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Remedial Investigation Report

Stoneway Concrete
1915 SE Maple Valley Highway
Renton, Washington 98055

Prepared For:

Stoneway Concrete
1915 SE Maple Valley Highway
Renton, Washington 98055

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EXECUTIVE SUMMARY

Environmental Partners, Inc. (EPI) is pleased to present this Remedial Investigation (RI) report for the Stoneway Concrete (Stoneway) facility located at 1915 Southeast Maple Valley Highway in Renton, Washington (site). The general location of the site is shown on Figure 1.

This report, and the work documented herein, are intended to meet the investigation and reporting requirements of the Model Toxics Control Act (MTCA; WAC 173-340) and implementing regulations. It is EPI's understanding that the work described herein may also be used by Stoneway to facilitate potential future redevelopment of the site. In most cases, as discussed below, it is appropriate to incorporate remedial actions into redevelopment activities. This will result in a readily practicable and effective remedial action(s) that would not be cost effective if performed in advance of redevelopment activities. This approach is appropriate because the RI has demonstrated that there are no completed exposure pathways, either human or environmental, at the site and because access to the site is controlled.

The work described herein completes the characterization of impacts at the site. The site was characterized using a phased investigative approach where each phase of investigation iteratively focused the subsequent phase. This report documents each phase of work performed, the successive findings and conclusions of each phase, as well as the cumulative findings of the RI and the conclusions supported by those findings.

Contaminants of concern (COCs) for soils at the site are limited to formaldehyde and petroleum hydrocarbons. Formaldehyde is present as the result of its presence in a concrete additive and the spillage of that additive onto the surface of the central area of the site where the batch plant was formerly located. Formaldehyde is not present in soil at a concentration that exceeds a direct human contact risk but is present at concentrations that the MTCA regulation predicts may represent a potential threat to impact ground water or indoor air quality for residential structures built directly over the impacted soils.

COCs for ground water at the site are limited to formaldehyde and arsenic. Formaldehyde is not present in ground water at a concentration that exceeds a drinking water standard but it is present at a concentration that MTCA predicts could potentially result in a threat to impact indoor air quality for a residential structure. Arsenic is present in ground water at a limited number of locations at a concentration that slightly exceeds the drinking water standard. However, in both the case of formaldehyde and arsenic, the site data clearly demonstrate that the observed impacts do not extend beyond the hydraulically down-gradient property boundary and do not represent a threat to impact City of Renton ground water supply wells northwest of the site.

There are no COCs for surface water at the site. The hydraulic gradient at the property has consistently been to the northwest, away from the Green River, and there is no potential for ground water migration from the site into the surface water. It appears that the shallow ground water is generally recharged by the river and that the direction of ground water flow generally mimics surface water flow.

Given the lack of current completed exposure pathways it is clear that the site does not represent an imminent or substantial environmental or human health threat. Moreover, there exists the ability to assess changes at the site through ground water monitoring. Given that the site does not represent a threat to human health or the environment in its current configuration and site use, it appears wholly appropriate to incorporate remedial actions into the pending development activities. In the interim, Stoneway will establish a monitoring program to assess changes in site conditions and to take appropriate actions if site conditions change to a point where a human health or environmental threat does come into existence.

Stoneway currently plans to perform an interim action to address petroleum-contaminated soils (PCS) prior to redevelopment activities. That interim action would include excavation of all accessible PCS with on-site treatment using ex situ bioremediation. Stoneway also has plans to address historic settling ponds through excavation. The removal of those high pH soils will reduce the pH of the local ground water, which is the source of the dissolved arsenic in ground water immediately adjacent to these former ponds.

It is likely that the presence of formaldehyde in soil and ground water will be addressed during redevelopment and that the remedial action may include some limited excavation of impacted soils and the use of institutional controls and possibly engineering controls to eliminated potential human and environmental threats.

It is Stoneway's intention to continue to perform its investigative and remedial actions within the framework of the MTCA regulation and Ecology policies. While the work to date has been performed on an independent basis, the site will be enrolled into the Voluntary Cleanup Program (VCP) and guidance and feedback will be sought from Ecology at various stages of the remedial process. Stoneway's ultimate goal is to attain a No Further Action (NFA) designation for the property that allows development to its highest and best use.

1.0 INTRODUCTION

Environmental Partners, Inc. (EPI) is pleased to present this Remedial Investigation (RI) report for the Stoneway Concrete (Stoneway) facility located at 1915 Southeast Maple Valley Highway in Renton, Washington (site). The general location of the site is shown on Figure 1.

This report, and the work documented herein, are intended to meet the investigation and reporting requirements of the Model Toxics Control Act (MTCA; WAC 173-340) and implementing regulations. It is EPI's understanding that the work described herein may also be used by Stoneway to facilitate potential future redevelopment of the site. The work described herein completes the characterization of impacts at the site and provides the basis for a preliminary evaluation of cleanup alternatives and applicable regulatory criteria.

The site was characterized using a phased investigative approach where each phase of investigation iteratively focused the subsequent phase. This report documents each phase of work performed and the successive findings and conclusions of each phase, as well as the cumulative findings of the RI and the conclusions supported by those findings.

1.1 Site Description

The site is an irregularly shaped parcel about 13.5 acres in size and is situated between the Cedar River and Maple Valley Highway, just east of Interstate 405. Figure 2 is a representation of the current site features and structures. The site was most recently occupied by a concrete batch plant and associated support operations. The batch plant ceased operation prior to October 14, 2002 in conformance with City of Renton (City) ordinances relative to its Aquifer Protection Zone and the operating permits for the batch plant. Because of the site's location within the Aquifer Protection Zone, industrial activities that use, handle, or store hazardous substances are precluded from operating at the site.

1.2 Background

Previous environmental investigations have been performed at the site by others. EPI reviewed the following documents as part of this RI:

- *Final Report – Stoneway Tetrachloroethene (PCE) Assessment* by Pacific Groundwater Group dated September 20, 1998;
- *Draft Phase I Environmental Site Assessment* by GeoEngineers dated January 13, 2000;
- *Groundwater Monitoring at the Renton Batch Plant* by Smayda Environmental Associates, Inc. dated March 19, 2001;

- *Department of Ecology Memorandum – Subject: Discontinuation of groundwater monitoring for tetrachloroethene at Stoneway Concrete*, Renton dated April 17, 2001, and

- *Groundwater Monitoring at the Renton Batch Plant* by Smayda Environmental Associates, Inc. dated February 25, 2002.

Copies of these reports are presented in Attachment A.

Based upon a review of past reports, PCE was released to ground water at the site. The release was discovered in 1988 when the City detected concentrations of PCE in a ground water supply well down-gradient of the site. The source of the PCE was determined to be PCE-contaminated soil and/or sediment located in settling ponds along the southern boundary of the site. The ultimate source of the PCE in these soils was never determined and PCE was never used on-site.

Stoneway undertook all necessary actions to address the PCE release as required by the City and the Washington Department of Ecology (Ecology). Soils and sediments were removed from the settling ponds and quarterly ground water monitoring was initiated and continued until April 2001. PCE concentrations steadily decreased after removal of the soil and sediment from the ponds. On April 17, 2001, Ecology issued a consent to discontinue ground water monitoring at the facility and considered the site "clean". Although a consent to discontinue ground water monitoring was issued by Ecology, Stoneway continued to monitor ground water on a semi-annual basis to comply with additional City of Renton requirements. Ground water monitoring was terminated in January 2002 when samples from all on-site and off-site monitoring locations had contained less than 5.0 micrograms/Liter (µg/L) of PCE for two years.

In addition to PCE, elevated pH has historically been observed at the site. Figure 2, prepared by GeoEngineers and dated January 13, 2000 shows hand-drawn pH contours generated from measurements collected on April 11, 2000. This figure shows elevated pH measurements in ground water originating from the settling pond located along the southern boundary of the site. This figure has been included with this report in Attachment B.

2.0 OBJECTIVES

The general objectives of this RI were to:

- Develop a conceptual site model of potential environmental releases and resulting impacts at the site.

- Perform a comprehensive, site-wide data gaps analysis to identify areas of potential concern (AOPCs) and contaminants of potential concern (COPCs) based upon the historical information reviewed for the site.

- Investigate and, if present, delineate the extent of contaminants of concern (COC)s using the AOPCs and COPCs as the basis for sampling.

- Develop site-specific cleanup levels for established COCs.

3.0 CONCEPTUAL SITE MODEL

The site is located within the historical flood plain of the Cedar River. In the area of the site the Cedar River Valley is relatively narrow and the site is situated between two upland areas comprised of glacial till sediments from the most recent Vashon Glaciation.

The Cedar River has been in its current flood plain for at least the last 14,000 years, since the end of the Vashon Glaciation. The valley between the two uplands has resulted from erosion as the land level rises after glacial unweighting and the river incises itself to establish a new base level. As such, there is likely only a relatively thin layer of Holocene age alluvium (flood plain sediments) at the site, underlain by a sequence of Pleistocene Age glacial till of varying thickness from earlier glacial events. The Pleistocene age glacial till is in turn underlain by Cretaceous Age consolidated sediments.

The stratigraphic sequence described at a City of Renton drinking water well immediately to the northwest of the site is fully consistent with the depositional history described above. A copy of the log for that well is presented in Attachment C. The boring for this well extended to a maximum depth of about 100 feet below ground surface (bgs) with consolidated sandstone encountered at 99 feet bgs. The sandstone was overlain by materials consistent with a glacial till from about 72 to 99 feet bgs and more permeable alluvial sediments from near the surface down to about 72 feet bgs. The City of Renton well is screened from 50 to 70 feet below grade.

The water table aquifer at the City of Renton well is highly transmissive and, from a 24-inch diameter well, provided a flow rate of 2,235 gallons/minute from a 20-foot screened interval with only 5 feet of drawdown. As noted, the soil and aquifer conditions encountered during the drilling of this well are consistent with the site conceptual model presented above and indicates that the contact between the recent alluvial sediments and the underlying glacial till is at about 72 feet bgs and that the underlying Cretaceous Age consolidated sediments are present at about 100 feet bgs. The exact depths to these contacts will vary with local topographic elevation. The area of the City of Renton well is about 10 to 15 feet higher in elevation than the southern portion of the subject site.

There appears to be a laterally continuous shallow water table aquifer present beneath the site. Unconfined saturated conditions are generally present at a depth of about 10 to 20 feet below grade (depending upon location) and soil appears to be continuously saturated from the top of the water table to a depth of at least 72 feet below grade and possibly down to 100 feet bgs. This unconfined water table aquifer is very likely to be hydraulically connected with the surface water in the Cedar River.

Piezometric data collected at the site indicate that the local ground water flow direction is consistently northwesterly. This finding suggests that the Cedar River recharges the water table aquifer and that ground water flow within the alluvial sediments mimics surface water flow (i.e., along the Cedar River Valley toward Puget Sound.) This is the normal condition that is observed in most western Washington river valleys.

Figure 2 illustrates the current site features. The site has two predominant elevations. The elevation of the entrance is about 10 to 12 feet higher than the lower portion of the property nearer to the river. The property elevation, at it lowest point, is about 10 feet above the summertime level of the Cedar River. It is assumed that prior to development the southern portion of the property had low bank river frontage and that the southern portion of the property has received fill over the years to bring it up to its current elevation.

Much of the property's river frontage is protected with erosion control features such as rip-rap, cast in place concrete walls, "Ecology" blocks, and a poured concrete veneer over the native soils. Very little, if any, of the original low bank frontage remains and there does not appear to be a riparian habitat currently on the property, although a formal habitat assessment was not performed.

The majority of the subject site is currently paved with reinforced concrete that is 4 to 12 inches (or more) thick. This concrete has molded expansion joints, cold joints, and areas with cellulose expansion joint filler. There are unpaved areas in the eastern and western portions of the property and some areas where the concrete is heavily cracked. The site contains subsurface improvements such as storm sewer control in the upper portion of the property. There are several catch basins and oil/water separators in this system and the site reportedly has a valid general storm water permit. Storm water in the lower portion of the site drains to the settlement ponds.

Given the subsurface conditions at the site and the current site features there are several potential modes of impact to the environment. These modes of impact include:

- Surface spillage with subsequent infiltration. This would include recent or historic chemical releases and has the potential to impact both soil and ground water. Such a release could have occurred in both paved and unpaved areas due to cracks and/or joints in the concrete surface. Based upon the known site history, if impacts do exist, this is assumed to be the most likely source of impacts to the property.

- Surface spillage with subsequent run off. This mode of release is most likely to have occurred in paved areas without storm water control. Very few such areas currently exist. Spillage in unpaved areas would need to be of a very large quantity to run off the property and areas that are paved and without storm water control drained via sheet flow to the settlement ponds.

- Subsurface leakage. This mode of release would be possible from former underground tanks, storm sewers, sanitary sewers, oil/water separators, and settlement ponds. Due to the subsurface improvements in the northern portion of the property and the presence of current and former infiltration ponds, this mode of release could have occurred in various area of the property.

- Subsurface discharge directly to the water table aquifer. This mode of release is only possible in areas with deeper below grade discharges that were close to the elevation of the water table. This mode of release is therefore limited to the areas of the current and former settling ponds, and only to the extent that settling ponds were unlined.

Contaminants released into the aquifer would migrate to the northwest in the same direction as ground water flow. Contaminant migration within the ground water depends upon the type of contaminant and the abundance of organic carbon in the aquifer soils. Most organic contaminants would migrate at about one-half the rate of ground water migration whereas inorganic compounds or changes in chemical properties (i.e., pH) could migrate at about the same rate as ground water. Based upon the data collected during the additional phase of investigation, ground water migration rates at the site are relatively rapid. High rates of ground water migration are also conducive to higher rates of natural attenuation due to the enhanced effects of dispersion and dilution.

Given the direction of ground water migration it is not likely that ground water impacts, if present, would impact the Cedar River. Potential historic surface water impacts from the site are expected to have been transient events. Moreover, any one-time or transient releases to the surface water would be quickly attenuated by the surface water flow and mixing within the river. There have been no reported or recorded violations of surface water regulations at the site during Stoneway Concrete's ownership.

The risk of potential impacts to freshwater sediment is likewise considered to be marginal. The Cedar River carries a sediment bed load consisting almost exclusively of coarse sediments and the river is a high-energy environment that scours finer sediments that could contain entrained contaminants. This is especially true during periods of high discharge during the spring snowmelt in the Cascades and during periodic storms. During a site walk, fine-grained sediments were not observed along the site riverbank.

Given the current understanding of the site it is reasonable to conclude that the environmental media most likely to be impacted are soil and ground water. The most likely mode of impact to the soil is through surface or near surface releases in Areas of Potential Concern (AOPCs). Contaminants sorbed to soil have the potential to migrate through infiltration and dissolution to a relatively shallow water table aquifer and then migrate in the dissolved-phase to the northwest.

4.0 DATA GAPS AND PHASED INVESTIGATIONS

As mentioned above EPI used a phased investigative approach for this RI. The general phases of investigation were:

- Initial data gaps analysis based upon available data;
- Initial phase of subsurface investigation;
- Data review and additional data gaps analysis; and
- Final phase of subsurface investigation

The following subsections of this report discuss the methodologies and findings of each phase of investigation.

4.1 Initial Data Gap Analysis and AOPCs

This phase of work identified AOPCs based upon documented locations of historic activities and the compounds known to have typically been associated with those activities. The current owners and workers at the facility have first-hand knowledge back to about the mid-1980s. Consequently it was necessary to review other sources of historical information in order to identify the AOPCs.

Initially EPI reviewed the *Draft Phase I Environmental Site Assessment* (ESA) by GeoEngineers dated January 13, 2000, EPI then performed a visual reconnaissance of the current site facilities and more recent on-site activities. The Phase I ESA did not contain detailed historical maps or the source maps or aerial photos that were apparently used as the basis for the figures presented in the Draft Phase I ESA. As a result, the locations and features presented in the Phase I ESA could not be verified.

EPI performed a review of various sources of public domain documents in order to independently assess historical information regarding potential historic on-site activities. EPI's review of historical data, and the supporting documentation are presented in Attachment A. Figure 3 shows the locations of historical features at the site.

AOPCs are generally those areas where historic or current site activities may have included the handling or use of chemicals that may be of regulatory concern. EPI reviewed the available data and identified 13 AOPCs at the site. Each of the AOPCs is summarized in detail in Table 1, and the location of each of the AOPCs is depicted on Figure 4. Table 1 presents a comprehensive summary for each AOPC of the current or historic activities, previous investigative or remedial activities, and the most likely potential mode of release and the compounds most likely to have been released if a release had occurred. Table 1 formed the basis for evaluating potential impacts at the site, the types of investigative approaches used and the chemical analyses performed during the initial phase of subsurface investigation.

4.2 Initial Phase of Subsurface Investigation

The general objective of the initial phase of investigation was to assess the nature of contaminants that might be present on the site before attempting to identify the lateral and vertical extent of impacts in later phases of investigation. The basic approach was to assess the presence or absence of those chemicals that may have been released in specific areas of the site, either from historic or more recent activities. As explained below, the initial phase of investigation necessarily evaluated the potential presence of a very broad range of compounds.

EPI mobilized to the site to perform the initial phase of subsurface investigation on March 8, 2004. The following sections describe the investigative methodologies and findings of this initial phase of investigation.

4.2.1 Methodology

As noted above, EPI identified 13 AOPCs and the chemicals or families of chemicals that could potentially be present within each. These AOPC and COPCs, as well as the rationale for their selection, are summarized in Table 1 and the AOPCs are presented graphically on Figure 4.

Prior to any fieldwork, EPI contracted with a utility locating service to identify the presence of locatable buried utilities at the site. The utility search was most intense in the northern (upper) portion of the site but a screening level locating effort was also performed on the lower part of the site. The utility locator also attempted to identify the alignment of some of the storm sewer lines in the upper portion of the site since their exact alignment was not well known. At the time of the initial phase of investigation, most of the storm sewer lines were filled with sediment and therefore, the alignment of these lines could not be accurately located using standard methods.

In investigating the AOPCs, EPI collected a combination of surface and near surface soil samples, subsurface soil samples and reconnaissance ground water samples. A total of 74 environmental samples were collected during the initial phase of the investigation.

EPI collected 6 surface and near surface soil samples (i.e., SS-1 through SS-4, SS-6, and SS-7) in the locations depicted on Figure 5. Surface soil samples were collected using standard hand tools and those tools were decontaminated between uses by brushing off loose soil material, washing with tap water followed by scrubbing with a non-phosphate detergent and finally followed by a tap water rinse. Samples submitted for non-volatile analyses were homogenized in a stainless steel bowl and placed in an appropriate sample container supplied by the analytical laboratory. The surface soil samples submitted for analysis are summarized on Table 2 with an "SS" prefix.

EPI also collected 40 subsurface soil samples and 20 reconnaissance ground water samples using standard direct-push technology (DPT) methods and equipment. DPT boring locations are depicted on Figure 5. The soil samples submitted for analysis are summarized in Table 2 and ground water samples submitted are summarized in Table 3. Both soil and ground water samples submitted from DPT borings are designated with the "B" prefix.

Each DPT boring was sampled continuously from the surface down to the target sampling depth. The soil conditions encountered were recorded on descriptive boring logs for each location. Each boring log is presented in this report in Attachment D. With the exception of those borings in which refusal was encountered, borings were advanced to total depths ranging between 13 and 24 feet below grade. Boring depths corresponded to about 5 feet below the unsaturated/saturated interface (i.e., water table) at the time of exploration. For sampling, the DPT sample barrel was lined with a clear acetate liner. The liner was removed from the sample barrel and the sample interval indicated on Table 2 was cut out of the liner section and both ends were capped. This approach limited the potential loss of volatile constituents during the sampling process and provides more reliable and reproducible sample results.

Reconnaissance ground water samples were collected by inserting a temporary stainless steel well screen into the hollow center of the DPT probe and then retracting the protective outer casing to expose the screen to the saturated formation. As noted above, the depth of the sample was within about the upper 5 feet of the water table. Samples were extracted from the screen using a peristaltic pump and disposable tubing. After purging about 1 gallon of water from the temporary well screen, an aliquot of water was pumped directly into a laboratory-supplied container appropriate for the intended analysis. During sample collection, the pumping rate did not exceed 100 milliliters/minute.

Due to refusal resulting from apparent buried debris, EPI augmented the DPT sampling by performing soil and ground water sampling from excavation test pits at locations TP-8, TP-9, TP-17, and TP-20. Test pit excavation locations are depicted on Figure 5. Merlino Construction provided a track-mounted excavator and an operator to excavate the test pits under EPI's direction. Soil samples were collected from the backhoe bucket. Ground water samples were collected from the open pits using a peristaltic pump and disposable tubing. Ground water sampling techniques, purging, and pumping rates were consistent with the methods used to collect ground water samples from DPT probes. An additional 4 soil samples and 4 ground water samples were submitted for analysis from test pit excavations. Test pit excavation samples are noted on Tables 2 and 3 with a "TP" prefix.

Immediately upon collection, all samples were labeled and placed in an iced cooler pending submittal to the analytical laboratory. All samples were handled and transported using standard chain-of-custody procedures.

The samples collected during the initial subsurface investigation were submitted for a variety of analyses as summarized in Tables 2 and 3. Sample analyses included the following:

- Hydrocarbon Identification (HCID) using the Northwest Total Petroleum Hydrocarbons methods. HCID is a screening method that identifies the presence and the type of petroleum hydrocarbons in a given sample above a threshold concentration. But, does not quantify the concentration. In general, HCID was used to identify the presence and type of hydrocarbons in a sample and, if present, archived samples were submitted for the appropriate follow-up analyses to fully quantify the concentration of petroleum hydrocarbons present using the appropriate method.

- Diesel-range petroleum hydrocarbons (DRPH) using the Northwest Total Petroleum Hydrocarbons as Diesel-Extended (NWTPH-Dx) Method,

- Gasoline-range petroleum hydrocarbons (GRPH) using the Northwest Total Petroleum Hydrocarbons as Gasoline (NWTPH-Gx) Method,

- Aromatic fuel compounds (i.e., benzene, toluene, ethylbenzene, total xylenes; BTEX) using EPA Method 8021B,

- Volatile organic compounds (VOCs) using EPA Method 8260,

- Semivolatile organic compounds (SVOCs) using EPA Method 8270,

- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) using EPA Method 8270, Selected Ion Method (SIM).

- The 5 Model Toxics Control Act (MTCA) metals (i.e., arsenic, cadmium, chromium, lead, and mercury),
- Polychlorinated biphenyls (PCBs) by EPA Method 8082,
- Formaldehyde by EPA Method 8315-Modified, and
- pH using field techniques and instruments.

As noted in Tables 2 and 3, not all samples were submitted for each of these analyses. Rather, analyses were targeted to those areas where a particular chemical may have been used. In some instances, samples were archived (i.e., stored at the laboratory pending requests for additional analyses). If an initial result indicated that no releases had occurred, then follow-up analysis of the archived samples was not requested. However, if an initial analysis such as HCID indicated the presence of a class of hydrocarbons like DRPH, the necessary samples were available for the follow-up analyses without the need to re-mobilize to the site and collect additional samples.

With the exception of pH, all sample analyses were performed by CCI Laboratories in Everett, Washington. The pH measurements were recorded at the time of sampling using field equipment.

4.2.2 Findings

4.2.2.1 Subsurface Conditions

Subsurface conditions observed at the site during the initial investigation indicated that the northern portion of the site is generally underlain by sand containing variable quantities of silt and gravel to a depth ranging from about 5 to 18 feet below grade. This soil type is consistent with flood plain deposits which are expected adjacent to the Green River. The sands were underlain by a brown, very dense, Poorly Graded Sand with Gravel consistent with the Glacial Till commonly encountered in the area of the site. The southern portion of the property was generally underlain by various types of fill material including (but not limited to) concrete, gravel, and sands to depths ranging from near the surface (i.e., 0.5 feet) to 13 feet below grade. General construction debris such as wood, asphalt, cables, and riprap were also encountered in test pit sampling locations in the southwest corner of the property. The Glacial Till also underlies the fill material in the southern portion of the site.

Ground water was encountered at depths ranging from 10 feet below grade in the southern portion of the property to 20 feet below grade in the northern portion of the property. This is consistent with expectations given the change in surface grade from north to south at the site. Due to the sampling technique used during the initial phase of investigation (i.e., DPT borings), a ground water gradient could not be calculated. Ground water gradient information is provided in Section 4.4.2.1.

4.2.2.2 Analytical Results

A comprehensive summary of the compounds detected in soil and ground water for the initial phase of investigation is on Figure 7. Individual analytical results are summarized in Tables 4 and 5. Original laboratory report is included in Attachment E.

In evaluating the analytical results MTCA Method A and Method B soil and ground water cleanup levels were used for screening purposes. Although this RI has evaluated a range of potentially applicable cleanup levels, final cleanup levels have not yet been established. Final cleanup levels would be established in a Cleanup Action Plan (not yet prepared) which would consider the planned land use and the likely exposure scenarios. Final cleanup levels and any institutional and/or engineering controls to be incorporated into the remedial action and development would be fully protective of human health and the environment and subject to Ecology review and approval.

Soil Samples

A total of 50 soil samples were submitted from 28 individual sampling locations for the range of analyses as indicated in Table 2. The analytical results for soil sampling collected during the initial phase of investigation are summarized in Table 4.

GRPH, DRPH and HRPH were detected in a total of 10 soil samples from 9 individual sampling locations using HCID methods. The detected analytes and locations were:

- GRPH – detected in a total of 2 samples from boring B-28;

- DRPH – detected in a total of 8 samples from borings B-7, B-14, B-17, B-19, B-28, SS-3, and SS-7; and

- HRPH – detected in a total of 8 samples from borings B-7, B-14, B-16, B-17, B-19, SS-3, and SS-7.

Using the HCID results as a guide, additional samples were submitted for appropriate follow up analysis using NWTPH-Gx and NWTPH-Dx Methods. The samples were selected for analysis to both quantify the concentrations present and to characterize the vertical extent of those impacts.

GRPH concentrations exceeded the MTCA Method A Soil Cleanup Level for Unrestricted Land Uses of 100 milligrams per kilogram (mg/kg) in only two samples from boring B-28. The detected concentrations were 120 mg/kg and 636 mg/kg. GRPH were not detected at a concentration exceeding the detection limit of the method used in any other samples collected at the site. The 100 mg/kg cleanup level is applicable at sites where no benzene is present and the total of ethylbenzene, toluene, and xylene concentrations is less than 1% of the gasoline mixture.

DRPH concentrations exceeded the MTCA Method A Soil Cleanup Level for Unrestricted Land Uses of 2,000 mg/kg in only sample B-7:2. DRPH were detected in 14 samples from borings B-7, B-14, B-16, B-17, B-19, B-28, B-31, SS-3, SS-7, TP-8, and TP-10 at concentrations ranging from 31 mg/kg to 11,000 mg/kg.

HRPH concentrations exceeded the MTCA Method A Soil Cleanup Level for Unrestricted Land Uses of 2,000 mg/kg in only sample B-14:2. HRPH were detected in 11 samples from borings B-7, B-14, B-16 through B-19, B-28, B-31, SS-7, and TP-10 at concentrations ranging from 62 mg/kg to 4,600 mg/kg.

Neither benzene nor toluene were detected at concentration exceeding the detection limit of the method used.

Ethylbenzene was detected in one sample (i.e., B-28:14) at a concentration of 0.3 mg/kg. The detected concentration of ethylbenzene did not exceed the MTCA Method A Cleanup Level of 6 mg/kg.

Total xylenes were detected in one sample (i.e., B-28:14) at a concentration of 0.7 mg/kg. The detected concentration of ethylbenzene did not exceed the MTCA Method A Cleanup Level of 9 mg/kg.

No VOCs other than ethylbenzene and total xylenes, were detected at a concentration exceeding the detection limit of the method used.

None of the individual PAHs or TEF-modified total cPAH detected concentrations exceeded an applicable MTCA cleanup level. The following PAHs and their maximum concentrations were detected in soil samples collected from test pits TP-8 and TP-10:

- 1-Methylnaphthalene – 0.03 mg/kg;
- Phenanthrene – 0.04 mg/kg;
- Fluoranthene – 0.08 mg/kg;
- Pyrene – 0.05 mg/kg;
- Benzo[G,H,I]perylene – 0.05 mg/kg;
- Benzo[A]anthracene – 0.03 mg/kg;
- Chrysene – 0.05 mg/kg;
- Benzo[B]fluoranthene – 0.04 mg/kg;
- Benzo[K]fluoranthene – 0.06 mg/kg;
- Benzo[A]pyrene – 0.05 mg/kg; and
- Indeno[1,2,3-CD]pyrene – 0.04 mg/kg.

PCBs were not detected in any soil samples at a concentration exceeding the detection limit of the method used.

Formaldehyde was detected in four soil samples from borings B-6 and B-7. The detected concentrations of formaldehyde ranged from 7.1 mg/kg to 15 mg/kg and exceeded a site specific MTCA Method B Soil Cleanup Level for Protection of Ground Water [using MTCA Equations 747-1 and 747-2 (WAC 173-340-747)] of 0.006 mg/kg. The derivation of this cleanup level is detailed in Section 4.0.

<u>Ground Water Samples</u>

A total of 25 ground water samples were submitted for the range of analyses as indicated in Table 3. The ground water analytical results for the initial phase of investigation are summarized in Table 5.

No petroleum hydrocarbons were detected in the ground water samples submitted for HCID analysis.

GRPH were not detected in ground water samples at a concentration exceeding the detection limit of the method used.

No detected concentrations of DRPH in ground water exceeded the MTCA Method A Cleanup Level of 500 micrograms/Liter (µg/L). DRPH were detected in ground water samples from locations B-29, B-31, TP-8, TP-10, and TP-17 at concentrations ranging from 140 µg/L to 360 µg/L.

Detected concentrations of HRPH exceeded the MTCA Method A Cleanup Levels for Ground Water of 500 µg/L only in sample B-29. HRPH were detected in ground water samples from locations B-29, B-31, TP-8, and TP-17 at concentrations ranging from 270 micrograms/Liter (µg/L) to 1,100 µg/L

BTEX compounds were not detected in any ground water samples at a concentration exceeding the detection limit of the method used.

Carcinogenic PAHs were not detected in any ground water samples at a concentration exceeding the detection limit of the method used. No other PAHs were detected at a concentration exceeding an applicable cleanup level. The following 8 PAHs and their maximum concentrations were detected in ground water samples from locations TP-8 and TP-10:

- Naphthalene – 0.3 µg/L;
- 1-Methylnaphthalene – 0.14 µg/L;
- 2-Methylnaphthalene – 0.15 µg/L;
- Acenaphthene – 0.18 µg/L;
- Fluorene – 0.06 µg/L;
- Phenanthrene – 0.25 µg/L;
- Fluoranthene – 0.13 µg/L; and
- Pyrene – 0.04 µg/L.

Dissolved arsenic was detected in three ground water samples from locations B-25, B-26, and TP-20. The detected concentrations ranged from 9 µg/L to 13 µg/L. The detected concentration in each of these samples exceeded the MTCA Method A Cleanup Levels for Ground Water of 5 µg/L.

None of the remaining MTCA 5 metals (i.e., cadmium, chromium, mercury, and lead) were detected in any ground water samples at a concentration exceeding the detection limit of the method used.

Formaldehyde was detected in one ground water sample (i.e., B-6) at a concentration of 140 µg/L. This detected concentration exceeded the MTCA Method B Cleanup Level for ground water (as drinking water) of 1.46 µg/L.

Measurements of pH in water ranged from 5.21 to 10.54 during the initial phase of investigation. The highest pH measurements were located near the sediment pond located in the south central portion of the property and decreased in the down-gradient direction (i.e., northwesterly, see Section 4.4.2.1 for gradient information). A map showing the distribution of pH measurements in ground water is included on Figure 6.

4.3 Additional Data Gap Analysis

After completion of the initial subsurface investigation, EPI compared the resulting analytical data to MTCA Method A and Method B cleanup levels. This comparison formed the basis for a list of remaining data gaps focused primarily on the characterization of the lateral extent of identified impacts. It was EPI's opinion that the initial phase of investigation had adequately evaluated the presence and absence of a very broad range of potential contaminants across the entire site.

A total of six data gaps remained at the site after completion of the initial phase of investigation. A summary of those data gaps, including the rationale for their selection and potential resolution, is included in Table 6. During discussions with Stoneway it became clear that many of the data gaps could be addressed using a remedial scenario consisting of excavation and performance sampling and that additional investigation prior to remedial excavation was not necessary.

After considering the use of excavation as a presumptive remedial scenario, two potential data gaps remained:

- Characterizing the lateral extent of formaldehyde impacts in soil and ground water; and
- Evaluating dissolved arsenic concentrations in ground water at potential points of compliance.

EPI subsequently received authorization to perform an additional subsurface investigation to address these data gaps and complete this RI.

4.4 Additional Phase of Investigation

EPI mobilized to the site on November 9, 2004 to perform the additional phase of subsurface investigation. The general objective of the additional phase of investigation was to fill the data gaps identified in section 4.3. Specific objectives included:

- Characterizing the lateral extent of formaldehyde impacts to soil and ground water in AOPC 11; and
- Evaluating concentrations of formaldehyde and arsenic in ground water at the hydraulically down-gradient property boundary.

4.4.1 Methodology

EPI advanced an additional seven direct-push technique (DPT) borings in areas surrounding the previously identified impacts. The locations of the borings for the additional phase of investigation are indicated on Figure 8. A total of two soil samples and one ground water sample were generally collected from each boring location and submitted for analysis of formaldehyde. Soil and ground water samples were collected using the techniques described above in Section 4.2.1.

Based upon the analytical data from the seven borings discussed above, three monitoring wells (i.e., EPI-MW-2 through EPI-MW-4) were installed based upon the analytical locations indicated on Figure 8. These wells were installed to facilitate ground water quality assessment and monitoring in AOPC 11.

Each well was installed to a total depth of 22 feet below grade. These wells were constructed of 2-inch diameter schedule 40 PVC with 15 feet of 0.01-inch factory slotted well screen. These monitoring wells were completed with traffic-rated flush mounted well monuments.

Seven monitoring wells had been installed at the site by others during prior investigations. The distribution of these monitoring wells is shown in Figure 2 which was prepared by GeoEngineers (dated January 13, 2000) and is provided in Attachment B. Two of these previously-installed wells (i.e. MW-2 and MW-4) could be readily located through visual inspection. These wells were reportedly completed with steel traffic-rated monuments.

EPI utilized the services of Underground Detection Services (UDS) to scan the general locations where site maps indicated the previously-installed wells were located. UDS used a magnetometer to scan for electromagnetic anomalies that could indicate the presence of a buried wellhead. If a wellhead appeared to be present, hand tools were used to unearth the wellhead and inspect it for damage. A total of two existing monitoring wells (i.e., MW-5 and MW-40) were located using this technique. Three of the seven previously existing wells could not be located. Figure 8 shows the locations of all identified and newly-installed wells at the site.

EPI determined that two of the previously-installed wells (i.e., MW-2 and MW-4) could be used for point of compliance monitoring. It should be noted that prior to having the map of existing wells available, EPI sampled MW-2 and designated it as MW-1. Since the existing MW-1 (which could not be located) was replaced by EPI-MW-5, it is appropriate to rename MW-2 to MW-1 for the purposes of this RI. The summary analytical tables and maps reflect this change.

Two new monitoring wells (i.e., EPI-MW-1 and EPI-MW- 5) were installed solely for purpose of point of compliance monitoring. Monitoring wells EPI-MW-1 and EPI-MW-5 were installed to a total depth of 32 and 22 feet below grade, respectively. These wells were installed using the same techniques and construction materials as EPI-MW-2 through EPI-MW-4. Due to its location, EPI-MW-5 was completed with protective above-grade steel monuments to prevent accidental filling or damage by heavy equipment. These two new wells, in addition to the existing wells, provide very good point of compliance monitoring capabilities.

Once the previously-installed monitoring wells were located and the new wells were installed, the vertical elevations and horizontal locations of the wells were surveyed to a common datum. The survey was conducted by a Professional Engineer using standard rod and level techniques with an accuracy 0.01 foot. Using these data, EPI generated a piezometric contour map for shallow ground water at the site.

Each of the new wells was developed by surging and over pumping to remove fines accumulated during well installation. Due to a lack of significant accumulation of fines in the previously-installed monitoring wells, it was not necessary to redevelop those wells.

Following development and purging, each of the new and existing wells was sampled using low-flow sampling techniques. Measurements of pH, conductivity, and temperature were collected and recorded during well purging.

Samples from each well were retained for analysis of dissolved arsenic using EPA Method 6010 and for analysis of formaldehyde using EPA Method 8315-Modified. Samples submitted for analysis of dissolved arsenic were filtered using a 0.45-micron disposable filter and preserved with nitric acid. All samples were collected in laboratory-supplied containers and handled and transported using standard chain-of-custody procedures. Ground water analyses were performed by CCI.

4.4.2 Findings

4.4.2.1 Subsurface Conditions

The subsurface soil conditions encountered during the additional phase of investigation were consistent with those observed during the initial phase of investigation.

Ground water was encountered in DPT borings at a depth of approximately 14 feet below grade. Ground water was first encountered in monitoring well borings at depths ranging from 12.5 feet to 23 feet below grade. The piezometric elevation stabilized at depths ranging from 12.15 feet to 23.14 feet below grade. A summary of monitoring well and ground water elevation measurements collected is included in Table 7. The hydraulic gradient for December 2, 2004 was approximately 0.007 feet per foot in a generally northwesterly direction. A ground water elevation contour map is included as Figure 9.

Standard reference values (Freeze and Cherry 1979), indicate that hydraulic conductivity for the poorly-graded sand with silt and gravel at the site likely ranges from 10^{-5} to 10^{-1} centimeters per second (cm/s). This range corresponds to the reference range for "Silty Sand" and "Clean Sand" and the lower limit for "Gravel".

Using a standard effective porosity value of 0.3, the ground water velocity in the water table aquifer at the site ranges from 22 to 2,230 feet per year (ft/yr). Site-specific hydraulic conductivity data, which reflect actual soil conditions, would be required to better constrain water velocity beneath the site. Such data are not generally necessary at the site since the extent of impacts is now well know and any dissolved-phase impacts are likely in a steady state configuration. It is likely that the shallower soils (10 to 50 bgs) at the site have a lower hydraulic conductivity than the deeper soils (50 to 70 feet bgs) in which the City of Renton drinking water well is screened.

4.4.2.2 Analytical Results

Soil Samples

A total of 14 samples were submitted for formaldehyde analysis from six individual sampling locations. The soil sample analytical results for this phase of investigation are summarized in Table 8 and are presented graphically on Figure 10. The original laboratory report is included in Attachment E.

Formaldehyde concentrations exceeded the MTCA Method B Soil Cleanup Level for Protection of Ground Water (using MTCA Equation 747-1) of 0.006 mg/kg in each of the soil samples submitted. The derivation of this cleanup level is detailed below in Section 5.0. Formaldehyde was detected in 13 soil samples from borings B-34 through B-37, B-39 and B-40 at concentrations ranging from 2.4 mg/kg to 42 mg/kg.

Ground Water Samples

A total of 14 ground water samples were submitted for analysis of formaldehyde and dissolved arsenic. The ground water analytical results for this phase of investigation are summarized in Table 8 and are presented graphically on Figure 10. The original laboratory report is included in Attachment E.

Formaldehyde was detected in one ground water sample (i.e., B-40) at a concentration of 60 µg/L. The detected concentration of formaldehyde exceeded the MTCA Method B Cleanup Level for ground water (as drinking water) of 1.46 µg/L.

Dissolved arsenic was not detected in any of the ground water samples at a concentration exceeding the detection limit of the method used.

5.0 CONTAMINANTS OF CONCERN AND CLEANUP LEVELS ANALYSIS

Cleanup levels are a performance standard for whatever remedial action may be appropriate at a particular site. The cleanup levels to be used must be protective of human health and the environment based upon the exposure pathways that remain after completion of the selected remedial action and implementation of engineering controls (if any). Therefore, for the same chemical compounds, different cleanup levels are available for differing final exposures. For example, if a site is fully capped with asphalt or concrete and used for parking it may be permissible to allow a higher concentration of a contaminant to remain on a site than if the site were to be uncapped and used for recreational purpose. Site-specific cleanup levels must be appropriate for, and consistent with, the ultimate land use scenario. EPI has therefore developed various cleanup levels based upon differing potential land uses.

A point of compliance is that point on a property where the cleanup level is attained. The point of compliance is ideally throughout an entire site, but a "conditional" point of compliance may also be established. There may also be different points of compliance for different contaminants at a site (i.e., formaldehyde versus petroleum hydrocarbons) or for different media (i.e., soil versus ground water). The point of compliance must also be protective of human health and the environment based upon the intended land use.

If a conditional point of compliance is incorporated into site remediation, or if cleanup levels are based upon specific exposure scenarios, Ecology may require the use of Institutional Controls. For example, an commercial or mixed use property that incorporates the use of a cap to limit exposure to soils would likely carry a restrictive covenant attached to the property deed that requires maintenance of the cap, notification of Ecology of changes in property ownership, notification of Ecology prior to intended changes in land use, or other requirements that would generally preclude the property owner from redeveloping the property for a different purpose.

The MTCA regulation establishes Method B as the "Universal Method" and the procedures in Method B can be applied to both ground water (WAC 173-340-720) and soil (173-340-740) for any compound at any site. MTCA Method A is intended to be a simplified set of values for the most common subset of contaminants in soil and ground water at relatively simple sites. Method A is considered to be equally as protective of the environment as Method B, but is predicated on the most restrictive exposure pathway, which is generally protection of ground water as a drinking water source.

The contaminants of concern (COCs) for the site were selected by screening the concentrations of each detected compound against the Method A and Method B "Book Values" for Unrestricted Land Uses. Based on this review, the COCs at the site vary for soil and ground water. The COCs for soil at the site are:

- GRPH;
- DRPH;
- HRPH; and
- Formaldehyde.

The COCs for ground water at the site are:

- Arsenic; and
- Formaldehyde.

When considering potential cleanup levels for the COCs at the site for evaluation purposes, there are three potential exposure pathways to be considered:

- Direct human contact with impacted soils;
- Ingestion of impacted drinking water; and
- Vapor migration from contaminants in soil and ground water to indoor air of potential future structures.

It should be noted that this evaluation process does not consider the use of institutional controls or engineering controls. Such controls (e.g., placement of a vapor barrier) could be used to eliminate a potential exposure pathway (e.g., vapor exposure) that would then allow the use of a cleanup level that might not be applicable in the absence of an institutional or engineering control.

Although the site is located adjacent to the Cedar River, the piezometric data collected quarterly or semi-annually from 1998 to 2002 has consistently shown that the Cedar River recharges the local ground water table (i.e. ground water flows away from the river) and it is therefore not appropriate to consider potential surface water or sediment exposures.

The cleanup levels for GRPH, DRPH, and HRPH in soil that are least restrictive of future land uses at the site are the MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses. MTCA Method A Cleanup Levels for Unrestricted Land Uses are protective of the direct contact pathway, protective of ground water, and are generally considered protective of the indoor air exposure pathway. In addition, a lack of detected volatile carcinogenic compounds associated with the GRPH, DRPH, and HRPH (e.g., benzene) would eliminate the indoor air migration as a pathway of concern for these compounds.

In general, the process for identifying potentially applicable cleanup levels for formaldehyde in soil and ground water included the following:

- Identifying the appropriate MTCA cleanup level for ground water that is protective of ingestion as drinking water;
- Calculating site-specific soil cleanup levels that would be protective of indoor air for two construction scenarios of potential future on-site structures (i.e., a structure with, or without, a below grade living space);
- Calculating a ground water cleanup level that is protective of indoor air for each of the two construction scenarios;
- Calculating site-specific soil cleanup levels that would be protective of ground water as drinking water and protective of ground water as a source of vapors for a proposed structure with and without a basement; and
- Identifying the applicable MTCA cleanup level for direct contact of impacted soils.

The MTCA Method B cleanup level for formaldehyde in ground water as drinking water is 1.46 µg/L. This cleanup level is based on an allowable excess cancer risk of 1 in 1,000,000; the maximum allowable for a single compound.

As stated above, the MTCA regulation requires evaluating potential indoor air exposures that could result from the indoor intrusion of vapors from volatile compounds present in soil and ground water underlying a living or working spaces. This evaluation is performed using the Johnson & Ettinger (J&E) model developed by the United States Environmental Protection Agency (EPA) version 3.0, dated April 2003. The calculations are based on either default values or conservative assumptions for site-specific parameters. The results serve as a quantitative first-tier screening assessment to calculate those concentrations of formaldehyde in soil and ground water that would be protective of the indoor air exposure pathway. Results of the J&E screen are presented in Table 10.

According to the J&E model, the maximum detected concentration of formaldehyde in soil (42 mg/kg) represents about a 1 in 1,000 excess cancer risk for an at grade structure and about a 2 in 1,000 excess cancer risk in a structure with a basement. Both of these risks exceed the allowable single compound risk of 1 in 1,000,000 for a residential scenario. The J & E Model indicates that a soil cleanup level protective of indoor air exposure is 0.031 mg/kg for an at grade structure and 0.021 mg/kg for a structure with a basement.

The maximum detected concentration of formaldehyde in ground water of 140 µg/L represents about a 1.1 in 1,000,000 excess cancer risk in a structure with a basement. This risk slightly exceeds the allowable single compound risk of 1 in 1,000,000 for a residential scenario. The 140 µg/L concentration of formaldehyde in ground water represents about a 0.7 in 1,000,000 excess cancer risk for indoor air exposure in an at grade structure, which does not exceed the allowable single compound risk of 1 in 1,000,000 for a residential scenario. The ground water cleanup level protective of indoor air exposure is 124 µg/L for an at grade structure and 195 µg/L for a structure with a basement based upon the J&E analysis of current site conditions

Based upon the J&E analysis of current site conditions, the presence of formaldehyde in soil at the site represents more of a human health risk than formaldehyde in ground water. Current ground water impacts only slightly exceed the allowable indoor air exposure risk for a structure with a basement, and comply for an at-grade structure. However, the indoor air exposure risk posed by soil impacts substantially exceeds the allowable risk for both an at-grade structure and a structure with a basement. It is again important to point out that this evaluation cannot consider the risk that would be posed if an institutional control or engineered control is used as part of a remedial strategy. Rather this evaluation can be used to assess where an institutional control or a type of engineered control may be useful in eliminating or mitigating a particular site risk.

Given the location of COCs at the site, indoor air is not currently a concern as there are no structures above any of the compounds detected in soil and ground water. However, future development of the site may include additional structures and indoor air exposures, and methods for mitigating those exposures, should be considered.

MTCA considers soil impacts to be a potential source of impact to ground water and requires that soil cleanup levels be protective of ground water exposure pathways. Therefore, soil cleanup levels were also calculated using the equations 747-1 and 747-2 in WAC 173-340-747 for the following scenarios:

- Protection of ground water as drinking water;
- Protection of ground water for indoor air at a structure with a basement; and
- Protection of ground water for indoor air at a structure without a basement.

Results of these calculations are presented in Table 11. The calculated soil cleanup levels ranged from 0.006 mg/kg for protection of ground water as drinking water to 0.8 mg/kg for protection of indoor air vapors from ground water for a structure without a basement.

The MTCA Method B cleanup level for protection of direct contact with formaldehyde in soil is 33.3 mg/kg. This concentration is not protective of ground water as drinking water or of the indoor air exposures. Only one of the observed formaldehyde concentrations exceeds this cleanup level.

Each of the derived cleanup levels for formaldehyde in soil at the site is potentially applicable. The applicability of these cleanup levels depends upon the selected future land use and Stoneway's ability to use restrictive covenants or engineering controls as a component of redevelopment. For example, the 33.3 mg/kg cleanup level could potentially be used if Stoneway were to place an impervious surface (e.g. concrete, asphalt, etc.) over the area of formaldehyde impacts and use restrictive covenants and ground water monitoring at the conditional point of compliance. However, if future development included a residential land use scenario, one of the formaldehyde cleanup levels that is protective of indoor air quality may be more appropriate, or the use of an engineered control such as a vapor barrier to eliminate the indoor air exposure pathway may be incorporated into the remedial action. A range of remedial options that incorporate institutional and engineered controls into the remedial strategy is potentially applicable at the site, as long as the final remedial scenario can be demonstrated to be fully protective of human health and the environment.

A summary of the potentially applicable soil cleanup levels for formaldehyde is presented in Table 12.

The MTCA Method A cleanup level for arsenic in ground water is 5 µg/L, which is based on a drinking water scenario. This value is also the federal maximum contaminant level (MCL). Since arsenic is not a volatile compound, the indoor air exposure pathway is eliminated. The MTCA Method B cleanup level for arsenic, using a drinking water scenario is 0.0583 µg/L. The Method B value is generally considered to be overly conservative and does not account for natural background concentrations. The MTCA Method A cleanup level of 5 µg/L is almost universally used for arsenic in ground water.

The MTCA regulation also requires an evaluation of potential risks to ecological receptors and could potentially require the performance of a Terrestrial Ecological Evaluation (TEE) (WAC 173-340-7490). The MTCA regulation also provides exclusions from performance of a TEE (WAC 173-340-7491) or for performing a simplified TEE (WAC 173-340-7492). For the purposes of this document EPI has assumed that the site will not pose an ecological threat after site development and that it will be excluded from performance of a TEE either under WAC 173-340-7491 or –7492. This assumption is based upon the following:

- After development, remaining impacted soils (if any) will be covered with buildings, pavement or other physical barriers that will prevent ecological exposures and are exempt from a TEE under WAC 173-340-7491(1)(b), and

- Formaldehyde is not a Priority Chemical of Ecological Concern and is excluded from a TEE under WAC 173-340-7492(2)(c).

It is expected that any of the cleanup levels presented above are fully protective of human health and the environment through a combination of remedial actions, engineering controls, and institutional controls.

It should also be recognized that some of the cleanup levels calculated using the MTCA methods may be below the capability of analytical methods (i.e. soil concentrations protective of indoor air). MTCA recognized this and, in such cases, allows the practical quantitation limit (PQL) for the analytical method to be used as the functional cleanup level. In the case of formaldehyde in soil, the most restrictive cleanup level would likely be a PQL of about 0.5 mg/kg.

6.0 CONCLUSIONS

The findings for this RI support the following:

- The site has been adequately characterized and the nature and extent of environmental impacts are well understood. The RI has allowed for the identification of COCs, development of appropriate and potentially applicable cleanup levels and an evaluation of remedial alternatives and strategies.

- A shallow water table is present at the site at depths ranging from 12.15 feet to 23.14 feet below grade. The hydraulic gradient for December 2, 2004 is approximately 0.007 feet per foot in a generally northwesterly direction. Using standard reference values, the ground water velocity of the water table aquifer at the site ranges from 22 to 2,230 feet per year (ft/yr), and likely varies significantly with depth.

- Subsurface conditions observed at the site during the initial investigation indicate that the northern portion of the site is generally underlain by sand containing variable quantities of silt and gravel to a depth ranging from about 5 to 18 feet below grade. This soil type is consistent with river flood plain deposits. The sands were underlain by brown, very dense, poorly graded sand with gravel consistent with glacial till. The southern portion of the property was generally underlain by various types of fill material including (but not limited to) concrete, gravel, and sands to depths ranging from near surface (i.e., 0.5 feet) to 13 feet below grade. General construction debris such as wood, asphalt, cables, and riprap were encountered in many of the sampling location in the southwest corner of the property. Glacial till underlies the fill material in the southern portion of the site.

- GRPH impacts exceeding an applicable MTCA cleanup level were observed in soil in one location at the site. Based upon the location of the detected impacts, the likely mode of release was from historical USTs. Although the extent of GRPH was not fully characterized, the presumed remedy would be direct excavation with on-site ex situ bioremediation with performance sampling at the limits of remedial excavation. The goal of remedial excavation would be to attain MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses throughout the excavation. GRPH were not detected in ground water above an applicable MTCA cleanup level.

- DRPH and HRPH impacts exceeding applicable MTCA cleanup levels in several near surface locations. The likely mode of release is surface release to soils with limited infiltration. Although the extent of DRPH and HRPH were not fully characterized, the presumed remedy would be direct excavation and performance sampling at the limits of remedial excavation. The goal of remedial excavation would be to attain MTCA Method A Soil Cleanup Level for Unrestricted Land Uses throughout the excavation. Neither DRPH or HRPH were not detected in ground water above an applicable MTCA cleanup level.

- Formaldehyde impacts were observed in soils within, and adjacent to, the southern portion of the former batch plant. Various cleanup levels have been calculated for several scenarios (i.e., protection of ground water as drinking water, protection of ground water for indoor air at a structure with a basement; and protection of ground water for indoor air at a structure without a basement). Each of the detected concentrations of formaldehyde exceeded one of the potentially applicable cleanup levels for formaldehyde. Depending upon the remedial goals of the property and the planned land use, any of the calculated formaldehyde cleanup levels in soil, in combination with institutional controls, may be applicable. It should be noted that vapor impacts to residences other than on the ground floor or basement are not considered by MTCA and are presumed to not be at risk. Therefore, almost any land use that involves subsurface parking or elevated residences, so long as a permeable concrete cap is maintained, will likely be applicable at the site.

- Formaldehyde impacts were observed in ground water samples from DPT sampling locations at concentrations slightly exceeding a potentially applicable cleanup level. However, formaldehyde was not detected in ground water samples from any monitoring wells in and immediately down-gradient of the formaldehyde-impacted soils, or at the boundary of the property in any of the monitoring wells installed. One of the monitoring wells was installed immediately adjacent to the highest detected formaldehyde concentration detected in a reconnaissance sample. It is likely that the formaldehyde concentration in that water sample resulted from "drag down" of a small amount of impacted soil into the ground water. Continued ground water monitoring will be needed to confirm the absence of formaldehyde in ground water. This finding supports the conclusion that formaldehyde in ground water does not represent a substantial risk to human health or the environment. In addition, this issue could potentially be addressed through the use of institutional controls limiting the uses of ground water for beneficial purposes. This would be possible because the monitoring wells at the property boundary would establish a point of compliance of formaldehyde (if present) in ground water.

- No dissolved arsenic was observed in samples from monitoring wells at the down-gradient property boundary. Dissolved arsenic impacts were observed in ground water samples collected using DPT and test pit sampling techniques. Dissolved arsenic is likely a by-product of dissolution of natural background metals resulting from high pH soil and ground water conditions. Removal of high pH soil should allow for natural attenuation of the limited amount of dissolved arsenic observed in the ground water in the interior at the site. The available data strongly indicate that dissolved arsenic in shallow ground water at the site does not extend off-site.

- The source of the high pH conditions in ground water appears to be the large settling pond located on the southern boundary of the site. A comparison of data from April of 2000 collected by GeoEngineers shows that pH conditions have decreased since the concrete batch plant ceased operation in 2002. This supports the concept that removal of high pH materials (i.e., sediment in settling ponds) and natural attenuation would be an effective approach to remediation of pH conditions at the site.

Limitations and Exceptions

To the extent that this RI has required judgment, there can be no assurance that fully definitive or desired results were obtained, or if any results were obtained, that they were supportive of any given course of action. The services have included the application of judgment to scientific principles; to that extent, certain results of this work have been based on subjective interpretation. We make no warranties, express or implied including without limitation, warranties as to merchantability or fitness for a particular purpose. The information provided in this report is not to be construed as legal advice.

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