens and separated into various size fractions. The concept behind remediation using this technology is that the concentrations of COCs in soil particles often increase with decreasing particle size. In addition, large-mesh screens (e.g., a grizzly) are commonly used to remove debris and other large objects from waste and affected soil to facilitate handling. Although not as effective as physical soil washing, it is easy to implement and much less costly (generally a few dollars per ton of soil treated). When applicable, it is highly cost-effective because of reduction in disposal costs. Therefore, this technology is retained for possible use in the design phase for separating clean soil, debris, and affected soil in conjunction with excavation if an excavation alternative is selected.

Physical Soil Washing (Aqueous Physical Separation). The term "soil washing" has been used to describe a variety of treatment processes. As used here, physical soil washing refers to soil washing for physical separation; "chemical extraction" is used to refer to processes using aqueous and non-aqueous solvents for extraction of COCs. Physical soil washing is applicable to soil where the COCs are concentrated in a particular size fraction. In practice, the majority of COCs in soils are often associated with the silt and clay soil fractions (collectively called the fines), with coarser soil (sand and gravel) being relatively clean.

The effectiveness of physical soil washing is highly variable, depending on the COCs and site-specific conditions. In addition, treatment of the wash water is necessary prior to discharge, and the fines must be dewatered for landfill disposal. Physical soil washing is also a relatively complex process and requires use of specialized contractors. For the most part the limited solubility of petroleum products particularly the heavier end oils eliminates the use of water alone and requires the use of surfactants. Soil washing systems for site remediation are innovative and currently in various stages of development and implementation. Physical soil washing would not provide proven, reliable treatment for this site, and would be difficult to implement. This technology is therefore not retained.

Chemical Extraction. Chemical extraction is a generic term for treatment processes where a liquid solvent is used to extract COCs from waste or affected soil. The spent solvent must then be treated or recovered and recycled. The terms "soil washing" and "solvent extraction" are sometimes used for processes included in this treatment category. Aqueous soil washing is included in this category when the purpose of the treatment is removal of COCs from the soil, rather than separation of soil into affected and clean fractions as in physical soil washing. Other solvents and reagents that can be used include surfactants, liquid carbon dioxide, and triethylamine (TEA) for organic compounds; petroleum solvents for oil recovery; and acids or complexing agents for metals.

A number of chemical extraction processes, including extractive soil washing, have been attempted at bench and pilot project scales with varying degrees of success. The effectiveness of chemical extraction is highly dependent on the COCs and site-specific waste characteristics. Published data show large variations in effectiveness between sites. Chemical extraction at this site would have all of the problems cited for physical soil washing, but to a greater degree. It is less proven technology, more complex and difficult to implement, and could result in a disproportionate cost. This technology is therefore not retained.

Fixation (Chemical Stabilization). Fixation, also called chemical stabilization or simply stabilization, involves mixing soil affected by COCs with binding agents to form a solid matrix that immobilizes the COCs, and thereby reduces constituent mobility (leachability) and associated risk. Fixation typically uses pozzolanic agents, such as cement, fly ash, and lime. Selecting stabilization as a remediation technique requires laboratory testing to verify the fixing agent is effective. The presence of high concentrations of adsorbed oil on soil particles being stabilized may interfere with the process and result in structurally poor soils. Proprietary additives are available that are claimed to improve immobilization and stability. Fixation is a common, established technology for treatment of wastes and soils affected by heavy metals. Metals are typically immobilized by both chemical bonding and physical entrapment; organic compounds are immobilized only by entrapment. Fixation is a proven technology for immobilization of a variety of constituents, and is not difficult to implement on-site or off-site. This technology is therefore retained for possible use, but only to the extent required to meet regulatory requirements for treatment prior to off-site disposal.

Biological Treatment. Biological treatment is a class of technologies commonly applied for destruction of organic COCs. Biological treatment encompasses a number of treatment methodologies and can be performed ex-situ and in-situ, with varying effectiveness, and may be accomplished by aerobic oxidation or anaerobic reduction processes.

Whether considering ex-situ or in-situ methods biological treatment is based on the principle that a number of microorganisms exist naturally in most soils or can be introduced. These organisms which include many species of bacteria and fungi can use organic chemicals as an energy supply and results in the degradation of the chemicals. Many factors impact the effectiveness of the biological treatment of soils including moisture content, soil porosity, availability of oxygen, pH, toxicity of chemical present in the soil to microbes, and temperature to identify a few. The balance of these and other factors determines the effectiveness of biological treatment.

Biological treatment can have high effectiveness for some constituents, such as lighter petroleum hydrocarbons, and poor effectiveness for many others, such as PAHs and heavy oils. Biological treatment will not destroy metals or remove them from soil. It is usually not suitable for solids wastes with high concentrations of COCs. The difficulty of implementation can vary wide, depending on the matrix and the COCs. When effective, biological treatment is usually inexpensive relatively to other organic destruction technologies. Because of its limitations and lack of proven effectiveness in treating the heavier organic COCs (motor oil range petroleum hydrocarbons) associated with this Site, biological treatment technologies are not retained.

Chemical Oxidation/Reduction. Chemical oxidation-reduction reactions can be used to reduce toxicity or to transform a substance to one more easily handled. Oxidizing or reducing reagents (as appropriate) are added to cause or promote the desired reaction. For example, oxidizing agents can be used to destroy or detoxify organic compounds. However, chemical oxidation/ reduction of solid waste or affected soil is unproven technology as many factors impact the effectiveness of the chemical treatment of soils including moisture content, soil porosity, pH, buffering capacity of the soil with respect to the reagent used, and temperature to identify a few. The balance of these and other factors determines the effectiveness of chemical treatment, which can be difficult to control. Monitoring the reaction for control purposes can also prove difficult. This technology is therefore not retained.

Thermal Treatment. Thermal treatment technologies are primarily designed for destruction of organic COCs. Thermal desorption is a typical thermal treatment technology, where COCs are volatilized (put in the vapor phase) for subsequent thermal destruction. Thermal treatment does not destroy or immobilize metals; thus the ash from thermal treatment may require fixation before landfill disposal.

On-site thermal treatment and off-site thermal treatment are both technically and administratively achievable for this Site, and are both are retained for further consideration. On-site thermal treatment would minimize or eliminate the requirements for off-site transportation and have less impacts on traffic. However, on-site thermal treatment is generally more difficult to implement from both a technical and administrative standpoint, due to stack testing, air permitting requirements and resistance often encountered from the public.

8.1.6 In-Situ Treatment

This section considers technologies that treat COCs in place. As with ex-situ treatment, the purpose of in-situ treatment is to reduce the toxicity, mobility or volume of COCs. The same classes of treatment that are available for ex-situ soil treatment are generally available for in-situ treatment. However, the treatment conditions are very different. There are a number of in-situ treatment technologies that could be considered, including:

- Biological treatment (soil/groundwater).
- Chemical oxidation/reduction (soil/groundwater).
- In-situ fixation (e.g., grout injection or deep soil mixing).

When feasible, the key advantage to in-situ treatment is that excavation of the soil is avoided. However, the difficult aspects with these three technologies were presented in Section 8.1.5. The key disadvantage to in-situ treatment is that the treatment process cannot be controlled nearly as well as the same treatment in a reactor or other process equipment following excavation. This decrease in control results from a combination of greater difficulties in achieving desired process conditions, and the inherent heterogeneity of the subsurface. Therefore, an in-situ treatment process is generally less effective at achieving treatment objectives and less reliable in achieving uniform treatment than the corresponding ex-situ treatment process. Treatment effectiveness is also often difficult to verify, therefore, no in-situ treatment technologies are retained. For this site, treatment would be better performed ex-situ, if treatment is selected.

8.1.7 Disposal

Disposal is a general response action for final disposition of excavated waste and affected soil, or waste generated by treatment processes. Landfill disposal relocates COCs from one place to another for long-term containment; it does not use treatment to destroy or detoxify COCs. However, if needed, treatment can be used prior to disposal. The options for disposal following excavation are an on-site constructed landfill, and off-site landfill disposal (including any treatment under land disposal regulations).

On-Site Disposal (Consolidation of Impacted Soil). On-site consolidation of impacted soil requires excavation of an area large enough to contain the contaminated soil, containment (i.e., liner), and capping. Long-term monitoring would also be required.

At this Site, groundwater is not impacted (except at MW-11), therefore reducing infiltration would be more effective than having a liner below the impacted soils. In-place containment would provide protection against direct contact or migration of COCs. In-place containment would also avoid the added step of excavating. Capping with groundwater monitoring would provide the same level of protection of human health and the environment, but would be much easier to implement. Off-site disposal would be a better option in the event an excavation alternative was selected. On-site disposal (consolidation of impacted soil) is therefore not retained.

Off-Site Disposal. Commercial or municipal landfills could be used for disposal of waste or affected soil excavated from the contaminated areas. The appropriate landfill would depend on the nature of the material for disposal. Municipal landfills are allowed to accept waste that is not classified as hazardous under federal (RCRA) regulations or as dangerous under Washington State regulations. The Rabanco Landfill in Roosevelt, Washington and the Waste Management Graham Road Landfill in Medical Lake, Washington have been identified as potential landfill locations. The cost of off-site disposal could potentially be decreased if this technology were combined with appropriate ex-situ treatment technology. Off-site disposal is retained for further consideration.

9.0 DEVELOPMENT OF ALTERNATIVES

In this section, remediation alternatives are developed from the remediation technologies retained after screening. The technologies are combined to create a wide range of alternatives that represent various approaches to achieving remedial action objectives. The alternatives are then evaluated in Section 10.

Under WAC 173-340-360(2)(a) remediation alternatives are developed to meet the minimum requirements previously identified in Section 8.1 and include:

- Protect human health and the environment.
- Comply with cleanup standards.
- Comply with applicable laws and regulations.
- Provide for compliance monitoring.

Other requirements under WAC 173-340-360(2)(b) include utilizing permanent solutions to the maximum extent practicable and providing for a reasonable restoration time frame.

Cleanup technologies are evaluated in consideration of the hierarchical criteria presented in WAC 173-340-360(3)(f) and listed below:

- Protectiveness,
- Permanence,
- Cost,
- Effectiveness over the long term,
- Management of short-term risk,
- Technical and administrative implementability and,
- Consideration of public concerns.

The WAC 173-340-360 definition for each of these criteria was previously presented in Section 8.1.

Considering MTCA regulations, other ARARs, remedial action objectives, and the technology screening, the following alternatives have been assembled:

Alternative 1: No Action
Alternative 2 Institutional Control and Monitoring
Alternative 3: Capping - Monitoring and Institutional Controls
Alternative 4: Excavation and Off-Site Landfill
Alternative 5: Excavation and On-Site Treatment
Alternative 6: Excavation and Off-Site Treatment

These alternatives are described and developed below in Sections 9.1 and 9.2. It is necessary to make a number of design assumptions to fully develop and evaluate each alternative. These design assumptions are representative of the technologies used in the alternatives. However, the design assumptions used here are not necessarily the same as the design basis that would be used for the final, detailed design. In most cases, additional investigations may be necessary to allow final design. Waste characterization would be required following excavation for potential treatment or disposal.

9.1 Common Elements

Several alternatives share common elements in their formulation. To avoid repetition, this section presents the descriptions of elements common to two or more alternatives. These common elements are then referenced in the descriptions of the alternatives.

9.1.1 Institutional Controls

Institutional controls are a key component to maintain long-term effectiveness for alternatives where COCs remain above cleanup levels on-site following completion of remedial action. Deed restrictions would be instituted for Alternatives 2 and 3 to ensure that site use restrictions remain in force regardless of the property owner and to notify any prospective purchasers of the presence of subsurface hazardous substances. For capping alternatives, restrictions would prohibit penetrating the cap and any site use that could damage the cap or significantly reduce its effectiveness. Warning signs would be used to provide notice of the presence of a contaminated site. Site use restrictions would remain in force indefinitely.

Permanent fencing is not addressed in any of the alternatives, because the existing fence would provide adequate protection against direct contact for passersby until a cap could be installed or the COCs above MTCA cleanup criteria are removed. Signage would be placed to educate Site workers of hazards and restrictions. Periodic site inspections and maintenance of a cap, fencing, signs, and any other physical components of the institutional controls would be included in the cap alternative.

The only location identified on-site where groundwater has been impacted above MTCA cleanup criteria is a limited area at MW-11. Therefore, groundwater use restrictions are necessary under the capping alternative.

9.1.2 Monitoring

Monitoring is included as part of all alternatives, except Alternative 1 (No Action). Separate monitoring programs will be used for the compliance/short term (during remedial action and verification period) and the long term (following completion of remediation). Compliance/short-term monitoring is viewed being conducted for a period of up to five years, long-term monitoring is viewed as being on the order of 20 years. The monitoring requirements will be evaluated if required as part of the Cleanup Action Plan (CAP). In particular, monitoring frequency and number of years over which monitoring will be required will be defined in the CAP. Detailed monitoring plans will be developed for the selected remedy during final design for public comment and Ecology approval.

9.1.2.1 Short-Term Monitoring

Short-term monitoring is required during remediation to ensure that there are no adverse effects from remediation activities, to provide quality control, and to confirm the attainment of cleanup standards and/or relevant performance criteria. Health and safety monitoring is also performed to ensure that site workers are not exposed to undue or unexpected risks.

Short-term monitoring to demonstrate attainment of cleanup standards is applicable for Alternatives 4, 5 and 6 because affected soil will be removed and either treated on- or off-site or disposed of off-site. This monitoring would include confirmatory soil sampling and analysis to verify the attainment of cleanup standards in the contaminated areas. No monitoring would be required for Alternative 1 (No Action).

9.1.2.2 Long-Term Monitoring

Long-term monitoring is conducted to 1) verify that the remedy performs as expected over time, and 2) allow timely maintenance of a cap (Alternative 3) and other physical components of an alternative. Periodic site inspections and surveys would be sufficient for determining maintenance needs and monitoring cap performance. Cap performance is also measured by groundwater monitoring. Long-term cap and groundwater monitoring would continue during the post-closure period, assumed for the purposes of the FS to last 20 years per WAC 173-340-350, and then cease. It is not expected that long-term monitoring (20 years or more) would be required for Alternatives 4, 5 or 6.

Cap Monitoring. Cap monitoring would consist primarily of visual inspections for damage and subsidence. The cap would be periodically examined for the presence of offsets, scarps, low-points, ponded water, odd changes in grade, and excessive erosion. For the first year, such inspections may be performed quarterly and may then be reduced to once or twice per year.

Groundwater Monitoring. Groundwater monitoring would include periodic groundwater sampling and analysis at selected key locations throughout the site to confirm that COCs do not exceed acceptable limits. Site groundwater is currently not substantially impacted, so the monitoring program will be designed predominately for detection of release of petroleum constituents into site groundwater, should it occur. The existing monitoring wells should be sufficient for this purpose with the addition of one monitoring well down-gradient of MW-11. Groundwater monitoring is included in all alternatives as a threshold requirement under WAC 173-340-360.

9.1.3 Excavation

Excavation is included in Alternatives 4, 5 and 6. Excavation of contaminated soil would protect human health and the environment by locating and removing affected soil from the Site.

The cleanup criteria considered in the removal alternatives involves removal to meet MTCA cleanup levels protective of human health and the environment. Removal of COCs to detection limits was not considered due to the practical benefit compared to costs. If groundwater impacts are not entirely remediated under the removal alternative, institutional controls may be required for the Site.

Prior to initiation of construction activities, some of the existing Site fence may be taken down to facilitate remediation activities. Temporary fencing will be placed around the perimeter of the excavation and loading area.

Conventional construction equipment such as backhoes scrapers would be used for contaminated soil excavation. Excavation equipment would not require decontamination until completion of the project, as long as the equipment remains within the fenced project area. Equipment will be decontaminated prior to removal from the fenced project area.

Excavation will be performed according to standard industry practices. Water spray would be used if necessary for dust suppression during excavation and loading activities. Low volume water sprays will be applied to material surfaces using equipment appropriate for the task. Water trucks will be used for suppression of roadway dust if necessary.

The average depth of the excavation is anticipated to be 4 to 5 ft bgs. Means of egress for both personnel and equipment would be provided in accordance with Washington State Labor and Industry requirements (WAC 296-155). If excavation depth should exceed 4 ft, the excavation side slopes will be 1.5 ft horizontal to 1 ft vertical (WAC 296-155-657) or properly shored for stability.

Excavated soils may be placed directly into the transport vehicles, or loading may occur from temporary stockpiles next to the excavation.

All excess water (if present) would be drained from soil in trucks prior to transporting soil from the excavation area. Impacted drainage from the trucks will be captured and treated on-site then discharged or taken off-site for treatment and disposal. On-site stockpiles would be placed on sheeting and have berms constructed of soil, hay bales, or other suitable materials sufficient to prevent off-site migration of the stockpiled soils. Stockpiles would be covered overnight to minimize wind-blown dust or exposure to precipitation.

Transport vehicles and transportation will be provided by the contractor. Conventional highway approved equipment would be used, and could include standard dumps, pony trailers and roll-off containers. All contaminated soil loads would be covered during transport to the disposal facility.

The excavation would remain open and secured until confirmation sampling results have been received and evaluated, and approval has been obtained from Ecology stating that the selected cleanup criteria have been achieved. The excavated area would then be backfilled with clean fill and the area will be returned to its original grade. Backfill would be placed in lifts and compacted to a stated compaction level within a defined moisture content range that will be specified in the design report.

9.2 Description of Remediation Alternatives

9.2.1 Alternative 1: No Action

A "no action" alternative is included as a baseline for comparison to the other alternatives. This alternative would leave the Site in its current state assuming no restrictions on future site use and no site maintenance or monitoring.

9.2.2 Alternative 2: Institutional Controls and Monitoring

This alternative would decrease potential site risks by preventing exposure to COCs in the contaminated areas at the Site. Public exposure would be prevented by a physical barrier in the form of fencing with warning signs, and by preventing site use via deed restrictions.

Long-term maintenance and monitoring would be included to ensure the continued effectiveness of the remedy. This alternative would consist of implementing and maintaining institutional controls as described in Section 9.1.1 and long-term monitoring as described in Section 9.1.2. Institutional controls would prevent direct exposure to impacted soil through fencing and site use restrictions. Because this alternative relies on institutional controls more than physical covering of the contamination for its effectiveness, the site would be dedicated as a hazardous site and not available for beneficial use.

Groundwater at this site is currently not significantly impacted. However, groundwater monitoring would be provided to detect future groundwater impacts in the unlikely event that they were to occur.

9.2.3 Alternative 3: Capping – Monitoring and Institutional Controls

This alternative would protect human health and the environment by providing proven, reliable containment of any affected soil in the contaminated area. If this alternative were selected, an appropriate cap design would be selected during detailed design. For the purposes of this FS, an asphalt cap has been used as a representative process option.

The cap would prevent collection and infiltration of stormwater run-on, provide a barrier against direct contact with any waste or affected soil, and prevent off-site migration of COCs in stormwater run-off or airborne dust. The extent of the cap would cover the contaminated areas above the detection limit criteria. Long-term effectiveness of this alternative is contingent on the monitoring and maintenance of the integrity of the cap for a minimum period of up to 20 years or more.

The major steps in this alternative are:

1. Fill and grade the site for even slope and good stormwater drainage.
2. Place a low-permeability cap over the contaminated area, including appropriate surface water controls.
3. Maintain the cap for 20 years.
4. Implement and maintain institutional controls and monitoring (as described in Sections 9.1.1 and 9.1.2.

The area that would be capped is shown in Figure 9-1. This area covers the areas with soil containing COCs above the cleanup goals (based on RI data).

Suitable land uses would include commercial, industrial, and/or recreational, but not residential. Short-term exposure to the contamination (i.e., during construction) would not present unacceptable risk with regard to worker exposure during construction with proper health and safety controls. Health and safety considerations during grading and construction would be implemented.

Groundwater at this site is currently not impacted significantly. However, groundwater monitoring would be provided to detect future groundwater impacts in the unlikely event that they were to occur.

9.2.4 Alternative 4: Excavation and Off-Site Landfill

This alternative would protect human health and the environment by locating and removing any affected soil from the contaminated area for off-site landfill disposal. This alternative would involve excavation to achieve final remediation goals or cleanup levels established in the CAP. Removal of COC to the Cleanup goals identified in Section 7.0 would require the excavation of soil in the Central Portion of the Site and near MW-11. The areas that would be excavated are shown on Figure 9-2. Excavation would follow the procedures outlined in Section 9.1.3. Transporting impacted soils to a landfill would require the import of replacement fill materials for backfill.

The Rabanco landfill has agreed to accept and provide disposal at their landfills for contaminated soils generated during this remediation project. Rabanco's intent is to recycle the soils as landfill cover. The landfill is located approximately 150 miles from the Site. The likely transportation route out of town will be via U.S. Highway 17 to minimize traffic issues. However, the transportation of excavated soil off-site and the return of semi-trailers would impact traffic in the immediate vicinity of the Site.

9.2.5 Alternative 5: Excavation and On-Site Treatment

This alternative would protect human health and the environment by locating and removing any affected soil from the contaminated area and treating it on-site by thermal desorption. This alternative would involve excavation to achieve final remediation goals or cleanup levels established in the Draft Cleanup Action Plan (DCAP). Removal of COC to the Cleanup goals identified in Section 7.0 would require the excavation of soil in the Central Portion of the Site and near MW-11. The areas that would be excavated are shown on Figure 9-2. Excavation would follow the procedures outlined in Section 9.1.3.

Excavated material will be stockpiled and treated on-site using a mobile thermal desorption unit. Mobile thermal desorption units typically process 12 to 15 tons per hour. On-site treatment has the potential for reusing the treated soil as backfill, if it can properly compact. The process rate of the thermal desorption unit and length of working day can greatly affect the cost efficiency of on site treatment. Additional permitting is also required for air emissions on-site for treatment.

9.2.6 Alternative 6: Excavation and Off-Site Treatment

This alternative would protect human health and the environment by locating and removing any affected soil from the contaminated area for off-site treatment. This alternative would involve excavation to achieve final remediation goals or cleanup levels established in the CAP. Removal of COC to the cleanup goals identified in Section 7.0 would require the excavation of soil in the Central Portion of the Site and near MW-11. The areas that would be excavated are shown on Figure 9-2.

Excavated material will be hauled to a facility capable of thermal treatment. TPS Technology Inc. (TPS) is a facility in Tacoma, Washington capable of the required treatment and willing to accept the contaminated material. Treated material could then be sold to the general public as fill. The transportation of excavated soil off-site and the return of semi-trailers would impact traffic in the immediate vicinity of the Site. In addition, transporting impacted soils to the treatment facility would require the import of replacement fill materials for backfill.

10.0 EVALUATION OF ALTERNATIVES

The remediation alternatives described in Sections 8 and 9 are evaluated in this section. The evaluation concludes with a discussion of the overall evaluation and scoring, and identification of the recommended alternative. Tables 10-1 through 10-4 provide the key evaluation criteria for the remedial alternative selection process conducted during the FS.

10.1 Threshold Evaluation

Under MTCA, remediation alternatives must meet the following threshold requirements (WAC 173-340-360(2)(a):

- Protection of human health and the environment
- Compliance with cleanup standards
- Compliance with ARARs
- Provision for compliance monitoring

Each alternative is evaluated individually against the threshold criteria in the following sections.

10.1.1 <u>Protection of Human Health and the Environment</u>

As a threshold criterion, protection of human health and the environment addresses whether a remediation alternative would result in sufficiently low residual risk to human and ecological receptors after completion of the alternative, resulting in a minimum acceptable level of protection. The relative degree of protection provided by the alternatives is considered in the comparative evaluation. One measure of sufficient protectiveness is the second threshold criteria, compliance with cleanup standards (see Section 8.1.2). Evaluation of protection of human health and the environment also considers short-term risks posed by remedial action.

Alternative 1 (No Action) does not mitigate potential exposure pathways (i.e., exposed contaminated soil) and would not provide acceptable protection of human health and the environment. The fact that no significant groundwater impacts were found indicates the low risk posed by this site. The No Action alternative is not compliant with the ARARs as required by WAC 173-340-360(2).

Alternative 2 (Institutional Controls and Monitoring) would prevent direct public exposure to contaminated soil, but would not prevent worker exposure or off-site migration in surface water or airborne dust. Institutional controls prohibiting the excavation of soil are in direct conflict with City plans to construct additional facilities on the Central Portion of the Site (increase beneficial use). This alternative is therefore not considered sufficiently protective of human health and the environment and does not maximize the beneficial use of the Site. The Institutional Controls and Monitoring alternative is not compliant with the ARARs as required by WAC 173-340-360(2)

Alternative 3 (Capping – Monitoring and Institutional Controls) would prevent direct exposure to any contaminated soil via the cap. The cap reduces infiltration of precipitation, which would reduce the mobility and potential for it to become impacted. In addition, the cap would prevent off-site migration in surface water or airborne dust. Therefore, this alternative is protective of human health and the environment.

Alternatives 4 (Excavation and Off-site Landfill), and 6 (Excavation and Off-site Treatment) would remove contaminated soil off-site for secure landfill disposal or treatment. This removal would prevent direct exposure to contaminated soil, and also prevent off-site migration in surface water or airborne dust. Therefore, this alternative is protective of human health and the environment. In addition, by removing the contaminants from the Site, the need for long-term monitoring would be reduced.

Alternative 5 (Excavation and On-site Treatment) would remove contaminated soil for treatment on-site. This removal and treatment would prevent direct exposure to contaminated soil, and also prevent off-site migration in surface water or airborne dust. Therefore, this alternative is protective of human health and the environment. In addition, by removing the contaminants from the Site soil, the need for long-term monitoring would be reduced.

10.1.2 Compliance with Cleanup Standards

Compliance with cleanup standards is defined by meeting the requirements of WAC 173-340-700 through -760. Compliance with cleanup standards does not require removal of all waste or affected soil from a site; the regulations include provisions for meeting cleanup standards through containment. All of the alternatives except Alternative 1 (No Action) and Alternative 2 would comply with MTCA cleanup standards. Alternative 1 would have exposed contaminated soils and would not provide compliance monitoring. Alternative 2 (Institutional Controls and Monitoring) would rely on institutional controls to comply with cleanup standards, however total reliance on institutional controls is not allowed where "action" (i.e. treatment or removal) is technically feasible to implement. Alternative 3 relies on engineered containment and a conditional point of compliance at the site boundary. Alternative 4 relies on off-site containment and would comply with the Site cleanup standards specified in the CAP. Alternatives 5 and 6 rely on treatment technologies and would comply with the Site cleanup standards specified in the CAP.

10.1.3 Compliance with ARARs

Compliance with ARARs addresses whether an alternative complies with all applicable or relevant and appropriate regulations (ARARs), as defined in Section 6.

10.1.4 Provision for Compliance Monitoring

Compliance monitoring requirements are defined in WAC 173-340-410. Compliance monitoring includes: (1) "protection monitoring" to confirm that human health and the environment are adequately protected during implementation of an alternative; (2) "performance monitoring" to confirm that cleanup standards or other performance standards (e.g., cap permeability) have been attained; and (3) "confirmational monitoring" to monitor the long-term effectiveness of the remedy after completion of the alternative.

Alternative 1 (No Action) does not provide compliance monitoring, and therefore does not meet this requirement. The remaining alternatives meet this requirement by providing appropriate protection, performance, and confirmational monitoring.

10.1.5 Summary of Threshold Evaluation

Based on the foregoing evaluation, the following alternatives do not meet threshold criteria:

Alternative 1 (No Action)

Alternative 2 (Institutional Controls and Monitoring).

Alternatives 1 and 2 do not meet threshold criteria and are therefore not carried on through the alternative evaluation process. Alternatives 3, 4, 5 and 6 fulfilled the threshold requirements under WAC 173-340-360(2)(a) and are retained for further evaluation. WAC 173-340-360(2)(b) dictates that cleanup actions that fulfill the threshold criteria must also use permanent solutions to the maximum extent practicable; provide for a reasonable restoration time frame; and consider public concerns. These other requirements are given equal consideration under the MTCA hierarchy. Alternatives 3, 4, 5 and 6 are evaluated with respect to these requirements in the following sections.

10.2 Use of Permanent Solutions

WAC 173-340-360(2)(b)(i) requires that the remediation alternatives must use permanent solutions to the maximum extent practicable. WAC 173-340-360(3) describes the procedures for determining whether a cleanup action provides permanent solutions to the maximum extent practicable. A determination that a cleanup action satisfies the requirement to use permanent solutions to the maximum extent practicable is based on the same basic principles or hierarchical criteria listed in WAC 173-340-360(3)(f) for a disproportionate cost analysis. The WAC 173-340-360(3)(f) hierarchical list was presented in Section 8.1 and used in a qualitative analysis for screening remedial technologies or cleanup action components. The hierarchical list or "permanence criteria," are further discussed below and used in a more quantitative manner to evaluate the remaining alternatives.

The following performance criteria definitions are consistent with MTCA regulations definitions presented in Section 8.1, but have been refined to minimize the overlap of considerations in the criteria. This allows decision makers to consider each criterion independently and minimizes double counting of criteria. In addition, use of independent criteria allows better comparisons between the criteria; i.e., determining the value of each criterion in terms of the other criteria. Well-defined criteria minimize misunderstandings between the concerned parties and facilitate effective communication during selection of a recommended alternative.

10.2.1 Protectiveness

Protectiveness addresses the degree to which each alternative reduces existing risk and is protective of human health and the environment, considering both on-site and off-site risks. This criterion is derived from the evaluation of the other criteria. It is not an independent criterion, but more a summary of the overall evaluation and indicative of the overall improvement of environmental quality.

10.2.2 Permanence

This criterion addresses the degree to which a remediation alternative permanently reduces the inherent toxicity, ability of contaminants to migrate in the environment, or the quantity of contaminated material including the adequacy in destroying the contaminants. This criterion also evaluates alternative against the reduction or elimination of the potential for releases of contaminants and degree of irreversibility.

10.2.3 Costs

This criterion is used to consider the costs of performing each alternative, including capital, operation and maintenance, and monitoring costs. Alternative costs are compared on a net present value basis. Known implementation difficulties with quantifiable cost impacts are included in the cost estimates.

10.2.4 Effectiveness Over the Long-Term

This criterion addresses risks remaining at the site after the remediation alternative has been implemented, and the effectiveness of the alternative at reducing risks over an extended period of time. Risks during the implementation period are addressed under short-term effectiveness. Evaluation of long-term effectiveness involves estimation of the residual risk associated with each alternative, and can be measured by the degree to which RAOs are met.

Long-term effectiveness is evaluated using the following criteria:

- The alternatives are qualitatively compared for reducing the magnitude of residual risk, including meeting RAOs. The long-term effectiveness criterion addresses both residual human health and ecological risk. However, for this site there is no need to evaluate the removal alternatives for these risks separately. Each alternative provides long-term effectiveness by eliminating pathways of exposure for human health risks in the same manner as ecological risks. Therefore, the evaluation would be the difference in the comparative analysis between the removal and non removal alternatives.
- "The degree of certainty that the alternative will be successful" as specified in WAC 173-340-360(3)(f)(iv).
- Alternatives are qualitatively evaluated for their reliability in achieving the anticipated degree of effectiveness during the period of time that hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels.
- Alternatives are qualitatively evaluated for the estimated longevity of the remedy at its expected degree of effectiveness to manage treatment of residues or remaining hazardous materials.

The overall score for this criterion is obtained by giving equal weight to each of the above sub-criteria

10.2.5 Management of Short-Term Risk

This criterion addresses short-term effects on human health and the environment while the alternative is being implemented. The evaluation includes consideration of the following factors:

- Risk to site workers
- Risk to the community
- Risk to the environment (short-term ecological risk).

The primary risk to site workers would be due to construction accidents and inhalation exposure to contaminated airborne dust during grading and excavation.

The remedial action would include controls as necessary to ensure that the remedy does not create an unacceptable risk to the community or the environment. However, the risk to the site workers, community and the environment are evaluated as a whole for each remedial alternative.

10.2.6 Technical and Administrative Implementability

This criterion addresses the degree of difficulty in implementing each alternative. Implementability issues are important because they address the potential for delays, cost overruns, and failure. Known implementation difficulties with quantifiable cost impacts are included in the cost estimates. The implementability criterion focuses on less quantifiable known and potential difficulties. Implementability is evaluated considering the following per WAC 173-340-360(3)(f)(vi):

- **Technical Feasibility**. Technical feasibility addresses the potential for problems during implementation of the alternative and related uncertainties. The evaluation includes the likelihood of delays due to technical problems and the ease of modifying the alternative, if required.
- **Availability of Services and Materials**. The availability of experienced contractors and personnel, equipment, and materials needed to implement the alternative. Availability of disposal capacity is also included in the evaluation.
- **Administrative Feasibility**. The degree of difficulty anticipated due to regulatory constraints and the degree of coordination required between various agencies.
- **Scheduling**. The time required until remedial action would be complete, and any difficulties associated with scheduling.
- **Complexity and Size**. The more complex or larger a remedial action, the more difficult it is to construct or implement. In addition, the more items there are that can go wrong, the greater the chance of failure that could affect remedy effectiveness.
- **Other Considerations**. Monitoring requirements, access for construction and operation and maintenance, integration with existing operations and current or potential remedial action, and other factors were considered.

10.2.7 Community Acceptance

After the FS is finalized, an alternative is selected as the proposed remedial action. The proposed remedial action will be described in the Draft Cleanup Action Plan (DCAP) along with the remedial action selected (which may not be the remedial action recommended by the FS) and the basis for its selection. Determination of community concerns is based on public comments on the DCAP. Therefore, community acceptance is not included in the FS comparative evaluation. Instead, Ecology evaluates community acceptance after the FS is completed. The selected remedial action may be modified to address community concerns based on public comments on the FS and DCAP.

10.3 Reasonable Restoration Time Frame

WAC 173-340-360(2)(b)(ii) requires a remedial action to provide for a reasonable restoration time frame. WAC 173-340-360(4)(b) provides the factors to be considered to determine whether a cleanup action provides a reasonable restoration time frame. Those factors include:

- Potential risks posed by the site to human health and the environment;
- Practicability of a shorter restoration time frame;
- Current and potential future use of the site, surrounding areas and associated resources that are or may be, affecting releases for the site;

- Availability of alternative water supplies;
- Likely effectiveness of institutional controls;
- Ability to control and monitor migration of hazardous substances form the site;
- Toxicity of hazardous substances at the site; and
- Natural processes that reduce concentration of hazardous substances and have been documented to occur at the site or under similar site conditions.

Even when a cleanup action is determined to provide a reasonable restoration time frame, it does not necessarily mean that the WAC 173-360(2)(a) threshold criteria or the requirement that permanent solutions to the maximum extent possible have been met.

10.4 Comparative Evaluation Methodology

Selection of a remediation alternative is based on comparative evaluation of the alternatives (that satisfy the threshold criteria) with respect to whether they provide permanent solutions to the maximum extent practicable; provide for a reasonable restoration time frame; and consider public concerns.

The permanence criteria from WAC-173-340-360(3)(f): (1) Protectiveness, (2) Permanence, (3) Cost, (4) Effectiveness over the Long-Term (5) Management of Short-Term Risks, (6) Technical and Administrative Implementability and (7) Consideration of Public Concern are used to determined if the alternatives provide permanent solutions to the maximum extent practical. Each alternative is scored relative to the other alternatives for the permanence criteria. Because of the nature of the criteria and the uncertainties in the evaluation, the scores for these criteria are expressions of relative qualitative or semi-quantitative professional judgments. A scale of 0 (worst) to 10 (best) is used, where the best alternative with respect to the other alternatives being evaluated receives a score of 10. The worst alternative receives a score of 0. Qualitative scoring for the criteria is appropriate and is typically conducted when information to provide meaningful and defensible quantitative scoring is not available, such as is the case for this site. Each of the criteria receives equal consideration or "weight" within the evaluation of permanence of the solution.

Reasonable Restoration Time Frame is evaluated in much the same manner as the permanence of the solution. Each alternative is scored from 0 to 10 based on comparative evaluation of the alternatives with overall respect to the applicable factors listed in Section 10.3.

Consideration of Public Concern is not scored in this evaluation, as described in Section 10.2.7, Ecology evaluates community acceptance after the FS is completed, and public comment on the DCAP is registered. Consideration of Public Concerns is ensured by its incorporation in the MTCA process, under WAC 173-340-600.

These three overall requirements are considered equally under the MTCA hierarchy. Consideration of Public Concern is not evaluated by the scoring method used for the other two major criteria. Therefore, each represent 50 percent of the evaluation.

10.5 Evaluation of Remediation Alternatives for Permanence

This section provides a comparative evaluation of the alternatives using the permanence criteria (see Sections 10.2 and 10.3) and Reasonable Restoration Time Frame. All of the retained alternatives evaluated in Section 10.1 (Alternatives 3 through 6) are included in the evaluation, those that do not meet the threshold criteria are not. The basis for the scoring is provided below. The evaluation and scoring of the retained alternatives is summarized in Table 10-1.

10.5.1 Evaluation of Alternative Use of Permanent Solutions the Maximum Extent Possible

10.5.1.1 Protectiveness

Alternative 3 (Capping – Monitoring and Institutional Controls) reduces the on-site risk by providing a contact barrier, but does not provide any improvement in the overall environmental quality on- or off-site. For this reason, Alternative 3 is the least protective alternative and is given a score of 0.

The three remaining alternatives would present risks to remediation workers during excavation activities. Alternative 4 (Excavation and Off-Site Landfill) removes the hazardous substances and ultimately the associated environmental risk from the Site. Alternative 4 is given a score of 7. In addition to the benefits of Alternative 4, Alternatives 5 (Excavation and On-Site Treatment) and 6 (Excavation and Off-Site Treatment) destroy the hazardous substances. Therefore, Alternatives 5 and 6 are the most protective alternatives and are given scores of 10.

10.5.1.2 Permanence

Alternative 3 (Capping – Monitoring and Institutional Controls) provides limited reduction in the effective mobility of constituents of concern by reducing infiltration of rainwater through the contaminated soil. However, the general lack of groundwater problems indicates that the mobility of waste constituents at the Site is already low. The alternative does not allow for the destruction of the hazardous substances or permanent removal from site. Alternative 3 offers the least permanent solution and is given a score of 0.

Landfill disposal (Alternative 4) would allow the contaminated soil to be recycled and be used as cover material at the landfill. Under Alternative 4 the landfill liner would reduce the ability of the COCs to migrate. Alternative 4 is given a score of 6.

Treatment is the most effective means of permanent reduction in toxicity, mobility, and volume. The excavation and treatment alternatives (Alternatives 5 and 6) would destroy the hazardous substances and are therefore each given a score of 10.

10.5.1.3 Cost

The estimated costs for the alternatives are summarized in Table 10-2. The costs for remediation alternatives are estimated for budgetary and evaluation purposes; the actual cost of the remediation may vary. The cost estimates in this FS are based on the description of the alternatives and associated design assumptions in Section 7. The detailed costs for the evaluated alternatives are provided in Table 10-3. The design assumptions used here are representative and sufficient for the purposes of comparative evaluation of the alternatives, but are not necessarily the same as the design basis that would be used for the final, detailed design. Pre-design investigations would be included in the final design phase for any of these remedial actions, and the results of these investigations could result in changes from the preliminary designs presented in this FS.

The estimates were prepared to allow comparative evaluation of alternatives, not for budgeting purposes. The uncertainties in the FS designs and associated cost estimates are such that actual costs could vary significantly from these estimates. However, the uncertainty in the *relative* cost of the alternatives is much less than the uncertainty in the magnitude of the costs, and these cost estimates are suitable for comparative evaluation of the alternatives. The alternatives are given the following scores based on the costs presented in Table 10-2:

Alternative		Score
Alternative 3:	Capping – Monitoring and Institutional Controls	10
Alternative 4:	Excavation and Off-Site Landfill	6
Alternative 5:	Excavation and On-Site Treatment	3
Alternative 6:	Excavation and Off-Site Treatment	0

10.5.1.4 Effectiveness Over the Long-Term

Alternative 3 (Capping – Monitoring and Institutional Controls) would achieve the remedial action objectives. It would provide a cover over the contaminated soil, which would prevent direct contact with contaminated soils. Although groundwater is not currently impacted (with the exception of MW-11) an impermeable (asphalt) cap would decrease the possibility of migration of COCs, in the vadose zone soils by reducing or eliminating infiltrating rainwater from contacting COCs. Potential cap deterioration enhanced by large equipment and truck traffic would be countered by maintenance controls and patching over 20 years. However, the contaminated soil would remain on-site within a busy, developed area. Considering the overall effectiveness of removal to on-site containment, Alternative 3 is considered the least effective alternative over the long term and is given a score of 0.

Alternative 4 (Excavation and Off-Site Landfill) would achieve all remedial action objectives. It would remove affected soil to MTCA cleanup levels, thus preventing direct contact with contaminated soil and essentially eliminating the possibility of migration of COCs. Although, under Alternative 4 some impacted soil would remain on-site, it would be below MTCA cleanup levels. This alternative is slightly less effective than Alternatives 5 and 6 because placement of impacted soils in an off-site landfill does not completely eliminate the potential for release of contaminants. This alternative is therefore given a long term effectiveness score of 8.

Alternative 5 (Excavation and On-Site Treatment) would provide the benefits just given for Alternative 4. It would remove affected soil to MTCA cleanup levels, thus preventing direct contact with contaminated soil, and eliminate the possibility of migration of COCs. On-site treatment would generate thermally treated soil (fill) with less than desirable soil properties with respect to paving and construction projects. Under this alternative some impacted soil would remain on-site (although below MTCA cleanup levels). Alternative 5 would be effective over the long term because it includes treatment that destroys the primary (organic) COCs but not metal COCs (lead). There is a potential for treatment by thermal desorption to be incomplete or generate unacceptable air emissions. There is a greater potential for these circumstances to occur with a mobile unit than an off-site stationary unit. This alternative is therefore given a long term effectiveness score of 9.

Alternative 6 (Excavation and Off-Site Treatment) would provide the benefits just given for Alternative 4 and 5. It would remove affected soil to MTCA cleanup levels, thus preventing direct contact with contaminated soil and eliminate the possibility of migration of COCs. Under this alternative some impacted soil would remain on-site but it would be below MTCA cleanup levels. Alternative 6 would be effective over the long term because it includes treatment that destroys the primary (organic) COCs but not metal COCs (lead). There is a potential for treatment by thermal desorption to be incomplete or generate unacceptable air emissions. However, there is less potential for these circumstances to occur with an off-site stationary unit than a mobile unit. Alternative 6 is the most effective alternative over the long term and is therefore given a score of 10.

10.5.1.5 Management of Short-Term Risk

None of the alternatives would involve significant short-term risk (i.e., during remedial action) to ecological or off-site receptors. Therefore, evaluation of short-term effectiveness focuses on relative potential risk to site workers.

For Alternative 3 (Capping – Monitoring and Institutional Controls), there would be some potential for exposure, but less than removal alternatives. On this basis, Alternative 3 (Cap) is given a score of 10.

Alternative 4 (Excavation and Off-Site Landfill) will provide the shortest exposure period of the removal alternatives, and is therefore given a score of 7.

Treatment (Alternatives 5 and 6) involves more potential for worker exposure during treatment off-site than landfill disposal, and therefore are given lower scores. Alternative 5 (Excavation and On-Site Treatment) is given the lowest score (0) as there would be more potential for public and worker exposure due to the increased length of time and the logistics of moving stockpiles on-site than there would be at the off-site treatment facility. Because Alternative 6 has a lower potential for public and worker exposure than Alternative 5, it is been given a score of 6.

10.5.1.6 Implementability

Alternative 3 (Capping – Monitoring and Institutional Controls) would be the easiest to implement from a construction point of view and is given the highest score of 10. However, it would still require establishing deed restrictions and the associated stipulations for Ecology notification for cutting the cap, below grade construction activities.

Alternative 4 (Excavation and Off-Site Landfill) is the least complex of the removal alternatives, and would not be much more difficult to implement than Alternative 3 and is therefore given a score of 7.

Alternative 5 (Excavation and On-Site Treatment) is the most complex and difficult to implement. On-Site treatment involves issues regarding the availability of mobile thermal treatment units, air and noise permitting issues, stack testing and operating efficiencies. The on-site treatment alternative is therefore given the lowest score, a 0.

Alternative 6 (Excavation and Off-Site Treatment) is similar in complexity to Alternative 4, but due to volume constraints and maximum treatment capacities off-site treatment facilities do not always accept soil. The Off-Site treatment alternative is therefore given a score of 6, a slightly lower score than Off-Site disposal.

10.5.2 <u>Evaluation of Reasonable Restoration Time Frame</u>

The evaluation of reasonable restoration time frame was conducted from an on-site perspective with respect to the applicable factors listed in Section 10.3. Alternative 3 (Capping – Monitoring and Institutional Controls) would be the easiest to implement from a construction point of view. However, no true remediation of hazardous material would occur and compliance monitoring could continue for

20 years or more. Due to the extended period of monitoring Alternative 3 is given a 0, the lowest score.

The focal point of the excavation alternatives, which involve the removal of hazardous substances from the Site could be completed within two months from implementation of the cleanup action. However, compliance monitoring would be required as part of the threshold criteria. Alternative 4 and Alternative 6 are the off-site treatments alternatives and are given a scores of 10 and 9, respectively. Alternative 4 was rated the slight higher of the two alternatives, since soils may be held in stockpiles on site for blending purposes or due to the operating capacity of the treatment system.

Alternative 5 is given a lower score of 7, as the logistics of the on-site treatment may extend the period of performance for setup, excavation and treatment.

10.5.3 Net Benefit (Overall Non-Cost Evaluation)

The net benefit of the alternatives is determined by combining the criteria scores (see Table 10.4). The net benefit, or overall non-cost scores, is given in Table 10-1. Using these scores, the alternatives rank in the following order (most to least preferred):

1. Alternative 4 - Excavation and Off-Site Disposal.
2. Alternative 6 - Excavation and Off-Site Treatment.
3. Alternative 5 - Excavation and On-Site Treatment.
4. Alternative 3 - Capping – Monitoring and Institutional Control.

10.5.4 Cost/Benefit Analysis and Overall Evaluation

When the overall evaluation process identifies more than one alternative equally suited (based on equal evaluation scores) as the recommended alternative based on the FS, cost may be used to determine the final distinction between alternatives. The net benefit scores for the excavation and treatment alternatives (4, 5 and 6) are relatively close to one another. Due to the semi-quantitative/qualitative nature of the evaluation, the overall evaluation scores for the alternatives are considered to be subjective. As a result, a cost benefit analysis was conducted to determine if the cost of the alternative (Alternative 4) that received the most favorable score from the evaluation process had a disproportionate cost to the incremental degree of protection offered by this alternative.

Under WAC 173-340-360(3)(b) "a cleanup action shall not be considered practicable if the incremental cost of the cleanup action is substantial and disproportionate to the incremental degree of protection it would achieve over a lower preference cleanup action." The determination of practicability is made using an analysis of cost vs. benefit. The cost/benefit analysis can be performed quantitatively using the overall scoring of the non-cost criteria as the net benefit.

The estimated costs for the alternatives are summarized in Table 10-2. The costs of remediation alternatives are estimated for budgetary and evaluation purposes; the actual cost of the remediation may vary. The cost estimates in this FS are based on the description of the alternatives and associated design assumptions in Section 7. The detailed cost for the evaluated alternatives are provided in Table 10-3. The total yards to be excavated under alternatives 4, 5 and 6 were based on the excavation area identified on Figure 9-2 and an average depth of 5 ft.

The estimates were prepared to allow comparative evaluation of alternatives, not for budgeting purposes. The design basis is subject to change during final, detailed design of the selected alternative, and these changes would affect the cost of the remedy. The cost estimates are suitable for comparative evaluation of the alternatives as discussed in Section 10.5.1.3.

The ratio of net benefit to estimated cost, which is a measure of cost-effectiveness, is given in Table 10-4. On a cost/benefit basis, the alternatives rank as follows:

1. Alternative 4 - Excavation and Off-Site Disposal.
2. Alternative 5 - Excavation and On-Site Treatment.
3. Alternative 6 - Excavation and Off-Site Treatment.
4. Alternative 3 - Capping – Monitoring and Institutional Controls.

10.6 Recommended Alternative

Alternative 4 provides the optimum combination of the permanence criteria and reasonable restoration time frame factors. In addition, this alternative provides the best cost/benefit ratio. Considering the criteria and approach specified in WAC 173-340-360, Alternative 4 is the remediation alternative for the Site that is "permanent to the maximum extent practicable," and is therefore the recommended alternative for remediation of this site.

11.0 REFERENCES

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TABLES

TABLE 2-1

SUMMARY OF DECOMMISSIONED UNDERGROUND STORAGE TANKS

CONTENTS	CAPACITY (gallons)	YEAR INSTALLED	YEAR REMOVED
Regular gasoline	unknown	unknown	early 1970s *
Used oil	500	1960s *	1992
Diesel	500	unknown	1986
Diesel	1,000	1986	1992
Regular gasoline	6,000	1972	1992
Unleaded gasoline	8,000	1977	1992

Note:
Information from Groundwater Technology (1994).
* estimated

TABLE 2-2

SITE WELL CONSTRUCTION DETAILS

Monitoring Well	Borehole Diameter (inch)	Well Diameter (inch)	Well Depth (ft btoc)[b]	Ground Surface (ft MSL)[c, d]	Top of Riser Casing (ft MSL)[c, d]	Depth to Base of Seal/Top of Sand (ft bgs)[a]	Elevation of Base of Seal/Top of Sand (ft MSL)[c, d]	Depth to Bottom of Sand Pack (ft bgs)[a]	Elevation of Bottom of Sand Pack (ft MSL)[c, d]	Screen Slot Size (inch)	Depth to Top of Screen (ft bgs)[a]	Elevation of Top of Screen (ft MSL)[c, d]	Bottom of Bottom of Screen (ft bgs)[a]	Elevation of Bottom of Screen (ft MSL)[c, d]
MW02	8	2	6.04	1085.32	1084.88	2.00	1083.32	6.60	1078.72	0.01	2.04	1083.28	6.04	1079.28
MW04	8	2	14.17	1077.94	1077.57	3.40	1074.54	14.40	1063.54	0.01	4.17	1073.77	14.17	1063.77
MW05	8	2	13.95	1083.11	1082.64	3.00	1080.11	14.00	1069.11	0.01	4.50	1078.61	13.95	1069.16
MW06	8	4	12.00	1075.18	1074.88	2.50	1072.68	12.00	1063.18	0.01	2.50	1072.68	11.00	1064.18
MW07	8	2	10.00	1071.64	1071.24	3.00	1068.64	10.00	1061.64	0.01	5.00	1066.64	10.00	1061.64
MW08	8	2	13.50	1070.16	1069.76	3.00	1067.16	13.50	1056.66	0.01	3.50	1066.66	13.50	1056.66
MW09	8	2	15.00	1069.06	1068.62	4.00	1065.06	15.00	1054.06	0.01	5.00	1064.06	15.00	1054.06
MW10	8	2	9.00	1078.20	1077.21	3.00	1075.20	9.00	1069.20	0.01	4.00	1074.20	9.00	1069.20
MW11	8	2	14.00	1082.70	1082.35	3.00	1079.70	14.00	1068.70	0.01	4.00	1078.70	14.00	1068.70
MW12	8	2	14.00	1082.99	1082.49	3.00	1079.99	14.00	1068.99	0.01	4.00	1078.99	14.00	1068.99
MW15*	8	2	12.40	1065.30	1064.91	2.00	1063.30	15.00	1050.30	0.01	2.40	1062.90	12.40	1052.90
MW16*	8	2	13.00	1063.00	1062.38	2.00	1061.00	15.00	1048.00	0.01	3.00	1060.00	13.00	1050.00
MW17*	8	2	13.35	1060.90	1060.54	2.50	1058.40	15.00	1045.90	0.01	3.35	1057.55	13.35	1047.55
MW18*	8	2	10.48	1060.95	1061.52	2.00	1058.95	11.00	1049.95	0.01	2.48	1058.47	10.48	1050.47

Note:

[a] ft bgs means "below ground surface" measured in feet.

[b] ft btoc means "below top of riser casing" measured in feet.

[c] ft MSL means "means sea level" measured in feet.

[d] elevations based on City of Moses Lake Engineering Dept April 2-3, 2003 survey.

* Surface completions for MW15, MW16, MW17 and MW18 were modified on May 2, 2003 and resurveyed by the City on May 13, 2003.

Wells MW01 through MW14 drilled prior to Phase 1 RIFS.

Oversight for drilling MW15, MW16, MW17 and MW18 by Golder Associates Inc for RIFS.

MW01 and MW03 abandoned.

MW13 unable to locate - likely located beneath a permanent shelf.

MW14 unable to locate.

Well dimensions for MW02 and MW04 from Century West (1992) report and measurements made on Site 3/17/03. Seal and sand pack depths inferred from report.

Well dimensions for MW05, MW06, MW07, MW08, MW09, MW10, MW11, MW12 from Groundwater Technology (1994) report and measurements made on Site 3/17/03.

SUMMARY OF SUBSURFACE STRATIGRAPHY

BORING / TEST PIT	Thickness of Lithologic Units (depths in feet below ground surface)			
	FILL	WETLAND DEPOSITS	FLUVIAL DEPOSITS	RINGOLD FORMATION
Eastern Investigation Area				
TP01	0.0 – 8.0 (TD)	Not Encountered	Not Encountered	Not Encountered
TP02	0.0 – 2.2	Not Encountered	Not Encountered	2.2 - 10.0 (TD)
TP03	0.0 – 3.0	Not Encountered	Not Encountered	3.0 - 9.0 (TD)
GP01	0.0 – 2.5	Not Encountered	Not Encountered	2.5 - 7.0 (TD)
GP02	0.0 – 3.0	Not Encountered	Not Encountered	3.0 - 7.0 (TD)
GP03	0.0 – 1.5	Not Encountered	Not Encountered	1.5 - 8.0 (TD)
Central Investigation Area				
TP04	0.0 – 4.5 (TD)	Not Encountered	Not Encountered	Not Encountered
TP05	0.0 – 5.0 (TD)	Not Encountered	Not Encountered	Not Encountered
TP06	0.0 – 4.5 (TD)	Not Encountered	Not Encountered	Not Encountered
GP04	0.0 – 2.5	2.5 - 3.0	Not Encountered	3.0 - 8.0 (TD)
GP05	0.0 – 2.8	2.8 - 8.0 (TD)	Not Encountered	Not Encountered
GP06	0.0 – 1.4	1.4 - 2.7	Not Encountered	2.7 - 8.0 (TD)
GP07	0.0 – 3.3	3.3 - 6.0	Transitional	6.0 - 8.0 (TD)
GP08	0.0 – 3.5	3.5 - 7.5	Not Encountered	7.5 - 8.0 (TD)
GP09	0.0 – 3.0	3.0 - 7.0	Not Encountered	7.0 - 8.0 (TD)
GP10	0.0 – 6.0	6.0 - 8.0	Not Encountered	8.0 - 12.0 (TD)
GP11	0.0 – 4.0	4.0 - 6.0	Not Encountered	6.0 - 8.0 (TD)
GP12	0.0 – 3.0	Transitional	3.0 - 8.0 (TD)	Not Encountered
GP13	0.0 – 3.0	Not Encountered	3.0 - 8.0 (TD)	Not Encountered
GP14	0.0 – 6.7	6.7 - 8.0	Not Encountered	8.0 - 12.0 (TD)
GP15	0.0 – 4.0	4.0 - 7.0	Not Encountered	7.0 - 8.0 (TD)
GP16	0.0 – 4.0	4.0 - 4.3	4.3 - 4.5	4.5 - 8.0 (TD)
Western Investigation Area				
GP17	0.0 – 4.0	5.0 - 7.5	4.0 - 5.0	7.5 - 8.0 (TD)
GP18	0.0 – 2.7	2.7 - 3.1	Not Encountered	3.1 - 8.0 (TD)
GP19	0.0 – 3.3	3.3 - 4.5	4.5 - 6.5	6.5 - 8.0 (TD)
GP20	0.0 – 3.0	Not Encountered	3.0 - 6.5	6.5 - 8.0 (TD)
GP21	0.0 – 4.0	Not Encountered	4.0 - 8.0 (TD)	Not Encountered
GP22	0.0 – 2.9	2.9 - 3.5	3.5 - 8.0 (TD)	8.0 (TD)
GP23	0.0 – 2.5	2.5 – 3.8	3.8 - 7.0	7.0 - 8.0 (TD)

TABLE 3-2

SOIL PHYSICAL PROPERTIES

SAMPLE ID	TP05 - 1.0 to 3.0	TP05 - 4.5	MW15 - 10.0 to 11.5
Location	TP05	TP05	MW15
Depth (ft)	1.0 - 3.0	4.5	10.0 - 11.5
Type	Grab from backhoe bucket	Grab from backhoe bucket	Shelby Tube
Description	Compact, dark brown, silty fine to coarse SAND, some fine to coarse gravel. (SM)	Compact, gray, ORGANIC SILT and fine to coarse SAND, trace fine to coarse gravel. (OL/SM)	Compact, brown, fine to coarse SAND and SILT, trace fine gravel. (SM)
Unit	FILL	WETLAND DEPOSITS	RINGOLD FORMATION
Moisture (% by weight)	11.9	26.6	27.6
ESTIMATED/MEASURED PROPERTIES			
Porosity (%)	NA	NA	42

SUMMARY OF GROUNDWATER MONITORING WELL MEASUREMENTS (APRIL 1, 2003)

Monitoring Well	Measuring Point Elevation (ft MSL)[b, c, d]	Date	Time	Depth to Water (ft btoc)[b]	Groundwater Elevation (ft MSL)[c, d]
MW02	1084.88	4/1/2003	15:55	3.00	1081.88
MW04	1077.57	4/1/2003	15:35	3.17	1074.40
MW05	1082.64	4/1/2003	15:50	4.83	1077.81
MW06	1074.88	4/1/2003	15:40	4.58	1070.30
MW07	1071.24	4/1/2003	15:20	6.92	1064.32
MW08	1069.76	4/1/2003	15:15	6.42	1063.34
MW09	1068.62	4/1/2003	15:10	5.71	1062.91
MW10	1077.21	4/1/2003	15:45	2.17	1075.04
MW11	1082.35	4/1/2003	16:00	4.92	1077.43
MW12	1082.49	4/1/2003	15:47	4.46	1078.03
MW15*	1065.27	4/1/2003	10:45	3.38	1061.90
MW16*	1063.51	4/1/2003	15:30	3.33	1060.18
MW17*	1061.49	4/1/2003	11:20	3.92	1057.57
MW18*	1062.19	4/1/2003	15:00	3.63	1058.57

Note:
[a] ft bgs means "below ground surface" measured in feet.
[b] ft btoc means "below top of riser casing" measured in feet.
[c] ft MSL means "means sea level" measured in feet.
[d] elevations based on City of Moses Lake Engineering Dept April 2-3, 2003 survey.
* Surface completions for MW15, MW16, MW17 and MW18 were modified on May 2, 2003 and resurveyed by the City on May 13, 2003 current elevations are provided on Table 2-2.
Wells MW01 through MW14 drilled prior to the RIFS.
Oversight for drilling MW15, MW16, MW17 and MW18 by Golder Associates Inc for the RIFS.
MW01 and MW03 abandoned.
MW13 unable to locate - likely located beneath a permanent shelf.
MW14 unable to locate.

SUMMARY OF SLUG TEST RESULTS

Well ID	Date	Screened Unit (ft bgs)	Water Level (ft bmp)	Sand Pack (ft bgs)	Test #	File	Hvorslev Hydraulic Conductivity (ft/s)
MW15	4/1/2003	Fill (2-3) Wetland / Fluvial Deposits (3-9) Ringold Formation (9-15)	3.38	2 to 15 (13 ft)	Falling Head 1	Hvorslev MW15 FH04.xls	3.5E-05
					Falling Head 2	Hvorslev MW15 FH05.xls	5.3E-05
					Falling Head 3	Hvorslev MW15 FH06.xls	1.8E-04
					Geometric Mean		**6.9E-05**
					Rising Head 1	Hvorslev MW15 RH01.xls	2.1E-04
					Rising Head 2	Hvorslev MW15 RH02.xls	2.1E-04
					Rising Head 3	Hvorslev MW15 RH03.xls	2.1E-04
					Geometric Mean		**2.1E-04**
MW17	4/1/2003	Fill (2.5-7) Wetland Deposits (7-11) Fluvial Deposits (11-12.5) Ringold Formation (12.5-15)	3.92	2.5 to 15 (12.5 ft)	Falling Head 1	Hvorslev MW17 FH04.xls	1.6E-04
					Falling Head 2	Hvorslev MW17 FH05.xls	1.1E-04
					Falling Head 3	Hvorslev MW17 FH06.xls	1.6E-04
					Geometric Mean		**1.4E-04**
					Rising Head 1	Hvorslev MW17 RH01.xls	2.2E-04
					Rising Head 2	Hvorslev MW17 RH02.xls	2.7E-04
					Rising Head 3	Hvorslev MW17 RH03.xls	2.2E-04
					Geometric Mean		**2.4E-04**

TABLE 4-1

SUMMARY OF EAST PORTION TEST PIT SOIL SAMPLES

SAMPLE ID	0TP01 - 2.0 to 4.0	0TP01 - 7.0	0TP02 - 6.25	0TP02 - 9.0	0TP03 - 3.5	0TP03 - 9.0 *
Location	TP01	TP01	TP02	TP02	TP03	TP03
Depth (ft bgs)	2.0 - 4.0	7	6.25	9	3.5	9
Type	Grab from excavation wall	Grab from backhoe bucket	Grab from backhoe bucket	Grab from backhoe bucket	Grab from excavation wall	Grab from backhoe bucket
Description	Compact, fine SAND, some silt, trace clay and gravel.	Loose, medium and coarse SAND, some gravel, little fine sand and silt.	Compact, fine SAND and SILT, trace coarse sand.	Compact, fine SAND, some silt.	Compact, fine SAND and SILT.	Compact, fine SAND and SILT.
PID (ppm)	0	0	0	0	0.2	0
Water Table (ft bgs)	3.5	3.5	5	5	3.5	3.5
Unit	FILL	FILL	RINGOLD FORMATION	RINGOLD FORMATION	RINGOLD FORMATION	RINGOLD FORMATION
Sample Date	3/18/2003	3/18/2003	3/18/2003	3/18/2003	3/18/2003	3/18/2003
Analyses	NWTPH-HCID	NWTPH-Dx	NWTPH-HCID	NWTPH-Dx	NWTPH-HCID	NWTPH-Dx

Note:
ft bgs - feet below ground surface
* Ecology split sample

TABLE 4-2

SUMMARY OF CENTRAL PORTION TEST PIT SOIL SAMPLES

SAMPLE ID	0TP04 - 2.0 to 3.0*	0TP04 - 2.2	0TP04 - 3.0	0TP04 - 4.2	0TP04 - 4.5	0TP05 - 1.0 to 3.0	0TP05 - 3.0	0TP05 - 3.9	0TP05 - 4.5	0TP06 - 4.0	0TP06 - 4.5
Location	TP04	TP04	TP04	TP04	TP04	TP05	TP05	TP05	TP05	TP06	TP06
Depth (ft bgs)	2.0 - 3.0	2.20	3.00	4.00	4.50	1.0 - 3.0	3.00	3.90	4.50	4.00	4.50
Type	Grab composite from excavation wall	Grab from excavation wall	Grab from excavation wall	Grab from excavation wall	Grab from excavation wall	Grab from backhoe bucket	Grab from excavation wall	Grab from excavation wall	Grab from excavation floor	Grab from excavation wall	Grab from excavation floor
Description	Compact, fine to coarse SAND and fine GRAVEL, trace silt.	Compact, fine to coarse SAND and fine GRAVEL, trace silt.	Compact, fine to coarse SAND and fine GRAVEL, trace silt.	Compact, fine to coarse SAND and fine GRAVEL, trace silt.	Loose rounded GRAVEL (drain rock).	Compact, fine to coarse SAND, little gravel, trace silt and rootlets. (SP)	Compact, fine to coarse SAND, little gravel, trace silt.	Compact, fine to coarse SAND, little gravel, trace silt and rootlets.	Compact, fine SAND, trace silt and rootlets.	Compact, medium to coarse SAND, little gravel.	Loose rounded GRAVEL (drain rock).
PID (ppm)	33	33	33	41	5.5	4.5	86	86	5.9	0	0
Water Table (ft bgs)	4	4	4	4	4	4.25	4.25	4.25	4.25	4.5	4.5
Unit	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	WETLAND DEPOSITS	FILL	FILL
Sample Date	3/18/2003	3/18/2003	3/18/2003	3/18/2003	3/18/2003	3/18/2003	3/18/2003	3/18/2003	3/18/2003	3/18/2003	3/18/2003
Analyses	NWTPH-Gx, NWTPH-Dx	NWTPH-G, NWTPH-Dx	NWTPH-G, NWTPH-Dx	NWTPH-G, NWTPH-Dx	NWTPH-G, NWTPH-Dx		NWTPH-Dx, PCBs 8082, total lead 6010B	NWTPH-Dx, PCBs 8082, total lead 6010B	NWTPH-Dx, NWTPH-Gx, PCBs 8082, total lead 6010		volatiles 8260B
Analyses for Composites	N/A	Equal weight composite for NWTPH-Gx/BTEX &MTBE, NWTPH-Dx, volatiles 8260B, EDB, EDC, PAHs 8270c SIM, PCBs 8082, total lead 6010B				Physical Properties (see Table 3-2)	Equal weight composite for NWTPH-Gx/BTEX & MTBE, NWTPH-Dx, volatiles 8260B, EDB, EDC, PAHs 8270c SIM, PCBs 8082, total lead		Physical Properties (see Table 3-2)	Composite of TP06-4.0 and 4.5 fines for NWTPH-Gx/BTEX & MTBE, NWTPH-Dx, EDB, EDC, PAHs 8270c SIM, PCBs 8082, total lead 6010B.	

Note:
ft bgs - feet below ground surface
* Ecology split sample

TABLE 4-3

SUMMARY OF EAST PORTION GEOPROBE SOIL SAMPLES

SAMPLE ID	0GP01 - 2.5	0GP02 - 3.0	0GP03 - 1.5	0GP24 - 2.6 to 2.8	0GP25 - 2.8 to 3.0	0GP26 - 2.8 to 3.2	1GP26 - 2.8 to 3.2 (Dup)	0HA01 - 2.5	0HA02 - 3.0
Location	GP01	GP02	GP03	GP24	GP25	GP26	GP26	HA01	HA02
Depth (ft bgs)	2.50	3.00	1.50	2.6 - 2.8	2.8 - 3.0	2.8 - 3.2	2.8 - 3.2	2.50	1.50
Type	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Stainless steel sampler	Stainless steel sampler
Description	Loose, medium to fine SAND, little silt, trace rounded gravel.	Compact, medium to coarse SAND, little gravel, trace fine sand, silt and clay.	Loose, coarse SAND and GRAVEL.	Compact, Structurless, fine SAND, some silt	Compact, Structurless, SAND, some silt	Compact, Structurless, fine SAND, little gravel	Compact, Structurless, fine SAND, little gravel	Compact, SILT and sand	Compact, SILT and sand
PID (ppm)	1	1	0	0	0	0	0	0	0
Water Table (ft bgs)	3	3	2	2.8	4.8	2.8	2.8	3.2	3
Unit	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL	FILL
Sample Date	3/26/2003	3/26/2003	3/26/2003	5/1/2003	5/1/2003	5/1/2003	5/1/2003	5/2/2003	5/2/2003
Analyses	NWTPH-Dx	NWTPH-Dx	NWTPH-Dx	NWTPH-Dx	NWTPH-Dx	NWTPH-Dx	NWTPH-Dx	NWTPH-Dx	NWTPH-Dx

Note:
ft bgs - feet below ground surface

TABLE 4-4

SUMMARY OF CENTRAL PORTION GEOPROBE SOIL SAMPLES

SAMPLE ID	0GP04 - 3.0 to 3.5	0GP05 - 3.0 to 3.5	0GP06 - 2.5 to 2.8	0GP07 - 2.9 to 3.25	0GP08 - 3.0 to 3.3	2GP08	0GP09 - 3.5 to 4.0	1GP09 - 3.5 to 4.0
Location	GP04	GP05	GP06	GP07	GP08	GP08	GP09	GP09 (dup)
Depth (ft bgs)	3.0 - 3.5	3.0 - 3.5	2.5 - 2.8	2.9 - 3.25	3.0 - 3.3	na	3.5 - 4.0	3.5 - 4.0
Type	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Equipment Blank	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler
Description	Compact, fine SAND and SILT, trace clay and medium sand and caliche.	Compact, fine SAND and SILT, trace rootlets.	Firm, fine SAND, trace silt, clay and rootlets.	Compact, fine to coarse SAND, trace silt and clay.	Compact, medium to coarse SAND, trace silt and gravel.	DI water rinse from decontaminated 4-foot sampler.	Firm, fine SAND, litte silt.	Firm, fine SAND, litte silt.
PID (ppm)	0	1	0	0	4	0	111	111
Water Table (ft bgs)	3.5	3.5	2.7	3.0	2.8	na	3.3	3.3
Unit	RINGOLD FORMATION	WETLAND DEPOSITS	WETLAND DEPOSITS	FILL	FILL	na	FILL	FILL
Sample Date	3/26/2003	3/26/2003	3/26/2003	3/26/2003	3/26/2003	3/26/2003	3/26/2003	3/26/2003
Analyses	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx/BTEX &MTBE, NWTPH-Dx, volatiles 8260B, EDB, EDC, cPAHs 8270c SIM, PCBs 8082, total lead 6010B	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx

Note:
ft bgs - feet below ground surface

SUMMARY OF CENTRAL PORTION GEOPROBE SOIL SAMPLES

SAMPLE ID	0GP10 - 3.5 to 4.0	0GP11 - 3.5 to 4.0	0GP12 - 3.0 to 3.25	0GP13 - 3.0 to 3.25	0GP14 - 3.5 to 4.0	0GP15 - 3.5 to 4.0	0GP16 - 3.5 to 4.0
Location	GP10	GP11	GP12	GP13	GP14	GP15	GP16
Depth (ft bgs)	3.5 - 4.0	3.5 - 4.0	3.0 - 3.25	3.0 - 3.25	3.5 - 4.0	3.5 - 4.0	3.5 - 4.0
Type	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler
Description	Compact, medium SAND, trace gravel.	Compact, coarse SAND, little gravel, trace fine sand and silt.	Firm, fine SAND, some silt, trace clay and gravel, caliche.	Firm, fine SAND, some silt, trace clay, med to coarse sand and wood pieces.	Dense, fine SAND, little med sand, little silt, trace gravel.	Loose, coarse SAND and GRAVEL, trace silt.	Compact, fine to coarse SAND and GRAVEL, little silt, trace clay.
PID (ppm)	124	0.6	0	0	0	1.6	0.6
Water Table (ft bgs)	4.0	4.0	3.5	3.3	4.0	4.0	4.0
Unit	FILL	FILL	FLUVIAL DEPOSITS	FLUVIAL DEPOSITS	FILL	FILL	FILL
Sample Date	3/26/2003	3/26/2003	3/26/2003	3/26/2003	3/27/2003	3/27/2003	3/27/2003
Analyses	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx	NWTPH-Gx, NWTPH-Dx

Note:
ft bgs - feet below grou

TABLE 4-5

SUMMARY OF WEST PORTION GEOPROBE SOIL SAMPLES

SAMPLE ID	0GP17 - 3.5 to 4.0	0GP18 - 2.5 to 2.8	0GP19 - 2.8 to 3.0	0GP20 - 2.7 to 3.0	0GP21 - 3.8 to 4.0	0GP22 - 2.8 to 3.0	0GP23 - 2.7 to 3.0
Location	GP17	GP18	GP19	GP20	GP21	GP22	GP23
Depth (ft bgs)	3.5 - 4.0	2.5 - 2.8	2.8 - 3.0	2.7 - 3.0	3.8 - 4.0	2.8 - 3.0	2.7 - 3.0
Type	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler	Lined 1.5-inch ID 4-foot long split sampler
Description	Dense, fine to medium SAND, little gravel, trace silt and clay.	Dense, fine SAND and GRAVEL, trace silt and clay.	Soft, fine SAND and SILT, trace clay and rootlets.	Dense, SAND and GRAVEL, trace silt and clay.	Dense, medium to coarse SAND, little gravel, trace silt and clay.	Soft, fine SAND and SILT, trace sand, gravel and rootlets.	Soft, fine SAND and SILT, trace clay and rootlets.
PID (ppm)	0	0	0.5	0	0	0	0
Water Table (ft bgs)	3.5	3.0	3.8	3.0	4.0	3.0	3.5
Unit	FILL	FILL	WETLAND DEPOSITS	FILL	FILL	WETLAND DEPOSITS	WETLAND DEPOSITS
Sample Date	3/27/2003	3/27/2003	3/27/2003	3/27/2003	3/27/2003	3/27/2003	3/27/2003
Analyses	NWTPH-Gx, NWTPH-Dx, total RCRA metals	NWTPH-Gx, NWTPH-Dx, total RCRA metals	NWTPH-Gx, NWTPH-Dx, total RCRA metals	NWTPH-Gx, NWTPH-Dx, total RCRA metals	NWTPH-Gx, NWTPH-Dx, total RCRA metals	NWTPH-Gx, NWTPH-Dx, total RCRA metals	NWTPH-Gx, NWTPH-Dx, total RCRA metals

Note:
ft bgs - feet below ground surface

TABLE 4-6

SUMMARY OF CENTRAL PORTION WELL BORING SOIL SAMPLES

SAMPLE ID	0MW15 - 6.5 to 7.5	0MW15 - 8.5	0MW16 - 4.5 to 6.0	0MW16 - 7.0	0MW17 - 5.0	1MW17 - 5.0 (dup)	0MW17 - 6.0	0MW18 - 4.0 to 8.0	0MW18 - 8.5
Location	MW15	MW15	MW16	MW16	MW17	MW17	MW17	MW18	MW18
Depth (ft bgs)	6.5 - 7.5	8.5	4.5 - 6.0	7.0	5.0	5.0	6.0	4.0 - 8.0	8.50
Type	2.5-inch ID split spoon	2.5-inch ID split spoon	2.5-inch ID split spoon	2.5-inch ID split spoon	2.5-inch ID split spoon	2.5-inch ID split spoon	2.5-inch ID split spoon	2.5-inch ID split spoon	2.5-inch ID split spoon
Description	Loose, coarse SAND, little silt and clay, trace gravel.	Soft, fine to medium SAND and SILT, some coarse sand, trace gravel, clay and rootlets.	Compact, fine to medium SAND and SILT, little gravel, trace clay.	Loose, fine SAND, some silt, trace rootlets.	Dense, fine to medium SAND, some coarse sand, little gravel, trace silt.	Dense, fine to medium SAND, some coarse sand, little gravel, trace silt.	Dense, fine SAND and SILT, trace coarse sand and gravel.	Soft, fine SAND, little silt.	Loose, fine SAND, trace coarse sand, trace silt.
PID (ppm)	3.7	1.2	6.8	0.8	2.0	2.0	0.0	0.5	0.0
Water Table (ft bgs)	3.5	3.5	3.0	3.0	4.0	4.0	4.0	3.5	3.5
Unit	FLUVIAL DEPOSITS	WETLAND DEPOSITS	FILL	WETLAND DEPOSITS	FILL	FILL	FILL	FLUVIAL DEPOSITS	FLUVIAL DEPOSITS
Sample Date	3/24/2003	3/24/2003	3/24/2003	3/24/2003	3/25/2003	3/25/2003	3/25/2003	3/25/2003	3/25/2003
Analyses	NWTPH-HCID	Total organic carbon, EPA 9060	NWTPH-G, NWTPH-Dx, volatiles 8260B, EDB, EDC, PAHs 8270c SIM, PCBs 8082, total lead 6010B	Total organic carbon, EPA 9060	NWTPH-HCID	NWTPH-HCID	Total organic carbon, EPA 9060	NWTPH-HCID	Total organic carbon, EPA 9060

Note:
ft bgs - feet below ground surface

TABLE 4-7

SUMMARY OF EAST PORTION INVESTIGATION AREA WELL GROUNDWATER SAMPLES

SAMPLE ID	0MW08 - 031703	0MW10 - 031703	0MW04 - 031703	0MW05 - 031703	0MW11 - 032803 (PRODUCT)	0MW11 - 032803*	0GP25 -050103	0HA01 - 050203*
Location	MW08	MW10	MW04	MW05	MW11	MW11	GP25	HA01
Sampling Equipment	Grundfos submersible with dedicated tubing	Grundfos submersible with dedicated tubing	Grundfos submersible with dedicated tubing	Grundfos submersible with dedicated tubing	Bailer	Grundfos submersible with dedicated tubing	Peristaltic pump with deticated tubing	Peristaltic pump with deticated tubing
Sample Date	3/17/2003	3/17/2003	3/17/2003	3/17/2003	3/28/2003	3/28/2003	5/1/2003	5/2/2003
Analyses	NWTPH-Gx/BTEX & MTBE, NWTPH-Dx, EDB, EDC, total lead 6010B	NWTPH-Gx/BTEX & MTBE, NWTPH-Dx, EDB, EDC, total lead 6010B	NWTPH-Gx/BTEX & MTBE, NWTPH-Dx, EDB, EDC, total lead 6010B	NWTPH-Gx/BTEX & MTBE, NWTPH-Dx, EDB, EDC, total lead 6010B	NWTPH-Gx/BTEX & MTBE, NWTPH-Dx	NWTPH-Gx/BTEX & MTBE, NWTPH-Dx, EDB, EDC, volatiles 8260B, PCBs 8082, cPAHs 8270cSIM, total lead 6010B	NWTP-Dx	NWTP-Dx

Note:
Sample details on sample integrity data sheets and well purging forms in Appendix B.
* Ecology split sample for NWTPH-Gx.

TABLE 4-8

SUMMARY OF CENTRAL PORTION WELL GROUNDWATER SAMPLES

SAMPLE ID	0MW15 - 032803*	0MW16 - 032803	1MW16 - 032803 (dup)	0MW17 - 032803	0MW18 - 032803	0GP27 - 050103	GP28 - 050203
Location	MW15	MW16	MW16	MW17	MW18	GP27	GP28
Sampling Equipment	Grundfos submersible with dedicated tubing	Grundfos submersible with dedicated tubing	Grundfos submersible with dedicated tubing	Grundfos submersible with dedicated tubing	Grundfos submersible with dedicated tubing	Peristaltic pump with deticated tubing	Peristaltic pump with deticated tubing
Sample Date	3/28/2003	3/28/2003	3/28/2003	3/28/2003	3/28/2003	5/1/2003	5/1/2003
Analyses	NWTPH-Gx/BTEX &MTBE, NWTPH-Dx	NWTPH-Gx/BTEX &MTBE, NWTPH-Dx, EDB, EDC, volatiles 8260B, PCBs 8082, cPAHs 8270cSIM, total lead 6010B	NWTPH-Gx/BTEX &MTBE, NWTPH-Dx, EDB, EDC, volatiles 8260B, PCBs 8082, cPAHs 8270cSIM, total lead 6010B	NWTPH-HCID	NWTPH-HCID	NWTPH-HCID	NWTPH-HCID

Note:
Sample details on sample integrity data sheets and well purging forms in Appendix B.
* Ecology split sample.

TABLE 4-9

SUMMARY OF WEST PORTION TEMPORARY GEOPROBE BORING GROUNDWATER SAMPLES

SAMPLE ID	0GP18 - 032703	0GP19 - 032703*	0GP20 - 032703	0GP21 - 032703	0GP22 - 032703
Location	GP18	GP19	GP20	GP21	GP22
Sampling Equipment	Peristaltic pump with dedicated tubing	Peristaltic pump with dedicated tubing	Peristaltic pump with dedicated tubing	Peristaltic pump with dedicated tubing	Peristaltic pump with dedicated tubing
Sample Date	3/27/2003	3/27/2003	3/27/2003	3/27/2003	3/27/2003
Analyses	HOLD SAMPLE	NWTPH-Gx, NWTPH-Dx, EDB, EDC, volatiles 8260B, PCBs 8082, cPAHs 8270cSIM, total lead 6010B	HOLD SAMPLE	HOLD SAMPLE	NWTPH-Gx, NWTPH-Dx, EDB, EDC, volatiles 8260B, PCBs 8082, cPAHs 8270cSIM, total lead 6010B

Note:

Sample details on sample integrity data sheets and well purging forms in Appendix B.

* Ecology split sample.

TABLE 5-1.1

MOSES LAKE MAINTENANCE FACILITY RIFS
EAST PORTION SOIL
PETROLEUM HYDROCARBON RESULTS

Location				TP-01				TP-02				TP-03					
Sample Identifier				0TP01-7.0		0TP01-2 to 4		0TP02-9.0		0TP02-6.5		0TP03-9.0		1TP03-9.0		0TP03-3.5	
Sample Type				N	Q	N	Q	N	Q	N	Q	N	Q	Dup	Q	N	Q
Analyte	Method	MTCA Method A Soil Cleanup Criteria (mg/kg) [a]	Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg) [b]	Concentration (mg/kg)													
Petroleum Hydrocarbons																	
Gasoline Range	NWTPH-HCID	NA	NA	N/A	-	27	U	N/A	-	30	U	N/A	-	N/A	-	27	U
Diesel Range	NWTPH-HCID	NA	NA	N/A	-	68	U	N/A	-	75	U	N/A	-	N/A	-	68	U
Lube Oil Range	NWTPH-HCID	NA	NA	N/A	-	140	U	N/A	-	150	U	N/A	-	N/A	-	140	U
Diesel Range	NWTPH-Dx	2,000	460	34	U	N/A	-	34	U	N/A	-	39	U	40	U	N/A	-
Lube Oil Range	NWTPH-Dx	2,000	NSA	68	U	N/A	-	68	U	N/A	-	78	U	81	U	N/A	-

Location				GP-01		GP-02		GP-03		GP-24		GP-25		GP-26		GP-26		HA-01		HA-02	
Sample Identifier				0GP01-2.5		0GP02-3.0		0GP03-1.5		0GP24-2.6 to 2.8		0GP25-2.8 to 3.0		0GP26-2.8 to 3.2		1GP26-2.8 to 3.2		0HA01-2.6 to 3.0		0HA02-2.8 to 3.2	
Sample Type				N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	Dup	Q	N	Q	N	Q
Analyte	Method	MTCA Method A Soil Cleanup Criteria (mg/kg) [a]	Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg) [b]	Concentration (mg/kg)																	
Petroleum Hydrocarbons																					
Gasoline Range	NWTPH-HCID	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Diesel Range	NWTPH-HCID	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Lube Oil Range	NWTPH-HCID	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Diesel Range	NWTPH-Dx	2,000	460	29	U	32	U	29	U	35	U	31	U	33	U	33	U	32	U	31	U
Lube Oil Range	NWTPH-Dx	2,000	NSA	550		63	U	58	U	70	U	61	U	66	U	65	U	63	U	63	U

Note:
Q - Validated data qualifier
N - Normal sample
Dup - Duplicate sample
U - Indicates that the analyte was not detected above its practical quantitation limit (PQL)
NA - Not Applicable
NSA - No standard available
N/A - Not Analyzed
a - Chapter 173-340 WAC MTCA Method A Cleanup Levels for unrestricted use
b - Chapter 173-340-900 WAC Table 749-2 Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure

TABLE 5-1.2

MOSES LAKE MAINTENACE FACILITY RIFS
EAST PORTION GROUNDWATER
PETROLEUM HYDROCARBON, PCBS, ARSENIX AND LEAD RESULTS

Location					MW-02		MW-02		MW-04		MW-04		MW-05		MW-05		MW-05		MW-08		MW-08		MW-10		MW-10		MW-11				MW-11		GP-25		HA-02	
Sample Identifier					0MW02-092503		0MW02-120903		0MW04-031703		0MW04-092603		0MW05-031703		0MW05-092603		1MW05-092603		0MW08-031703		0MW08-092603		0MW10-031703		0MW10-092603		0MW11-032803		0MW11-032803		0MW11-092603		0GP25-050103		0HA02-050203	
Sample Type					N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	**Product**	Q	N	Q	N	Q	N	Q
Analyte	**Method**	**MTCA Method A Cleanup Criteria For Groundwater (ug/L)[a]**	**MTCA Method B Cleanup Criteria for Surface Water (ug/L)**	**National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (ug/L)[d]**	**Concentration (ug/L)**																															
Petroleum Hydrocarbons																																				
Diesel Range	NWTPH-Dx	500	NSA	NSA	N/A	-	N/A	-	250	U	N/A	-	250	U	N/A	-	N/A	-	250	U	N/A	-	250	U	N/A	-	14,000		1,500,000 ppm		N/A	-	250	U	260	U
Lube Oil Range	NWTPH-Dx	500	NSA	NSA	N/A	-	N/A	-	400	U	N/A	-	400	U	N/A	-	N/A	-	400	U	N/A	-	400	U	N/A	-	400	U	48,000 ppm	U	N/A	-	400	U	420	U
Gasoline Range	NWTPH-Gx	800 / 1,000*	NSA	NSA	N/A	-	N/A	-	100	U	N/A	-	170		N/A	-	N/A	-	100	U	N/A	-	100	U	N/A	-	100	U	400	U	N/A	-	N/A	-	N/A	-
Methyl t-Butyl Ether (MTBE)	NWTPH-Gx	20	NSA	NSA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	10	U	N/A	-	N/A	-	N/A	-
Benzene	NWTPH-Gx	5	22.7	NSA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.0	U	N/A	-	N/A	-	N/A	-
Toluene	NWTPH-Gx	1,000	4,850	NSA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.0	U	N/A	-	N/A	-	N/A	-
Ethyl Benzene	NWTPH-Gx	700	6,910	NSA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.0	U	N/A	-	N/A	-	N/A	-
m,p-Xylene	NWTPH-Gx	1,000[b]	16,000	NSA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.0		N/A	-	N/A	-	N/A	-
o-Xylene	NWTPH-Gx	1,000[b]	16,000	NSA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.0	U	N/A	-	N/A	-	N/A	-
1,2-Dibromoethane (EDB)	EPA 8011	0.01	NSA	NSA	N/A	-	N/A	-	0.0096	U	N/A	-	0.0095	U	N/A	-	N/A	-	0.0096	U	N/A	-	0.0095	U	N/A	-	0.0092	U	N/A	-	N/A	-	N/A	-	N/A	-
Polychlorinated Biphenyls																																				
Aroclor 1016	EPA 8082	0.1 [c]	NSA	0.014[e]	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.047	U	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1221	EPA 8082	0.1 [c]	NSA	0.014[e]	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.047	U	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1232	EPA 8082	0.1 [c]	NSA	0.014[e]	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.047	U	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1242	EPA 8082	0.1 [c]	NSA	0.014[e]	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.047	U	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1248	EPA 8082	0.1 [c]	NSA	0.014[e]	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.047	U	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1254	EPA 8082	0.1 [c]	NSA	0.014[e]	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.047	U	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1260	EPA 8082	0.1 [c]	NSA	0.014[e]	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.047	U	N/A	-	N/A	-	N/A	-	N/A	-
Metals																																				
Total Lead	EPA 6020	15	NSA	2.5	N/A	-	N/A	-	1.1	U	N/A	-	1.1	U	N/A	-	N/A	-	1.1	U	N/A	-	1.1	U	N/A	-	1.1	U	NA	-	N/A	-	NA	-	NA	-
Total Arsenic	EPA 6020	10.5[f]	17.7	150.0	6.4		5.2		8.4		8.7		9.3		9.3		9.4		4.3		4.6		6.8		7.8		6.5		NA	-	8.2		NA	-	N/A	-

Note:
< - indicates that the analyte was not detected above its practical quantitation limit (PQL)
Q - Validated data qualifier
N - Normal sample
NSA - No standard available
Product - Product sampled from MW-11 using Teflon bailer. Analytical calculated value reflects error in sample dilution steps
NA - Not Applicable
N/A - Not analyzed
a - Chapter 173-340 WAC Method A Groundwater Cleanup Levels for potable water use unless otherwise noted
* - The MTCA Method A cleanup level for gasoline range petroleum hydrocarbons is 800 ug/L if benzene is present
b - The MTCA Method A Cleanup Level is for total xylene, i.e. the sum of m,p-Xylene and o-Xylene
c - Cleanup level is a total for all PCBs (aroclors) based on the concentration derived from Chapter 173-340 WAC equation 720-1
d - The most conservative of the National Water Quality Criteria (EPA, 2002) or Chapter 201A WAC Aquatic Water Quality Criteria is provided both chronic or acute values were considered
e - Cleanup level is a total for all PCBs (aroclors) based on the chronic National Water Quality Criteria.
f - Cleanup criteria set at Arsenic background concentration as established under WAC 173-340-709
Shading indicates the value exceeds one or more of the MTCA cleanup criteria

TABLE 5-1.3

MOSES LAKE MAINTENANCE FACILITY RIFS
EAST PORTION GROUNDWATER
POLYNUCLEAR AROMATIC HYDROCARBON RESULTS

Location						MW11	
Sample Identifier						0MW11-02803	
Sample Type						N	Q
Analyte	Method	MTCA Method Cleanup Criteria For Groundwater (ug/L)[a]	MTCA Method B Cleanup Criteria for Surface Water (ug/L)	Toxicity Equivalency Factor (TEF)	National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (ug/L)[d]	Concentration (ug/L)	
Polynuclear Aromatic Hydrocarbons							
Naphthalene	EPA 8270C	5	NSA	NA	NSA	3.6	
2-Methylnaphthalene	EPA 8270C	NSA	NSA	NA	NSA	19	
1-Methylnaphthalene	EPA 8270C	NSA	NSA	NA	NSA	19	
Acenaphthylene	EPA 8270C	NSA	NSA	NA	NSA	0.36	
Acenaphthene	EPA 8270C	960 [b]	643	NA	NSA	2.0	
Fluorene	EPA 8270C	640 [b]	3,460	NA	NSA	3.7	
Phenanthrene	EPA 8270C	NA	NSA	NA	NSA	7.4	
Anthracene	EPA 8270C	2,400 [b]	25,900	NA	NSA	0.46	
Fluoranthene	EPA 8270C	640 [b]	90.2	NA	NSA	0.14	
Pyrene	EPA 8270C	2,400 [b]	NSA	NA	NSA	0.65	
Benzo[a]anthracene[c]	EPA 8270C	0.1 / TEF*	NSA	0.100	NSA	0.019	
Chrysene[c]	EPA 8270C	0.1 / TEF*	NSA	0.010	NSA	0.071	
Benzo[b]fluoranthene[c]	EPA 8270C	0.1 / TEF*	NSA	0.100	NSA	0.0095	U
Benzo[k]fluoranthene[c]	EPA 8270C	0.1 / TEF*	NSA	0.140	NSA	0.0095	U
Benzo[a]pyrene[c]	EPA 8270C	0.1 / TEF*	NSA	1.000	NSA	0.0095	U
Indeno[1,2,3-cd]pyrene[c]	EPA 8270C	0.1 / TEF*	NSA	0.100	NSA	0.0095	U
Dibenz[a,h]anthracene[c]	EPA 8270C	0.1 / TEF*	NSA	0.400	NSA	0.0095	U
Benzo[g,h,i]perylene	EPA 8270C	NSA	NSA	NA	NSA	0.0095	U
Total TEF cPAH concentration	-		-	-		0.00261	

Note:
Q - Validated data qualifier.
N - Normal sample.
Dup - Duplicate sample.
U - indicates that the analyte was not detected above its practical quantitation limit (PQL).
NSA - No standard available.
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Groundwater Cleanup Levels for potable water unless otherwise noted.
b - Chapter 173-340 WAC Method B Groundwater Cleanup Levels for potable water use.
c - Carcinogenic PAH
d - The most conservative of the National Water Quality Criteria (EPA, 2002) or Chapter 201A WAC Aquatic Water Quality Criteria is provided both chronic or acute values were considered.
* - The MTCA Method A Cleanup level for cPAHs is based the total toxicity equivalence of benzo[a]pyrene. The individual cPAHs are multiplied by their TEF, and the values summed to determine the total cPAH based on their TEF. (WAC 173-340-708).

CITY OF MOSES LAKE MAINTENANCE FACILITY RIFS
EAST PORTION GROUNDWATER
VOLATILE ORGANIC COMPOUND RESULTS (DETECTS ONLY)

Location					MW-04		MW-05		MW-08		MW-10		MW-11	
Sample Identifier					0MW04-031703		0MW05-031703		0MW08-031703		0MW10-031703		0MW11-032803	
Sample Type					N	Q	N	Q	N	Q	N	Q	N	Q
Analyte	Analytical Method	MTCA Cleanup Criteria For Groundwater (ug/L)[a]	MTCA Method B Cleanup Criteria for Surface Water (ug/L)	National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (ug/L)[c]	Concentration (ug/L)									
Volatile Organic Compounds														
Methyl t-Butyl Ether	EPA 8260B	20	NSA	NSA	0.23		0.20	U	0.20	U	0.20	U	0.31	
Chloroform	EPA 8260B	7.17[b]	283	NSA	0.41		0.20	U	0.36		0.66		1.4	
Bromodichloromethane	EPA 8260B	0.706[b]	27.9	NSA	0.20	U	0.20	U	0.20	U	0.45		1.1	
Dibromochloromethane	EPA 8260B	0.521[b]	2.06	NSA	0.20	U	0.20	U	0.20	U	0.27		0.49	
Bromoform	EPA 8260B	5.54[b]	2.19	NSA	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Isopropylbenzene	EPA 8260B	NSA	NSA	NSA	0.20	U	0.20	U	0.20		0.20	U	0.20	U
n-Propylbenzene	EPA 8260B	NSA	NSA	NSA	0.20	U	0.20	U	0.38		0.20	U	0.20	U
1,3,5-Trimetylbenzene	EPA 8260B	NSA	NSA	NSA	0.20	U	0.20	U	0.39		0.20	U	0.42	
1,2,5-Trimetylbenzene	EPA 8260B	NSA	NSA	NSA	0.20	U	0.20	U	0.52		0.20	U	1.4	
sec-Butylbenzene	EPA 8260B	NSA	NSA	NSA	0.20	U	0.69		0.27		0.20	U	0.20	U
n-Butylbenzene	EPA 8260B	NSA	NSA	NSA	0.20	U	0.35		0.2	U	0.20	U	0.20	U
1,2-Dibromoethane (EDB)	EPA 8011	0.01	NSA	NSA	0.0096	U	0.0095	U	0.0096	U	0.0095	U	0.0095	U

Note:
N - Normal sample.
Q - Validated data qualifier.
NSA - No standard available.
U - indicates that the analyte was not detected above its practical quantitation limit (PQL).
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Groundwater Cleanup Levels for potable water use unless otherwise noted.
b - Chapter 173-340 WAC Method B Groundwater Cleanup Levels for potable water use.
c - The most conservative of the National Water Quality Criteria (EPA, 2002) or Chapter 201A WAC Aquatic Water Quality Criteria is provided both chronic or acute values were considered.

MOSES LAKE MAINTENANCE FACILITY RIFS
CENTRAL PORTION SOURCE AREA SOIL
PETROLEUM HYDROCARBON, PCBs AND LEAD RESULTS

Analyte	Method	MTCA Method A Cleanup Criteria (mg/kg)[a]	Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg)[b]	0TP04-2.2,3.0,4.2,4.5 Comp.		0TP04-2.2		0TP04-3.0		0TP04-4.2		0TP04-4.5		0TP04-2 to 3	
Location				TP-04											
Sample Type				N	Q	N	Q	N	Q	N	Q	N	Q	N	Q
				Concentration (mg/kg)											
Petroleum Hydrocarbons															
Diesel Range	NWTPH-HCID	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Lube Oil Range	NWTPH-HCID	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Gasoline Range	NWTPH-HCID	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Diesel Range	NWTPH-Dx	2,000	460	800		2,200	J	1,500	J	300	J	230	J	1,700	
Lube Oil Range	NWTPH-Dx	2,000	NSA	2,100		5,800	J	5,700	J	1,000	J	830	J	3,700	
Gasoline Range	NWTPH-Gx	30 / 100 [b]	200	230	Z	570	U	450	U	57	Z	50	Z	300	Z
Methyl t-Butyl Ether (MTBE)	NWTPH-Gx	0.1	NSA	Results are	U	N/A	-	N/A	-	N/A	-	N/A	-	0.060	U
Benzene	NWTPH-Gx	0.03	NSA	Presented on	U	N/A	-	N/A	-	N/A	-	N/A	-	0.012	U
Toluene	NWTPH-Gx	7	NSA	Table 5.2.3	U	N/A	-	N/A	-	N/A	-	N/A	-	0.060	U
Ethyl Benzene	NWTPH-Gx	6	NSA	With	U	N/A	-	N/A	-	N/A	-	N/A	-	0.27	
m,p-Xylene	NWTPH-Gx	9 [c]	NSA	Other	U	N/A	-	N/A	-	N/A	-	N/A	-	0.25	
o-Xylene	NWTPH-Gx	9 [c]	NSA	VOCs	U	N/A	-	N/A	-	N/A	-	N/A	-	0.23	
Polychlorinated Biphenyls															
Aroclor 1016	EPA 8082	1.0 [d]	NSA	0.061	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1221	EPA 8082	1.0 [d]	NSA	0.061	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1232	EPA 8082	1.0 [d]	NSA	0.061	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1242	EPA 8082	1.0 [d]	NSA	0.061	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1248	EPA 8082	1.0 [d]	NSA	0.061	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1254	EPA 8082	1.0 [d]	NSA	0.061	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1260	EPA 8082	1.0 [d]	NSA	0.061	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Metals															
Lead	EPA 6010B	250	220	43		N/A	-	N/A	-	N/A	-	N/A	-	N/A	-

Analyte	0TP05-3.0,3.9 Comp.		1TP05-3.0, 3.9 Comp.		0TP05-3.0		0TP05-3.9		0TP05-4.5		0TP06-4.0, 4.5 Comp.		0TP06-4.0		0MW-16-4.5 to 6.0	
Location	TP-05										TP-06				MW-16	
Sample Type	N	Q	Dup	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q
	Concentration (mg/kg)															
Petroleum Hydrocarbons																
Diesel Range	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	24	U
Lube Oil Range	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	>60	
Gasoline Range	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	>120	
Diesel Range	2,100		1,900		1,500	J	4,500	J	32	UJ	33	U	N/A	-	280	
Lube Oil Range	5,000		4,700		6,000	J	8,700	J	63	UJ	67		N/A	-	1400	
Gasoline Range	27	U	27	U	N/A	-	N/A	-	N/A	-	5.8	U	6.6	U	90	J
Methyl t-Butyl Ether (MTBE)	Results are	-	Results are	-	N/A	-	N/A	-	0.059	U	0.058	U	0.066	U	Results are	
Benzene	Presented on	-	Presented on	-	N/A	-	N/A	-	0.012	U	0.013		0.013	U	Presented on	
Toluene	Table 5.2.3	-	Table 5.2.3	-	N/A	-	N/A	-	0.059	U	0.058	U	0.066	U	Table 5.2.3	
Ethyl Benzene	With	-	With	-	N/A	-	N/A	-	0.50		0.058	U	0.066	U	With	
m,p-Xylene	Other	-	Other	-	N/A	-	N/A	-	0.49		0.058	U	0.066	U	other	
o-Xylene	VOCs	-	VOCs	-	N/A	-	N/A	-	0.27		0.058	U	0.066	U	VOCs	
Polychlorinated Biphenyls																
Aroclor 1016	0.054	U	0.054	U	0.052	U	0.057	U	0.063	U	N/A	-	0.066	U	0.060	U
Aroclor 1221	0.054	U	0.054	U	0.052	U	0.057	U	0.063	U	N/A	-	0.066	U	0.060	U
Aroclor 1232	0.054	U	0.054	U	0.052	U	0.057	U	0.063	U	N/A	-	0.066	U	0.060	U
Aroclor 1242	0.054	U	0.054	U	0.052	U	0.057	U	0.063	U	N/A	-	0.066	U	0.060	U
Aroclor 1248	0.054	U	0.054	U	0.052	U	0.057	U	0.063	U	N/A	-	0.066	U	0.060	U
Aroclor 1254	0.56		0.46		0.81		0.40		0.063	U	N/A	-	0.066	U	0.081	
Aroclor 1260	0.054	U	0.054	U	0.052	U	0.057	U	0.063	U	N/A	-	0.066	U	0.060	U
Metals																
Lead	220		260		330		48		7.5		25		N/A	-	87	

Note:
N - Normal sample.
Q - Validated data qualifier.
NSA - No standard available.
> - indicates that the analyte was detected above its practical quantitation limit (PQL).
Dup - Duplicate sample.
U - indicates that the analyte was not detected above its PQL.
J - indicates concentration is an estimated value.
Z - Gasoline results are being influenced by the presence of diesel range organics.
N/A - Not analyzed.
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Compliance Cleanup Levels for unrestricted use.
* - Chapter 173-340-900 WAC Table 749-2 Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure.
b - The MTCA Method A Compliance Cleanup Level for gasoline range petroleum hydrocarbons is 100 mg/kg if benzene is not present and the total of TEX is greater than 1%.
c - The MTCA Method A Cleanup Level is for total xylene, i.e. the sum of m,p-Xylene and o-Xylene.
d - Cleanup level is a total for all PCBs (aroclors) based on the concentration derived from Chapter 173-340 WAC equation 720-1.
Shading indicates the value exceeds one or more of the MTCA cleanup criteria.

MOSES LAKE MAINTENANCE FACILITY RIFS
CENTRAL PORTION SOIL
PETROLEUM HYDROCARBON RESULTS

Location				GP-04		GP-05		GP-06		GP-07		GP-08		GP-09				GP-10	
Sample Identifier				0GP04-3.0 to 3.5		0GP05-3.0 to 3.5		0GP06-2.5 to 2.8		0GP07-2.9 to 3.25		0GP08-3.0 to 3.3		0GP09-3.5 to 4.0		1GP09-3.5 to 4.0		0GP10-3.5 to 4.0	
Sample Type				N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	Dup	Q	N	Q
Analyte	Method	MTCA Method Soil Cleanup Criteria (mg/kg)[a]	Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg)*	Concentration (mg/kg)															
Petroleum Hydrocarbons																			
Diesel Range	NWTPH-HCID	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Lube Oil Range	NWTPH-HCID	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Gasoline Range	NWTPH-HCID	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Diesel Range	NWTPH-Dx	2,000	460	32	U	33	U	32	U	29	U	170		2,000		5,700		12,000	
Lube Oil Range	NWTPH-Dx	2,000	NSA	64	U	65	U	64	U	320		1,500		62.0	U	62	U	4,100	
Gasoline Range	NWTPH-Gx	30 / 100 [b]	200	6.4	U	6.5	U	6.4	U	5.9	U	5.6	U	1,300	Z	5,800	Z	5.9	U
Methyl t-Butyl Ether (MTBE)	NWTPH-Gx	0.1	NSA	0.064	U	0.065	U	0.064	U	0.059	U	0.056	U	0.120	U	0.120	U	0.059	U
Benzene	NWTPH-Gx	0.03	NSA	0.013	U	0.013	U	0.013	U	0.012	U	0.011	U	0.025	U	0.025	U	0.012	U
Toluene	NWTPH-Gx	7	NSA	0.064	U	0.065	U	0.064	U	0.059	U	0.056	U	0.120	U	0.34		0.059	U
Ethyl Benzene	NWTPH-Gx	6	NSA	0.064	U	0.065	U	0.064	U	0.059	U	0.056	U	0.59		2.3		0.50	
m,p-Xylene	NWTPH-Gx	9 [c]	NSA	0.064	U	0.065	U	0.064	U	0.059	U	0.056	U	2.7		11		0.49	
o-Xylene	NWTPH-Gx	9 [c]	NSA	0.064	U	0.065	U	0.064	U	0.059	U	0.056	U	7.7		32		0.27	

Location	GP-11		GP-12		GP-13		GP-14		GP-15		GP-16		GP-27		GP-28		GP-29		MW-15		MW-17				MW-18	
Sample Identifier	0GP11-3.5 to 4.0		0GP12-3.0 to 3.25		0GP13-3.0 to 3.25		0GP14-3.5 to 4.0		0GP15-3.5 to 4.0		0GP16-3.5 to 4.0		0GP27-16.0 to 16.4		0GP28-13.0 to 13.6		0GP29-17 to 17.5		0MW-15-6.5 to 7.5		0MW-17-5.0		1MW-17-5.0		0MW18-4 to 8	
Sample Type	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q
Analyte	Concentration (mg/kg)																									
Petroleum Hydrocarbons																										
Diesel Range	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	23	U	23	U	22	U	24	U
Lube Oil Range	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	58	U	57	U	55	U	59	U
Gasoline Range	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	>120		110	U	110	U	>120	
Diesel Range	150	U	31	U	31	U	28	U	29	U	28	U	33	U	35	U	32	U	29	U	N/A	-	N/A	-	29	U
Lube Oil Range	490		61	U	62	U	250		75		57	U	66	U	69	U	63	U	980		N/A	-	N/A	-	270	U
Gasoline Range	5.8	U	6.1	U	6.2	U	5.6	U	5.8	U	5.7	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Methyl t-Butyl Ether (MTBE)	0.058	U	0.061	U	0.062	U	0.056	U	0.058	U	0.057	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Benzene	0.013		0.012	U	0.012	U	0.011	U	0.012	U	0.019		N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Toluene	0.058	U	0.061	U	0.062	U	0.056	U	0.058	U	0.057	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Ethyl Benzene	0.058	U	0.061	U	0.062	U	0.056	U	0.058	U	0.057	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
m,p-Xylene	0.058	U	0.061	U	0.062	U	0.056	U	0.058	U	0.057	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
o-Xylene	0.058	U	0.061	U	0.062	U	0.056	U	0.058	U	0.057	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-

Note:
N - Normal sample.
Q - Validated data qualifier.
NSA - No standard available.
N/A - Not analyzed.
Z - Gasoline results are being influenced by the presence of diesel range organics.
> - indicates that the analyte was detected above its practical quantitation limit (PQL).
Dup - Duplicate sample.
U - indicates that the analyte was not detected above its PQL.
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Cleanup Levels for unrestricted use.
* - Chapter 173-340-900 WAC Table 749-2 Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure.
b - The MTCA Method A Compliance Cleanup Level for gasoline range petroleum hydrocarbons is 100 mg/kg if benzene is not present and the total of TEX is greater than 1%.
c - The MTCA Method A Cleanup Level is for total xylene, i.e. the sum of m,p-Xylene and o-Xylene.
Shading indicates the value exceeds one or more of the MTCA cleanup criteria.

MOSES LAKE MAINTENANCE FACILITY RIFS
CENTRAL PORTION SOURCE AREA SOIL
POLYNUCLEAR AROMATIC HYDROCARBON RESULTS

Location					**TP-04**		**TP-05**				**TP-06**		**MW-16**	
Sample Identifier					0TP04-2.2,3.0,4.2,4.5 Comp.		0TP05-3.0,3.9 Comp.		1TP05-3.0, 3.9 Comp.		0TP06-4.0, 4.5 Comp.		0MW06-4.5 to 6.0	
Sample Type					N	Q	N	Q	Dup	Q	N	Q	N	Q
Analyte	**Method**	**MTCA Cleanup Levels For Unrestricted Use (mg/kg)[a]**	**Toxicity Equivalency Factor (TEF)**	**Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg)**	**Concentration (mg/kg)**									
Polynuclear Aromatic Hydrocarbons														
Naphthalene	EPA 8270C	5	NA	NSA	0.39		2		1.00		0.011	U	0.11	J
2-Methylnaphthalene	EPA 8270C	NSA	NA	NSA	1.40		10		5.80		0.011	U	0.24	J
1-Methylnaphthalene	EPA 8270C	NSA	NA	NSA	2.70		7.1		4.10		0.011	U	0.71	J
Acenaphthylene	EPA 8270C	NSA	NA	NSA	0.10		0.20		0.18	U	0.011	U	0.010	UJ
Acenaphthene	EPA 8270C	4,800 [b]	NA	d	0.26		0.39		0.29		0.011	U	0.057	J
Fluorene	EPA 8270C	3,200 [b]	NA	NSA	0.76		1.5		0.95		0.011	U	0.12	J
Phenanthrene	EPA 8270C	NSA	NA	NSA	0.62		1.1		0.70		0.011	U	0.14	J
Anthracene	EPA 8270C	24,000 [b]	NA	NSA	0.10	U	0.18	U	0.18	U	0.011	U	0.01	UJ
Fluoranthene	EPA 8270C	3,200 [b]	NA	NSA	0.10	U	0.49	U	0.31		0.018		0.092	J
ene	EPA 8270C	2,400 [b]	NA	NSA	0.15		0.27		0.18	U	0.021		0.140	J
nzo[a]anthracene[c]	EPA 8270C	0.1 / TEF*	0.100	NSA	0.10	U	0.18	U	0.18	U	0.011	U	0.027	J
Chrysene[c]	EPA 8270C	0.1 / TEF*	0.010	NSA	0.10	U	0.18	U	0.18	U	0.017		0.073	J
Benzo[b]fluoranthene[c]	EPA 8270C	0.1 / TEF*	0.100	NSA	0.10	U	0.18	U	0.18	U	0.014		0.067	J
Benzo[k]fluoranthene[c]	EPA 8270C	0.1 / TEF*	0.140	NSA	0.10	U	0.18	U	0.18	U	0.011	U	0.01	UJ
Benzo[a]pyrene[c]	EPA 8270C	0.1 / TEF*	1.000	30	0.10	U	0.18	U	0.18	U	0.014		0.024	J
Indeno[1,2,3-cd]pyrene[c]	EPA 8270C	0.1 / TEF*	0.100	NSA	0.10	U	0.18	U	0.18	U	0.011	U	0.035	J
Dibenz[a,h]anthracene[c]	EPA 8270C	0.1 / TEF*	0.400	NSA	0.10	U	0.18	U	0.18	U	0.011	U	0.010	UJ
Benzo[g,h,i]perylene	EPA 8270C	NSA	NA	NSA	0.10	U	0.18	U	0.18	U	0.013		0.065	J
Total TEF cPAH concentration	-	0.1 / TEF*	-	-	NA		NA		NA		0.016		0.038	

Note:
N - Normal sample.
Q - Validated data qualifier.
NSA - No standard available.
Dup - Duplicate sample.
U - indicates that the analyte was not detected above its practical quantitation limit (PQL).
J - indicates concentration is an estimated value.
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Cleanup Levels for unrestricted use unless otherwise noted.
b - Chapter 173-340 WAC Method B Cleanup Levels for unrestricted use.
c - Carcinogenic PAH.
d - Safe concentration has not yet been established by Ecology.
* - The MTCA Method A Cleanup level for cPAHs is based the total toxicity equivalence of benzo[a]pyrene that is 0.1 mg/Kg. The individual cPAHs are multiplied by their TEF, and the values summed to determine the total cPAH based on their toxicity equivalent factor (TEF). Reference WAC 173-340-708.

MOSES LAKE MAINTENANCE FACILITY RIFS
CENTRAL PORTION SOURCE AREA SOIL
VOLATILE ORGANIC COMPOUND RESULTS (DETECTS ONLY)

Location				TP-04		TP-05				TP-06		MW-16	
Sample Identifier				0TP04-2.2,3.0,4.2,4.5 Comp.		0TP05-3.0,3.9 Comp.		1TP05-3.0, 3.9 Comp.		0TP06-4.0, 4.5 Comp.		0MW-16-4.5 to 6.0	
Sample Type				N	Q	N	Q	Dup	Q	N	Q	N	Q
Analyte	Method	MTCA Cleanup Levels for Unrestricted Use (mg/kg)[a]	Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg)*	Concentration (mg/kg)									
Volatile Organic Compounds													
Acetone	EPA 8260B	8,000 [b]	NSA	0.12		0.1400		0.11		0.067		0.0092	J
Carbon Disulfide	EPA 8260B	8,000 [b]	NSA	0.0012	U	0.0052		0.0050		0.0014	U	0.0012	UJ
2-Butanone	EPA 8260B	48,000 [b]	NSA	0.040		0.20		0.065		0.015		0.0060	UJ
Benzene	EPA 8260B	0.03	NSA	0.0012	U	0.013		0.0069		0.0014	U	0.0012	UJ
Toluene	EPA 8260B	7 [b]	NSA	0.0015		0.0034		0.0032		0.0014	U	0.0012	UJ
Tetrachloroethene	EPA 8260B	19.6 [b]	NSA	0.0012	U	0.0015		0.0011	U	0.0014	U	0.0012	UJ
Chlorobenzene	EPA 8260B	1,600 [b]	NSA	0.0012	U	0.0270		0.0067		0.0014	U	0.0012	UJ
Ethylbenzene	EPA 8260B	6 [b]	NSA	0.053		0.053		0.027		0.0014	U	0.0012	UJ
[illegible]-Xylene	EPA 8260B	9 [bc]	NSA	0.059		1.1		0.32		0.0027	U	0.0049	J
[illegible]lene	EPA 8260B	9 [bc]	NSA	0.032		0.30		0.14		0.0014	U	0.0075	J
[illegible]opropylbenzene	EPA 8260B	NSA	NSA	0.059		0.33		0.16		0.0014	U	0.0019	J
n-Propylbenzene	EPA 8260B	NSA	NSA	0.15		1.0		0.53		0.0014	U	0.0048	J
1,3,5-Trimethylbenzene	EPA 8260B	NSA	NSA	0.46		0.21		1.40		0.0014	U	0.006	J
1,2,4-Trimethylbenzene	EPA 8260B	NSA	NSA	1.1		6		5.1		0.0014	U	0.03	UJ
sec-Butylbenzene	EPA 8260B	NSA	NSA	0.13		0.78		0.50		0.0014	U	0.0038	J
p-Isopropyltoluene	EPA 8260B	NSA	NSA	0.16		0.71		0.52		0.0014	U	0.0044	J
1,4-Dichlorobenzene	EPA 8260B	41.7 [b]	NSA	0.0012	U	0.0082		0.0026		0.0014	U	0.0012	UJ
1,2-Dichlorobenzene	EPA 8260B	7,200 [b]	NSA	0.0013		0.16		0.17		0.0014	U	0.0012	UJ
Naphthalene	EPA 8260B	5	NSA	0.0012	U	1.25		1.10		0.0014	U	0.0065	J

Note:
N - Normal sample.
Q - Validated data qualifier.
NSA - No standard available.
Dup - Duplicate sample.
U - indicates that the analyte was not detected above its practical quantitation limit (PQL).
J - indicates analytical value is estimated.
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Cleanup Levels for unrestricted use.
* - Chapter 173-340-900 WAC Table 749-2 Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure.
b - Chapter 173-340 WAC Method B Cleanup Levels for unrestricted use.
c - This is total value for all xylenes m,p-xylenes and o-xylene combined.

MOSES LAKE MAINTENANCE FACILITY RIFS
CENTRAL PORTION GROUNDWATER
PETROLEUM HYDROCARBON, PCBs, ARSENIC AND LEAD RESULTS

Location					MW-15		MW-15		MW-15		MW-16				MW-16		MW-17		MW-17		MW-18		MW-18		GP-27		GP-28	
Sample Identifier					0MW15-032803		0MW15-092503		0MW15-120903		0MW16-032803		1MW16-032803		0MW15-092603		0MW17-032803		0MW15-092603		0MW18-032803		0MW18-092603		0GP27-050103		0GP28-050103	
Sample Type					N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q
Analyte	Method	MTCA Groundwater Cleanup Criteria For Unrestricted Use (μg/L)[a]	MTCA Method B Cleanup Criteria for Surface Water (μg/L)	National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (μg/L)[e]	Concentration μg/L																							
Petroleum Hydrocarbons																												
Diesel Range	NWTPH-HCID	NA	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	250	U	N/A	-	250	U	N/A	-	N/A	-	N/A	-
Lube Oil Range	NWTPH-HCID	NA	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	400	U	N/A	-	400	U	N/A	-	N/A	-	N/A	-
Gasoline Range	NWTPH-HCID	NA	NA	NA	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	100	U	N/A	-	100	U	N/A	-	N/A	-	N/A	-
Diesel Range	NWTPH-Dx	500	NSA	NSA	250	U	N/A	-	N/A	-	250	U	250	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	250	UJ	250	UJ
Lube Oil Range	NWTPH-Dx	500	NSA	NSA	400	U	N/A	-	N/A	-	400	U	400	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	410	UJ	400	UJ
Gasoline Range	NWTPH-Gx	800 / 1000[b]	NSA	NSA	100	U	N/A	-	N/A	-	100	U	100	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Methyl t-Butyl Ether (MTBE)	NWTPH-Gx	20.0	NSA	NSA	10	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Benzene	NWTPH-Gx	0.030	22.7	NSA	1.0	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Toluene	NWTPH-Gx	1,000	4,850	NSA	1.0	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Ethyl Benzene	NWTPH-Gx	700	6,910	NSA	1.0	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
m,p-Xylene	NWTPH-Gx	1000[c]	16,000	NSA	1.0	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
o-Xylene	NWTPH-Gx	1000[c]	16,000	NSA	1.0	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
1,2-Dibromoethane (EDB)	EPA 8011	0.01	NSA	NSA	N/A	-	N/A	-	N/A	-	0.0092	U	0.0091	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Polychlorinated Biphenyls																												
Aroclor 1016	EPA 8082	0.1[d]	NSA	0.014[f]	N/A	-	N/A	-	N/A	-	0.048	U	0.048	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1221	EPA 8082	0.1[d]	NSA	0.014[f]	N/A	-	N/A	-	N/A	-	0.048	U	0.048	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1232	EPA 8082	0.1[d]	NSA	0.014[f]	N/A	-	N/A	-	N/A	-	0.048	U	0.048	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1242	EPA 8082	0.1[d]	NSA	0.014[f]	N/A	-	N/A	-	N/A	-	0.048	U	0.048	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1248	EPA 8082	0.1[d]	NSA	0.014[f]	N/A	-	N/A	-	N/A	-	0.048	U	0.048	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1254	EPA 8082	0.1[d]	NSA	0.014[f]	N/A	-	N/A	-	N/A	-	0.048	U	0.048	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Aroclor 1260	EPA 8082	0.1[d]	NSA	0.014[f]	N/A	-	N/A	-	N/A	-	0.048	U	0.048	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Metals																												
Total Lead	EPA 6010B	15	NSA	2.5	N/A	-	N/A	-	N/A	-	1.1	U	1.1	U	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
Total Arsenic	EPA 6010B	10.5[g]	17.7	150.0	N/A	-	9.1		8.5		5.4		4.7		6.0		N/A	-	10.0		N/A	-	9.5		N/A	-	N/A	-

Note:
N - Normal sample.
Q - Validated data qualifier.
Dup - Duplicate sample.
U - indicates that the analyte was not detected above its practical quantitation limit (PQL).
NSA - No standard available.
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Groundwater Cleanup Levels for potable water use.
b - The MTCA Method A cleanup level for gasoline range petroleum hydrocarbons is 800 ug/L if benzene is present.
c - The MTCA Method A Cleanup Level is for total xylene, i.e. the sum of m,p-Xylene and o-Xylene.
d - Cleanup level is a total for all PCBs (aroclors) based on the concentration derived from Chapter 173-340 WAC equation 720-1.
e - The most conservative of the National Water Quality Criteria (EPA, 2002) or Chapter 201A WAC Aquatic Water Quality Criteria is provided both chronic or acute values were considered.
f - Cleanup level is a total for all PCBs (aroclors) based on the chronic National Water Quality Criteria.
g - Cleanup criteria set at Arsenic background concentration as established under WAC 173-340-709.
Shading indicates the value exceeds one or more of the MTCA cleanup criteria.

TABLE 5-2.6

MOSES LAKE MAINTENANCE FACILITY RIFS
CENTRAL PORTION SOURCE AREA GROUNDWATER
VOLATILE ORGANIC COMPOUND RESULTS (DETECTS ONLY)

Location					**MW-16**			
Sample Identifier					0MW16-032803		1MW16-032803	
Sample Type					N	Q	Dup	Q
Analyte	**Method**	**MTCA Cleanup Criteria For Groundwater (µg/L)[a]**	**MTCA Method B Cleanup Criteria for Surface Water (µg/L)**	**National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (µg/L)[c]**	**Concentration µg/L**			
Volatile Organic Hydrocarbons (EPA Method 8260B) Detected Compounds Only								
Methyl t-Butyl Ether (MTBE)	EPA 8260B	20	NSA	NSA	0.59		0.51	
Chloroform	EPA 8260B	7.17 [b]	283	NSA	0.62		0.58	
1,2,4 - Trimethylbenzene	EPA 8260B	7.17 [b]	283	NSA	0.20	U	0.22	

Note:
N - Normal sample.
Q - Validated data qualifier.
Dup - Duplicate sample.
NSA - No standard available.
a - Chapter 173-340 WAC Method A Groundwater Cleanup Levels for potable water use unless other wise noted.
b - Chapter 173-340 WAC Method B Groundwater Cleanup Levels for potable water use.
c - The most conservative of the National Water Quality Criteria (EPA, 2002) or Chapter 201A WAC Aquatic Water Quality Criteria is provided both chronic or acute values were considered.

CITY OF MOSES LAKE MAINTENANCE FACILITY RIFS
WEST PORTION SOIL
PETROLEUM HYDROCARBON RESULTS

Location				GP-17		GP-18		GP-19		GP-20		GP-21		GP-22		GP-23	
Sample Identifier				0GP17-3.5 to 4.0		0GP18-2.5 to 2.8		0GP19-2.8 to 3.0		0GP20-2.7 to 3.0		0GP21-3.8 to 4.0		0GP22-2.8 to 3.0		0GP23-2.7 to 3.0	
Sample Type				N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q
Analyte	Method	MTCA Method Cleanup Levels for Unrestricted Soil Use[a] (mg/Kg)	Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg)	Concentration (mg/kg)													
Petroleum Hydrocarbons																	
Diesel Range	NWTPH-Dx	2,000	460	28	U	32	U	27	U	32	U	28	U	31	U	33	U
Lube Oil Range	NWTPH-Dx	2,000	NSA	920		89		74		190		56	U	62	U	65	U
Gasoline Range	NWTPH-Gx	30*	200	6.4		6.3	U	5.4	U	6.3	U	5.6	U	6.2	U	6.5	U
Methyl t-Butyl Ether (MTBE)	NWTPH-Gx	0.01	NSA	0.055	U	0.063	U	0.054	U	0.063	U	0.056	U	0.062	U	0.065	U
Benzene	NWTPH-Gx	0.03	NSA	0.011	U	0.013	U	0.011	U	0.013	U	0.011	U	0.012	U	0.013	U
Toluene	NWTPH-Gx	7	NSA	0.055	U	0.063	U	0.054	U	0.063	U	0.056	U	0.062	U	0.065	U
Ethyl Benzene	NWTPH-Gx	6	NSA	0.055	U	0.063	U	0.054	U	0.063	U	0.056	U	0.062	U	0.065	U
m,p-Xylene	NWTPH-Gx	9[b]	NSA	0.055	U	0.063	U	0.054	U	0.063	U	0.056	U	0.062	U	0.065	U
o-Xylene	NWTPH-Gx	9[b]	NSA	0.055	U	0.063	U	0.054	U	0.063	U	0.056	U	0.062	U	0.065	U

Note:
N - Normal sample.
Q - Validated data qualifier.
U - indicates that the analyte was not detected above its practical quantitation limit (PQL).
NSA - No standard available.
NA - Not Applicable
a - Chapter 173-340 WAC Method A Cleanup Levels for unrestricted use.
* - The MTCA Method A Compliance Cleanup Level for gasoline range petroleum hydrocarbons is 100mg/kg if benzene is not present and the total of TEX is less than 1%.
c - The MTCA Method A Cleanup Level is for total xylene, i.e. the sum of m,p-Xylene and o-Xylene.

MOSES LAKE MAINTENANCE FACILITY RIFS
WEST POINT SOIL
RCRA METALS RESULTS

Location				GP-17		GP-18		GP-19		GP-20		GP-21		GP-22		GP-23	
Sample Identifier				0GP17-3.5 to 4.0		0GP18-2.5 to 2.8		0GP19-2.8 to 3.0		0GP20-2.7 to 3.0		0GP21-3.8 to 4.0		0GP22-2.8 to 3.0		0GP23-2.7 to 3.0	
Sample Type				N	Q	N	Q	N	Q	N	Q	N	Q	N	Q	N	Q
Analyte	Method	MTCA Cleanup Levels for Unrestricted Soil Use[a]	Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg)	Concentration (mg/kg)													
RCRA Metals																	
Arsenic	EPA 6010B	20	20	11	U	13	U	11	U	13	U	11	U	12	U	13	U
Barium	EPA 6010B	5600 [b]	1,250	73		110		78		93		43		80		100	
Cadmium	EPA 6010B	2 [b]	25	0.55	U	0.63	U	0.54	U	0.63	U	0.56	U	0.62	U	0.65	U
Chromium	EPA 6010B	2000 [b*]	42[c]	3.8		5.5		4.6		7.5		4.4		5.5		7	
Lead	EPA 6010B	250	220	18		9.1		22		13		5.6	U	9.4		8.5	
Mercury	EPA 7471A	2 [b]	9	0.27	U	0.32	U	0.27	U	0.32	U	0.28	U	0.31	U	0.32	U
Selenium	EPA 6010B	400 [b]	0.8	11	U	13	U	11	U	13	U	11	U	12	U	13	U
Silver	EPA 6010B	400 [b]	d	0.55	U	0.63	U	0.54	U	0.63	U	0.56	U	0.62	U	0.65	U

Note:
N - Normal sample.
Q - Validated data qualifier.
U - indicates that the analyte was not detected above its practical quantitation limit (PQL).
a - Chapter 173-340 WAC Method A Cleanup Levels for unrestricted use unless otherwise noted.
b - Chapter 173-340 WAC Method B Cleanup Levels for unrestricted use.
c - Value is for total chromium.
d - Safe concentration has not yet been established by Ecology.

TABLE 5-3.3

CITY OF MOSES LAKE MAINTENANCE FACILITY RIFS
WEST PORTION GROUNDWATER
PETROLEUM HYDROCARBON, PCBs, DETECTED VOCs AND PAH RESULTS

Location					GP-19		GP-22		GP-23	
Sample Identifier					0GP19-032703		0GP22-032703		0GP23-032703	
Sample Type					N	Q	N	Q	N	Q
Analyte	Method	MTCA Cleanup Criteria For Groundwater (µg/L)[a]	MTCA Method B Cleanup Criteria for Surface Water (µg/L)	National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (µg/L)[f]	Concentration (µg/L)					
Petroleum Hydrocarbons										
Diesel Range	NWTPH-Dx	500	NSA	NSA	250	U	250	U	260	U
Lube Oil Range	NWTPH-Dx	500	NSA	NSA	410	U	400	U	410	U
Gasoline Range	NWTPH-Gx	1000*	NSA	NSA	100	U	100	U	100	U
Polychlorinated Biphenyls (PCBs)										
Aroclor 1016	EPA 8082	0.1 [c]	NSA	0.014[g]	0.048	U	0.048	U	0.048	U
Aroclor 1221	EPA 8082	0.1 [c]	NSA	0.014[g]	0.048	U	0.048	U	0.048	U
Aroclor 1232	EPA 8082	0.1 [c]	NSA	0.014[g]	0.048	U	0.048	U	0.048	U
Aroclor 1242	EPA 8082	0.1 [c]	NSA	0.014[g]	0.048	U	0.048	U	0.048	U
Aroclor 1248	EPA 8082	0.1 [c]	NSA	0.014[g]	0.048	U	0.048	U	0.048	U
Aroclor 1254	EPA 8082	0.1 [c]	NSA	0.014[g]	0.048	U	0.048	U	0.048	U
Aroclor 1260	EPA 8082	0.1 [c]	NSA	0.014[g]	0.048	U	0.048	U	0.048	U
Volatile Organic Hydrocarbons (Detected Compounds Only)										
Methyl t-Butyl Ether	EPA 8260B	20	NSA	NSA	0.47		0.56		0.42	
Chloroform	EPA 8260B	7.17 [b]	283	NSA	0.46		0.74		0.66	
Polynuclear Aromatic Hydrocarbons										
Naphthalene	EPA 8270C SIM	160	4,940	NSA	0.096	U	0.095	U	0.097	U
2-Methylnaphthalene	EPA 8270C SIM	NSA	NSA	NSA	0.096	U	0.095	U	0.097	U
1-Methylnaphthalene	EPA 8270C SIM	NSA	NSA	NSA	0.096	U	0.095	U	0.097	U
Acenaphthylene	EPA 8270C SIM	960	643	NSA	0.096	U	0.095	U	0.097	U
Acenaphthene	EPA 8270C SIM	NSA	NSA	NSA	0.096	U	0.095	U	0.097	U
Fluorene	EPA 8270C SIM	640	3,460	NSA	0.096	U	0.095	U	0.097	U
Phenanthrene	EPA 8270C SIM	NSA	NSA	NSA	0.096	U	0.095	U	0.097	U
Anthracene	EPA 8270C SIM	2,400	259,000	NSA	0.096	U	0.095	U	0.097	U
Fluoranthene	EPA 8270C SIM	640	90.2	NSA	0.096	U	0.095	U	0.097	U
Pyrene	EPA 8270C SIM	480	2,590	NSA	0.096	U	0.095	U	0.097	U
Benzo[a]anthracene[d]	EPA 8270C SIM	0.1 / TEF[e]	0.0296	NSA	0.0096	U	0.0095	U	0.0097	U
Chrysene[d]	EPA 8270C SIM	0.1 / TEF[e]	0.0296	NSA	0.0096	U	0.0095	U	0.0097	U
Benzo[b]fluoranthene[d]	EPA 8270C SIM	0.1 / TEF[e]	0.0296	NSA	0.0096	U	0.0095	U	0.0097	U
Benzo[k]fluoranthene[d]	EPA 8270C SIM	0.1 / TEF[e]	0.0296	NSA	0.0096	U	0.0095	U	0.0097	U
Benzo[a]pyrene[d]	EPA 8270C SIM	0.1 / TEF[e]	0.0296	NSA	0.0096	U	0.0095	U	0.0097	U
Indeno[1,2,3-cd]pyrene[d]	EPA 8270C SIM	0.1 / TEF[e]	0.0296	NSA	0.0096	U	0.0095	U	0.0097	U
Dibenz[a,h]anthracene[d]	EPA 8270C SIM	0.1 / TEF[e]	0.0296	NSA	0.0096	U	0.0095	U	0.0097	U
Benzo[g,h,i]perylene	EPA 8270C SIM	NSA	NSA	NSA	0.0096	U	0.0095	U	0.0097	U

Note:
N - Normal sample.
Q - Validated data qualifier.
J - Concentration is an estimated value.
NSA - No standard available.
a - Chapter 173-340 WAC Method A Compliance Cleanup Levels for potable water use unless otherwise noted.
* - The MTCA Method A Cleanup Level for gasoline range petroleum hydrocarbons is 800 ug/L if benzene is present.
b - Chapter 173-340 WAC Method B Cleanup Levels for unrestricted use.
c - Cleanup level is a total for all PCBs (aroclors) based on the concentration derived from Chapter 173-340 WAC equation 720-1.
d - Carcinogenic PAH.
e - The MTCA Method A Cleanup level for cPAHs is based the total toxicity equivalence of benzo[a]pyrene that is 0.1 mg/Kg. The individual cPAHs are multiplied by their TEF, and the values summed to determine the total cPAH based on their toxicity equivalent factor (TEF). Reference WAC 173-340-708.
TEFs were not calculated as no cPAHs were detected above PQLs.
f - The most conservative of the National Water Quality Criteria (EPA, 2002) or Chapter 201A WAC Aquatic Water Quality Criteria is provided both chronic or acute values were considered.
g - Cleanup level is a total for all PCBs (aroclors) based on the chronic National Water Quality Criteria.
TEFs were not calculated as no cPAHs were detected above PQLs.

MOSES LAKE MAINTENANCE FACILTY
WEST PORTION GROUNDWATER
RCRA METALS RESULTS

Location					GP-19		GP-22		GP-23	
Sample Identifier					0GP19-032703		0GP22-032703		0GP23-032703	
Sample Type					N	Q	N	Q	N	Q
Analyte	Method	MTCA Method Cleanup Criteria For Groundwater (µg/L)[a]	MTCA Method B Cleanup Criteria for Surface Water (µg/L)	National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (µg/L)[d]	Concentration (µg/L)					
RCRA Metals										
Arsenic	EPA 6010B	10.5[g]	2	150	5.8		6		11	
Barium	EPA 6010B	560[b]	NSA	NSA	28	U	28	U	28	U
Cadmium	EPA 6010B	5	20.3	0.25[ef]	**0.56**	U	**0.56**	U	**0.56**	U*
Chromium	EPA 6010B	50	486[c]	74	11	U	11	U	11	U
Lead	EPA 6010B	15	NSA	2.5	1.1	U	1.1	U	1.1	U
Mercury	EPA 7471A	2	NSA	1	0.5	U	0.5	U	0.5	U
Selenium	EPA 6010B	80[b]	2,700	5[ef]	5.0	U	5.0	U	5.0	U*
Silver	EPA 6010B	80[b]	25900	3.2[ef]	**3.1**	U	**3.1**	U	**3.1**	U*

Note:
N - Normal sample.
NSA - No standard available.
Q - Validated data qualifier.
U - indicates that the analyte was not detected above its practical quantitation limit (PQL).
U* - indicates that the analyte was not detected above the method dectection limit (MDL)..
a - Cleanup Criteria are WAC Chapter 173-340 MTCA Method A Cleanup Levels for potable water unless otherwise indicated.
b - Chapter 173-340 WAC Method B Cleanup Levels for unrestricted use.
c - Value is for total chromium.
d - The most conservative of the National Water Quality Criteria (EPA, 2002) or Chapter 201A WAC Aquatic Water Quality Criteria is provided both chronic or acute values were considered.
e - The analyte was undetected however, the PQL exceeded the National Water Quality Criteria.
f - Analytical Laboratory MDL could not meet criteria by EPA 6010B Method.
g - Cleanup criteria set at Arsenic background concentration as established under WAC 173-340-709.
Bold - indicates that the analyte is hardness dependent.
Shading indicates the value exceeds one or more of the MTCA cleanup criteria.

MOSES LAKE MAINTENANCE RIFS
WEST CATCH BASIN SEDIMENT
PETROLEUM HYDROCARBON AND POLYCHLORINATED BIPHENYL RESULTS

Location				West Catch Basin	
Sample Identifier				Western Sump-Soil	
Sample Type				N	Q
Analyte	Method	MTCA Method A Cleanup Criteria (mg/kg)	Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg)*	Concentration (mg/kg)	
Petroleum Hydrocarbons					
Diesel Range	NWTPH-HCID	NA	NA	30	U
Lube Oil Range	NWTPH-HCID	NA	NA	76	U
Gasoline Range	NWTPH-HCID	NA	NA	>150	
Diesel Range	NWTPH-Dx	2,000	460	190	U
Lube Oil Range	NWTPH-Dx	2,000	NSA	13,000	
Gasoline Range	NWTPH-Gx	30 /100 [b]	200	NA	-
Polychlorinated Biphenyls					
Aroclor 1016	EPA 8082	1.0 [c]	NSA	0.076	U
Aroclor 1221	EPA 8082	1.0 [c]	NSA	0.076	U
Aroclor 1232	EPA 8082	1.0 [c]	NSA	0.076	U
Aroclor 1242	EPA 8082	1.0 [c]	NSA	0.076	U
Aroclor 1248	EPA 8082	1.0 [c]	NSA	0.076	U
Aroclor 1254	EPA 8082	1.0 [c]	NSA	0.076	U
Aroclor 1260	EPA 8082	1.0 [c]	NSA	0.076	U

Note:
N - Normal sample.
Q - Validated data qualifier.
NSA - No standard available.
> - indicates that the analye was detected above its practical quatitation limit (PQL).
U - indicates that the analye was not detected above its PQL.
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Compliance Cleanup Levels for unrestricted use.
* - Chapter 173-340-900 WAC Table 749-2 Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure.
b - The MTCA Method A Compliance Cleanup Level for gasoline range petroluem hydrocarbons is 100 mg/kg if benzene is present and the total of TEX is greater than 1%.
c - Cleanup level is a total for all PCBs (aroclors) based on the concentration derived from Chapter 173-340 WAC equation 720-1.

MOSES LAKE MAINTENANCE FACILITY RIFS
WEST CATCH BASIN SEDIMENT
POLYNUCLEAR AROMATIC HYDROCARBON RESULTS

Location					West Catch Basin	
Sample Identifier					Western Sump-Soil	
Sample Type					N	Q
Analyte	Method	MTCA Cleanup Levels For Unrestricted Use (mg/kg)[a]	Toxicity Equivalency Factor (TEF)	Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg)**	Concentration (mg/kg)	
Polynuclear Aromatic Hydrocarbons (cPAHs and all other detected SVOCs)						
2-Methylnaphthalene	EPA 8270C	NSA	NA	NSA	0.015	
Fluorene	EPA 8270C	3,200 [b]	NA	NSA	0.023	
Phenanthrene	EPA 8270C	NSA	NA	NSA	0.12	
Anthracene	EPA 8270C	24,000 [b]	NA	NSA	0.017	
Di-n-butylphthalate	EPA 8270C	NSA	NA	NSA	0.580	
Fluoranthene	EPA 8270C	3,200 [b]	NA	NSA	0.220	
Pyrene	EPA 8270C	2,400 [b]	NA	NSA	0.170	
Benzo[a]anthracene[c]	EPA 8270C	0.1 / TEF*	0.100	NSA	0.034	
Chrysene[c]	EPA 8270C	0.1 / TEF*	0.010	NSA	0.160	
bis(2-ethylhexyl)phthalate	EPA 8270C	NA	NA	NSA	93	
Benzo[b]fluoranthene[c]	EPA 8270C	0.1 / TEF*	0.100	NSA	0.089	
Benzo[k]fluoranthene[c]	EPA 8270C	0.1 / TEF*	0.140	NSA	0.013	U
Benzo[a]pyrene[c]	EPA 8270C	0.1 / TEF*	1.000	30	0.017	
Indeno[1,2,3-cd]pyrene[c]	EPA 8270C	0.1 / TEF*	0.100	NSA	0.028	
Dibenz[a,h]anthracene[c]	EPA 8270C	0.1 / TEF*	0.400	NSA	0.013	U
Benzo[g,h,i]perylene	EPA 8270C	NSA	NA	NSA	0.070	
Total TEF cPAH concentration	-		-	-	0.034	

Note:
N - Normal sample.
Q - Validated data qualifier.
NSA - No standard available.
Dup - Duplicate sample.
U - indicates that the analyte was not detected above its practical quantitation limit (PQL).
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Cleanup Levels for unrestricted use unless otherwise noted.
** - Chapter 173-340-900 WAC Table 749-2 Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure.
b - Chapter 173-340 WAC Method B Cleanup Levels for unrestricted use.
c - Carcinogenic PAH.
d - Safe concentration has not yet been established by Ecology.
* - The MTCA Method A Cleanup level for cPAHs is based the total toxicity equivalence of benzo[a]pyrene. The individual cPAHs are multiplied by their TEF, and the values summed to determine the total cPAH based on their toxicity equivalent factor (TEF). (Reference WAC 173-340-708).

MOSES LAKE MAINTENANCE FACILITY RIFS
WEST CATCH BASIN SEDIMENT
RCRA METALS RESULTS

Location				**West Catch Basin**	
Sample Identifier				Western Sump-Soil	
Sample Type				N	Q
Analyte	**Method**	**MTCA Cleanup Levels for Unrestricted Soil Use[a]**	**Ecological Concerns Criteria WAC 173-340 Table 749-2 (mg/kg)****	**Concentration (mg/kg)**	
RCRA Metals					
Arsenic	EPA 6010B	20	20	15	U
Barium	EPA 6010B	5600 [b]	1,250	54	
Cadmium	EPA 6010B	2 [b]	25	3.1	
Chromium	EPA 6010B	2000 [b*]	42[c]	32	
Lead	EPA 6010B	250	220	47	
Mercury	EPA 7471A	2 [b]	9	0.38	U
Selenium	EPA 6010B	400 [b]	0.8	15	U
Silver	EPA 6010B	400 [b]	d	0.76	U

Note:
N - Normal sample.
Q - Validated data qualifier.
U - indicates that the analye was not detected above its practical quatitation limit (PQL).
a - Chapter 173-340 WAC Method A Cleanup Levels for unrestricted use unless otherwise noted.
** - Chapter 173-340-900 WAC Table 749-2 Priority Contaminants of Ecological Concern
for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure.
b - Chapter 173-340 WAC Method B Cleanup Levels for unrestricted use.
c - Value is for total chromium.
d - Safe concentration has not yet been established by Ecology.
* - Value is for chromium III
Shading indicates the value exceeds one or more of the MTCA cleanup criteria.

MOSES LAKE MAINTENANCE FACILITY RIFS
WEST CATCH BASIN WATER
PETROLEUM HYDROCARBON RESULTS

Location					**West Catch Basin**	
Sample Identifier					Western Sump-Water	
Sample Type					N	Q
Analyte	**Method**	**MTCA Groundwater Cleanup Criteria For Unrestricted Use (µg/L)**	**MTCA Method B Cleanup Criteria for Surface Water**	**National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (µg/L)[d]**	**Concentration (µg/L)**	
Petroleum Hydrocarbons						
Diesel Range	NWTPH-HCID	NA	NA	NA	400	U
Lube Oil Range	NWTPH-HCID	NA	NA	NA	250	U
Gasoline Range	NWTPH-HCID	NA	NA	NA	100	U
Diesel Range	NWTPH-Dx	500	NSA	NSA	NA	-
Lube Oil Range	NWTPH-Dx	500	NSA	NSA	NA	-
Gasoline Range	NWTPH-Gx	800 / 1000[b]	NSA	NSA	NA	-
Methyl t-Butyl Ether (MTBE)	NWTPH-Gx	20.0	NSA	NSA	Results are	-
Benzene	NWTPH-Gx	0.030	22.7	NSA	Presented on	-
Toluene	NWTPH-Gx	1,000	4,850	NSA	Table 5.4.5	-
Ethyl Benzene	NWTPH-Gx	700	6,910	NSA	With	-
m,p-Xylene	NWTPH-Gx	1000[c]	16,000	NSA	other	-
o-Xylene	NWTPH-Gx	1000[c]	16,000	NSA	VOCs	-

Note:
N - Normal sample.
Q - Validated data qualifier.
Dup - Duplicate sample.
U - indicates that the analye was not detected above its practical quatitation limit (PQL).
NSA - No standard available.
NA - Not Applicable.
a - Chapter 173-340 WAC Method A Groundwater Cleanup Levels for potable water use.
b - The MTCA Method A cleanup level for gasoline range petroluem hydrocarbons is 800 ug/L if benzene is present.
c - The MTCA Method A Cleanup Level is for total xylene, i.e. the sum of m,p-Xylene and o-Xylene.
d - Cleanup level is a total for all PCBs (aroclors) based on the concentration derived from Chapter 173-340 WAC equation 720-1.
Shading indicates the value exceeds one or more of the MTCA cleanup criteria.

MOSES LAKE FACILITY RIFS
WEST CATCH BASIN WATER
VOLATILE ORGANIC COMPOUND RESULTS (DETECTS ONLY)

Location					West Catch Basin	
Sample Identifier					Western Sump-Water	
Sample Type					N	Q
Analyte	Method	MTCA Cleanup Criteria For Groundwater (µg/L)[a]	MTCA Method B Cleanup Criteria for Surface Water (µg/L)	National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (µg/L)[c]	Concentration ug/L	
Volatile Organic Hydrocarbons						
Methyl t-Butyl Ether	EPA 8260B	20	NSA	NSA	0.51	
2-Butanone	EPA 8260B	4,800	NSA	NSA	80.0	
Chloroform	EPA 8260B	7.17 [b]	283	NSA	0.58	

Note:
N - Normal sample.
Q - Validated data qualifier.
NSA - No standard available.
a - Chapter 173-340 WAC Method A Groundwater Cleanup Levels for potable water use unless other wise noted.
b - Chapter 173-340 WAC Method B Groundwater Cleanup Levels for potable water use.
c - The most conservative of the National Water Quality Criteria (EPA, 2002) or Chapter 201A WAC Aquatic Water Quality Criteria is provided both chronic or acute values were considered.

MOSES LAKE MAINTENANCE FACILITY RIFS
WEST CATCH BASIN WATER
RCRA METALS RESULTS

Location					West Catch Basin	
Sample Identifier					Western Sump-Water	
Sample Type					N	Q
Analyte	Method	MTCA Method Cleanup Criteria For Groundwater (µg/L)[a]	MTCA Method B Cleanup Criteria for Surface Water (µg/L)	National Water Quality Criteria/WAC 201A Aquatic Water Quality Criteria (µg/L)[d]	Concentration (µg/L)	
RCRA Metals						
Arsenic	EPA 6010B	5	2	150	6.1	
Barium	EPA 6010B	560[b]	NSA	NSA	28	U
Cadmium	EPA 6010B	5	20.3	0.25[ef]	**0.56**	U*
Chromium	EPA 6010B	50	486[c]	74	11	U
Lead	EPA 6010B	15	NSA	2.5	1.1	U
Mercury	EPA 7471A	2	NSA	1	0.5	U
Selenium	EPA 6010B	80[b]	2,700	5[ef]	**5.0**	U*
Silver	EPA 6010B	80[b]	25900	3.2[ef]	**3.1**	U*

Note:
N - Normal sample.
NSA - No standard available.
Q - Validated data qualifier.
U - indicates that the analyte was not detected above its practical quatitation limit (PQL).
U* - indicates that the analyte was not detected above the method detection limit (MDL).
a - Cleanup Criteria are WAC Chapter 173-340 MTCA Method A Cleanup Levels for potable water unless otherwise indicated.
b - Chapter 173-340 WAC Method B Cleanup Levels for unrestricted use.
c - Value is for total chromium.
d - The most conservative of the National Water Quality Criteria (EPA, 2002) or Chapter 201A WAC Aquatic Water Quality Criteria is provided both chronic or acute values were considered.
e - The analyte was undetected however, the PQL exceeded the National Water Quality Criteria.
f - Analytical Laboratory MDL could not met criteria by EPA 6010B Method.
Bold - indicates that the analyte is hardness dependent.
Shading indicates the value exceeds one or more of the MTCA cleanup criteria.

TABLE 6-1

FEDERAL ARARS FOR THE MOSES LAKE MAINTENANCE FACILITY

Requirements	Applicable or Relevant & Appropriate	Comment (informal and not legal opinion)
Archeological and Historic Preservation Act Title 16 USC 469a	Applicable	This act requires that actions conducted at the Site must not cause the loss of any archeological and historic data. This act mandates preservation of the data and does not require protection of the actual facility. The requirements of this Act are potentially applicable based on a determination of whether such archaeological data occur on Site.
Clean Air Act of 1977, as amended Title 42 USC 7401 et seq.	Applicable	The Clean Air Act (CAA) regulates emission of hazardous pollutants to the air. Controls for emissions are implemented through federal, state, and local programs. Pursuant to the CAA, EPA has promulgated National Ambient Air Quality Standards, National Emission Standards for Hazardous Air Pollutants, and New Source Performance Standards. The Clean Air Act is implemented in the State of Washington through the Washington Clean Air Act. Washington Clean Air Act criteria which are potentially ARAR for the Moses Lake Maintenance Facility Site are presented in Table 6-2 under the State ARAR discussions.
Clean Water Act of 1977 Title 33 USC 1251, as amended		The Clean Water Act establishes the guidelines and standards to control discharge of pollutants to waters of the U.S. Selected sections are discussed below.
Water Quality Standards 40 CFR 131	Applicable	40 CFR 131 establishes the requirements and procedures for states to develop and adopt water quality standards based on federal water quality criteria that are at least as stringent as the federal standards. Washington State has received EPA approval and has adopted more stringent water quality criteria under WAC 173-201A.
National Pollutant Discharge Elimination System (NPDES) 40 CFR 122 to 125	Applicable	The NPDES program controls release of toxic pollutants through monitoring requirements and implementation of a best management practices program. The substantive requirements of the program would be required if discharge of treated waste water were to occur as part of remediation; however, a permit would not be required due to a MTCA exemption.
Section 404 of the Clean Water Act	Not Applicable	Section 404 regulates the placement of fill in the waters of the United States including wetlands. Wetlands will not be filled in association with the Site.
Endangered Species Act of 1973 Title 16 USC 1531 et seq.	Applicable	The Endangered Species Act of 1973 establishes requirements for the protection of threatened and endangered species. The requirements of this act are potentially applicable based on a determination of whether such species occur on the Moses Lake Maintenance Facility Site or could be impacted by Site remedial activities.

TABLE 6-1

FEDERAL ARARS FOR THE MOSES LAKE MAINTENANCE FACILITY

Requirements	Applicable or Relevant & Appropriate	Comment (informal and not legal opinion)
Hazardous Materials Transportation Act 49 USC 1801, et seq		
Hazardous Materials Regulation 49 CFR 171	Applicable	No person may offer to accept hazardous material for transportation in commerce unless the material is properly classed, described, packaged, marked, labeled, and in condition for shipment. These requirements are applicable to hazardous material generated during remedial activities that would be sent offsite for disposal.
Hazardous Materials Tables, Hazardous Materials Communications Requirements, and Emergency Response Information Requirements 49 CFR 172	Not Applicable	These requirements are applicable if hazardous waste is generated during remediation and is transported offsite. Tables are used to identify requirements for labeling, packaging, and transportation based on categories of waste types. Specific performance requirements are established for packages used for shipping and transport of hazardous materials. Since hazardous wastes are not present on the Site, this regulation is not applicable.
National Historic Preservation Act of 1966 Title 16 USC 470	Applicable	The National Historic Preservation Act requires that historically significant properties be protected. The National Register of Historic Places is a list of sites, buildings or other resources identified as significant to United States history. An eligibility determination provides a site the same level of protection as a site listed on the National Register of Historic Places. The requirements of this federal law are potentially applicable based on a determination of whether such properties occur on the Moses Lake Maintenance Facility Site.
National Oil and Hazardous Substances Contingency Plan (NCP) 40 CFR 300	Relevant & Appropriate	Since the Moses Lake Maintenance Facility Site is not on the NPL, the NCP is not applicable to this RI/FS. Sections of the NCP may be relevant and appropriate, however, depending on site conditions.
Resource Conservation and Recovery Act Title 42 USC 6901 et seq	Portions Applicable	The Resource Conservation and Recovery Act (RCRA) consists of standards and criteria controlling the treatment, storage and disposal of hazardous wastes. The EPA has granted the State of Washington the authority to implement RCRA through the Department of Ecology's dangerous waste program (WAC 173-303). Therefore, to avoid redundancy, RCRA criteria which are potentially ARAR for the Moses Lake Maintenance Facility Site are not detailed here. The State of Washington equivalent criteria are presented in the state ARAR discussions and in Table 6-2. Since hazardous wastes are not present on the Site, this regulation is not applicable.

TABLE 6-1

FEDERAL ARARS FOR THE MOSES LAKE MAINTENANCE FACILITY

Requirements	Applicable or Relevant & Appropriate	Comment (informal and not legal opinion)
Safe Drinking Water Act of 1974 Title 42 USC 300, et seq. National Primary and Secondary Drinking Water Standards 40 CFR 141, 143	Applicable	MTCA requires that groundwater clear up levels be at least as stringent as maximum contaminant levels (MCLs), secondary maximum contaminant levels (SMCLs), and non-carcinogen maximum contaminant level goals (MCLGs) established under the Safe Drinking Water Act where groundwater is a current or potential future source of drinking water.
Toxic Substance Control Act (TSCA) Title 15 USC 2601 et seq. Regulation of PCBs 40 CFR 761	Not Applicable	TSCA requires that material contaminated with PCBs at concentrations of 50 ppm or greater be disposed of in an incinerator or by an alternate method that achieves an equivalent level of performance. Liquids at concentrations between 50 and 500 ppm and soils above 50 ppm may also be disposed in a chemical waste landfill. TSCA requirements do not apply, however, to PCBs at concentrations less than 50 ppm. TSCA requirements are potentially applicable to remedial actions at the Site if PCBs are detected above this level in excavated soils. To date, however, there is no historical evidence of PCB use or disposal at the Moses Lake Maintenance Facility Site and therefore this regulation is not applicable to the Site.

TABLE 6-2

STATE AND LOCAL ARARS FOR THE MOSES LAKE MAINTENANCE FACILITY

Requirements	Applicable or Relevant & Appropriate	Comment (informal and not legal opinion)
STATE ARARs		
Model Toxics Control Act Ch. 70.105D RCW	Applicable	MTCA is the key governmental regulation governing the conduct of the overall investigation and cleanup process for the Site and is therefore applicable. MTCA describes the requirements for selecting cleanup actions, preferred technologies, policies for use of permanent solutions, the time frame for cleanup, and the process for making decisions. The regulation specifies that all cleanup actions be protective of human health, comply with all applicable state and federal regulations, and provide for appropriate compliance monitoring. Specific criteria for the various cleanup methods are presented in the MTCA regulations. The MTCA regulations specify that cleanup actions utilize permanent solutions to the maximum extent practicable. Although MTCA identifies a hierarchy of preferred technologies that should be evaluated for use in the cleanup action, cost may also be a factor in determining points of compliance and selection of cleanup actions. For example, if the cost of cleanup action is substantial and disproportionate to the incremental increase in protection compared to a lesser preferred cleanup action, the less preferred action may be selected. Generally, technologies that recycle or re-use materials are preferred most, followed by methods that destroy or detoxify hazardous substances, and cleanup methods that may leave contaminants on-site. Amendments to MTCA (RCW 70.105D.090) exempt remedial actions conducted pursuant to an Agreed Order or a Consent Decree from the procedural requirements of several state laws. These include the State Clean Air Act (RCW 70.94), Solid Waste Management - Reduction and Recycling Act (RCW 70.95), Hazardous Waste Management Act (RCW 70.105), Water Pollution Control Law (RCW 90.48), Shoreline Management Act (RCW 90.58), and Construction Projects in State Waters (RCW 75.20). In addition, the exemption also applies to the procedural requirements of any laws requiring or authorizing local governmental permits or approval for the remedial action. Therefore, while substantive compliance is necessary, permits and approvals are not required for remedial actions at the Site.
Model Toxics Control Act Cleanup Regulations WAC 173-340	Applicable	WAC 173-340, which implement the requirements of MTCA, contains the primary regulations under which the Moses Lake Maintenance Facility Site RI/FS process is being conducted and is therefore applicable. These regulations establish administrative processes and standards to identify, investigate and cleanup facilities where hazardous substances have been released.

TABLE 6-2

STATE AND LOCAL ARARS FOR THE MOSES LAKE MAINTENANCE FACILITY

Requirements	Applicable or Relevant & Appropriate	Comment (informal and not legal opinion)
Regulation of Public Groundwater Ch. 90.44 RCW Water Quality Standards for Groundwater WAC 173-200	Not ARAR	The rule establishes groundwater quality standards to provide for the protection of public health and existing/future beneficial uses. This standard specifically exempts CERCLA and MTCA cleanup actions, and provides for groundwater cleanup standards at such sites to be developed under WAC 173-340-720. Therefore, WAC 173-200 is neither applicable nor relevant and appropriate to the Moses Lake Maintenance Facility Site.
Department of Health Standards for Public Water Supplies WAC 246-290	Applicable	The rule established under WAC 246-290 defines the regulatory requirements necessary to protect consumers using public drinking water supplies. The rules are intended to conform with the federal Safe Drinking Water Act (SDWA), as amended. WAC 246-290-310 establishes maximum contaminant levels (MCLs) which define the water quality requirements for public water supplies. WAC 246-290-310 establishes both primary and secondary MCLs and identifies that enforcement of the primary standards is the Department of Health's first priority. The standards set under WAC 246-290-310 are set at the levels established under the federal SDWA.
Department of Game Procedures WAC 212-12	Potentially Applicable	This standard defines the requirements that the Department of Game must take to protect endangered or threatened wildlife. These requirements may be applicable if endangered or threatened wildlife are identified at the Site or within Department of Natural Resources records searches.

TABLE 6-2

STATE AND LOCAL ARARS FOR THE MOSES LAKE MAINTENANCE FACILITY

Requirements	Applicable or Relevant & Appropriate	Comment (informal and not legal opinion)
State Environmental Policy Act (SEPA) Ch. 43-21C RCW SEPA Rules WAC 197-11 SEPA Procedures WAC 173-802	Applicable	SEPA is applicable to remedial actions at the Moses Lake Maintenance Facility Site. Ecology is the lead agency for MTCA remedial actions performed under a Consent Decree or an Agreed Order pursuant to WAC 197-11-253. The SEPA process is triggered when a governmental action is taken on a public or private proposal. According to WAC 197-11-784, a proposal includes both regulatory decisions of agencies and actions proposed by applicants. If the proposal is not "exempt", Ecology will require the submission of a SEPA checklist which solicits information regarding how the proposal will affect elements of the environment, such as air, water, etc. Ecology will use the SEPA process for this site as a mechanism to identify potential wetland-related concerns early in the permitting process. While substantive authority under SEPA can be used to require additional wetland protection, it is used primarily as a means of identifying impacts that are regulated under other statutes. If the proposal is determined by Ecology to have a "probable significant adverse environmental impact", an environmental impact statement (EIS) will be required which examines potential environmental problems that would be caused by the proposal and options for mitigation. If in Ecology's opinion, there will be no significant adverse environmental impact, a Determination of Nonsignificance (DNS) will be issued and the SEPA process is completed without preparation of an EIS. Any public comment period required under SEPA must be combined with any comment period associated with the MTCA process in order to expedite and streamline public input. According to WAC 197-11-259, if Ecology makes a determination that the proposal will not have a probable significant adverse environmental impact, the DNS can be issued with the draft Cleanup Action Plan prepared pursuant to MTCA.
Hazardous Waste Management Act 70.105 RCW	Portions Applicable	Recent amendments to MTCA (RCW 70.105D.090) exempt cleanup actions conducted pursuant to a Consent Decree or Agreed Order from the procedural requirements of this law. The exemption does not apply to the substantive provisions, however, which still may apply depending on site conditions. Also, recent amendments to RCW 70.105 provide a conditional exemption to state-only dangerous wastes generated during a cleanup action conducted under a Consent Decree. Therefore, substantive provisions of this Act may be applicable if non-exempt dangerous wastes are generated during cleanup.

TABLE 6-2

STATE AND LOCAL ARARS FOR THE MOSES LAKE MAINTENANCE FACILITY

Requirements	Applicable or Relevant & Appropriate	Comment (informal and not legal opinion)
Dangerous Waste Regulations WAC 173-303		A partial list of potentially applicable sections of the Dangerous Waste Regulations is included below.
Designation of Waste WAC 173-303-070	Applicable	These requirements establish the methods and procedures to determine if solid waste requires management as dangerous waste. The substantive requirements of this section may be applicable if remedial activities involve the generation of waste.
Requirements for Generators of Dangerous Waste WAC 173-303-170	Applicable	Substantive requirements for generators of dangerous waste established under this chapter may be applicable to remedial actions performed at the Site if dangerous waste is generated.
Closure and Post Closure WAC 173-303-610	Potentially relevant and appropriate	This section describes closure and post-closure performance standards for dangerous waste units, including requirements for plan preparation, maintenance and monitoring of waste containment systems, groundwater monitoring, and deed notices, etc. Most of the requirements of this section are procedural, and not relevant because of the MTCA exemption for procedural requirements. Subsection 610(2), "Closure performance standard", corresponds to threshold requirements under MTCA. Therefore, the remedy selected by Ecology will satisfy this closure performance standard by definition. Some of these regulations may be relevant and appropriate, however. The most relevant portion of Section 610 is subsection (7), "Post-closure care and use of property". This subsection addresses post-closure maintenance and monitoring, including groundwater monitoring. Section (10) requires a notice in the property deed. The relevant requirements of Section 610(7) and (10) may be appropriate for the Moses Lake Maintenance Facility Site.
Releases from Regulated Units WAC 173-303-645	Potentially relevant and appropriate	WAC 173-303-645 regulates releases from regulated units. Although the Moses Lake Maintenance Facility Site does not meet the definition of a regulated dangerous waste unit, the requirements of this section are relevant. Portions of this section may be appropriate, such as: • Groundwater protection standard, 645(3) • Compliance period, 645(7) • General groundwater monitoring requirements, 645(8) • Detection monitoring program, 645(9) • Compliance monitoring program, 645(10). The relevance and appropriateness of these sections will be considered in the preparation and review of the Compliance Monitoring Program required under MTCA.

TABLE 6-2

STATE AND LOCAL ARARS FOR THE MOSES LAKE MAINTENANCE FACILITY

Requirements	Applicable or Relevant & Appropriate	Comment (informal and not legal opinion)
Solid Waste Management, Recovery, and Recycling Act Ch. 70.95 RCW		Amendments to MTCA (RCW 70.105D.090) exempt cleanup actions conducted pursuant to a Consent Decree or Agreed Order from the procedural requirements of this law. The exemption does not apply to the substantive provisions, however, which still may apply depending on site conditions.
Minimum Functional Standards (MFS) for Solid Waste Handling WAC 173-304	Applicable	MTCA regulations [WAC 173-340-710(b)(c)] specify that WAC 173-304 contains the "minimum requirements" for landfill closure conducted as a MTCA cleanup action.
Water Well Construction CH. 18.104 RCW		
Minimum Standards for Construction and Maintenance of Water Wells WAC 173-160	Applicable	These requirements are applicable to remedial actions that include construction of wells used for groundwater extraction, monitoring, or injection of treated groundwater or wastes. These requirements also include standards for well abandonment.
Water Pollution Control/Water Resources Act Ch. 90.48 RCW/Ch. 90.54 RCW		Recent amendments to MTCA (RCW 70.105D.090) exempt cleanup actions conducted pursuant to a Consent Decree or Agreed Order from the procedural requirements of this law. The exemption does not apply to the substantive provisions, however, which still may apply depending on site conditions.
Surface Water Quality Standards WAC 173-201A	Applicable	WAC 173-201A is the primary regulation covering wetlands and other waters of the State. .Since water quality standards are set at levels protective of aquatic life, these standards are only applicable to surface waters at the Site which either support or have the potential to support aquatic life. Groundwater beneath the Site may eventually discharge to Milwaukee drainage or the wetlands, therefore surface water quality criteria established under this chapter may potentially be applicable to the groundwater at the point of discharge to the waterway. Ecology has announced anticipated rule development for the purpose of adopting risk-based numeric limits for protection of public health as required by the federal CWA (WSR-18-095). Other proposed changes to the standard were also announced in WSR-94-16-056.
State Waste Discharge Program WAC 173-216	Applicable	Requirements of this program may be applicable to remedial actions that include discharges to the ground. The chapter implements a permit system applicable to industrial and commercial operations that discharge to the groundwater, surface waters, or municipal sewerage systems. Specific discharges prohibited under the program are identified. Cleanup actions conducted under a Consent Decree or Agreed Order are exempt, however, from procedural requirement (permits).

TABLE 6-2

STATE AND LOCAL ARARS FOR THE MOSES LAKE MAINTENANCE FACILITY

Requirements	Applicable or Relevant & Appropriate	Comment (informal and not legal opinion)
National Pollution Discharge Elimination System Permit Program WAC 173-220	Applicable	Establishes a state permit program pursuant to the national NPDES system. Substantive sections of the regulation may be applicable to remedial alternatives that involve discharges to surface waters. Discharges may include site run-off, spillage, leaks, sludge, or treated waste disposal.
Shoreline Management Act Ch 90.58 RCW	Not Applicable	The wetlands adjacent to the Site are not within 200 feet of a shoreline water body.
Washington Clean Air Act Ch. 70.94 RCW and Ch. 43.21A RCW		Recent amendments to MTCA (RCW 70.105D.090) exempt cleanup actions conducted pursuant to a Consent Decree or Agreed Order from the procedural requirements of this law. The exemption does not apply to the substantive provisions, however, which still may apply depending on site conditions.
General Regulations for Air Pollution Sources WAC 173-400	Applicable	Substantive standards established for the control and prevention of air pollution under this regulation may be applicable to remedial actions proposed for the operable unit. The regulation requires that all sources of air contaminants meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Washington State Department of Ecology Air Quality Program enforces and administers these requirements in Grant County. Refer to discussion under Washington State Department of Ecology Air Quality Program. .
Controls for New Sources of Air Pollution WAC 173-460	Applicable	This standard requires that new sources of air emissions provide emission estimates for toxic air contaminants listed in the regulation. The standard requires that emissions be quantified and used in risk modeling to evaluate ambient impacts and establish acceptable source impact levels. These standards are applicable since the regulation specifically lists sites subject to MTCA actions.
Washington State Department of Ecology Air Quality Program	Not ARAR	Ecology Air Quality Program has jurisdiction over regulation and control of the emission of air contaminants and the requirements of state and federal Clean Air Acts from all sources in Grant County.
LOCAL ARARs[a]		
Grant County Zoning Code	Applicable	Substantive requirements of the County zoning ordinance are applicable to remedial actions at the Moses Lake Maintenance Facility Site. A grading permit will likely be required by the County for any capping or excavation remedial alternatives.

TA..E 7-1

REMEDIATION CLEANUP GOALS
MOSES LAKE MAINTENANCE FACILITY

COC	Site Cleanup Goals		Units	Source of Criteria
	Soil (mg/kg)	Groundwater (ug/L)		
Diesel Range Petroleum Hydrocarbons	460	500	mg/kg	Ecological Concern Table 749-2
Oil Range Petroleum Hydrocarbons	2,000	500	mg/kg	MTCA Method A
Gasoline Range Petroleum Hydrocarbons	30 / 100*	800/1000*	mg/kg	MTCA Method A
Xylenes	9	NA	mg/kg	MTCA Method A
Lead	220	NA	mg/kg	Ecological Concern Table 749-2

Notes:

* - The MTCA Method A Compliance Cleanup Level for gasoline range petroluem hydrocarbons in soil is 100 mg/kg if benzene is not present and the total of TEX is less than 1%.

** - The MTCA Method A Compliance Cleanup Level for gasoline range petroluem hydrocarbonsin groundwater is 1000 ug/L if benzene is not present

NA - Not Applicable analyte is not a Site COC

SUMMARY OF REMEDIATION TECHNOLOGIES CONSIDERED FOR THE MOSES LAKE MAINTENANCE FACILITY

Technology	Screening Comments	Retained? (Yes/No)
NO ACTION		
No Action	Baseline	**Yes**
INSTITUTIONAL CONTROLS AND MONITORING		
Site Access Restrictions		
Fencing	Effective, easy to implement, low cost.	Yes
Warning signs	Effective, easy to implement, low cost.	Yes
Security patrols	Expensive and unnecessary.	No
Monitoring	Monitoring conducted for long term effects and migrationof COC. term and long	Yes
Land Use Restrictions	Site is an active maintenance facility with plans for additional development.	Yes
CONTAINMENT		
Capping	Capping is proven, effective technology for providing reliable long-term containment and preventing or minimizing off-site migration of COCs.	Yes
Dust Control	Potentially necessary during excavation or capping.	Yes
Surface water controls	Useful component of cap remedy.	Yes
REMOVAL		
Excavation (soil) Backhoe Loader Bulldozer	Excavation would be effective in preventing or minimizing off-site migration of COCs. It is a feasible technology.	Yes
EX-SITU SOIL TREATMENT		
Reuse/recycling	No waste materials identified with the potential for reuse or recycling; usually not feasible for complex mixtures of heterogeneous waste and affected soil.	Yes/Landfill Cap
Dry sieving	Potentially effective; easy to implement; inexpensive means of reducing off-site disposal costs.	Yes
Physical soil washing	May not be effective at this site; not established technology; difficult to implement due to the complexity and site constraints, unlikely to be cost-effective.	No
Chemical extraction	Unproven; may not be effective at this site; difficult to implement; costly.	No
Fixation (chemical stabilization)	Proven, effective treatment for metals; relatively easy to implement; not effective for petroleum hydrocarbons, moderate cost.	Yes / for off-site disposal
Biological treatment	Not effective on many constituents of potential concern, such as chlorinated organic compounds and metals, therefore not suitable as general treatment for this site	No
Chemical oxidation/reduction	Unproven; may not be effective for site constituents of concern; other technologies are at least as effective and less costly.	No
Thermal treatment On-site Off-site	On-site thermal treatment may be difficult to implement due to physical constraints and permitting difficulties; off-site thermal treatment is available and potentially more feasible.	 Yes Yes
IN-SITU TREATMENT Biological treatment Chemical oxidation/reduction In-situ fixation Soil flushing Vapor extraction	In-situ treatment technologies are inherently more difficult to control than the corresponding ex-situ treatment technologies. Treatment effectiveness is often difficult to verify. In-situ treatment would not be more protective than capping; therefore, no need for in-situ treatment.	No
DISPOSAL		
On-site disposal (constructed landfill)	In-place containment (capping in combination with natural subsurface conditions) would may not provide sufficient protection; off-site landfill is a better option.	No
Off-site commercial landfill	Feasible.	Yes

TABLE 10-1

EVALUATION SUMMARY OF RETAINED REMEDIATION ALTERNATIVES

Criteria	Calculated Criteria Weights	Alternative			
		3	4	5	6
		Capping, Monitoring and Institutional Controls	Excavation and Off-Site Landfill	Excavation and On-Site Treatment	Excavation and Off-Site Treatment
Determining Whether Alternative Uses Permanent Solution to the Maximum Extent Practicable [WAC 173-340-360(2)(b)(i)]					
Protectiveness	8.33%	5	8	9	9
Permanence	8.33%	3	7	10	9
Cost	8.33%	8	7	6	5
Effectiveness Over the Long-Term (and Reliability)	8.33%	3.5	9	7.5	8.5
Management of Short-Term Risk	8.33%	8	7	4	5
Technical and Administration Implementability	8.33%	8	7	3	6
Public Concerns*					
Permanent Solution Benefit Score	50.00%	5.9	7.5	6.6	7.1
Determining Whether Alternative Provides a Reasonable Restoration Time Frame [WAC 173-340-360(2)(b)(ii)]					
Reasonable Restoration Time Frame Score	50.00%	2	9	8	9
Total Net Benefit					
Total Score (Sum of Permanent Solution and Restoration Time Scores)	100%	7.9	**16.5**	14.6	16.1

[a] See text for criteria definitions.

[b] The numeric value of one scoring unit of the criterion relative to one scoring unit of the long-term effectiveness and reliability criterion.

[c] See text for score basis.

TABLE 10-2

SUMMARY OF COSTS FOR REMEDIATION ALTERNATIVES

Alternative		Estimated Costs [a]		
		Capital [b]	O&M [c]	Total
3	Capping, Monitoring and Institutional Controls	$204,900	$326,400	$531,300
4	Excavation and Off-Site Landfill	$742,153	$0	$742,153
5	Excavation and On-Site Treatment	$906,519	$0	$906,519
6	Excavation and Off-Site Treatment	$1,004,353	$0	$1,004,353

[a] Costs are for early 2004.

[b] Includes operating costs during remedial action.

[c] Long-term maintenance and monitoring for 30 years; net present value at 4% interest (net of inflation).

COST ESTIMATE FOR POTENTIAL REMEDIATION ALTERNATIVES FOR THE MOSES LAKE MAINTAINANCE FACILITY

Estimate for Remediation of Approximately 9500 tons of Impacted Soil

Alternative		Trucks per day (18 yards / truck)	Rate Yards/Day	Rate tons/day (1.7 tons / yard)	Days (10 to 12 hrs)	Disposal / Treatment ($/tons)	Transportation ($/tons)	Excavation ($/tons)	$/ton	$ for 9500 tons*	Backfill ($/ton)	$ Backfill total	On Site Treatment Setup	Wash racks and drainage replacement	Total $ for Soil Remediation Activities	Semi Annual Monitoring for 20 Years	Install Asphalt Cap and Monitoring Well
3	Capping, Monitoring and Institutional Controls	0	0	0	6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$272,000	$80,000
4	Excavate and Landfill Off-Site	20	360	612	15.5	$16	$18	$5	$39	$370,500	$3	$28,500	$0	$12,000	$399,000	$89,000	
5	Excavate and Treat On-Site Staged, 180 tons / 14 hr day	6.5	117	199	47.8	$32	$0	$10	$42	$399,000	$4	$38,000	$6,000	$12,000	$443,000	$89,000	
6	Excavate and Treat Off-Site	20	360	612	15.5	$32	$25	$5	$62	$589,000	$3	$28,500	$0	$12,000	$617,500	$89,000	

Estimate for Remediation of Approximately 9500 Tons of Impacted Soil cont.

Alternative		Golder w Lab per day	$ for Golder * days	Analytical (confirmatory) $150	Geotech Sub $250/day	Total $ for Oversight testing and analytical Services	PERMITTING: SEPA / Grading	PERMITTING: Stormwater	PERMITTING: Air Permit (Treatment On Site Alt.)	PERMITTING: Noise Issues (Treatment On Site Alt.)	Remediation Report	CAP, Negotiations, Public Meetings and Responsiveness Summary	Design Report / Bidders Package	Permits and Documents Total	Cleanup Totals without permits and reporting	TOTALS	TOTAL with 20% contingency
3	Capping, Monitoring and Institutional Controls	$900	$5,400	$1,200	$3,250	$10,750	$10,000	$10,000	-	-	$20,000	$20,000	$20,000	$80,000	$362,750	$442,750	**$531,300**
4	Excavate and Landfill Off-Site	$1,300	$20,180	$5,100	$3,881	$30,460	$10,000	$20,000	-	-	$25,000	$20,000	$25,000	$100,000	$518,460	$618,460	**$742,153**
5	Excavate and Treat On-Site Staged, 180 tons / 14 hr day	$1,300	$62,092	$5,100	$11,941	$80,432	$10,000	$20,000	$15,000	$8,000	$30,000	$25,000	$35,000	$143,000	$612,432	$755,432	**$906,519**
6	Excavate and Treat Off-Site	$1,300	$20,180	$5,100	$3,881	$30,460	$10,000	$20,000	-	-	$25,000	$20,000	$25,000	$100,000	$736,960	$836,960	**$1,004,353**

Note: Costs Estimated based excavation of 5,600 total yards (9,500 tons) of soil.
Estimation of total yards of soil is based on the excavation area identified on Figure 9-2 times an estimated average depth of 5 ft.

COST BENEFIT ANALYSIS FOR REMEDIATION ALTERNATIVES

	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Total Score (Sum of Permanent Solution and Restoration Time Scores)	7.9	**16.5**	14.6	16.1
Cost	$531,300	$742,153	$906,519	$1,004,353
Benefit : cost (i.e., cost-effectiveness)	14.9	**22.2**	**16.1**	16.0
Incremental cost	NA	$210,853	$164,366	$97,834

FIGURES

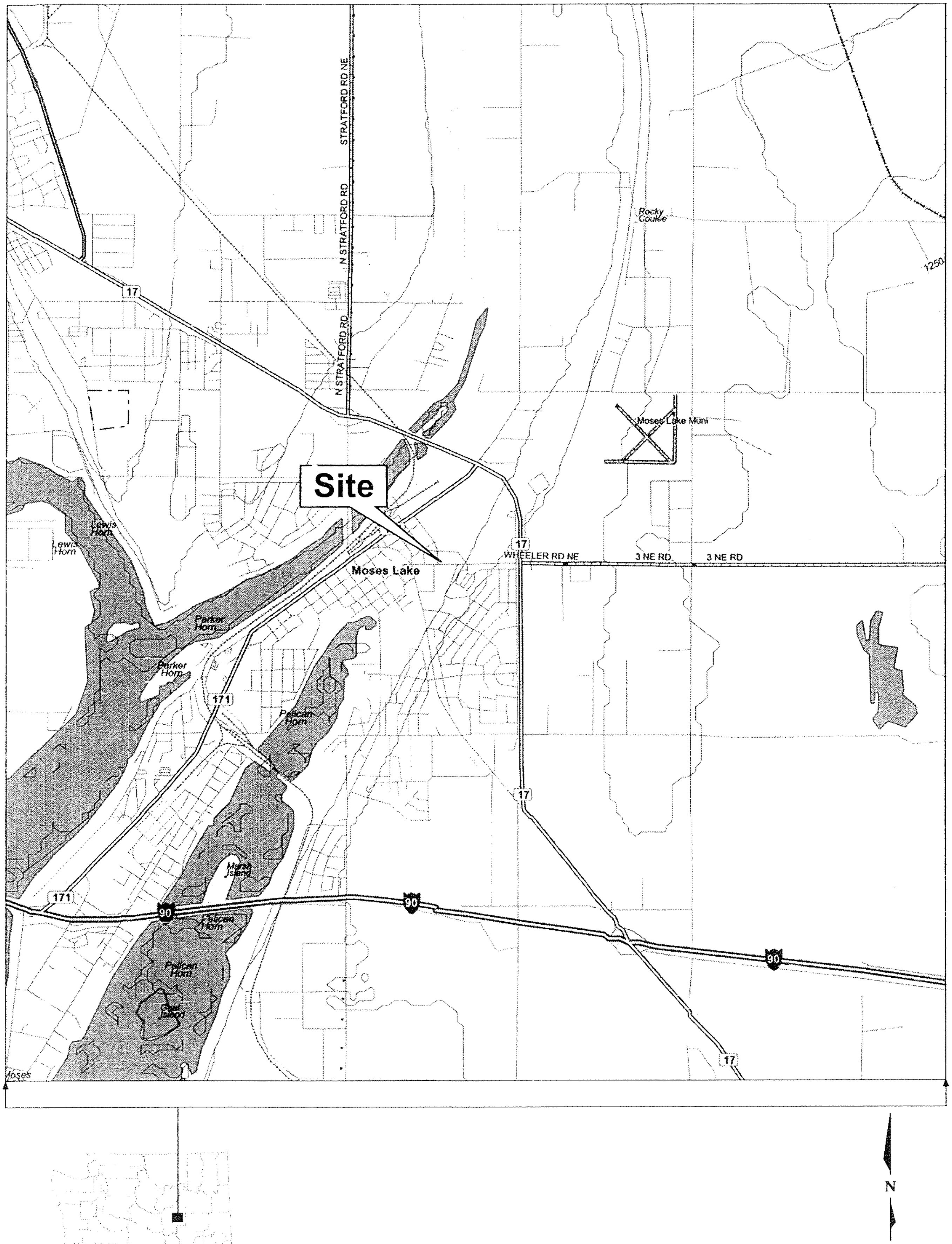


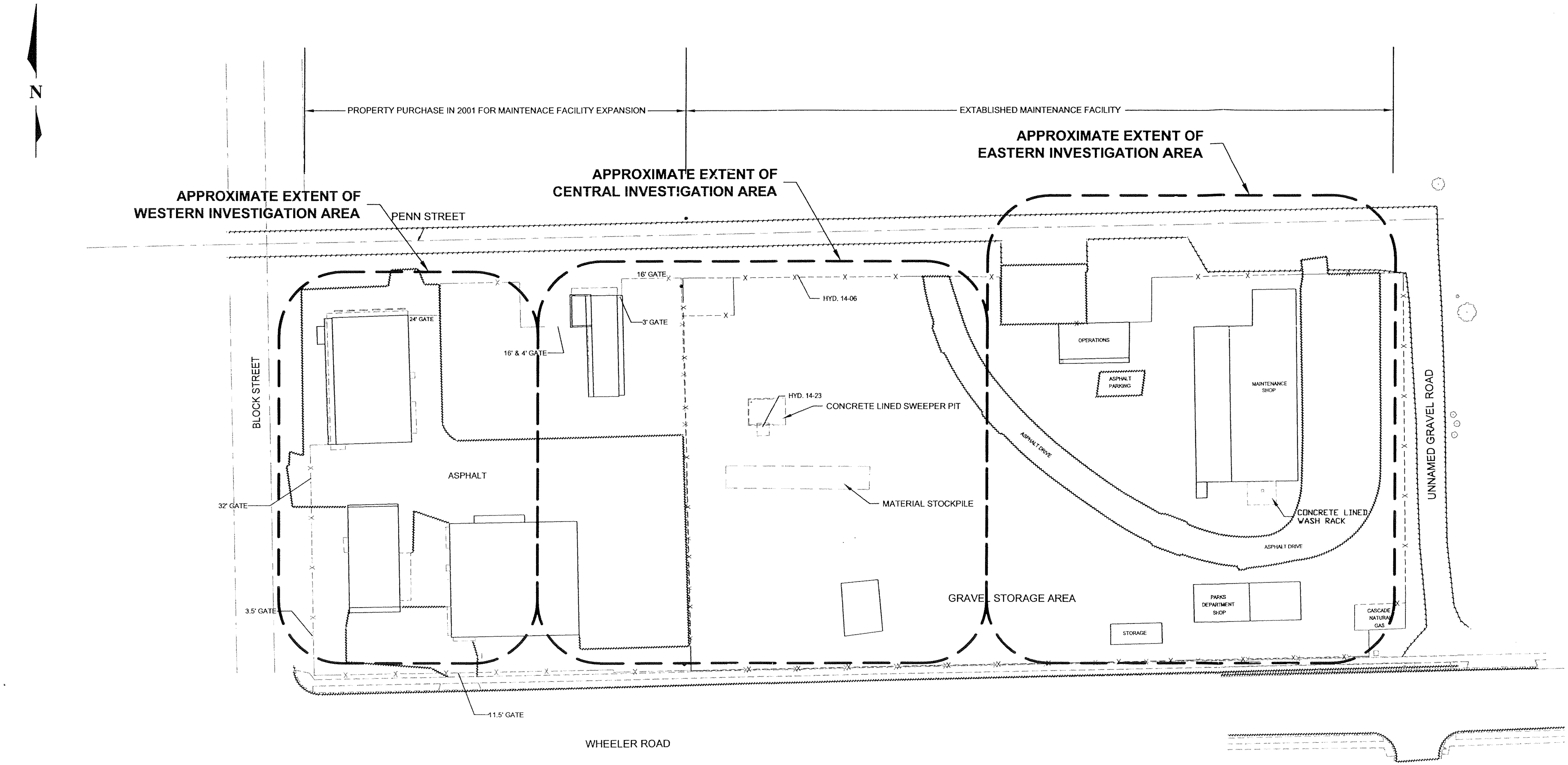
FIGURE **1-1**

SITE LOCATION MAP

MOSES LAKE/RIFS/WA

DRAWING NO. 0331335003fg01.fh11 DATE 07/07/03 DRAWN BY AMP

Golder Associates



SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

0 80 160
FEET

FIGURE **1-2**
SITE PLAN
MOSES LAKE/RI/FS/WA

Drawing file: 0331335003F02.dwg Jul 01, 2003 - 12:57pm

Golder Associates

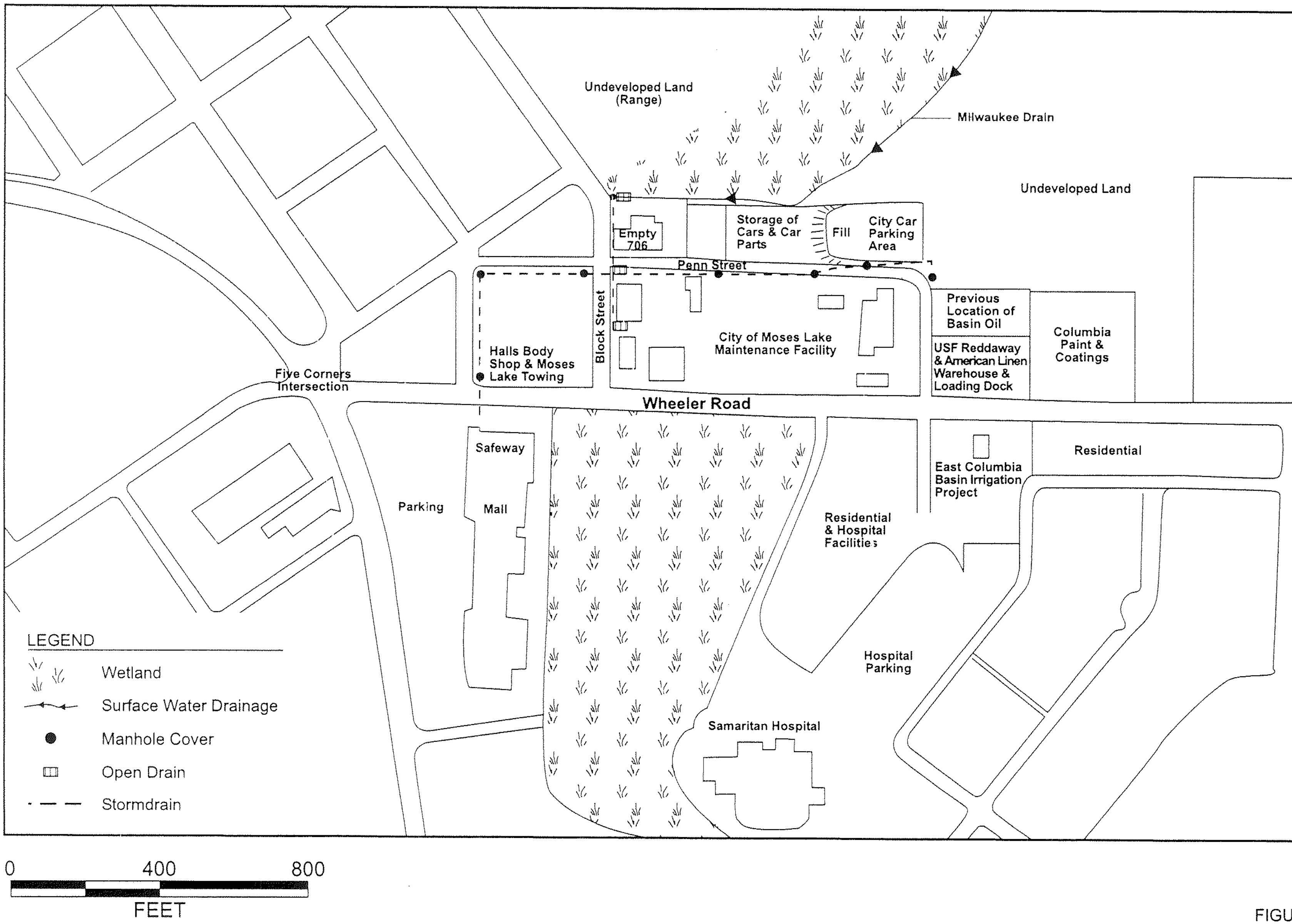


FIGURE **1-3**

SCHEMATIC OF SITE AND ADJACENT PROPERTIES

MOSES LAKE/RIFS/WA

DRAWING NO. 0331335003fg02a.fh11 DATE 07/07/03 DRAWN BY EFS

Golder Associates

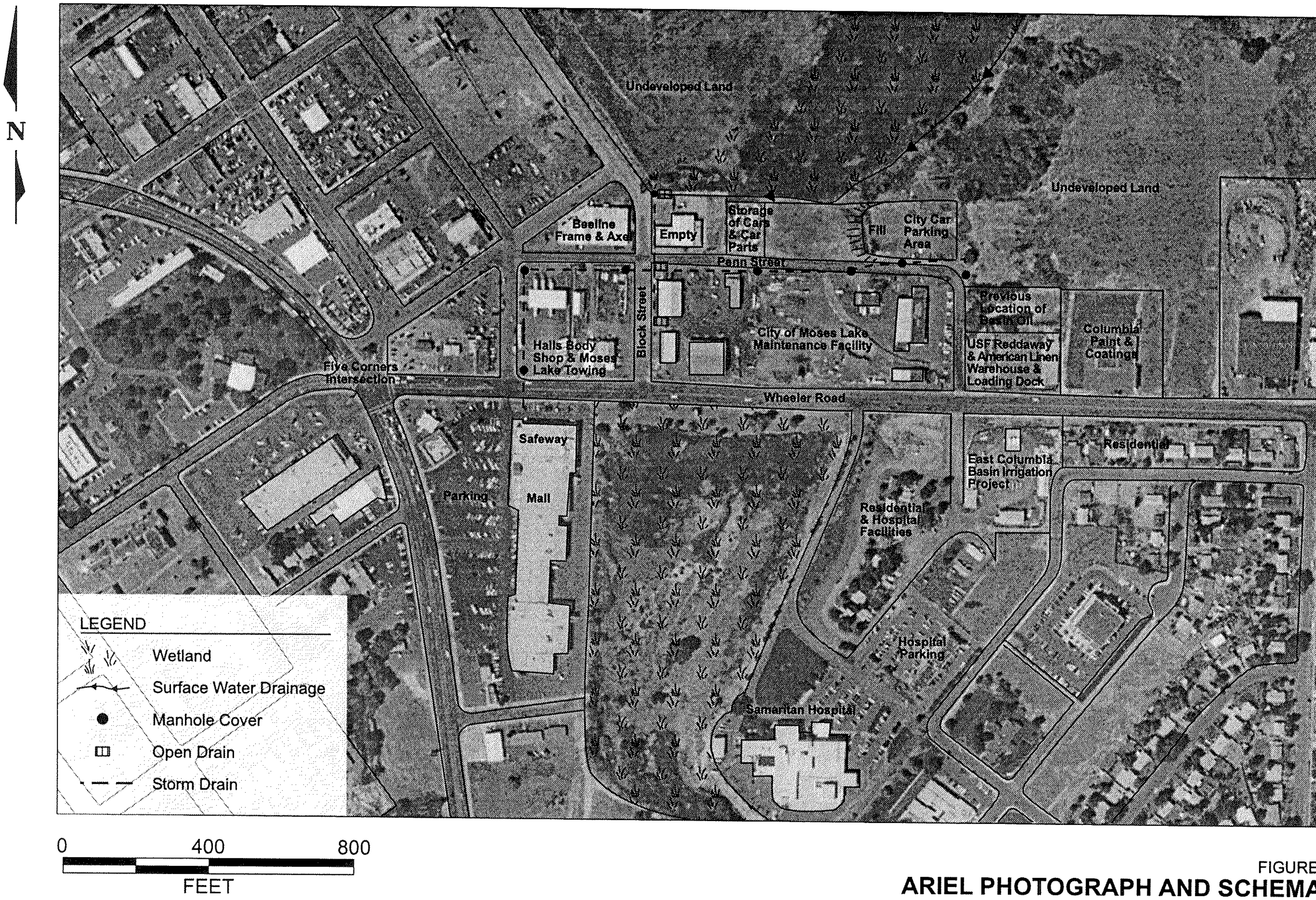


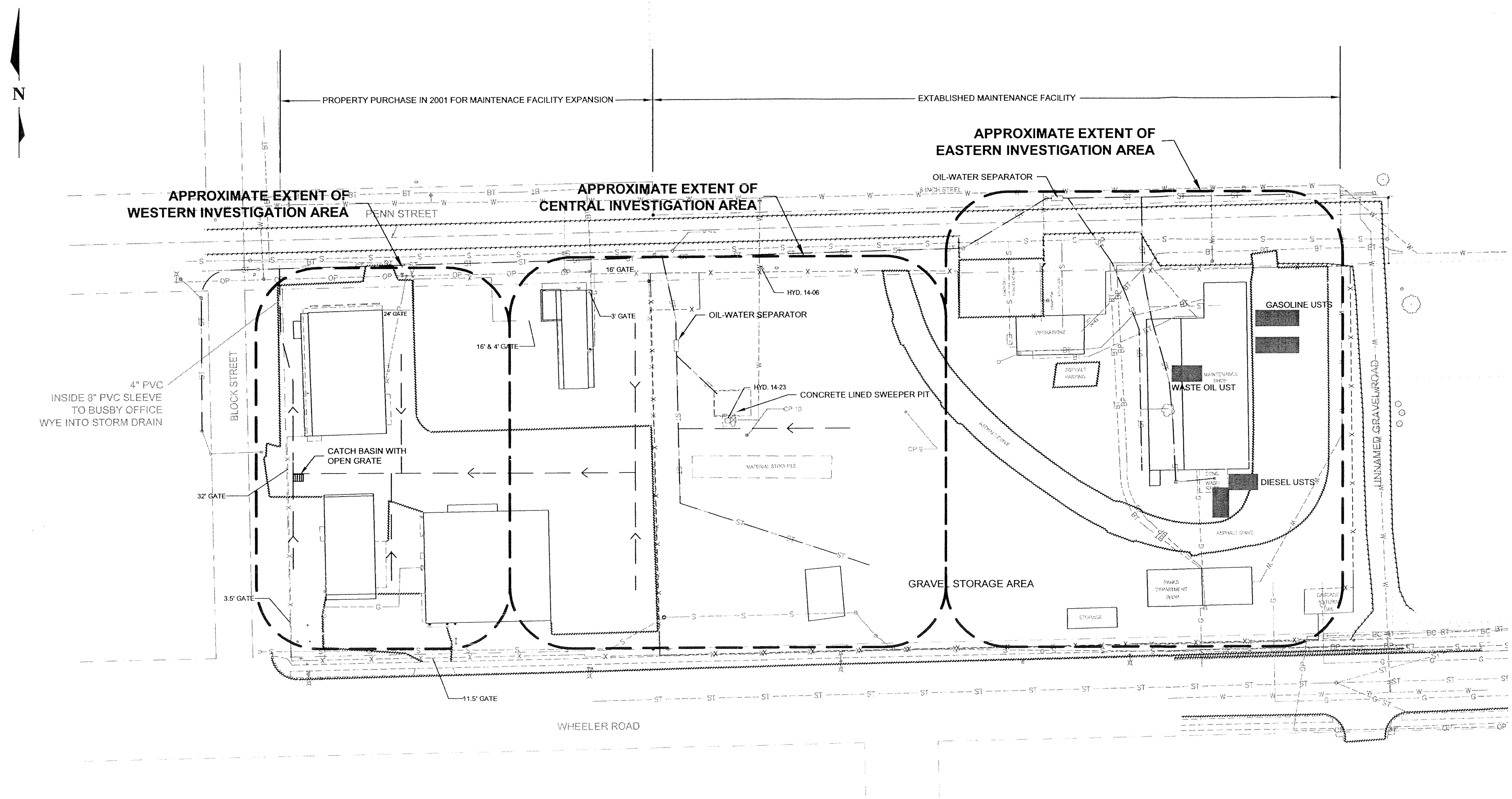
FIGURE **1-3a**

ARIEL PHOTOGRAPH AND SCHEMATIC OF SITE AND ADJACENT PROPERTIES

MOSES LAKE/RIFS/WA

DRAWING NO. 0331335003fg04.fh9 DATE 07/07/03 DRAWN BY EFS

Golder Associates



LEGEND

- APPROXIMATE LOCATION AND FLOW DIRECTION OF 6-INCH PERFORATED DRAIN PIPE
- CATCH BASIN WITH OPEN GRATE
- LOCATION OF PREVIOUS UNDERGROUND STORAGE TANKS (UST'S)

SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

0 80 160
FEET

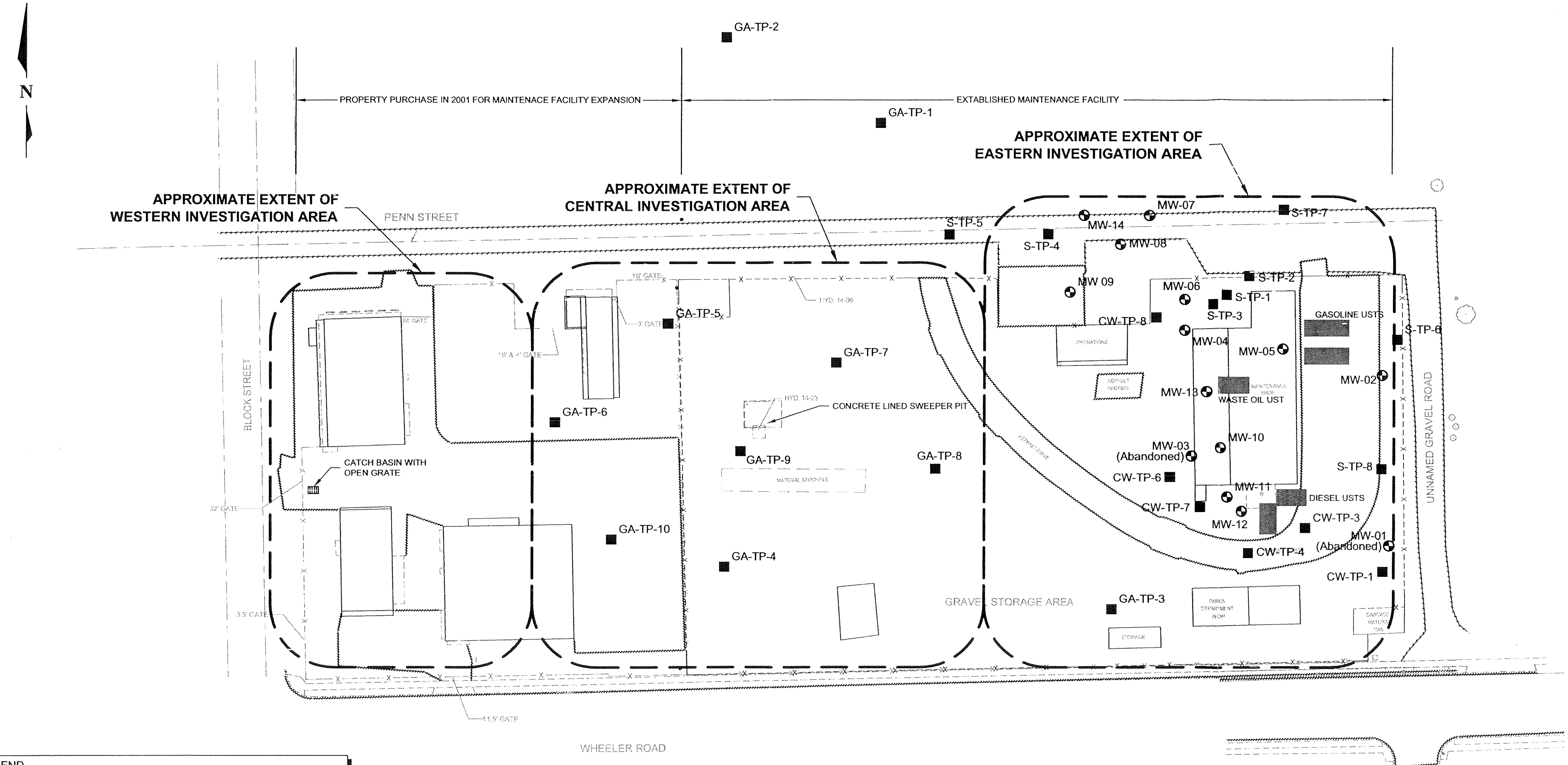
FIGURE **2-1**

UNDERGROUND UTILITIES AND FORMER UST's

MOSES LAKE/RI/FS/WA

Drawing file: 0331335003F13.dwg Jul 01, 2003 - 12:58pm

Golder Associates



LEGEND

CATCH BASIN WITH OPEN GRATE

LOCATION OF PREVIOUS UNDERGROUND STORAGE TANKS (UST'S)

LOCATION OF PREVIOUS TEST PITS (GA = GOLDER ASSOCIATES, 2002; S = SAGE, 1993; CW = CENTURY WEST, 1992)

LOCATION OF MONITORING WELLS (GROUNDWATER TECHNOLOGY, 1994)

MW-3 (Abandoned) MW 03 AND MW 01 HAVE BEEN ABANDONED

SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

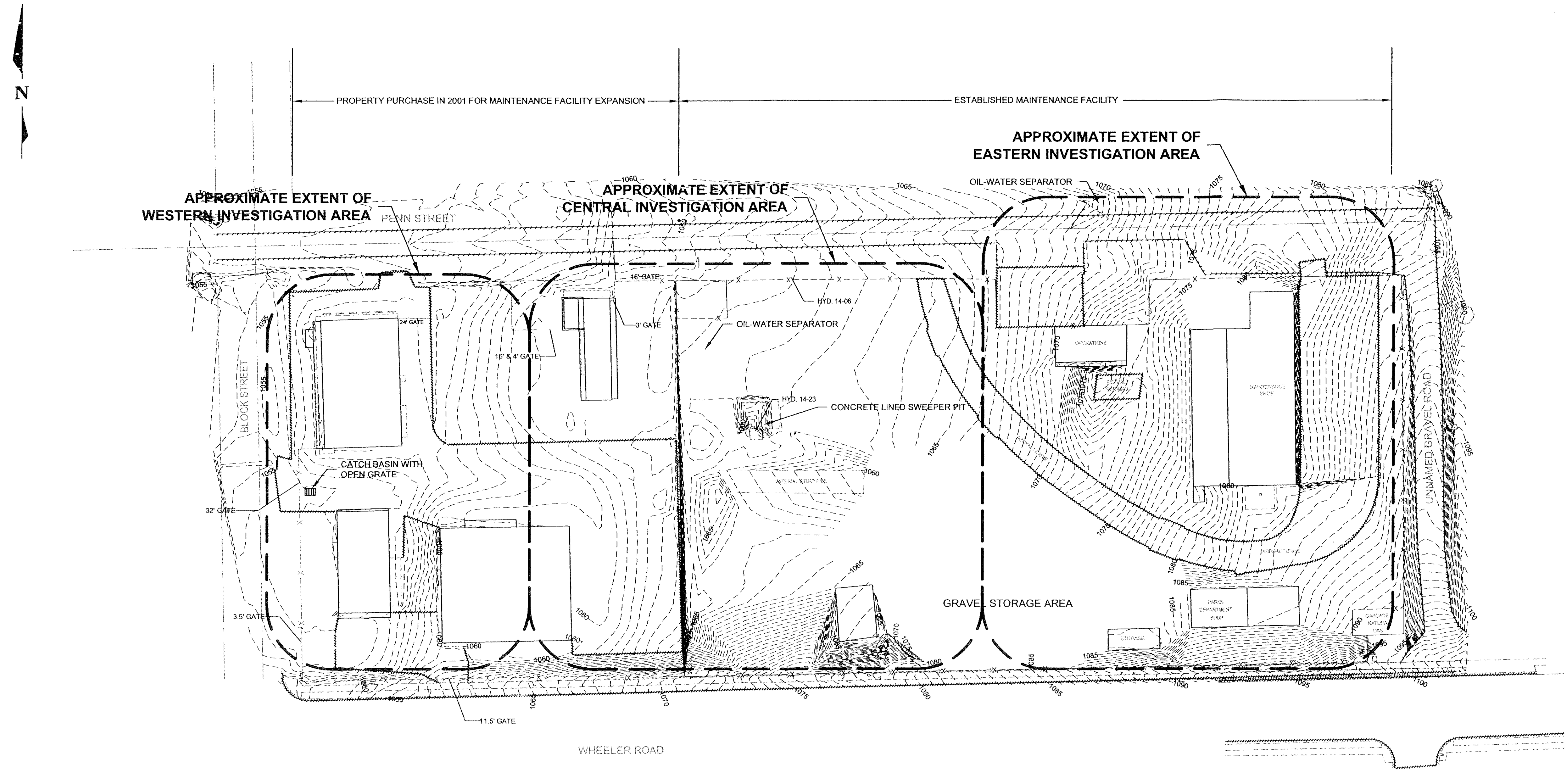
DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

0 80 160
FEET

FIGURE 2-2
PREVIOUS INVESTIGATION SAMPLE LOCATIONS AND FORMER UST's
MOSES LAKE/RI/FS/WA

Drawing file: 0331335003F03.dwg Jul 01, 2003 - 1:08pm

Golder Associates



LEGEND

CATCH BASIN WITH OPEN GRATE

SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

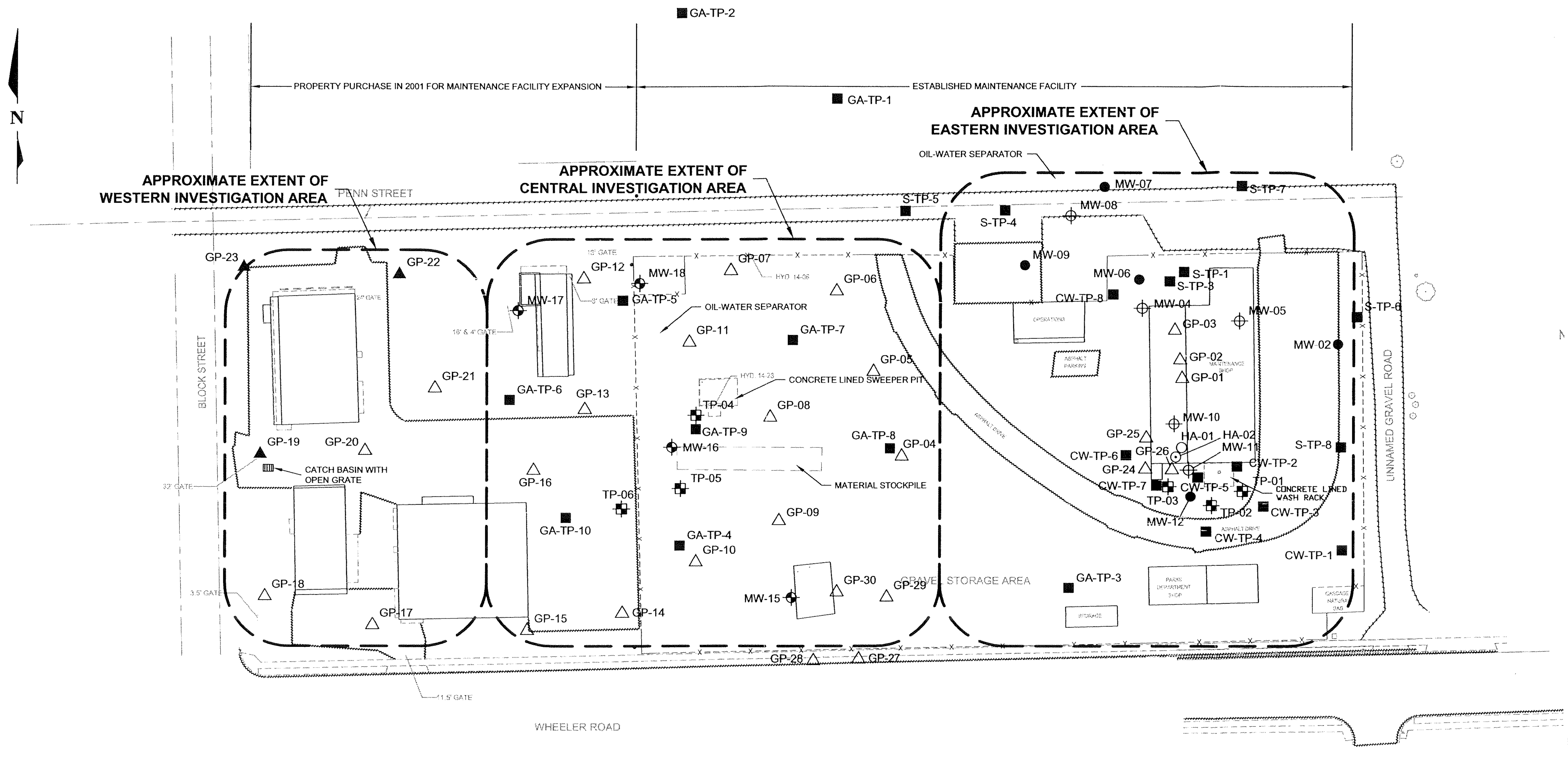
DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

0 80 160
FEET

FIGURE **3-1**
SITE TOPOGRAPHY
MOSES LAKE/RI/FS/WA

Drawing file: 0331335003F12.dwg Jul 07, 2003 – 5:51pm

Golder Associates



LEGEND

TP-06	TEST PITS (EXCAVATED 3/18/03)
GP-14	GEOPROBE BORINGS (DRILLED 3/26-27/03 OR 5/1/03)
GP-18	GEOPROBE BORINGS (DRILLED AND GROUNDWATER SAMPLED 3/27/03 OR 5/1/03)
HA-02	HAND AUGER (DRILLED AND GROUNDWATER SAMPLED 5/02/03)
HA-01	HAND AUGER (DRILLED 5/02/03)
MW-16	NEW MONITORING WELLS (DRILLED AND SAMPLED 3/24-28/03)
MW-11	EXISTING MONITORING WELLS (SAMPLED 3/17-28/03)
MW-12	EXISTING MONITORING WELLS (WATER LEVELS ONLY)
	GROUNDWATER DRAINAGE CATCH BASIN (SAMPLED 3/28-4/01/03)
	LOCATION OF PREVIOUS TEST PITS (GA = GOLDER ASSOCIATES, 2002; S = SAGE, 1993; CW = CENTURY WEST, 1992)

0 80 160
FEET

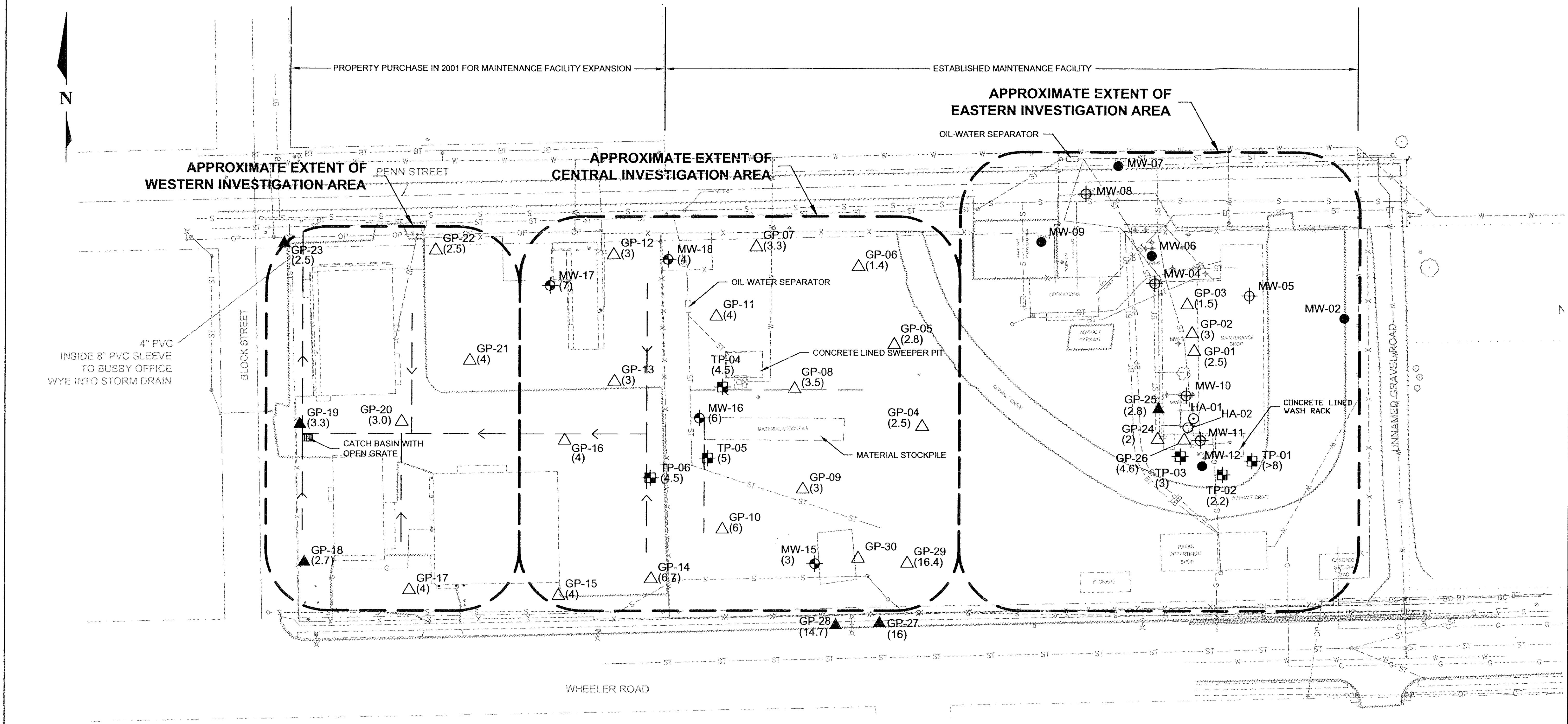
SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

FIGURE 3-2
REMEDIAL AND PREVIOUS INVESTIGATION SAMPLE LOCATIONS
MOSES LAKE/RI/FS/WA

Drawing file: 0331335003F08.dwg Jul 07, 2003 – 5:53pm

Golder Associates



LEGEND

TP-06	TEST PITS (EXCAVATED 3/18/03)	MW-11	EXISTING MONITORING WELLS (SAMPLED 3/17-28/03)
GP-14	GEOPROBE BORINGS (DRILLED 3/26-27/03)	MW-12	EXISTING MONITORING WELLS (WATER LEVELS ONLY)
GP-18	GEOPROBE BORINGS (DRILLED AND GROUNDWATER SAMPLED 3/27/03)	(4)	DEPTH OF FILL BELOW GROUND SURFACE (FT)
HA-01	HAND AUGER (DRILLED AND GROUNDWATER SAMPLED 5/02/03)		GROUNDWATER DRAINAGE CATCH BASIN (SAMPLED 3/28-4/01/03)
HA-02	HAND AUGER (DRILLED 5/02/03)		
MW-16	NEW MONITORING WELLS (DRILLED AND SAMPLED 3/24-28-03)		

0 80 160
FEET

SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

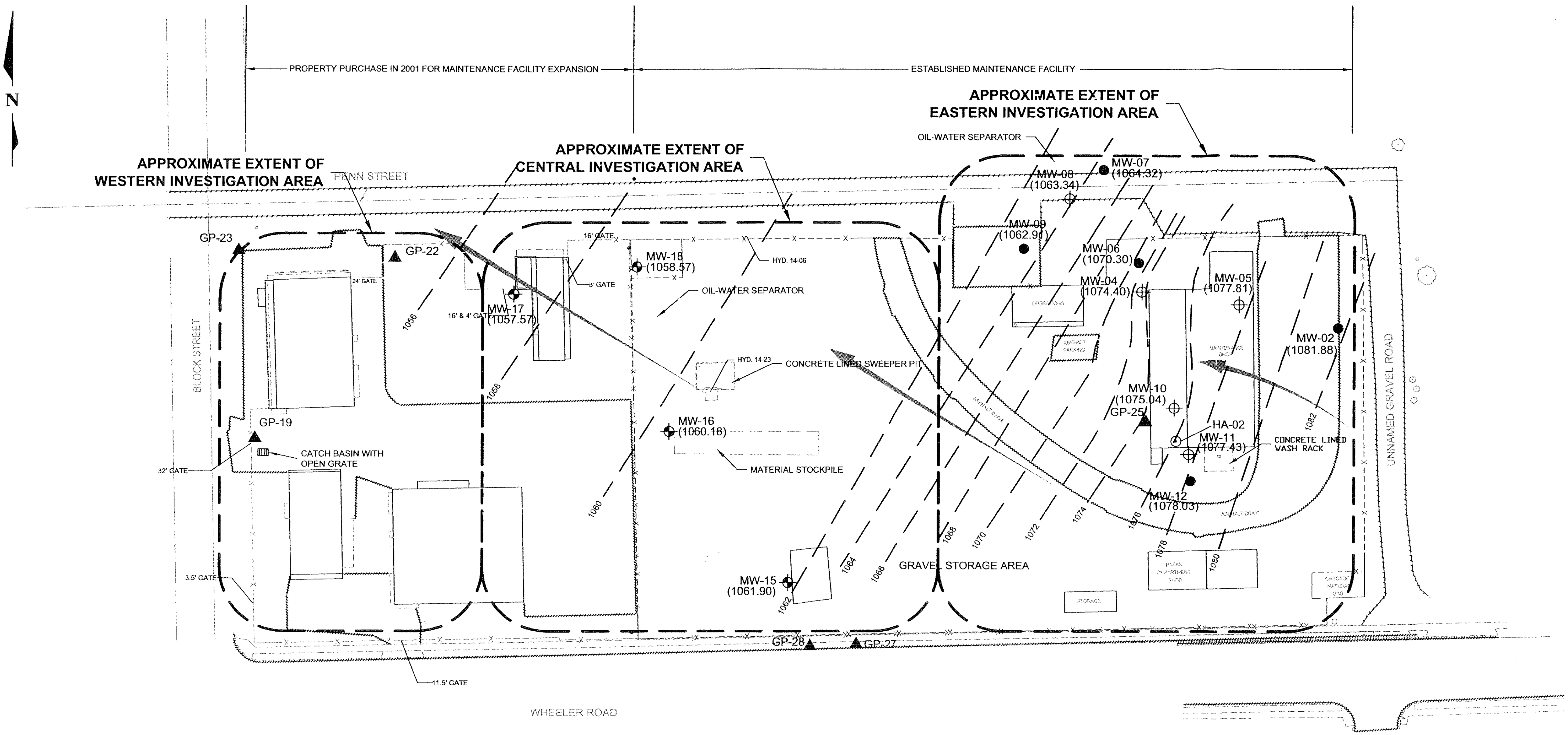
FIGURE **3-3**

FILL THICKNESS

MOSES LAKE/RIFS/WA

Drawing file: 0331335003F05.dwg Jul 07, 2003 – 5:24pm

Golder Associates



LEGEND

GP-18	GEOPROBE BORINGS (DRILLED AND GROUNDWATER SAMPLED 3/27/03 OR 5/1/03)	(1081.88)	APRIL 1, 2003 GROUNDWATER ELEVATION (FT AMSL) USED TO APPROXIMATE GROUNDWATER CONTOURS
HA-02	HAND AUGER (DRILLED AND GROUNDWATER SAMPLED 5/02/03)		
MW-16	NEW MONITORING WELLS (DRILLED AND SAMPLED 3/24-28-03)	— — —	APPROXIMATE GROUNDWATER ELEVATION CONTOUR (FT AMSL)
MW-11	EXISTING MONITORING WELLS (SAMPLED 3/17-28/03)		INFERRED GROUNDWATER FLOW DIRECTION
MW-12	EXISTING MONITORING WELLS (WATER LEVELS ONLY)		
	GROUNDWATER DRAINAGE CATCH BASIN (SAMPLED 3/28-4/01/03)		

0 80 160
FEET

SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

NOTE: GROUNDWATER LEVEL ELEVATIONS BASED ON CITY MOSES LAKE 4/1-2/03 SURVEY.

FIGURE 3-4
GROUNDWATER SAMPLING LOCATIONS AND CONTOUR MAP
MOSES LAKE/RI/FS/WA

Drawing file: 0331335003F06.dwg Jul 07, 2003 – 5:54pm

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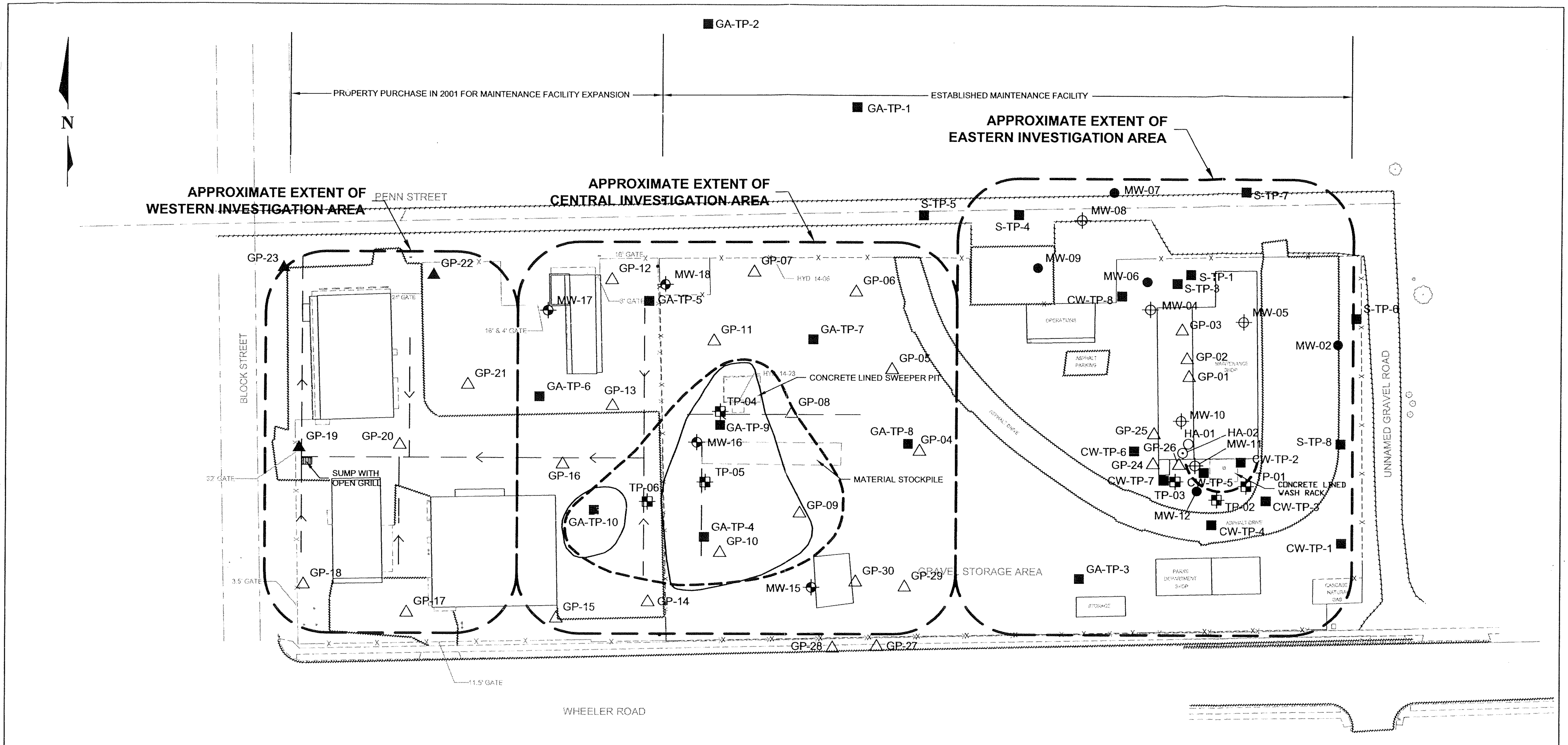

LEGEND

- TP-06 — TEST PITS (EXCAVATED 3/18/03)
- GP-14 — GEOPROBE BORINGS (DRILLED 3/26-27/03 OR 5/1/03)
- GP-18 — GEOPROBE BORINGS (DRILLED AND GROUNDWATER SAMPLED 3/27/03 OR 5/1/03)
- HA-02 — HAND AUGER (DRILLED AND GROUNDWATER SAMPLED 5/02/03)
- HA-01 — HAND AUGER (DRILLED 5/02/03)
- MW-16 — NEW MONITORING WELLS (DRILLED AND SAMPLED 3/24-28/03)
- MW-11 — EXISTING MONITORING WELLS (SAMPLED 3/17-28/03)
- MW-12 — EXISTING MONITORING WELLS (WATER LEVELS ONLY)
- GROUNDWATER DRAINAGE CATCH BASIN (SAMPLED 3/28-4/01/03)
- LOCATION OF PREVIOUS TEST PITS (GA = GOLDER ASSOCIATES, 2002; S = SAGE, 1993; CW = CENTURY WEST, 1992)
- ESTIMATE EXTENT OF EXCAVATED AREA
- AREAS IMPACTED WITH COC'S ABOVE REGULATORY CLEANUP CRITERIA

SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

FIGURE **5-2**

AREAS IMPACTED WITH COC'S ABOVE REGULATORY CLEANUP CRITERIA

MOSES LAKE/RI/FS/WA

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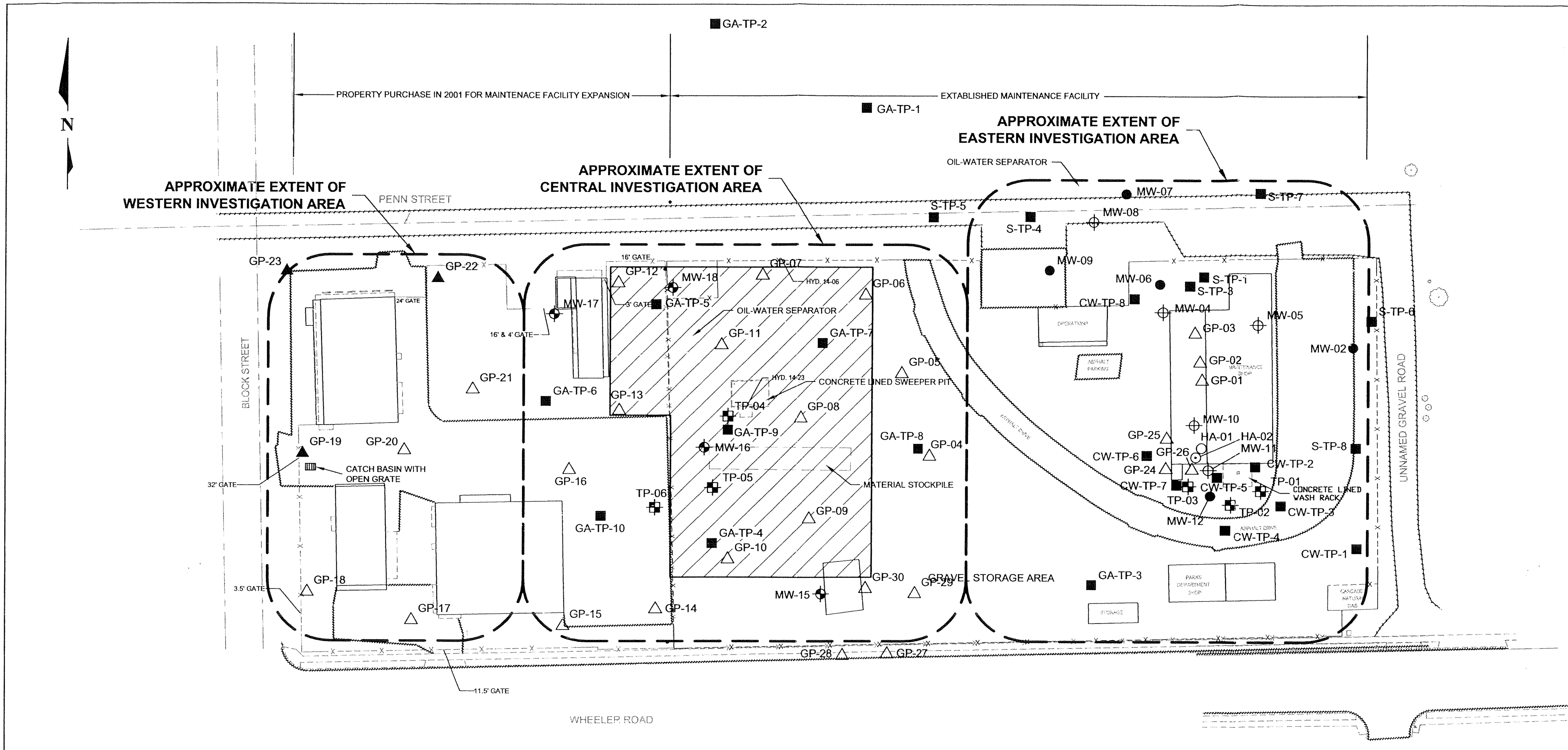
Golder Associates



LEGEND

- TP-06 TEST PITS (EXCAVATED 3/18/03)
- GP-14 GEOPROBE BORINGS (DRILLED 3/26-27/03 OR 5/1/03)
- GP-18 GEOPROBE BORINGS (DRILLED AND GROUNDWATER SAMPLED 3/27/03 OR 5/1/03)
- HA-02 HAND AUGER (DRILLED AND GROUNDWATER SAMPLED 5/02/03)
- HA-01 HAND AUGER (DRILLED 5/02/03)
- MW-16 NEW MONITORING WELLS (DRILLED AND SAMPLED 3/24-28/03)
- MW-11 EXISTING MONITORING WELLS (SAMPLED 3/17-28/03)
- MW-12 EXISTING MONITORING WELLS (WATER LEVELS ONLY)
- GROUNDWATER DRAINAGE CATCH BASIN (SAMPLED 3/28-4/01/03)
- LOCATION OF PREVIOUS TEST PITS (GA = GOLDER ASSOCIATES, 2002; S = SAGE, 1993; CW = CENTURY WEST, 1992)
- APPROXIMATE AREA OF ASPHALT CAP

SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

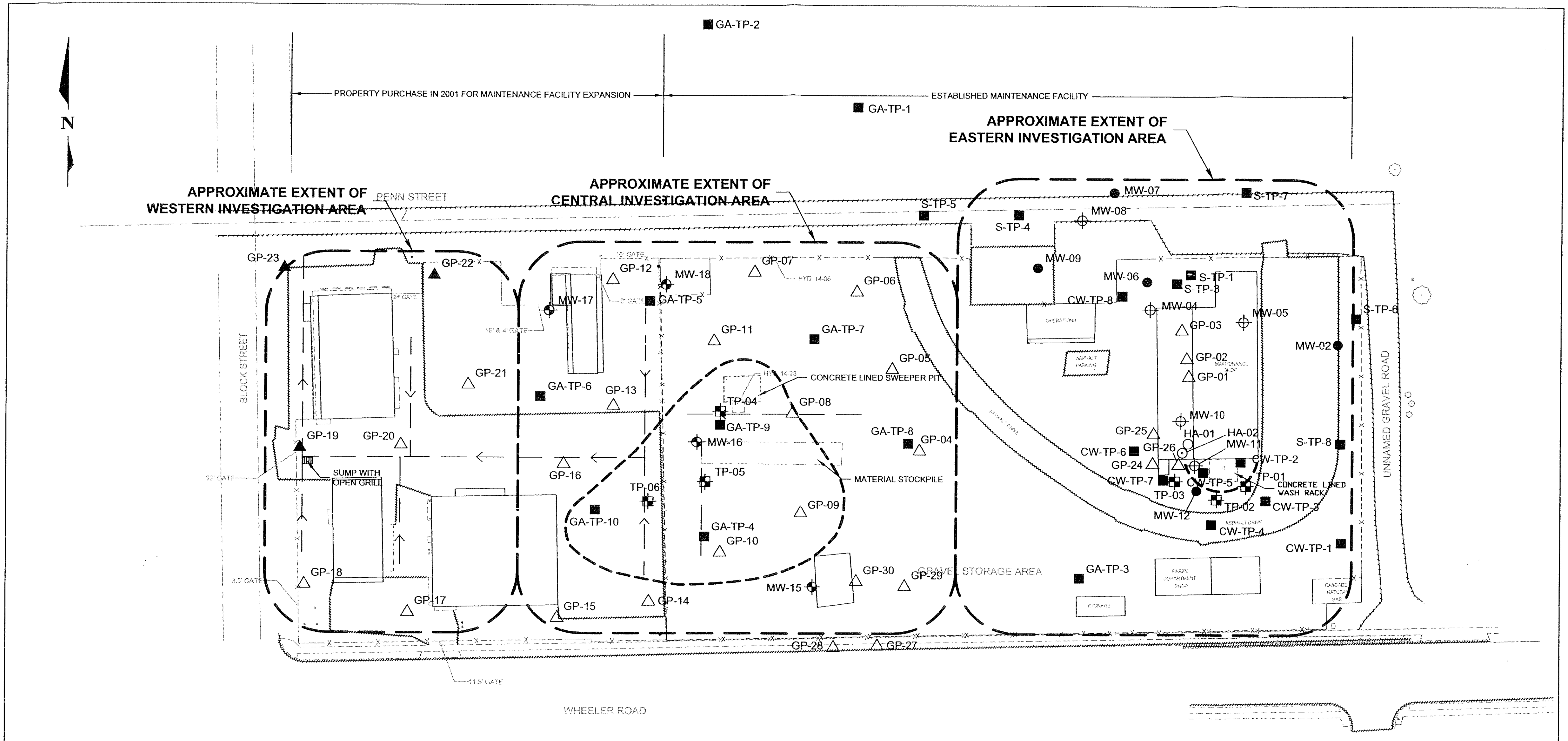
FIGURE **9-1**

APPROXIMATE AREA OF ASPHALT CAP

MOSES LAKE/RI/FS/WA

Drawing file: 0331335003F09.dwg Jul 01, 2003 – 1:28pm

Golder Associates



LEGEND

TP-06	TEST PITS (EXCAVATED 3/18/03)	MW-12	EXISTING MONITORING WELLS (WATER LEVELS ONLY)
GP-14	GEOPROBE BORINGS (DRILLED 3/26-27/03 OR 5/1/03)		GROUNDWATER DRAINAGE CATCH BASIN (SAMPLED 3/28-4/01/03)
GP-18	GEOPROBE BORINGS (DRILLED AND GROUNDWATER SAMPLED 3/27/03 OR 5/1/03)		LOCATION OF PREVIOUS TEST PITS (GA = GOLDER ASSOCIATES, 2002; S = SAGE, 1993; CW = CENTURY WEST, 1992)
HA-02	HAND AUGER (DRILLED AND GROUNDWATER SAMPLED 5/02/03)		ESTIMATE EXTENT OF EXCAVATED AREA
HA-01	HAND AUGER (DRILLED 5/02/03)		
MW-16	NEW MONITORING WELLS (DRILLED AND SAMPLED 3/24-28/03)		
MW-11	EXISTING MONITORING WELLS (SAMPLED 3/17-28/03)		

0 80 160

FEET

SOURCE: MUNICIPAL SERVICES DEPT., CITY OF MOSES LAKE, MUNICIPAL SERVICES SHOP SITE PLAN, 12/01.

DATUM: MOSES LAKE LOCAL SITE CALIBRATION USING NAD 83 AND NAVD 88 AS PUBLISHED BY THE W.S.D.O.T. FOR CONTROL
HORIZONTAL: CENTERLINE OF PENN STREET =N88°50'23" E (MUNICIPAL TRACT 2 = N89°48'E)
VERTICAL: CP # 9 =1064.52= (1061.65 CITY MOSES LAKE ELEVATION USBR DATUM)

FIGURE **9-2**

ESTIMATED EXTENT OF EXCAVATION

MOSES LAKE/RI/FS/WA

Drawing file: 0331335003F10.dwg Jul 08, 2003 - 12:28pm

Golder Associates