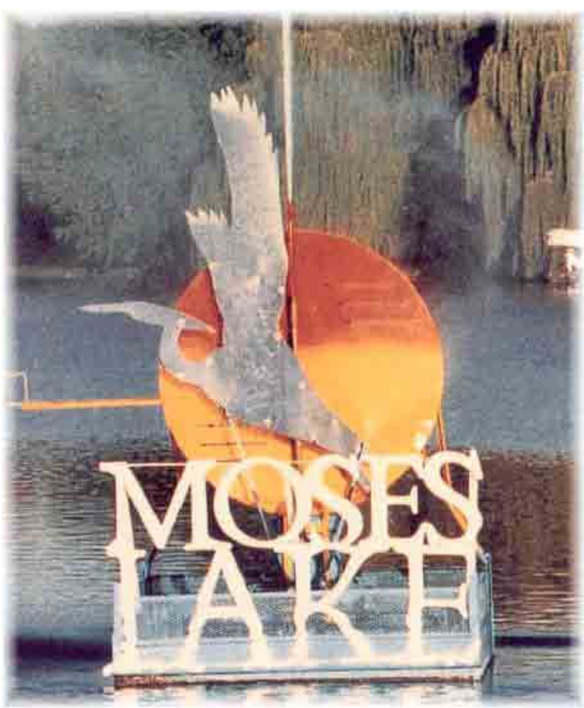
INTERIM RECORD OF DECISION
MOSES LAKE WELLFIELD SUPERFUND SITE
MOSES LAKE, WASHINGTON



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MOSES LAKE, WASHINGTON

Part 1: DECLARATION OF THE INTERIM RECORD OF DECISION

1.1 LOCATION

Moses Lake Wellfield Contamination
Moses Lake, Washington
CERCLIS ID No. WAD988466355

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedy for the Moses Lake Wellfield Contamination Area located in Moses Lake, Washington. The selected remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC 9601 et seq.), as amended by the Superfund Amendments and Reauthorization Act of 1986 (Public Law 99-499), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300). This decision is based on the Administrative Record file for this site.

1.3 ASSESSMENT OF SITE

Response actions selected in this Interim Record of Decision (ROD) are necessary to protect public health, welfare, or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment. Remedial actions selected in this ROD are designed to reduce potential threats to human health and the environment to acceptable levels.

1.4 DESCRIPTION OF THE SELECTED REMEDY

The selected remedy focuses on cleanup actions in soil release sites (soil sites) and groundwater to protect human health and the environment from site contamination. Thirty-nine soil sites were evaluated as part of the cleanup process, and it was determined that 27 soil sites posed little or no risk to human health or the environment. Eleven soil sites will require further characterization followed by removal of hazardous constituents if contamination exceeds risk- based concentrations; one soil site where existing sampling results indicate risk-based levels are exceeded (site 22) will be completely removed. Groundwater pump and treat systems will be installed for two of the five identified plumes of trichloroethylene (TCE) to remove contaminants until the drinking water standard of 5 ug/L is met. Information gathered during groundwater monitoring, as well as design and operation of the selected groundwater pump and treat system will be used to determine the need for refinement of the selected groundwater remedy, including expansion or modification of the extraction and treatment capabilities that may be needed to meet groundwater restoration goals.

1.5 STATUTORY DETERMINATIONS

Statutory Requirements—The selected remedy is an interim action but attains the mandates of CERCLA § 121 (42 USC 9621) and is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the scope of the remedial action, is cost-effective, and uses permanent solutions to the extent practicable.

Statutory Preference for Treatment—The National Oil and Hazardous Substances Pollution Contingency Plan articulates a preference for remedies that use permanent solutions and alternative treatment technologies to the maximum extent possible to reduce contaminant toxicity, mobility, and volume. The selected remedy employs treatment, which is statutorily preferred to the extent practical, as a principal element of the remedy, as follows:
(1) groundwater treatment to remove TCE from groundwater and (2) treatment of waste that is retrieved to meet disposal facility requirements.

There is currently no known principal threat waste at the Site. Soil contaminated with TCE, if and when any is identified, would be considered a principal threat waste since this waste may still be affecting the drinking water supply for citizens living near the Site. Although this is not the final remedy for the site, the selected interim remedy satisfies the statutory preference for treatment to reduce toxicity, mobility, or volume through treatment of extracted groundwater.

Five-Year Review Requirement—A review (in accordance with 40 CFR 300.430[f] [4][ii]) is required at a minimum every 5 years if a remedy is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. However, because the selected remedy will not achieve levels that allow for unlimited use and unrestricted exposure within 5 years, 5-year reviews will be conducted in accordance with EPA policy. Reviews will begin 5 years after initiation of the remedial action to help ensure that the selected remedy is protective of human health and the environment.

1.6 RECORD OF DECISION DATA CERTIFICATION CHECKLIST

The information listed below is included in the Decision Summary (Part 2) of this Record of Decision:

- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and Record of Decision.
- Contaminants of concern and their respective concentrations.
- Risks represented by the contaminants of concern.
- Cleanup levels established for contaminants of concern and the basis for the levels.
- Source materials constituting principal threat waste.
- Potential land use and groundwater use that will be available at the site as a result of the selected remedy.
- Estimated costs and duration.
- Key factors that led to selecting the remedy.

Additional information can be found in the Administrative Record for Moses Lake Wellfield Contamination.

1.7 AUTHORIZING SIGNATURES

Signature sheet for the *Interim Record of Decision for Moses Lake Wellfield Contamination, Moses Lake Washington* by the US Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Daniel D. Opalski, Director
Office of Environmental Cleanup,
Region 10
U.S. Environmental Protection Agency

9/30/2008
Date

Signature sheet for the *Interim Record of Decision for Moses Lake Wellfield Contamination, Moses Lake Washington* by the US Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

James J. Pendowski, Manager
Toxics Cleanup Program
Washington Department of Ecology

10/17/08
Date

Part 2: DECISION SUMMARY

This Interim Record of Decision (ROD) documents the selected remedy for the Moses Lake Wellfield Contamination Site located in Moses Lake, Washington. This decision summary, Part 2 of the ROD, identifies and describes the selected remedy, explains how the remedy fulfills statutory and regulatory requirements, and summarizes information in the Administrative Record.

2.1 SITE NAME, LOCATION, AND BRIEF DESCRIPTION

The Moses Lake Wellfield Contamination Site encompasses potential source areas around the former Larson Air Force Base (see Figure 1), and is currently the home of the Grant County International Airport, located in Moses Lake, Washington. Potential source areas are scattered throughout the area, and approximately 1000 acres of groundwater is contaminated. The contamination is the result of operations of the former Larson Air Force Base (Larson AFB) and industrial activities associated with the aircraft industry. There are 12 potentially contaminated soil waste sites and five groundwater plumes of trichloroethylene (TCE) that pose a threat to human health and the environment.

Cleanup actions in this ROD address both source areas as well as groundwater contamination. Remedial actions specified in this ROD address removing the source, preventing migration of contaminants to the underlying groundwater, and treating groundwater to remove TCE.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

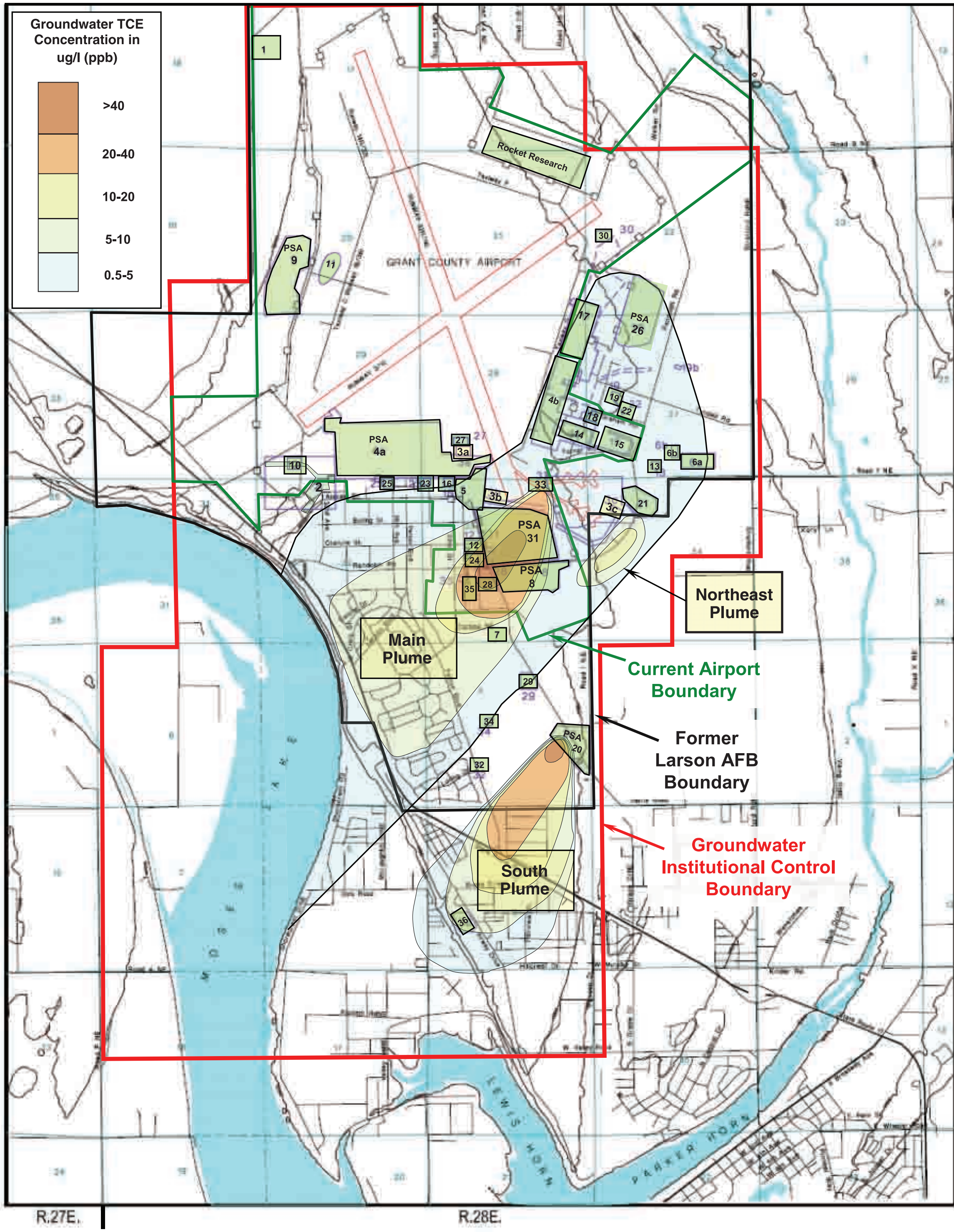
The Larson AFB was established in 1942 to provide training for pilots and crews. Between 1945 and 1948, The Boeing Company (Boeing) used the former base to test aircraft. In 1948 the facility was reopened under the U.S. Air Force Defense Command.

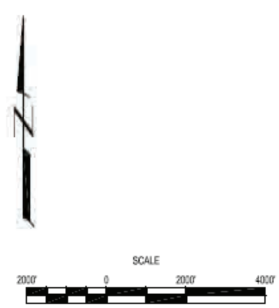
The former base had many facilities including a hospital, barracks, fueling depot, hangars, schools, waste water treatment and disposal, and conventional weapons storage. In 1954 the Boeing Flight Center was established. Operations included contract work for the U.S. Air Force involving preparation of aircraft for delivery. In 1960 the Strategic Air Command and Titan Missile program began missile-assembly and launching activities at the site, and Boeing operations closed during this time. In 1965 the Air Force announced that the base would be closed.

In 1966 the Port of Moses Lake (Port) acquired most of the former base and has since operated the property as the Grant County Airport. In addition, the housing associated with the base was sold to the Grant County housing authority and is currently in use. Other facilities were transferred to Big Bend Community College. The five former base drinking water supply wells were transferred to the City of Moses Lake (City). In 1968, Boeing returned to the Airport by purchasing 130 acres, including the Three-Place Hangar. Industrial activities are continuing around the Airport today. Most of the potential source areas either lie within the Airport boundary or are located adjacent to the Airport in the predominantly industrial zoned area.

In 1988 the Washington State Department of Social and Health Services analyzed groundwater samples from eight wells serving the City municipal water supply system. Testing indicated that three of the wells contained concentrations of TCE above EPA's primary drinking water

U.S. Environmental Protection Agency
Moses Lake Wellfield Contamination Superfund Site
Cleanup Plan for Contaminated Groundwater and Soils
Moses Lake, Washington





Contaminated Groundwater Plumes

Groundwater Base Actions for all TCE-Contaminated Groundwater Plumes:

- Test drinking water wells within "Institutional Control" boundary
- Provide water filters or alternate water supply for wells with TCE > 5 µg/L (ppb)
- Drill more monitoring wells to define the extent of contamination in lower aquifers
- Conduct long-term groundwater monitoring

Actions for Main/Northeast and South TCE Plumes in the Upper Basalt Aquifer (Roza 1):

- "Pump and Treat" groundwater to remove and contain the highest TCE concentration areas near the source zones

Possible Actions for TCE Plumes located in the Lower Basalt Aquifer (Roza 2):

- Conduct source treatment if high TCE source is found that needs to be treated

Contaminated Soil Areas

PSA 1	Liquid Waste Disposal Site
PSA 3	Aircraft Wash Rack (Areas 3a, 3b, 3c)
PSA 8	Randolph Road Base Dump
PSA 10	Fire Training Pit A
PSA 11	Fire Training Pit B
PSA 31	19th Avenue Base Dump
PSA 33	Dump At End of Runway 32
PSA 6a	Base Closure Landfill
PSA 19	LOX Plant
PSA 20	South Base Dump
PSA 22	Paint Hangar Leach Pit
----------	Rocket Research Perchlorate Disposal

Cleanup Actions for These Soil Areas:

- Conduct additional investigation to determine if soil areas are contaminated or are a continuing TCE source
- Excavate contaminated soil and dispose off-site if contamination is above risk-based levels
- Apply "Institutional Controls" such as deed restrictions

Figure 1

standard under the federal Safe Drinking Water Act, Maximum Contaminant Level (MCL, the maximum level of the contaminant allowed) of 5 ug/L (micrograms per liter, sometimes referenced as parts per billion). Additionally, TCE was detected in two wells operated by the Skyline Water System, Inc., a private water provider located in unincorporated Grant County south of the former Larson AFB property.

The USACE performed an early study of the extent of TCE contamination in groundwater and investigated four soil sites as potential source areas. Field investigations were conducted between August 1991 and January 1993, and monitoring well sampling continued until September 1994. Additional private wells and small water systems were sampled by the State and EPA.

In 1992 EPA placed the Moses Lake Wellfield Contamination Superfund Site (Site) on the National Priority List (NPL). Since 1992 the U.S. Army Corps of Engineers (USACE) has worked to characterize the Site under the Remedial Investigation/Feasibility Study (RI/FS) process. The RI/FS was performed by the USACE on behalf of the federal potentially responsible parties under EPA oversight according to a 1999 Interagency Agreement. The USACE has the lead role for cleanup of Formerly Used Defense Sites (FUDS), including the former Larson AFB.

Based on the TCE detections described above, between 1989 and 1993 the City fixed three contaminated City water-supply wells south of the Airport. The Port supplied bottled water to the Skyline community from 1997-1999. The USACE provided bottled water to Skyline community residents from 1999 to 2003, when the USACE completed construction of a replacement water-supply well for the Skyline Water System. The new Skyline water-supply well was constructed in approximately the same surface location, but draws water from a deeper uncontaminated groundwater aquifer. To date this well continues to provide reliable, clean drinking water to the Skyline community.

2.3 COMMUNITY PARTICIPATION

A broad range of activities have provided many opportunities for the public to be involved in the Moses Lake Wellfield Site under both the USACE work as well as under EPA. In 1992, EPA and USACE, in conjunction with City of Moses Lake and Washington Department of Health, hosted the first public meeting about the groundwater contamination problem. Multiple public meetings were subsequently hosted by EPA and USACE, most of which centered on the Skyline Water System contamination and subsequent well replacement. In 1999 the USACE established a Restoration Advisory Board to give advice on cleanup. In addition the USACE canvassed the Skyline Area, talked with each resident and offered bottled water service to all the affected homes within the area of groundwater contamination. In August 2007, in preparation for the release of the Proposed Plan, EPA mailed 5000 postcards to residents and businesses in the Moses Lake 98837 zip code in or near the site, notifying residents of the pending Superfund site cleanup proposal. EPA received 65 inquiries from Moses Lake residents based on this mailing. In January 2008 the public notice was published in the *Columbia Basin Herald* newspaper announcing the release and public availability of the proposed plan. EPA mailed a Fact Sheet describing the proposed cleanup action to over 2000 residents and businesses and also to each of the major rural postal routes within and near the Institutional Controls Boundary. Two public meetings were held during the comment period, an informal open house in January and a formal public meeting in February. No public comments were received at the public meeting. Appendix A contains the comments and responses received during the comment period.

2.4 SCOPE AND ROLE OF RESPONSE ACTION

This response action is designated an interim action because additional site characterization is needed to determine the scope of required soil remediation activities. In addition, information gathered during design and operation of the selected groundwater pump and treat system will be used to determine the need for refinement of the selected groundwater remedy, including expansion or modification of the extraction and treatment capabilities that may be needed to meet groundwater restoration goals. The groundwater component of this response action addresses 3 areas (encompassing five contaminated groundwater plumes) and the suspected sources thereof to restore the groundwater to beneficial use as a drinking water resource. This response also addresses soil contamination that poses an unacceptable risk to human health in the event of human exposure if or when soil sites are disturbed.

These actions required by this Interim Record of Decision are intended to achieve Applicable or Relevant and Appropriate Requirements (ARARs) and meet Remedial Action Objectives (RAOs) for both soils and groundwater. The actions required and those identified as contingencies should support a Final Record of Decision upon successful implementation.

The groundwater plumes will be addressed in a phased approach, starting with active remediation of the 2 shallow basalt groundwater plumes, characterization, monitoring and institutional controls for all five plumes, and further characterization of suspected source areas. If monitoring and evaluation indicates active remediation of the two shallow basalt plumes will not achieve the response objective for all five plumes within a reasonable timeframe (30 years) as currently expected, active remediation will be expanded to additional areas of the plume(s) as needed to achieve response objectives in a reasonable timeframe.

During the Remedial Investigation the USACE identified 39 soil sites that required characterization.   Of the 39 suspected soil sites, 27 were eliminated from further consideration, one (site 22) requires cleanup, and the remaining 11 sites are suspected to have contamination levels that require cleanup and/or to be sources of TCE contamination in groundwater. In addition to groundwater cleanup, this response action calls for cleanup of site 22 plus, for the other 11 soil sites, further characterization with a contingency for soil cleanup if necessary.

Cleanup is expected to begin in 2010 and will be phased over a number of years. The South groundwater plume, the South Base Dump (site 20), and site 22 will be the first sites targeted for characterization and cleanup.

2.5 SITE CHARACTERISTICS/CONCEPTUAL SITE MODEL

The Moses Lake Site encompasses soil sites and contaminated groundwater on and around the former Larson Air Force Base (see Figure 1), and is currently the home of the Grant County International Airport. TCE has been detected in 3 groundwater areas (5 plumes) beneath and downgradient from the Airport. Potential source areas are scattered throughout the area, and approximately 1,000 acres of groundwater is contaminated.

The conceptual site model identifies a number of source areas that are possible contributors to groundwater contamination at the Site. The transport of contaminants from source areas to groundwater has contaminated aquifers currently used as drinking water supplies and is the cause of the Site being listed on the National Priorities List. Currently available information indicates that TCE was used in several aircraft maintenance activities, including as a parts degreaser, aircraft body cleaner, and as a general solvent. Industrial facilities where TCE is believed to have been used or disposed include aircraft hangars, an aircraft wash rack, and facilities associated with Titan missile assembly, including a LOX (liquid oxygen) Plant where TCE dip tanks were likely used. TCE in degreaser tanks is thought to have been periodically drained and then either discharged to the soil or drummed up and disposed of in general purpose landfills. The sludge bottoms were also thought to be disposed of in general purpose landfills. At the Wash Rack Area, TCE was mixed with hot water, used to clean aircraft prior to repainting, and then allowed to discharge directly to the soils. Low levels of TCE were also found in the water that was sent to the water treatment facility. There is a strong possibility that water with low levels of TCE was discharged into the soil after treatment occurred at the water plant. The contamination in the groundwater is thought to be from a combination of the above-described processes, and sludge bottoms and TCE-contaminated soils are suspected to be continuing sources of TCE to the groundwater. Please see Section 2.5.7 for discussion of hydrogeologic aspects of the Conceptual Site Model.

During the remedial investigation, no source of TCE was located in the soil disposal sites, but further investigation is warranted. Of particular concern is landfill, site 20, which appears to be the source for the South plume. The sources for the Main and Northeast plumes are less clear; the Main plume in particular may have multiple sources. Although data is limited in the Roza 2 deeper basalt, it is assumed that small amounts of TCE traveled from Roza 1 to Roza 2 through small cracks and fissures in the basalt unit.

While TCE is the primary contaminant of concern at this site, soil sampling and historical knowledge have shown that other hazardous substances have been disposed of in the general purpose landfills, including lead, polychlorinated biphenyls (PCBs), arsenic, mercury, and petroleum products. In addition to serving as a source to groundwater, hazardous substances remaining in landfills pose a risk to human health in the event soils are disturbed during site use, development, or redevelopment.

Types and Characteristics of Chemicals of Concern

Trichloroethylene is toxic and a probable human carcinogen. Trichloroethylene dissolves slowly in water, but can remain in groundwater for extended periods of time. Trichloroethylene may bind to particles in water, which makes it more difficult to remove from groundwater. Trichloroethylene does not build up significantly in plants and animals.

Lead is toxic, particularly to infants and children, and is a probable human carcinogen. Lead binds readily to soil particles.

PCBs are toxic and probable human carcinogens. PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

Arsenic is toxic and a known human carcinogen. Arsenic speciation can change its toxicity. Many common arsenic compounds can dissolve in water.

Mercury is toxic and there is inadequate data to determine if it is a human carcinogen. Mercury combines with other elements. Mercury combines with carbon to make organic mercury compounds. Methylmercury builds up in the tissues of fish.

Total Petroleum Hydrocarbons (TPH) are a mix of many organic chemicals, some of which are toxic and known human carcinogens. Some of the chemicals are mobile in the environment, some are not. Petroleum hydrocarbons degrade, eventually to non-toxic carbon dioxide, via biological and abiotic processes.

2.5.1 Groundwater Use

Groundwater in the Moses Lake area is either located in alluvial (river or glacial flood) sediments or in porous or weathered portions of fractured basalt (volcanic rock) bedrock. These underground layers of water-bearing porous rock, sand, gravel or other material are called aquifers if they supply or are capable of supplying water to wells and springs. Groundwater is the major source of drinking water in Grant County. The groundwater consumed is either treated for bacteria or untreated, depending on how the water is obtained. Groundwater is also used for irrigation, livestock watering, and manufacturing. Groundwater use in the area is adjudicated in State courts and is regulated by the Washington State Department of Ecology (Ecology). All domestic drinking water in the area is supplied via either City water systems, private community water systems, or via individual residential (less than five connection) drinking water wells.

2.5.2 Surface Water Use

The Site and surrounding areas are bounded in three directions by surface waters: Crab Creek to the east, Lewis Horn and Parker Horn to the south and southeast, and Moses Lake to the west and southwest. The lake is made up of three main arms, which are over 18 miles long and up to 1 mile wide. The lake is the largest natural body of fresh water in Grant County; it has over 120 miles of shoreline and covers 6,500 acres. Surface water use includes recreation and fishing.

Non-recreational surface water use is dictated by the Columbia Basin Irrigation Project, which diverts water from the Columbia River below the Ground Coulee Dam through a series of irrigation canals and siphons. This water is distributed over approximately 70,000 acres for irrigation purposes in an area designated by the Washington Department of Natural Resources as agricultural, including agricultural areas immediately to the east of the former Larson AFB. Some of the water flows into the lake and into Potholes Reservoir by way of Rocky Coulee Waterway and Crab Creek. Surface drainage is from north to south in the Site area. Other surface drainages in the area include a short intermittent stream west of the Airport and several channels associated with agriculture in the eastern portion of the Site.

Water quality in the lake is of concern to local residents as well as to downstream users of Potholes Reservoir. In the past, the lake has had indications that it receives excessive nutrient loading of nitrogen and phosphorus. The principal nutrient source is irrigation return water via Crab Creek. Groundwater seeps, septic tank leachate, and recycling from bottom sediments add nutrients which result in floating algal mats during the summer recreation season.

2.5.3 Local Water Systems

According to the 2000 City Water Service Plan, the City is the largest drinking water provider in the county. Other small providers of water, such as the Skyline Water System and the Cascade Valley Water District, serve small residential areas and mobile home parks. In addition to the large and small water providers, there are many private wells serving individual homes or small groups of homes. The City currently has 15 wells drawing from various basalt aquifers. It also has one well drawing partially from the overlying unconsolidated alluvial aquifer. The City's pumping capacity is 24.8 million gallons per day with a peak demand estimated at 16.4 million gallons per day.

2.5.4 Geologic Setting

The Study Area mostly occupies a nearly flat fluvial terrace bounded to the east by Crab Creek and to the south and west by Moses Lake. The geologic units affected by contamination include, with increasing depth and from youngest to oldest: sand and coarse gravel deposited by huge glacial floods (Hanford formation), silt and sand deposited in lakes and rivers (Ringold Formation, locally eroded away to the north and east), and several extensive basalt flows of the Wanapum Basalt Formation. The Wanapum Basalt at the Site is divided into three members, from geologically youngest to oldest: the Priest Rapids Member, the Roza Member, and the Frenchman Springs Member. At the Site, the Roza Member consists of three basalt flows, of which Roza 1 is the youngest and always the first encountered. The Priest Rapids Member overlies the Roza Member in the central portions of the Site, but is mostly highly weathered and has been eroded away entirely along the east and west margins. The basalt flows typically have a vesiculated, fractured, and sometimes brecciated flowtop overlying a dense flow interior characterized by vertical cooling fractures. The deeper and less weathered the basalt flows are, the more likely these fractures are to be completely filled by secondary minerals.

2.5.5 Hydrostratigraphic Setting

The aquifers relevant to the Study Area are: 1) Hanford formation; 2) Priest Rapids and flowtop of Roza 1; 3) Roza 2 flowtop; and 4) Roza 3. The intervening water-confining units are: 1) Ringold Formation; 2) dense flow interior of Roza 1; and 3) dense flow interior of Roza 2. Based on feasibility study estimates, groundwater flows horizontally through the Hanford formation up to 100 times faster than in the basalt aquifers (the flowtop zones) and up to 1,000 times faster than in the Ringold Formation. Vertical groundwater flow is generally downward between all the units, and apparently some leakage of water (and contaminants where present) can occur naturally through the Ringold Formation and at least the first few dense basalt flow interiors. In addition, the extent of the Ringold Formation is limited. It becomes thin to absent in the northern and eastern portions of the Site.

2.5.6 Groundwater Occurrence and Flow Direction

Irrigation wells, small public water supply systems, and residential wells all withdraw groundwater from the upper aquifers (Hanford formation, Priest Rapids and Roza flowtops). Larger public water supply systems, such as the City's, draw primarily from sources deeper than the Roza 2 aquifer. There are also some groundwater discharges from the Hanford formation and possibly the shallowest basalt aquifers to surface water bodies (Moses Lake, Lewis Horn, and Parker Horn). Generally speaking, groundwater flow is to the south and southwest, although Roza 2 groundwater appears to flow generally to the west. Water level differences between

Figure 2. Moses Lake Geologic Column and Groundwater Stratigraphy

Depths generally based on Skyline Replacement Well -- actual depths and unit thicknesses vary across site.

alluvial and basalt aquifers increase downgradient. Groundwater flow directions exhibit only minor seasonal variation in the alluvial and Priest Rapids-Roza 1 aquifers, although local variations in flow direction of up to 40 degrees have been observed in the central portion of the Site. Winter and summer water level data are available and show significant seasonal effects in the Roza 2 aquifer. The summer variation in water table level is complex, probably due to groundwater withdrawals from wells and/or local variations in recharge from the Roza 1 aquifer.

2.5.7 Hydrogeologic Conceptual Model

Contaminant concentrations in the uppermost basalt aquifer have generally been slowly declining since their discovery in the late 1980s, but there appears to be a long-term source of TCE contamination to the Priest Rapids-Roza 1 plumes. However, the locations of the TCE source mass(es) for each plume have not been identified. TCE levels in soil gas below landfills associated with heads of plumes suggest that TCE was disposed in them, but the relatively low concentrations observed suggest that the primary sources may be depleted. The relatively low concentrations found in the Hanford Formation aquifer further supports this interpretation, but few wells exist in or near the source areas. There are occasional sand/silt lenses within the 80-foot thick Hanford formation vadose zone that may also contain TCE mass and contribute contamination to the Hanford formation aquifer. Contamination levels in the Ringold Formation aquitard have never been investigated. It is possible that TCE migrating downward through fractures and/or sandy zones has diffused into the matrix and remains a secondary source to the Priest Rapids-Roza 1 plumes. Within the Priest Rapids-Roza 1 aquifer, TCE sources may exist as dense non-aqueous phase liquid (DNAPL) residual or as isolated dissolved high-concentration zones that slowly release TCE to the more conductive portions of the aquifer. The maximum concentrations encountered at the site are two orders of magnitude less than the levels generally considered to be indicative of nearby DNAPL. However, the basalt aquifers are highly heterogeneous and few wells have been drilled in or near the heads of the plumes, so high-concentration sources in the basalts cannot be discounted. Presumably, downward leakage of contaminated water through the Roza 1 dense flow interior is the source of the two Roza 2 plumes that have been identified beneath the Main and South Priest Rapids-Roza 1 plumes. It is unknown whether contamination exists in the Roza 3 aquifer, but the dense flow interiors are more likely to form robust aquitards in deeper less-weathered basalt flows.

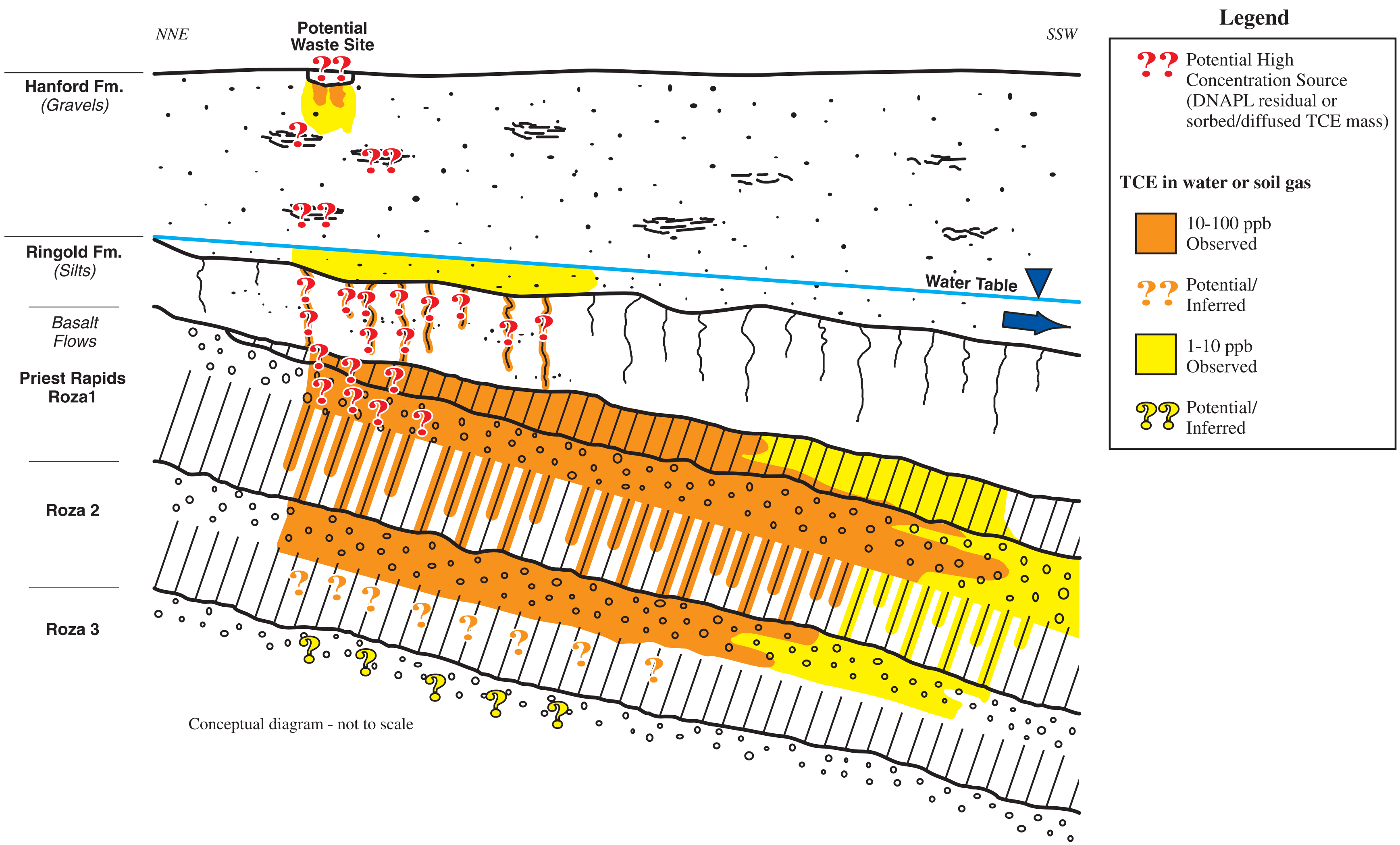
2.6 CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Current land use is variable and diverse within and around the Site. Land use in the southern portion and south of the Site consists of residential subdivisions, apartments, mobile home parks, commercial areas, and agricultural areas. The land in the northern portion of the Site is designated as commercial/industrial. In general, the areas north and east of the Site consist of unimproved open lands used for rural residences, agriculture, and rangeland; the western and southern edges of the Site are bounded by Moses Lake. The lake is used for recreation and the USACE has reported that it is also used for irrigation.

Three local governments – the City, the County and the Port – have jurisdictional authority over portions of the Study Area. Their respective jurisdictional boundaries have changed over time and may continue to change over the next 30 years. The City limits begin approximately 1 mile south of the Airport; most of the property between the Airport and the City limits is unincorporated Grant County (County). Two parcels of the former Larson AFB, the Larson

Figure 3.

Hydrogeologic Conceptual Model:
TCE Occurrence and Migration Pathways



Waste Water Treatment Plant and the former firing range, have been incorporated into the City. The County has zoned Port property to be developed adjacent to the Airport as "Industrial Light" and "Industrial Heavy." Because of these multiple jurisdictions, implementing institutional controls (land use restrictions to prevent human exposure to contaminated areas) will require close coordination among the City, County, and Port.

The Airport is expected to remain an airport and is subject to access restrictions, zoning, and requirements such that all soil sites of potential concern within it are expected to remain industrial with limited access for the foreseeable future. Four of the five soil sites of potential concern outside the airport are also in areas zoned industrial/commercial, surrounded by similar properties with similar uses, and expected to continue to be used for such purposes for the foreseeable future. The one exception is site 20, which is privately owned and located to the south of the Airport in an area that has potential to support mixed use, including potential residential development.

Groundwater is the major source of drinking water in Grant County. The Airport and facilities receive their water from the City, as does Big Bend Community College and the former base housing area south of the Airport, which includes Grant County Public Housing; however, many homes surrounding the former base receive their water from private community water system wells or via individual residential (less than five connection) drinking water wells and domestic wells.

2.7 SUMMARY OF SITE RISKS

2.7.1 Soils Site Risks

In the RI/FS, USACE examined and evaluated risks to both human receptors and ecological receptors. The ecological risk to plants and animals from surface soils was determined to be very low. In addition, based on monitoring data, no significant amount of TCE appears to be entering Moses Lake.

Exposure doses were calculated for the reasonable maximum exposure case consistent with an industrial/commercial land use. Only site 22 exceeded a hazard index of 1.0 due to Aroclor 1254 at 8.4 mg/kg. Also, lead concentrations of 1200 mg/kg could pose a risk to an industrial worker.

At site 20, TCE is suspected to have been disposed of, as the south groundwater plume in the Roza 1 lies directly below this landfill. For the other soils sites (11), where additional characterization is required by this Interim Record of Decision and cleanup actions may be triggered, EPA believes that currently available information requires that additional work to address prospective human exposures and mitigate potential groundwater source term contributions is necessary.

The major risk posed by the soil sites is the potential for people and animals to come in contact with contaminated soil and debris through intrusion during site development activities. In addition, 11 of the 12 soil sites have the potential to be a continuing source of TCE to groundwater. Without removal of the soil source term, cleanup of the groundwater could be hard to achieve.

During the RI/FS, ecological risk from soil sites was deemed to be low; however animals could come in contact with contaminated soil through intrusion. As sites are characterized, data will be compared with ecological screening levels to ascertain whether contaminated soil needs to be removed to be protective of the ecology.

The discussion about soil contamination at the Moses Lake Wellfield Site is separated into two categories: 1) sites located inside the Airport and 2) releases located outside the Airport. The current Airport boundary and lists of sites are shown on Figure 1.

The reason this distinction is important is because sites located inside the Airport are generally located on Port-owned land. Direct human exposures are therefore more easily controlled through security fencing required because public access to the Airport is already controlled by existing federal regulation. In addition, the Port has a facility land use plan that helps guide redevelopment activities and can track areas of concern.

Based on the available information, the following soil sites pose actual or potential risks to human health or the environment:

Soil Sites Inside the Airport [Numbers refer to Figure 1]

Liquid Waste Disposal Area (1)
Aircraft Wash Rack (3)
Randolph Road Base Dump (8)
Fire Training Pit A (10)
Fire Training Pit B (11)
19th Avenue Base Dump (31)
Dump at End of Runway 32 (33)

Public access is restricted for sites inside the Airport boundary, and controls are in place to limit exposure to contaminants. Although an adequate level of information was developed during the RI/FS for purposes of selection of an interim remedial action, information on these sites is limited, and additional investigations shall be performed as these sites have the highest probability of containing TCE or other contamination. If contaminants are found at these sites above levels which pose unacceptable levels of risk or will continue to contaminate groundwater, they will be removed. Below is a general description of each site and potential contaminants of concern within the Airport boundary.

Site 1 Liquid Waste Disposal Area

Site 1 is an area approximately 45’ x 25’ that may have been used to dispose of liquid wastes in two circular excavated areas. Vegetation is sparse at the site compared to the area adjacent to the site, indicating the possible presence of contamination. Characterization is required at this site to determine if cleanup is required.

Site 3 Aircraft Wash Rack

This is an area near the airport hangars where aircraft were washed with a solution of hot water and TCE to remove grease and paints. The liquids were discharged directly to the soil and there is a potential that residual TCE is located in the vadose zone. The deep vadose zone requires further characterization.

Site 8 Randolph Road Base Dump

Site 8 is a general purpose landfill primarily used to dispose of refuse in the early 1950s. Hazardous substances that could be present include metals, TPH, PCBs and TCE. Additional characterization is required to determine if cleanup is required.

Sites 10 and 11 Fire Training Pits A and B

This is an area where petroleum products, including jet fuel, were ignited for fire training purposes. TPH odors and stained soil are present at these sites. Characterization is required to determine if cleanup is required.

Site 31 19th Ave. Base Dump

This is a general purpose dump where refuse was disposed. Reports indicate much of the waste was burned in the pit to reduce mass. Further characterization is required to determine if cleanup is required.

Site 33 Dump at the End of Runway 32

This 5-acre site was used to dump an unknown liquid from tanker trucks and was also used as a general purpose disposal area. As noted on Figure 1, there is a TCE groundwater plume that appears to begin at site 33. Further characterization is required to determine if cleanup is required.

Soil Sites Outside the Airport [Numbers refer to Figure 1]

Rocket Research
Base Closure Landfill (6a)
Liquid Oxygen Plan (19)
South Base Dump (20)
Paint Hangar Leach Pit (22)

The following paragraphs describe the contaminants found in each area outside the Airport and any actual or potential exposure pathways that were identified for each. In these areas, additional investigation is warranted to confirm our current understanding of the situation.

Rocket Research Area

The Rocket Research location, north of the Airport, is an area where perchlorate wastes were reportedly disposed in a waste pit at the Site. The facility installed two monitoring wells which USACE sampled. Perchlorate was not detected, but the wells are too shallow to reach the basalt aquifers, and it is not clear whether they are properly located to detect contaminants from the reported disposal pit. Additional wells will be installed into the basalt aquifer to further characterize the area.

Site 6a Base Closure Landfill

This area is privately owned and currently accessible by the general public. Solid waste disposed in the landfill included scrap metal, construction and demolition debris, lumber, concrete, plaster, glass bottles, plastic, and possible liquids (e.g., petroleum or common solvents). Hazardous substances reportedly disposed in the Base Closure Landfill included metals (arsenic, copper, lead, mercury, nickel) and possibly petroleum, TCE and other volatile organic compounds (VOC)s, and PCBs. Lastly, discarded military munitions were reportedly disposed in various landfills at the Site, including the Base Closure Landfill. Site 6a is located generally upgradient from a groundwater plume, and TCE was detected in soil gas; thus, the landfill may be a current and/or former source of TCE to groundwater. The Base Closure Landfill is in an area of the Site that EPA has determined to be within the 0.5 ug/L TCE-plume concentration area (see Figure 1). Additional characterization is required to determine if cleanup is needed.

Site 19 Liquid Oxygen (LOX) Plant

The LOX Plant is no longer in use, but the buildings and other structures are accessible by the general public. Historically operations at these buildings and structures supported the handling of liquid oxygen used in the Titan I Missile Program at the Site. The handling of liquid oxygen is a dangerous and potentially explosive task, requiring clean surfaces free from oil and other surface contaminants. TCE was reportedly used in large quantities in this location as a solvent to clean all metal surfaces coming into contact with liquid oxygen. Hazardous substances reportedly discharged at the LOX Plant include TCE and other VOCs, sem-volatile organic compounds (SVOCs), and TPH. The USACE located and removed two sumps and associated piping that contained TCE-contaminated water and sludge and conducted several soil gas investigations. The high levels of soil gas found when the sumps were removed declined significantly over the following 3 years. One well located downgradient had no detections of TCE. However, site 19 is located generally upgradient from a groundwater plume, and uncertainty remains about deeper soil gas migration and whether a single well is sufficient to adequately characterize whether the LOX Plant continues to be a source of TCE contamination. Further characterization of the deep vadose zone is required.

Site 20 South Base Dump

The South Base Dump area is privately owned and currently accessible to the general public. Solid waste disposed in the landfill included construction and demolition debris and other miscellaneous debris. Hazardous substances reportedly disposed at the South Base Dump include metals (arsenic, copper, lead, mercury, nickel) and possibly petroleum, VOCs, SVOCs, and PCBs.

The soil contains elevated lead concentrations and military munitions may have been discarded. Information developed during the RI/FS this area was likely used to dispose of TCE waste. As noted on Figure 1, there is a TCE groundwater plume that appears to begin at site 20.

TCE detections in both soil gas and in shallow alluvial groundwater downgradient of this area suggest that it may be a source of continuing TCE releases to groundwater. It is more likely that the current TCE plumes are being created by TCE slowly being released from basalt layers underlying the Site, it is possible that TCE continues to be released from the landfill. Further characterization is required to determine if cleanup is needed.

Site 22 Paint Hangar Leach Pit

The Paint Hangar Leach Pit is privately owned and currently accessible to the general public. The Leach Pit appears to have been designed to drain large quantities of wastewater and waste chemical solutions from the Paint Hangar clarifiers and runoff from the refueling area. Hazardous substances reportedly discharged into the Paint Hangar Leach Pit include metals (arsenic, copper, lead, mercury, and nickel), gasoline, diesel, oil, TPH, and PCBs.

Soil sampling revealed lead concentrations up to 1,200 mg/kg, exceeding the EPA screening level of 1,000 mg/kg for industrial land use. In addition, PCBs have been detected at concentrations as high as 8.4 mg/kg. The Leach Pit is also set up to continue receiving industrial wastewaters, and it is located on private property that EPA understands may be developed by the property owner. Removal of contaminants is required.

2.7.2 Groundwater Risks

There are three groundwater areas with five distinct TCE plumes at the Site: three plumes in the upper aquifer and two plumes in the lower aquifer. There are a total of three upper TCE plumes: the Main Groundwater Plume, the South Groundwater Plume, and the Northeast Groundwater Plume. The upper TCE groundwater plumes (see Figure 1) generally exist more than 100 feet below the ground surface in two fractured basalt flows that form one functional aquifer, Priest Rapids/Roza 1. The lower TCE groundwater plumes exist at least 250 feet below the ground surface and are located in the Roza 2 basalt flow aquifer. It is believed that the TCE passed through the coarse sand and gravel aquifer above the basalt and has been largely flushed out. Monitoring data indicates that this aquifer is relatively clean due to the high groundwater flow rates. The lower Roza 2 plumes are beneath the Main and South upper plumes and are assumed to have a similar size but lower concentrations than the upper plumes. No monitoring wells have been drilled in Roza 2 below the Northeast Groundwater Plume, which has lower concentrations and is smaller than the other two upper plumes.

The exposure pathways, risks, and conclusions for groundwater cleanup actions are described below for the three areas with five distinct TCE plumes. All five of the TCE groundwater plumes contain TCE concentrations exceeding 5 ug/L, which is the MCL for TCE. Any consumption of water from drinking water systems containing TCE above 5 ug/L is unacceptable per the federal Safe Drinking Water Act. Any groundwater that exceeds MCLs also exceeds CERCLA’s criteria for taking a cleanup action. Therefore, all five TCE groundwater plumes identified below require remedial action to protect human health and the environment.

South Groundwater Plume, Upper Basalt Aquifer, Priest Rapids/Roza 1

This TCE groundwater plume begins approximately 150 feet below the ground surface and is approximately 40 feet thick (see Figure 1) in the Priest Rapid/Roza 1 upper basalt aquifer. It extends from site 20 (South Base Dump) approximately 7,000 feet south-southwest. The maximum TCE concentration detected in this plume is 88 ug/L.

South Groundwater Plume, Lower Basalt Aquifer/Roza 2

This TCE groundwater plume is the south plume in the Roza 2 basalt aquifer and consists of groundwater in the next lower aquifer, assumed to occur within the same general areal extent as described above for the Priest Rapids/Roza 1. The maximum TCE concentration detected in this plume is 30 ug/L.

Main Groundwater Plume, Upper Basalt Aquifer, Priest Rapids/Roza 1

This TCE groundwater plume which begins approximately 80 feet below the surface is the larger and main portion of the north plume (see Figure 1), and consists of groundwater in the upper fractured basalt aquifer, extending from Site 33 (Dump at End of Runway 32) at least 6,000 feet south-southwest. The downgradient extent is poorly defined, and the plume may extend as much as another 4,000 feet further south-southwest. The maximum TCE concentration detected in this plume is 41 ug/L.

Main Groundwater Plume, Lower Basalt Aquifer, Roza 2

This TCE groundwater plume in the Roza 2 basalt is the north plume in the Roza 2 basalt aquifer and consists of groundwater in the next lower aquifer, assumed to occur within the same general areal extent as described above. The only available TCE groundwater concentration sampling result for this plume is 22 ug/L.

Northeast Groundwater Plume, Upper Basalt Aquifer, Priest Rapids/Roza 1

This TCE groundwater plume is the smaller portion of the north plume (see Figure 1), and consists of groundwater in the upper basalt aquifer. It appears to begin approximately 500 feet southwest of Site 21 (currently the City of Moses Lake Wastewater Treatment Plant) and extends approximately 2,500 feet in a south-southwesterly direction. The maximum TCE concentration detected in this plume is 14 ug/L.

2.7.3 Basis for Action

Program expectations for contaminated ground water are stated in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), as follows: "EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site. When restoration of ground water to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction." (Federal Register, 1990a; §300.430 (a)(1)(iii)(F))

Groundwater in three areas (five plumes), which is the primary source of drinking water in the vicinity of the Site, has been and continues to be contaminated with TCE in excess of the Safe Drinking Water Act Maximum Contaminant Level of 5 ug/L. There are currently five homes that have whole house filters to remove TCE prior to using the water for domestic purposes. TCE levels ranged up to 8 ug/L prior to filter installation. The Roza 1 South groundwater plume has the highest observed TCE levels with a maximum concentration of 88 ug/L which equates to a 8.1 x 10-4 excess cancer risk.

While TCE in groundwater is the primary contaminant and pathway of concern at this site, soil sampling and historical knowledge have shown that other hazardous substances have been disposed of in the general purpose landfills, including lead, PCBs, arsenic, mercury, and petroleum products. Site 22 has lead concentrations of 1,200 ppm and PCBs at 8.4 ppb, which are above human health protection standards, and historical information indicates that the other

11 soil sites have a high potential to contain TCE or other hazardous substances that need to be removed to be protective of human health and the environment.

The response actions selected in this ROD are necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances, into the environment.

2.8 REMEDIAL ACTION OBJECTIVES

While this is an interim remedy and will eventually be followed by a final record of decision, the goals wherever possible are to:

- Provide long-term protection of public health and the environment;
- Comply with ARARs;
- Fully address any principal threats posed by the site; and,
- Address the statutory preference for treatment.

Remedial Action objectives for the Moses Lake Wellfield Contamination Site are listed below:

RAO 1 – Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris above levels that are protective based on reasonably anticipated future land use. The land area at and adjacent to the airport is zoned industrial.

RAO 2 – Prevent migration of hazardous chemical contaminants through the soil column to groundwater or reduce soil concentrations below those necessary to protect groundwater quality.

RAO 3 – Prevent further migration of the plume and restore groundwater to meet federal drinking water standards and state cleanup standards.

RAO 4 – Until groundwater standards are met, prevent human exposure to groundwater contamination above MCLs.

2.8.1 Basis and Rationale for RAOs for Soils

Current and Reasonably Anticipated Future Land Use

The current and reasonably anticipated future land use (and zoning) for all areas within and nearby to the east of the airport is industrial and expected to remain such for the foreseeable future. One soil area of concern (site 20) located to the south of the airport is in private ownership and in an area with potential to support a mixed use, potentially including residential. For all soil sites except site 20, the remediation goals will be based on industrial exposure.
For site 20, if action other than characterization is necessary, the remediation goal will be to meet standards for residential unrestricted use.

Soil Remediation Goals

For all COCs, remediation goals which are protective of human health for industrial use and meet the Washington Administrative Code (WAC) 173-340-745(5), "Soil Cleanup Standards for Industrial Properties" for human health have been developed, selected as cleanup levels, and presented in section 2.11. Because of its location outside the airport restricted area and its proximity to residential use areas, site 20 will be characterized and, if necessary, cleaned up using remediation goals which are protective of human health for and meet the WAC 173 340-740 standards for unrestricted use. Sites which exceed standards for unrestricted use after response actions are complete will require institutional controls that are protective of human health and consistent with the provisions outlined in WAC 173-340-440 (Institutional Controls).

Although the ecological risk from these sites is thought to be low, as data is collected it will be compared to “Site Specific Terrestrial Ecological Evaluation Procedures” for ecological receptors, and it will be used to modify cleanup levels if appropriate.

Furthermore, where TCE and arsenic are found in soils, to achieve RAO 2, the provisions found in WAC 173-340-747, “Deriving Soil Concentrations for Ground Water Protection,” will be used.

2.8.2 Basis and Rationale for RAOs for Groundwater

Current and Future Beneficial Groundwater Use

The program expectations for contaminated ground water are stated in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), as follows: "EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site. When restoration of ground water to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated ground water, and evaluate further risk reduction." (Federal Register, 1990a; §300.430 (a)(1)(iii)(F))

Groundwater at and in the vicinity of this site is used for drinking water purposes, and the risk from drinking contaminated groundwater is the main basis for action at this site. The long-term objective of this action is to restore all groundwater to meet federal and State drinking water standards, which for TCE is the MCL of 5 ug/L.

This interim remedy is expected at a minimum to prevent further migration of the plume and to prevent human exposure to groundwater contaminated above MCLs, and based on currently available information to achieve the long-term goal of aquifer restoration in a reasonable timeframe of approximately 30 years. The selected remedy provides for periodic evaluation of new information, remedy performance, and progress toward long and short-term objectives, as well as refinements during implementation to help meet remedy objectives and ensure protection of public health and the environment.

Groundwater Remediation Goals

The primary ARARs for groundwater used for determining the cleanup levels described in Section 2.11 to achieve RAO 3 are the federal MCLs under the Safe Drinking Water Act, State MCLs, and the provisions of WAC 173-340-720 of the Model Toxics Control Act (Method A). Based on current information, the only contaminant exceeding any of these is TCE, for which the protective cleanup level is the MCL of 5 ug/L.

2.9 DESCRIPTION OF ALTERNATIVES

There is one soil site requiring initial cleanup action and eleven soil sites where a contingent action is appropriate. That contingency is triggered when additional investigation reveals contamination above health-based levels. In those areas where groundwater concentrations exceed 5 ppb TCE actions are required to protect public health and the environment. This section describes various response actions that may be applied to soil and/or groundwater areas at this Site.

2.9.1 General Response Actions/Technologies

No Action – This action consists of leaving a site and/or plume in its current condition with no further investigation or remedial action. EPA is required by the NCP to consider No Action to be used as a base situation to compare other remedial alternatives.

Institutional Controls – Institutional controls comprise non-engineering measures designed to prevent or limit exposure to hazardous substances left in place or to assure effectiveness of the selected remedy. Institutional controls can be in the form of governmental requirements (such as land use zoning or permitting), property restrictions, educational programs, and many other forms.

Excavation – This action consists of physically removing contaminated soil and debris from a site and disposal in an appropriate waste facility.

Alternate Water Supplies – Alternate drinking water, such as bottled water, new wells from an uncontaminated aquifer, or connection to public water service, may be made available for those systems and individuals with water exceeding the groundwater cleanup level.

Point-of-Use or Wellhead Water Treatment – Installation and maintenance of whole house filters or wellhead treatments are engineering controls.

Long-term Groundwater Monitoring – Monitoring wells are a standard technique used to look for contaminants in groundwater (through collection and laboratory analysis of samples) and to monitor effectiveness and protectiveness of remedies. All remedial alternatives, except “No Action” will have some type of long-term monitoring associated with them, utilizing monitoring wells or a combination of monitoring wells and testing of selected domestic wells. However, monitoring alone would not meet any of the RAOs.

Physical Controls – Locked wellhead caps can be used to protect wellheads of contaminated monitoring wells from being used as a drinking water source and to prevent vandalism. Fencing may be used to provide secure storage for investigation-derived wastes or to control access by the general public.

Groundwater Extraction and Treatment of Plumes and/or Contaminant Source Zones – Groundwater pump and treat can be used to stop the movement of the contaminant plume or source and can speed up the rate at which contamination is removed from plumes. Typically, extraction wells can contain groundwater contamination plumes and restore the groundwater. Multiple groundwater extraction wells would be installed, pumping the contaminated groundwater to the surface and into a holding tank. Where necessary, the extracted water would be treated to remove contamination exceeding the groundwater cleanup level before the pumped water is allowed to re-infiltrate or is re-injected. Sorbents (e.g. granular activated charcoal) and/or air stripping are frequently used to remove TCE from extracted groundwater.

In-Situ Chemical Treatment of Groundwater by Injection of Reagents – Reagents are injected into the affected aquifer at or near the contaminant source zone as a means of promoting an in-situ (in place) chemical oxidation or an in-situ chemical reduction that results in breakdown of contaminants. This action requires injection wells to deliver the reagents to the desired treatment zone and selection of a reagent suited for site conditions.

Natural Attenuation with Monitoring – Natural attenuation processes (dilution, dispersion, and/or mineralization) may slowly decrease contamination in aquifers. Natural attenuation processes could be assisted by hydraulically containing or treating (pump and treat) source zones and portions of the plume with higher concentrations than those areas of the plumes extending horizontally and vertically downgradient. The areas near the plume margins may clean up more quickly through dilution by clean upgradient water.

2.9.2 Alternatives for Cleanup of Soil Sites

Three alternatives for soil sites were presented in the Proposed Plan. A capping alternative was evaluated as part of the Feasibility Study but was not carried forward to the Proposed Plan; insufficient data was available to determine that capping would be effective. The three alternatives presented were developed following an evaluation of the general response actions/technologies described above for the purpose of comparing cleanup options. In assembling the alternatives the goal was to address ongoing exposures, restore groundwater to beneficial uses, and address risks posed by soil sites (both to the aquifer and direct contact). TCE in groundwater was a critical consideration, as was mitigation of potential source term impacts on groundwater restoration objectives as well as addressing potential exposure to soil contamination above health-based limits. The No-Action alternative is required to be included in the evaluation as part of the Superfund remedy selection process.

- Alternative 1 – No Action
- Alternative 2 – Institutional Controls and Long-Term Groundwater Monitoring
- Alternative 3 – Additional Investigation and Source Removal, Institutional Controls, and Long-Term Groundwater Monitoring

As part of Alternative 3, the investigation/characterization and removal of contamination in the landfills above cleanup levels would follow the observational approach. Large equipment such as a backhoe is used to lay back an area and allow segregation of waste by type. As hazardous substances are encountered, they are removed and packaged for disposal. Records are kept to mark the locations of the contaminated material removed, and confirmation soil sampling for the specific contaminants of concern is preformed prior to backfill to ascertain whether cleanup levels have been met. The primary concern at most of these landfill disposal locations is the possibility that TCE sludge bottoms or spent TCE has been discarded and may continue to be a source of groundwater contamination.

The nine remedy selection criteria against which all remedial alternatives for any site are evaluated are: 1) protection of human health and the environment; 2) compliance with applicable, relevant, and appropriate requirements (ARARs); 3) long-term effectiveness and permanence; 4) reduction of toxicity, mobility, or volume through treatment; 5) short-term effectiveness; 6) implementability; 7) cost; 8) state acceptance; and 9) community acceptance.

There are 39 sites identified on Figure 1; 22 of these are located inside the Airport boundary and 17 are located outside the Airport. Additionally, during the remedial investigation EPA determined that 27 of these sites do not warrant further investigation, making these "No Further Action" sites (highlighted in green on Figure 1). This leaves 7 sites inside the Airport and 5 sites outside the Airport for which remedial alternatives are considered.

These soil sites are located both inside and outside the Airport boundary. However, the cleanup alternative is the same, so they have been grouped together for convenience.

List of Action Sites:

Liquid Waste Disposal Area (1)
Aircraft Waste Rack (3)
Randolph Road Base Dump (8)
Fire Training Pit A (10)
Fire Training Pit B (11)
19th Avenue Base Dump (31)
Dump at End of Runway 32 (33)
Base Closure Landfill (6a)
Liquid Oxygen Plant (19)
South Base Dump (20)
Rocket Research
Paint Hangar Leach Pit (22)

2.9.3 Comparison of Alternatives 2 and 3

Alternative 1 – The No-Action alternative is not protective of human health and the environment; therefore it is not evaluated further.

- Overall Protectiveness. Alternative 2 may not be protective of the environment over the long term as there is a potential for residual source material (TCE) that could further impact groundwater. In addition, if these sites are redeveloped, there are areas with metal contamination above an industrial standard to which people could be exposed. Further characterization of the soil sites and removal of contaminants would be protective as proposed in Alternative 3.

- Compliance with ARARs. Alternative 2 would not comply with ARARs if source material continues to migrate to groundwater or if people become exposed to metals during site disturbances. Characterization and removal of contamination would be compliant with ARARs; therefore Alternative 3 meets this goal.

- Short-term Effectiveness. Both alternatives are protective in the near term as there is no direct evidence of a continuing groundwater source of contamination. Currently no one has disturbed these sites.

- Long-term Effectiveness and Permanence. Alternative 2 does not remove any source of contamination, so over time contaminant exposure could occur. Alternative 3 would remove hazards and therefore is more protective.

- Reduction of Toxicity, Mobility, and Volume. Alternative 2 does not treat any waste. Alternative 3 would remove contaminants and treat them as required to meet disposal criteria. Further identification and removal of potential source term material would reduce the mobility of contaminants threatening the aquifer.

- Implementability. Both alternatives are implementable.

- Cost. Alternative 2 would cost approximately $758,000. Alternative 3 would cost approximately $18,600,000. Costs for alternative 3 are based on the assumption that 10 percent of the soil site's landfill volume would need to be removed to meet cleanup standards.

- State Acceptance. The State of Washington has reviewed the Administrative Record and the proposed plan and concurs with the remedial actions described in this ROD.

- Community Acceptance. A public comment period was held from January 7, 2008, through March 7, 2008, and a public meeting was held February 13, 2008, to review the proposed cleanup plan. The comments and EPA responses are contained in the responsiveness summary located in Appendix A.

Summary Table: Soil Sites 1, 3, 8, 10, 11, 31, 33, 6a, 19, 20, 22 & Rocket Research

Remedial Alternatives	**Protects HH&E**	**Complies with ARARS**	**Long-Term Effectiveness & Permanence**	**Reduction of Toxicity, Mobility, or Volume**	**Short-term Effectiveness**	**Implementa -bility**	**Cost**
1. No Action	No	No	No	No	No	Yes	$0
2. Institutional Controls & Long-term Groundwater Monitoring	No	No	No	No	Yes	Yes	$758,000
3. Additional Characterization, Removal of COC Above Health-based Standards, Institutional Controls, Long-term Groundwater Monitoring	Yes	Yes	Yes	Yes	Yes	Yes	$ 18,600,000

2.9.4 Alternatives for TCE Groundwater Plumes

Main Groundwater Plume, Upper Basalt Aquifer, Priest Rapids/Roza 1 and South Groundwater Plume, Upper Basalt Aquifer, Priest Rapids/Roza 1

General Response Actions/Technologies identified in 2.9.1 were evaluated for potential effectiveness in meeting remedial action objectives and assembled into three action alternatives for analysis. The No-Action alternative serves to provide a basis for comparison.

Alternative 1 – No Action
The No-Action alternative is required by the NCP. This alternative provides a baseline for the comparison of active remedial alternatives developed. Under the No-Action alternative, institutional controls are not implemented, except for controls required to operate the airport in compliance with FAA regulations, and remediation and monitoring of groundwater contamination are not conducted. The No-Action alternative also does not address migration of contaminants from the vadose zone to groundwater. Because TCE is above the MCL, "No Action" does not meet the threshold criterion of protection of human health and the environment and is not evaluated further.

Alternative 2 – Groundwater Base Program
Groundwater Base Program – This phrase applies only to the groundwater plume response actions. The response actions that are considered a groundwater base program action include: alternate water supplies, wellhead water treatment, point-of-use treatment, testing of new groundwater sources of drinking water (new domestic wells) and existing untested drinking water wells (upon request) within the Institutional Controls Boundary, well installation, and long-term monitoring. Alternative 2 groundwater monitoring is based on existing monitoring and domestic wells with additional monitoring wells in key aquifer locations.

Alternative 3 – Groundwater Extraction and Ex-Situ Treatment
Groundwater pump and treat can be used to stop the movement of the contaminant plume or source and to hasten plume cleanup. The proposed approach involves the utilization of multiple groundwater extraction wells, pumping the contaminated groundwater to the surface and treating extracted water to remove TCE contamination exceeding the groundwater cleanup level before the water is re-injected. Sorbents (e.g. granular activated charcoal) and/or air stripping are frequently used to remove TCE from extracted groundwater, and cost estimates assume the use of sorbents. However, the cost-effectiveness of the two treatment methods can vary with extraction system design and contaminant concentration, so the decision of which method to use will be made during remedial design and may differ between the two plumes. These pump and treat systems would be designed both to contain the groundwater contamination source zones at the head of each plume and to pump the more contaminated areas of the plumes to speed up restoration. It is estimated that approximately six wells will be needed in each plume to provide adequate pumping capacity. The estimated water to be pumped from each plume is between 500 and 750 gallons per minute. A similar number of re-injection wells would be required to return treated water to the aquifer.

Alternative 4 – In-Situ Groundwater Treatment

In-situ chemical treatment of groundwater involves injection of a reagent into the affected aquifer at or near the source zone as a means of promoting an in-situ (in place) chemical oxidation or an in-situ chemical reduction that results in breakdown of TCE. This action requires injection wells to deliver the reagents to the desired treatment zone and selection of a reagent suited for site conditions. Evaluated reagent options include: 1) sodium permanganate ($NaMnO_4$) oxidation of TCE; and 2) nanoscale zero-valent iron (ZVI) dechlorination of TCE.

2.9.5 Comparative Analysis of Groundwater Alternatives

Below is an analysis for Alternative 2. Because Alternative 2, Groundwater Base Program, is also a part of Alternatives 3 and 4, the following evaluation is generally applicable to those other alternatives as well. Therefore the comparative analysis will focus on the differences between Alternatives 3 and 4.

Overall protectiveness. The Groundwater Base Program alone is protective of human health by mitigating the potential for exposure to TCE above MCLs but does not contribute to restoration of the aquifer. If institutional controls are effective, there are no unacceptable short-term or cross-media impacts. The adequacy and reliability of the controls to prevent exposure to contamination will be periodically reviewed and changed if warranted. Because hazardous substances will remain on site, five-year reviews are required to assess effectiveness of institutional control measures, alternate water supply and individual well treatment systems, and long-term monitoring of groundwater.

- Compliance with ARARs. The Groundwater Base Program alone does not meet ARARs throughout the Site. Alternative 2 assumes the aquifer contaminant concentration levels remain at current levels or are decreasing at a slow pace such that current groundwater plumes will continue to exceed the MCL for an extended period of time. However, if combined with additional action in the upper aquifers, The Groundwater Base Program may eventually achieve ARARs in certain plumes, as discussed below.

- Short-term Effectiveness. The Groundwater Base Program would prevent public exposure to groundwater with TCE above the MCL. These controls and measures would need to be continued long into the future in order to ensure that new exposures do not occur. Also, institutional controls require extensive coordination among federal, state, and local agencies, and regular planned monitoring to ensure their success.

- Long-term Effectiveness and Permanence. The extent of the contaminated groundwater plumes comprises an area of about 1000 acres. This area would not be reduced under Alternative 2 except to the extent that natural attenuation may slowly reduce the extent of plumes. It is not possible at this time to estimate how long it will take for groundwater contamination to be low enough to allow removing all controls however it is expected that within 30 years plumes will have diminished away from areas of domestic use or city services will be available.

- Reductions in Toxicity, Mobility, and Volume through Treatment. The actions taken under Alternative 2 do not address the treatment of the principal threat (the TCE contamination) in the groundwater.

- Implementability. All services and materials are readily available and obtainable for the Groundwater Base Program. Implementation problems for this alternative are associated with the ability to consistently apply institutional controls, difficulties in connecting water users to existing (or future) water lines, operation and maintenance for individual well treatment, access to and sampling of long-term monitoring wells, and domestic well sampling. Key concerns about the controls in the short term and long term for this alternative involve the following:

    - The public must be made aware of the potential risks of withdrawing groundwater within an area of concern through an effective education/notification program. Delivery and availability of information to the public is critical in both short and long terms for this alternative.

    - Well testing must occur to determine specific risk for people living or working within the areas of groundwater contamination concern.

    - Individual well treatment installation and operation and maintenance of whole house filters would be offered for residences known to be exposed to TCE-contaminated groundwater. For the public in affected residential areas, a clean long-term water supply is required.

For many of the elements within this alternative, implementation of measures may begin or be continued from existing programs almost immediately. Actions such as public notices to construct a well (required by Ecology for new wells drawing over 5,000 gallons per day) and new or continued well treatment installation and whole house filters would proceed as soon as practicable without awaiting a delay for remedial design. Some institutional controls also require extensive agency coordination. Some of the constructed elements of this alternative, such as extending water lines to residences or new well installation, have remedial design components that would occur subsequently in the future.

- Cost. The estimated present value for Alternative 2 applied site-wide is $7.9 million.

2.9.5 Comparative Analysis of the Groundwater Base Program Combined with Groundwater Extraction and Ex-Situ Treatment and the Groundwater Base Program Combined with In-Situ Treatment

- Overall Protectiveness. Both alternatives are considered protective. Reviews every five years would continue until such time as drinking water standards are met.

- Compliance with ARARs. Both alternatives would comply with applicable relevant and appropriate requirements, although the time frame to achieve those goals would be different.

- Short-term Effectiveness. Since institutional controls are in place under the the groundwater base program, both alternatives are considered effective in the short term. Alternative 3, ex-situ treatment has the potential to return the water to its highest beneficial use the soonest.

- Long-term Effectiveness and Permanence. Alternative 3, ex-situ treatment, would provide the highest likelihood of protecting the City's (and County's) water supply and returning the aquifer to a drinking water source. In contrast, the long-term effectiveness of in-situ treatment is highly uncertain (as described below, see "Implementability").

- Reductions in Toxicity, Mobility, and Volume through Treatment. Both Alternative 3 and 4 employ treatment as a principal component. Ex-situ treatment rates slightly better because there is more uncertainty associated with in-situ treatment since it can be difficult to effectively deliver chemicals in all the source zones in a heterogeneous aquifer. An advantage of in-situ treatment is that little secondary waste is generated. However, if injections cease, contamination may rebound.

- Implementability. Groundwater extraction and ex-situ treatment: Pump and treat technology is common for groundwater contamination. This technology is well understood. The only difficulty is in determining how a fractured bedrock aquifer will hydraulically respond to the pumping. In-situ treatment: Injection wells are not difficult technology per se, but the injection of the reactive slurry into the subsurface is more difficult in fractured bedrock than in gravelly or sandy aquifers. Identification of appropriate treatment zones is also very difficult. Technical difficulties of in-situ treatment may include injection of the treatment agent into the most concentrated areas of the treatment zone and optimizing applications of reagent to account for dissolved oxygen. It may also require an unknown number of repeated injections of the treatment chemicals, making costs more difficult to determine. Therefore the implementability of the in-situ treatment alternative is unknown. If a suitable high-concentration TCE source zone is identified as a result of drilling associated with installing a groundwater pump and treat system, it may be appropriate to re-evaluate this option.

- Cost. Cost for Alternative 3, groundwater extraction and ex-situ treatment, combined with the Groundwater Base Program is estimated at approximately $13 million, and the estimated cost for Alternative 4, in-situ treatment, combined with the Groundwater Base Program is $14 million.

- State Acceptance. The State of Washington has reviewed the Administrative Record and the Proposed Plan and concurs with the remedial actions described in this Interim ROD.

- Community Acceptance. A public comment period was held from January 7, 2008, through March 7, 2008, and a public meeting was held February 13, 2008, to review the proposed cleanup plan. The comments and EPA responses are contained in the responsiveness summary located in Appendix A.

Summary Evaluation Table: <u>Main Groundwater Plume, Upper Basalt Aquifer, Priest Rapids/Roza 1 and South Groundwater Plume, Upper Basalt Aquifer, Priest Rapids/Roza 1</u> (Note the cost estimates include the cost of the Groundwater Base Program in other areas of the Site also.)

Remedial Alternatives	Protects HH&E	Complies with ARARS	Long-Term Effectiveness & Permanence	Reduction of Toxicity, Mobility, or Volume	Short-term Effectiveness	Implementa-bility	Cost
1. No Action	No	No	No	No	No	Yes	$0
2. Groundwater Base Program	No	No	No	No	Possibly	Unknown	$7,900,000
3. Groundwater Base Program, Groundwater Extraction and Ex-Situ Treatment	Yes	Yes	Yes	Yes	Yes	Yes	$12,900,000 -19,000,000 *
4. Groundwater Base Program, In-Situ Source Treatment	Yes	Yes	Yes	Yes	Yes	Unknown	$14,000,000

*based on additional characterization groundwater extraction and treatment may be required for the Roza 2 and Northeast groundwater plumes.

2.10 PRINCIPAL THREAT WASTE

Soil contaminated with TCE is considered a principal threat waste since this waste may still be affecting the drinking water supply for citizens living near the site. The selected remedy satisfies the statutory preference for treatment to reduce toxicity, mobility, or volume through treatment. Although not considered principal threat waste, extracted groundwater will be treated until TCE in the aquifer is removed to below the MCL of 5 ug/L. TCE contaminated source term material will be removed and treated as appropriate if discovered at soil sites..

2.11 SELECTED REMEDY

<u>Rationale for the Selected Remedy</u>

The selected remedy, described in detail below for soils and for groundwater, is an interim remedy that combines contaminated soil removal/treatment/disposal, further soil and groundwater characterization, source removal if identified during additional site characterization and remedy implementation actions, groundwater treatment, and institutional controls as long as necessary to mitigate potential exposure above risk thresholds.

The selected remedy is designated an interim action because while the selected remedy is anticipated to achieve RAOs in a reasonable timeframe, additional Site characterization activities and information collected during implementation of the interim groundwater remedy may be helpful in enhancing remedy performance. Experience with similar groundwater pump and treat systems has demonstrated that such remedies are best implemented in a phased approach.

Refinements to the proposed actions may be needed to completely address the threats at the site and attain all applicable or relevant and appropriate requirements.

While this selected remedy will eventually be followed by a final record of decision, the goals of the interim remedy wherever possible, to the extent practicable, are to:

- Achieve the Remedial Action Objectives and provide long-term protection of public health and the environment;
- Comply with ARARs;
- Address any principal threats posed by the site; and,
- Address the statutory preference for treatment.

The selected remedy will be phased over a number of years. The South groundwater plume, the South Base Dump (site 20), and site 22 will be the first areas targeted for characterization and/or cleanup as appropriate. The selected remedy for groundwater calls for ongoing monitoring, evaluation and refinements including additional extraction wells, if necessary, without the need for remedy modification. Remedy cost estimates include consideration of contingencies for soil remediation and groundwater pump and treatment system modifications. If soil areas in addition to site 22 require remedial action beyond characterization, and the nature and extent of contamination is such that the selected soil remedy of removal, treatment and disposal can address the area consistent with the nine criteria, the contingency for further remediation will be exercised and documented through an Explanation of Significant Differences.

This remedy is a combination of soil and groundwater alternatives that meet the statutory requirements and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The selected remedy will provide short-term protectiveness and is expected to be able to achieve the remedial action objectives for soils and groundwater, including groundwater restoration in a reasonable timeframe of less than 30 years, subject to the findings of the additional characterization and evaluations.

2.11.1 Selected Remedy for Soils

The selected interim remedy for soils includes:

- Additional characterization and evaluation of 12 soil areas representing a potential source of groundwater contamination or a direct contact human health risk;

- Removal and off-site disposal of contamination above soil cleanup levels, including off-site treatment if necessary for disposal. Once known contamination is removed, confirmation samples will be taken until the area is shown to meet cleanup levels, followed by backfilling and regrading with clean soil. Note that this element of the remedy is selected only for site 22. For the other soil areas, removal and off-site disposal (with treatment as required) is a contingent action which will be triggered by identification of contaminated soils exceeding the soil cleanup levels for the contaminants of concern described in Section 2.5. Where the nature and extent of contamination is such that the selected soil remedy will effectively address the contamination, an Explanation of Significant Differences will be issued by EPA describing how the action meets CERCLA program requirements. Note that if soil vapor extraction to treat TCE in soils or some other further action is necessary, it will be addressed through further evaluation and a ROD Amendment to this interim or the final ROD, as appropriate;

- Installation of groundwater monitoring wells, to include characterization of cores to determine if TCE is present in the vadose zone above levels for protection of groundwater
- Long-term groundwater monitoring;
- Institutional controls to ensure land use remains industrial for soil areas which exceed standards for unrestricted use after response actions are complete.

The estimated present value cost to implement this alternative is $18,600,000.

The additional characterization and removal of contamination in the landfills above cleanup levels will follow the observational approach. Large equipment such as a backhoe will be used to lay back an area and allow segregation of waste by type. As hazardous substances are encountered above cleanup levels, they will be removed and packaged for disposal. Records shall be kept to mark the locations of the contaminated material removed and confirmation soil sampling for the specific contaminants of concern will be preformed prior to backfill to ascertain whether cleanup levels have been met. The primary concern at most of the landfill disposal locations is the possibility that TCE sludge bottoms or spent TCE has been discarded and may continue to be source of groundwater contamination.

In general, the additional characterization of the other soil sites will be done using a combination of soil gas survey techniques coupled with extensive test pitting and soil sampling. Wastes above cleanup levels will be removed and sent offsite for disposal. Additional soil and groundwater investigations near the LOX Plant (site 19) and the Aircraft Wash Rack (site 3) will also take place in order to determine if a subsurface source of TCE may be located and extracted using soil vapor extraction. If the use of soil vapor extraction system is required, it will be documented through an amendment to this Record of Decision or in the final Record of Decision.

2.11.2 Cleanup Levels for Soil Sites

The cleanup levels for contaminants of concern at the soil sites and points of compliance have been selected to be protective of human health and the environment and comply with ARARs. Based on the current and reasonably anticipated future land use, the selected cleanup levels for soils are generally based on and will be in compliance with the State of Washington Model Toxics Control Act requirements for cleanup of industrial properties (WAC 173-340-745, Method C), and for PCBs, the more stringent Toxic Substances Control Act (TSCA) requirement. Where soils are cleaned up to industrial cleanup standards, institutional controls will be required to ensure such industrial land use is maintained. If land use changes occur, the remedy may need modification, which would be accomplished through an appropriate modification to the CERCLA decision document. If cleanup of site 20 is necessary, it will be cleaned up to meet unrestricted use/residential use standards as specified in WAC 173-340-740.

Site 20 cleanup levels are more restrictive because the site is currently in private ownership and has a high potential to support a mixed use, including residential development.

Soil cleanup levels must also be protective of groundwater. Soil cleanup levels protective of groundwater have been developed as specified (Method A) in WAC 173-340-747. For sites requiring cleanup where TCE or arsenic is found, the lower of the soil cleanup level calculated for protection of groundwater and the cleanup level for direct contact for a given land use will be the cleanup level.

Table 1. Soil Cleanup Levels for Chemical Constituents at Soil Sites.

Constituent	**Soil Cleanup Levels for Direct Contact[a] (mg/kg)**		**Soil Cleanup Levels for Protection of Groundwater[a,b] (mg/kg)** MTCA Method A
	Industrial MTCA Method C	**Unrestricted** MTCA Method B	
PCBs	50 (TSCA)	0.5	N/A
Petroleum Hydrocarbons	2000	2000	N/A
Trichloroethylene	330	2.5	.03
Arsenic	88	20[c]	20[d]
Lead	1000	250	N/A
Mercury	1100	24	N/A

Notes:
[a] For sites requiring cleanup where TCE or arsenic is detected in soils, the lower of the cleanup level for protection of groundwater and the cleanup level for direct contact for a given land use will be the cleanup level for the soil area.
[b] Cleanup levels for groundwater may be adjusted upward by conducting site-specific modeling as provided for in WAC 173-340-747. TCE and arsenic are the only COCs in groundwater.
[c] This number represents a regional background value for arsenic and may be adjusted during remedial design to reflect site-specific background information.
[d] The calculated value was 3.5; however that is below background, so the cleanup number is the regional background value for arsenic. This number may be adjusted during remedial design to reflect site-specific background information.

2.11.3 Selected Remedy for Groundwater

The selected remedy for TCE-contaminated groundwater includes:

- **Long-term Groundwater Monitoring –** To further assess contaminants in groundwater and to monitor effectiveness and protectiveness of the remedy and design refinements if/as necessary. This will be done utilizing a combination of monitoring wells, extraction wells, and testing of selected domestic wells. Monitoring/extraction wells will be drilled to further define the extent of contamination in the Roza 1, Roza 2, and Roza 3 basalt aquifers. In addition, as monitoring and extraction wells are drilled, soil samples and soil gas samples will be taken to ascertain whether the vadose zone is a continuing source of TCE;
- **Physical Controls –** Locked wellhead caps to protect wellheads of contaminated monitoring wells from being used as a drinking water source and to prevent vandalism. Fencing may also be added as necessary to control access by the general public;

- **Alternate Water Supplies –** Alternate drinking water, such as bottled water, new wells from an uncontaminated aquifer, or connection to public water service, will be made available for those systems and individuals with water exceeding the groundwater cleanup level;
- **Point-of-Use or Wellhead Water Treatment –** Installation and maintenance of whole house filters or wellhead treatments are engineering controls;
- **Institutional Controls –** Designation of a groundwater Institutional Control area within which governmental controls and periodic dissemination of public information to local government entities, residents, well-drillers, developers, and real estate agents will be implemented to protect against use of installation of drinking water wells. The Institutional Control area is designated in Figure 1 and will be re-evaluated periodically to ensure it encompasses the area of contamination, and as appropriate, to reduce the area requiring the institutional controls. The area can be changed with adequate justification, documentation, and public notification through an ESD or other form of remedy modification; and
- **Groundwater Extraction and Ex-Situ Treatment of Plumes –** Initially this component of the selected remedy will be implemented in the Main and South Roza 1 Basalt Plumes. The groundwater cleanup strategy will follow a phased approach as described in "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance," October 1996. This will include:
    - Installing groundwater extraction wells capable of capturing the more highly contaminated portions of groundwater contaminant plumes in the Priest Rapids/ Roza 1 aquifer, and adding/refining extraction wells over time as indicated by system performance and evaluation (see further explanation below).
    - Installing on-site groundwater treatment facilities to remove contaminants from the groundwater.
    - Re-injecting the treated groundwater to help control plume movement.

2.11.4 Further Explanation of the Groundwater Remedy

The selected interim remedy for TCE-contaminated groundwater will follow a phased implementation strategy consistent with the general approach described in "Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, Final Guidance," October 1996.

The groundwater plumes at this Site are designated as the: a) Main Roza 1; 2) South Roza 1; c) Main Roza 2; d) South Roza 2; and e) Northeast Priest Rapids/Roza 1 groundwater plumes. Initially the Groundwater Extraction and Ex-Situ Treatment component of the selected remedy will be implemented in the Main and South Roza 1 plumes; the Groundwater Base Program will be applied to all other plumes. Expansion of the active groundwater pump and treat components of the selected remedy will be applied to other plumes as contingent actions and documented in an ESD. These actions will be triggered based on an evaluation of: 1) the nature and extent of MCL exceedences in the aquifer, 2) the mass of contaminants projected to be removed by implementation of active remedial actions, and 3) the projected timeframe for achieving groundwater restoration. Groundwater modeling to be conducted during remedy design will help refine the specific parameters which will trigger implementation of contingent actions. A cost estimate for implementing additional pump and treat capacity is included as a contingency in the cost estimate for the groundwater remedial action.

The intent of these actions is to restore the groundwater to its highest beneficial use (drinking water) as soon as possible by pumping and treating groundwater areas contaminated with TCE that is significantly above the MCL of 5 ug/L in the Roza 1 aquifer and allowing dilution to clean up the lower-concentration areas (generally less than 20 ug/L) around the edges of the plumes. The selected remedy will include groundwater extraction and treatment for up to 30 years, during which time each system's performance will be monitored and adjusted as needed based on performance data. Cleanup levels will be attained throughout all the plumes, but active remediation may be discontinued if it can be demonstrated that natural attenuation (through dilution) can remediate the remnant plumes in a reasonable timeframe (within the estimated 30 years for cleanup). Contingent measures for expansion of the active pump and treat components of the remedy may be implemented to achieve cleanup goals as discussed above. The estimated present value cost to implement this alternative is $12,900,000 for the South and Main groundwater plumes. The cost estimate of contingent for expansion of active pump and treat measures is approximately $6,100,000.

Data is limited on the possibility of TCE contamination in the deeper aquifers. Monitoring/extraction wells will be drilled to further define the extent of contamination in the Roza 1, Roza 2, and Roza 3 basalt aquifers. In addition, as monitoring and extraction wells are drilled, soil samples and soil gas samples will be taken to ascertain whether the vadose zone is a continuing source of TCE.

The South TCE plume in the upper basalt aquifer (South Roza 1) is the most problematic of the plumes in terms of negative impacts on the greatest number of privately-owned parcels of land. It is this plume that impacted the Skyline community wells and, based on a review of the groundwater data; it appears that this plume derives from a single TCE source area in or near the South Base Dump (site 20).

The remedy assumes that containing the aquifer contamination sources and removing the more contaminated core zones of each plume through pumping will cause the areas near the plume margins to degrade more quickly through dilution than if the sources continued to feed the plumes. If attenuation of the outer portions of a plume is not occurring at an acceptable rate, additional wells will be added to treat more of the aquifer. Although generally conditions in the upper basalt aquifers are chemically unfavorable for natural attenuation through biodegradation, there is limited evidence that natural attenuation through dilution occurs in the Roza 1 aquifer. In the few locations where groundwater data has been collected since the early 1990's, TCE concentrations have slowly declined.

A specific circumstance that could significantly impact implementation of the proposed remedy for the South groundwater plume is degradation of water quality (i.e., increasing TCE groundwater concentrations approaching the MCL) pumped from City of Moses Lake groundwater production wells. The remedy is intended to facilitate continued delivery of clean drinking water supplies via City facilities, and any sampling data EPA obtains indicating this important objective is not being met by the proposed remedy will require EPA to reevaluate this remedy. If this specific circumstance does occur, EPA will require wellhead treatment or well replacement for impacted City production wells and document this decision through an appropriate remedy modification.

South Groundwater Plume, Lower Basalt Aquifer, Roza 2 Aquifer;
Main Groundwater Plume, Lower Basalt Aquifer, Roza 2 Aquifer

The remedy for these deeper aquifer plumes is Groundwater Base Program. The Groundwater Base Program consists of provision of alternate water supplies, whole house filters, wellhead water treatment, testing of new groundwater sources of drinking water, groundwater monitoring well installation, and long-term groundwater monitoring. The conceptual site model suggests that the TCE contamination migrates vertically from the upper basalt aquifer down to the lower basalt aquifer. Thus, as a technical strategy, it is appropriate to address the upper basalt aquifer more aggressively. EPA has adopted this approach by selecting the Groundwater Base Program for the deeper Roza 2 aquifer, while selecting the more aggressive extraction and treatment scenario for the upper Roza 1 aquifer to reduce the source of TCE to the Roza 2 aquifer below. In addition to reducing TCE concentrations in the Roza 1 aquifer migrating downward to Roza 2, the extraction system could also be designed to hydraulically contain the Roza 1 plume vertically so as to reduce the amount of contaminated water migrating downward. Therefore, when evaluated in the context of additional actions being taken to address the upper basalt aquifer, the Groundwater Base Program in the Roza 2 aquifer satisfies the threshold criteria of protectiveness and compliance with ARARs. The cost is a component of the site-wide estimate of $7.9 million for the Groundwater Base Program to address all five TCE plumes.

EPA also will require source treatment as a contingent remedy here if, during drilling for long-term monitoring, EPA finds a high-concentration, large mass, localized TCE source in Roza 2 that needs to be treated. In other words, if the contamination and both concentration and mass is similar to what is seen in Roza 1, then additional pumping wells will be installed in the Roza 2 aquifer. Wells that are drilled directly below the highest concentration areas of the Roza 2 plume will be finished as 6" completions to make it easier to install extraction pumps if needed. Cost for this contingency is estimated at approximately $4,000,000.

The remedy assumes that reducing the amount of contaminated groundwater migrating down to the Roza 2 aquifer will cause the existing plume to degrade or dilute more quickly than if the Roza 1 TCE source continued to feed the plume. If this assumption proves to be incorrect, then pumping wells will be installed into the Roza 2 basalt to clean the aquifer up to drinking water standards in a reasonable timeframe.

Northeast Groundwater Plume, Upper Basalt Aquifer, Priest Rapids/Roza 1

The remedy for the Northeast Plume is the Groundwater Base Program. The costs for the Groundwater Base Program are presented earlier. This plume is small and has relatively low TCE concentrations (see Figure 1). Moreover, there is some evidence of intrinsic bioremediation natural attenuation processes, likely caused by infiltration of wastewater from the Larson Wastewater Treatment Plant. The Base Groundwater Program in the Northeast Plume satisfies the threshold criteria of protectiveness and compliance with ARARs.

If monitoring indicates a need for action, additional pumping wells will be installed and either treated at the wellhead or tied into the treatment system for the Main plume. The cost for this contingency is estimated at approximately $2,000,000.

2.11.5 Cleanup Levels for Groundwater

The cleanup level for TCE in groundwater is 5 ug/L defined by the Safe Drinking Water Act (CFR 40 part 141) and WAC 173-340-720 (Method A). Method A is appropriate for selecting a cleanup level under MTCA because TCE is the sole contaminant in the groundwater, and the only exposure pathway is through use of groundwater as a domestic water supply. The groundwater plumes are too deep to be a source of vapor intrusion in areas where TCE-contaminated groundwater may also be consumed as drinking water.

2.11.6 Cost Tables for Soil and Groundwater

Summary of Soil Sites Remediation Cost Estimates

Site	Characterization	Institutional Controls	Removal	Total
6a	1,493,000	269,000	2,690,000[a]	4,452,000
8	636,000	232,000	2,410,000[a]	3,278,000
20	494,000	269,000	1,216,000[a]	1,979,000
22			226,000	226,000
31	639,000	232,000	1,648,000[a]	2,519,000
33	1,508,000	232,000	4,390,000[a]	6,130,000
1	10,000		30,000	40,000
10 & 11	10,000		30,000	40,000
LOX Plant	100,000[b]			
WashRack	100,000[b]			
Rocket Research	100,000[b]			
Totals				18,664,000

Notes:
[a] Assumes 10% of landfill volume excavated and disposed.
[b] Costs are for drilling characterization wells, and the cost is included as part of the groundwater base action.

Groundwater Remedial Action Costs for Selected Alternative

Action	Total Capital[a] Costs	Total Periodic[b] Costs	Total O&M[c] Costs	Total Costs[d]	Total Present Value Costs
Groundwater Base Program	4,900,000	180,000	11,000,000	16,000,000	7,900,000
Roza 1 South Pump & Treat	900,000		1,900,000	2,800,000	1,800,000
Roza 1 Main Plume Pump & Treat	1,700,000		3,400,000	5,100,000	3,200,000
Phase I Action Totals	7,500,000	180,000	16,300,000	23,900,000	12,900,000
Roza 2 Main Plume Pump & Treat	1,200,000		1,900,000	3,100,000	2,000,000
Roza 1 NE Plume Pump & Treat	1,000,000		2,400,000	3,400,000	2,000,000
Roza 2 South Pump & Treat	1,300,000		1,900,000	3,200,000	2,100,000
Contingent Actions Totals	3,500,000		6,200,000	9,700,000	6,100,000
Totals with Contingency	11,000,000		22,500,000	33,600,000	19,000,000

Notes:
[a]Includes costs for design, bench, and pilot testing (if necessary), equipment/chemical costs, construction and implementation, and institutional controls.
[b]Includes costs for groundwater monitoring and reporting (when necessary), electricity (when necessary), and periodic parts (when necessary).
[c]Includes costs for five-year reviews and closure reporting.
[d]Total Capital Costs + Total Periodic Costs + Total O&M Costs = Total Project Cost.

2.11.7 Details of Institutional Control Component of the Selected Remedy

In regards to contaminated groundwater, EPA requires the implementation of institutional controls designed to prevent human consumption of TCE-contaminated groundwater during the period before treatment remedies or natural attenuation have remediated the plumes. Such Site-wide institutional controls will be in the form of administrative (governmental) efforts that ensure new or expanded drinking water systems or private wells do not inadvertently deliver TCE-contaminated groundwater to people or do not increase the size and depth of the existing groundwater plumes. The extent of such institutional controls will be confined to the Institutional Control Boundary depicted in Figure 1 of the ROD. Within this area, which encompasses City, County, and Port jurisdictions, EPA anticipates being able to successfully implement institutional controls in partnership with the City, County, and the Port. Until such plans are in place, groundwater use will be evaluated on an ongoing basis. EPA has and is continuing to work with the local government to implement an effective institutional control program for groundwater. This program will be funded by appropriate sources and will involve sampling new wells drilled within the Institutional Control Boundary for TCE as part of the potable water suitability determination. If TCE is found above, at, or near the drinking water standard of 5 ug/L, a whole-house filter will be installed to allow for domestic use. EPA will develop, or require and oversee development of, an Institutional Control plan to document the

Institutional Control program components, requirements and responsibilities which will be updated as necessary to implement an effective institutional controls program.

In regards to soil sites that do not result in a remedial action that provides for unrestricted land use, EPA will require that easements and restrictive covenants be recorded in the local government office that records deeds so that the particular site may not be used in a manner that is inconsistent with the level of cleanup that is achieved by the implemented remedy and will not interfere with the continued effectiveness of the implemented remedy. These easements and restrictive covenants will be consistent with the Uniform Environmental Covenants Act.

On a periodic basis fact sheets will be issued to the community to update them on the cleanup progress and to inform citizens within the Institutional Controls Boundary of any restrictions.

2.11.8 Long-term Groundwater Monitoring

EPA requires the implementation of long-term groundwater monitoring designed to evaluate whether TCE plumes decrease in size and concentration over time. This monitoring will have the additional benefit of filling data gaps related to groundwater contamination. This monitoring will also evaluate whether the extent of TCE contamination is limited to the currently identified plume boundaries and determine whether the Roza 3 aquifer is contaminated. If the Roza 3 aquifer becomes contaminated in the future, additional cleanup actions in the Roza 2 or Roza 3 aquifer may be warranted. This groundwater monitoring is proposed for the area within the Institutional Control Boundary depicted on Figure 1. Long-term groundwater monitoring will include existing groundwater monitoring wells, some new monitoring wells, existing City and community system wells, and a representative subset of existing residential drinking water wells.

The current ongoing domestic well sampling program will be expanded to offer testing to all homes within the institutional controls boundary that are served by domestic wells of less than five hookups. These wells will become part of the Site well database, and a representative number of wells will be sampled on an annual basis. If an unacceptable level of contamination is detected in individual wells, whole-house filters will be installed.

2.11.9 Asbestos Monitoring

EPA recommends that asbestos monitoring be performed if (or when) wastes in the landfill areas associated with the Site are disturbed in any manner. If friable asbestos is identified, asbestos abatement must be performed in accordance with applicable requirements. EPA is not aware of any specific data suggesting there is asbestos in these landfills and no asbestos samples were obtained during the remedial investigation. However, based on the history of the former Larson AFB and EPA's knowledge of similar private-sector and military sites, there is a high probability that friable asbestos has been disposed in one or more of these landfill areas.

2.11.10 Remedial Design/Remedial Action Work Plan

A Remedial Design/Remedial Action work plan will be developed to address specific aspects of the characterization of both the soil source areas and groundwater contamination. Based on the characterization information, specific designs will be developed for remediation of each soil source area and each groundwater plume. These design documents will be available to the City for their review. It is anticipated that the South Groundwater Plume, site 20, and site 22 will be the first areas that are characterized and where cleanup will be implemented.

2.12 STATUTORY DETERMINATIONS

The selected remedy satisfies statutory requirements of CERCLA §121 (as required by the National Contingency Plan [40 CFR 300.430(f)(5)(ii)]). It will protect human health and the environment, comply with ARARs, be cost-effective, and use permanent solutions to the extent practicable, as described in the following subsections.

2.12.1 Protection of Human Health and the Environment

The selected remedy will adequately protect human health and the environment through treatment, engineered source control, and institutional controls. Any contaminants above health-based levels found in soil sites will be removed and disposed of offsite. TCE-contaminated groundwater will be treated until such time that the contaminant levels are below the MCL for TCE of 5 ug/L. Continued monitoring of domestic groundwater wells will continue on an annual basis until such time as EPA deems such monitoring is not needed. The five homes with filters in place currently will have the filters replaced annually or as needed. If additional wells require filters, they will also be changed out on an annual basis or as needed.

2.12.2 Compliance with Applicable or Relevant and Appropriate Requirements

The remedy complies with ARARs. Table 2 lists all ARARs for the selected remedy and explains how each ARAR applies.

The selected final remedy portion will attain all federal and state ARARs as required by 40 CFR 300.430(f)(5)(ii)(B) and (C). The federal and state ARARs are listed in Table 2.

2.12.3 Cost Effectiveness

The selected remedy is cost effective and will return the groundwater to its highest beneficial use in a reasonable timeframe.

2.12.4 Use of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable and Preference for Treatment as a Principal Element

The remedy uses treatment as a principal element for groundwater and for soils that require treatment prior to disposal.

2.12.5 Five-Year Review Requirements

A review (in accordance with 40 CFR 300.430[f] [4][ii]) is required at a minimum every 5 years if a remedy is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. However, because the selected remedy will not achieve levels that allow for unlimited use and unrestricted exposure within 5 years, 5-year reviews will be conducted in accordance with EPA policy. Reviews will begin 5 years after initiation of the remedial action to help ensure that the selected remedy is protective of human health and the environment.

If a five-year review concludes an existing remedy is not protective of human health or the environment, EPA will consider new technologies that were not available when this ROD was finalized. The Agencies can modify the ROD (e.g., ROD amendment) through the CERCLA process when necessary to ensure that the remedy is protective.

2.13 DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

The substantive elements of the remedial actions in this Interim Record of Decision are consistent with those identified in the Proposed Plan. The change from a Record of Decision to an Interim Record of Decision reflects the need to acknowledge some of the uncertainties inherent in implementing a groundwater cleanup remedy in an area of complex geology where source term has yet to be fully characterized. This interim Remedial Action reflects an effort to accommodate new information that may be gathered on the nature and extent of contamination in soils and groundwater by identifying and costing contingent measures that may require implementation in the future.

Table 2. Description of Applicable or Relevant and Appropriate Requirements for Selected Remedy.

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
"Hazardous Waste Cleanup -- Model Toxics Control Act of 1989," RCW 70.105D	"Model Toxics Control Act of 1989," WAC 173-340 (as amended Nov 2007) Specific subsections: WAC 173-340-720 WAC 173-340-740 (for site 20) WAC 173-340-745(5)(b) WAC 173-340-747 WAC 173-340-440 (1-4,9)	Applicable	Establishes the process and methods used to evaluate risk and develop cleanup standards for soil and other environmental media.	The substantive requirements of the specified subsections are relevant and appropriate to developing cleanup standards for the selected remedy.
Safe Drinking Water Act of 1974, 42 USC 300 et seq.	"National Primary Drinking Water Standards," Subpart G Specific subsections: 40 CFR 141.61 40 CFR 141.62 40 CFR 141.66	Applicable	Establishes maximum contaminant levels for drinking water.	The selected remedy is using the MCL of 5ug/L as the cleanup level for TCE.
Clean Air Act of 1977, 42 USC 7401 et seq.	"National Emission Standards for Asbestos, Standard for Demolition and Renovation," 40 CFR 61, Subpart M Specific subsections: 40 CFR 61.145(a)(1) 40 CFR 61.145(a)(5) 40 CFR 61.145(c) 40 CFR 61.150(a-c)	Applicable	Requires facilities to be inspected for the presence of asbestos before demolition; defines regulated asbestos-containing materials; and establishes removal, handling, and disposal requirements.	The selected remedy requires characterization and/or removal of soils that may be contaminated with asbestos-containing materials.

Table 2. Description of Applicable or Relevant and Appropriate Requirements for Selected Remedy.

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
"Washington Clean Air Act of 1967," RCW 70.94 and RCW 43.21A, "State Government – Executive"	"General Regulation for Air Pollution Sources," WAC 173-400 Specific subsections: WAC 173-400-040	Applicable	Requires all sources of air contaminants to meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Requires use of reasonably available control technology.	Applicable to remedial actions at the site due to the generation of fugitive dust that will occur during construction activities
	Specific subsection: WAC 173-400-113	Applicable	Requires controls to minimize the release of air contaminants resulting from new or modified sources of regulated emissions. Emissions are to be minimized through application of best available control technology.	Waste generated for disposal that does not meet Environmental Restoration Disposal Facility waste acceptance criteria, will require the use of a treatment technology (e.g., to treat generated waste to meet disposal facility acceptance requirements) that may emit regulated air emissions. If such treatment is required, this requirement would be applicable.
	"Controls for New Sources of Toxic Air Pollutants," WAC 173-460 Specific subsections: WAC 173-460-030 WAC 173-460-060 WAC 173-460-070	Applicable	Requires specific controls for new regulated air emissions.	Although unlikely, the selected remedy may require use of a treatment technology (e.g., to treat generated waste to meet disposal facility standards) that emits toxic air emission. If such treatment is required, this requirement would be applicable.

Table 2. Description of Applicable or Relevant and Appropriate Requirements for Selected Remedy.

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
"Hazardous Waste Management Act of 1985," RCW 70.105	"Dangerous Waste Regulations," WAC 173-303 Specific subsections: WAC 173-303-016 WAC 173-303-017 WAC 173-303-070(3) WAC 173-303-073 WAC 173-303-077 WAC 173-303-170(3)	Applicable	Specifies how to identify dangerous waste. Establishes the management standards for solid wastes that designate as dangerous wastes.	Applicable to identifying solid and dangerous wastes generated during OU remedial actions. The management standards are applicable to the management and disposal of those wastes identified as dangerous waste.
	"Dangerous Waste Regulations," WAC 173-303 Specific subsection: WAC 173-303-140	Applicable	Identifies dangerous wastes that are restricted from land disposal, describes requirements for state-only-restricted wastes, and prohibits land disposal of restricted wastes unless treatment standards have been met. Incorporates Federal land-disposal restrictions including provisions for treatability variances by reference.	Applicable to the disposal of dangerous waste that will be generated during implementation of the selected remedy.
"Solid Waste Management, Recovery, and Recycling Act of 1969," RCW 70.95	"Nondangerous Nonradioactive Solid Waste Management," WAC 173-304 Specific subsections: WAC 173-304-190 WAC 173-304-200 WAC 173-304-460	Applicable	Establishes requirements for the management of solid waste.	Applicable to the onsite management and disposal of solid waste that will be generated during implementation of the selected remedy.
Toxic Substances Control Act of 1976, 15 USC 2601 et seq.	"Regulation of PCBs," 40 CFR 761 Specific subsections: 40 CFR 761.50[b][7] 40 CFR 761.61[c]	Applicable	Identifies requirements applicable to the handling and disposal of PCB remediation waste.	The substantive portions of this regulation are applicable to this remedial action if PCB-contaminated soil is encountered during remediation.

Table 2. Description of Applicable or Relevant and Appropriate Requirements for Selected Remedy.

Authority	Requirement	Status	Synopsis of Requirement	Rationale for Use
"Water Well Construction," RCW 18.104	"Minimum Standards for Construction and Maintenance of Water Wells," WAC 173-160 "Rules and Regulations Governing the Licensing of Well Contractors and Operators," WAC 173-162	Applicable	Establishes minimum standards for design, construction, capping, sealing, and decommissioning of wells. Establishes qualifications for well contractors and operators.	Applicable to the installation of wells that will be required for groundwater extraction/injection and monitoring.
Archeological and Historic Preservation Act of 1974, 16 USC 469a		Applicable	Requires that actions conducted at the site not cause the loss of any archeological and historic data. Mandates preservation of the data and does not require protection of the actual facility.	No archeological or historic sites have been identified. However if found, substantive requirements of this standard are applicable to actions that might disturb such sites.
Native American Graves Protection and Repatriation Act, 25 USC 3001, et seq.		Applicable	Establishes Federal agency responsibility for discovery of human remains, associated and unassociated funerary objects, sacred objects and items of cultural patrimony.	Substantive requirements of this act are applicable if remains and sacred objects are found during remediation and will require Native American Tribal consultation in the event of discovery.
Endangered Species Act of 1973, 16 USC 1531 et seq., subsection 16 USC 1536(c)		Applicable	Prohibits actions by Federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification or critical habitat. If remediation is within critical habitat or buffer zones surrounding threatened or endangered species, mitigation measures must be taken to protect the resource.	Substantive requirements of this act are applicable if threatened or endangered species are identified in areas where remedial actions will occur.