REMOVAL ACTION PROJECT PLAN
DRAFT PRELIMINARY DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for Submittal to

U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Prepared by

Anchor Environmental, L.L.C.
6650 SW Redwood Lane Suite 110
Portland, Oregon 97224

On behalf of

NW Natural
220 NW Second Avenue
Portland, Oregon 97209

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AINW	Archeological Investigations Northwest
Anchor	Anchor Environmental, L.L.C.
AST	Aboveground Storage Tank
bgs	Below ground surface
BMP	Best Management Practice
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CHASP	Construction Health and Safety Plan
CQAO	Construction Quality Assurance Officer
CQAP	Construction Quality Assurance Plan
DEQ	Oregon Department of Environmental Quality
DMEF	Dredge Material Evaluation Framework
DNAPL	Dense Non-Aqueous Phase Liquid
DRET	Dredging Elutriate Test
EPA	United States Environmental Protection Agency
GPS	Global positioning system
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSM	Health and Safety Manager
HSO	Health and Safety Officer
MARP	Monitoring and Report Plan
MGP	Manufactured Gas Plant
NTU	Nephalometic turbidity unit
Order	Administrative Order on Consent
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Administration
OVM	Organic Vapor Monitor
PAH	Polycyclic Aromatic Hydrocarbon
PEC	Project Emergency Coordinator
PFD	Personal Flotation Device
PID	Photo-ionization detector
PM	Project Manager
PPE	Personal Protective Equipment
ppmv	Parts Per Million by Volume

QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RACR	Removal Action Completion Report
RAEPP	Removal Action Environmental Protection Plan
RAPP	Removal Action Project Plan
RAWP	Removal Action Work Plan
SAP	Sampling and Analysis Plan
SOW	Statement of Work
SSO	Site Safety Officer
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TDP	Transportation and Disposal Plan
TPAH	Total Polycyclic Aromatic Hydrocarbons
TPH	Total Petroleum Hydrocarbons
USACE	United States Army Corps of Engineers
VOC	Volatile Organic Compound
WQMP	Water Quality Monitoring Plan

1 INTRODUCTION

NW Natural entered into an Administrative Order on Consent (Order) with the U.S. Environmental Protection Agency (EPA) on April 28, 2004 to perform a time-critical removal action at the "Gasco" site (Site) (EPA 2004a). The location of the Site is shown on Figure 1. The Order requires that NW Natural perform a number of actions associated with removing a tar body (as defined in the Order) at the surface of the nearshore sediment adjacent to the Site. NW Natural submitted the Removal Action Work Plan (RAWP, Anchor 2004a), pursuant to Section VIII.16.a of the Order, and subsequently submitted an interim deliverable on preliminary design (Anchor 2004b) in response to EPA comments (EPA 2004b) on the RAWP. This document, the Removal Action Project Plan (RAPP), addresses the requirement of Section 3.A of the Statement of Work (SOW, Appendix B of the Order) and fulfills the commitment for documentation of the Preliminary Design in Section 2.2.2 of the RAWP.

The SOW requires that the project design documents include:

- A presentation of design options, evaluation of the options, and a recommended design for implementation
- A presentation of all sampling results, quality assurance reviews, and other data evaluations
- Various plans to support the implementation of the removal action.

This draft document, the RAPP, addresses these requirements. The results of the design characterization, including an evaluation of historical data where appropriate, are presented in Section 2. The evaluation of design options, originally presented in the interim submittal on preliminary design, is updated in Section 3. The overall requirement for the implementation of the removal action and the sequence of activities for the selected design option is presented in Section 4. The other design documents required by the SOW for the recommended alternative are included as appendices to the RAPP and cited, where appropriate, in the description of the recommended alternative. These documents are:

- Transportation and Disposal Plan (TDP, Appendix A)
- Construction Health and Safety Plan (CHASP, Appendix B)
- Construction Quality Assurance Plan (CQAP, Appendix C)
- Construction Water Quality Monitoring Plan (WQMP, Appendix D)
- Removal Action Environmental Protection Plan (RAEPP, Appendix E)

- Monitoring and Reporting Plan (MARP) outline (Appendix F)

2 DESIGN CHARACTERIZATION

Sampling was performed in July 2004 in general accordance with the EPA-approved RAWP and the Sampling and Analysis Plan (SAP) appendix to that document (Anchor 2004a). As explained in the following paragraph, three additional sediment cores were collected beyond those proposed in the RAWP. The other deviation from the RAWP was that a piston-core sampler was used to collect shallow, less than 5-foot, cores at several locations because direct-push core sampler did not recover sample from the shallow sediment at several locations.

The river level was low during the characterization field work, exposing most of the tar body. The weather was dry and hot. The exposed surface of the tar body was mostly viscid with some 10 to 20 cm diameter hard patches and gravel-size lumps of brittle sandy tar in many locations.

Sediment cores were collected from 20 sampling stations (Figure 2) within and surrounding the perimeter of the previously identified extent of the surface tar body. Three of the sampling stations (i.e., RAA-18, RAA-19, and RAA-20), located along the toe of the shoreline embankment within the area of coarse rip rap, were not proposed in the SAP but were added during the field sampling effort to obtain additional data for sediments/soils in the transition zone between the uplands and the nearshore zone. As the vertical extent of the surface tar body was unknown prior to the design characterization sampling, deep (i.e., 40 feet) reconnaissance cores were proposed to determine the depth of contamination and guide the sampling depths for the remaining coring stations. A single 40-foot core was advanced approximately in the middle of the surface tar body (RAA-09). Visible contamination at this location extended to a depth of approximately 16 feet below mudline, with tar extending approximately 13 feet below mudline at this location. Following discussions with EPA regarding these data, all additional cores were advanced to a depth of 20 feet below mudline. At each station, the full penetration depth was logged and the depths of the tar body zone, visibly contaminated zone, and visibly uncontaminated zone were identified. In addition, at each station subsamples were collected from each of these zones for potential physical and chemical analyses. The remainder of this section discusses in further detail the physical and chemical characterization results and the cultural resources characterization.

2.1 Physical Characterization

2.1.1 Identification of Sediment Zones

The primary objective of the design characterization sampling was to define the lateral and vertical extents of the tar body in the removal action area through visual observations. To achieve this objective, sediment cores were collected at 20 sampling stations (Figure 2) using a track-mounted Geoprobe rig (2-inch diameter core), either deployed from a barge or on land. At each station the full penetration depth of the cores was logged according to ASTM Method D 2487, with particular emphasis on identification of the tar body, visibly contaminated, and visibly uncontaminated zones as defined in the RAWP. The core logs are provided in Appendix G. In addition, core logs for previous subsurface investigations in the vicinity of the surface tar body are included in this appendix.

During evaluation of the cores, Anchor and EPA's oversight contractor, Parametrix, Inc., reached consensus on the depth(s) of the zones present at each station for the purposes of sampling. To maintain a consistent definition of each zone throughout the characterization, each zone was identified through the presence of particular physical characteristics. Observations of the tar body included:

- Thin tar laminations bounded by sediments
- Lenses of tar
- Soft, sticky masses of tar
- Dense brittle fragments of tar containing little or no sediments

Observations of the visibly contaminated zone included sediments:

- Saturated with oil
- Saturated with tar and tarry like substances (but composed primarily of sediments)
- With a heavy sheen
- With blebs of oil and/or tar
- With a slight sheen

Sediments with no sheen, oil, tar, or petroleum odor noted were identified as the visibly uncontaminated zone.

2.1.2 Surface Tar Body Extent

Based on the physical definitions discussed above for defining the presence of tar body, the lateral and vertical extents of the tar body were delineated (Figures 3, 4, and 5). The elevations and thicknesses of the surface tar body and visibly contaminated zones are provided in Tables 1 and 2. Based on these elevations and thicknesses, a dredge prism was identified as shown in Figures 4 and 5 and discussed in Section 4.1.2.

The surface tar body was found to extend approximately 200 feet from shore (average highwater mark). Depending on the water elevation at any given time, the surface tar body is in approximately 5 to 40 feet of water. The vast majority of the surface tar body is upstream of the existing dock and pipeway structures, with only a small portion underneath the pipeway. As a result, these structures should not cause any major logistical problems to tar body removal.

The presence of tar has been also noted in subsurface layers in two cores immediately upstream (AN 2-1 through AN 2-4) and two cores shoreward (RAA-19 and 20) of the surface tar body. Generally, the tar in these cores is covered by 1.5 to several feet of sediment or soil type material and the tar itself is approximately 1.5 to 5 feet thick (Table 1). It is possible that there is a connection between buried tar in RAA-19 and 20 close to the shoreline and the surface tar body on top of the river sediments. However, it is notable that this tar was not present in RAA-18 and RAA-15 (Table 1), which are slightly up and downstream (Figure 2) of RAA-19 and RAA-20. Further, this tar is not present in RAA-08 (Table 1), which is just riverward of RAA-19 (Figure 2). Thus, if there is a connection, it is confined to a narrow lateral region that runs in between these surrounding cores.

However, even if there is a component of buried tar within the shoreline materials, it does not represent either a current or future potential direct exposure to aquatic organisms as may be presented by the surface tar body as described in the SOW. Upon removal of the surface tar body, it is likely that a layer of tar material approximately 1.6 to 5 feet thick may be bisected by the cut line. Because this approach will result in a net reduction in the exposure of surface tar, and the entire area will be covered with sand

(as described below), removal of the surface tar shown in Figure 3 will meet the objectives of the SOW.

2.1.3 Physical Consistency

Field observations indicate that the surficial sediment is very soft. At five sampling locations, the direct-push coring device penetrated as much as 10 feet of sediment under its own weight. At several other locations, no sample was recovered using the direct-push coring device in the shallow sediment. No sediment entered the coring device, which suggests that soft sediment deformed around the device rather than entering the core barrel. A piston core sampler was used to collect shallow samples at several locations. Atterberg limits tests were performed on four samples to obtain additional information on the consistency of material in zones with a substantial fraction of silts and clays.

The tar material varied in consistency from soft, sticky, and plastic to brittle. The brittle material is generally gravel-size lumps of tarry sand that appears to have weathered. Much of the brittle tar is found on the sediment surface, although some of it was found in deeper samples. Most of the tar that was collected was the soft material. It is readily deformed with minimal pressure. Although it smears on surfaces it touches, it is too viscous to flow noticeably.

2.2 Chemical Characterization

At each sampling station a subsample was collected from within each identified zone (tar body, visibly contaminated, and visibly uncontaminated) for potential chemical analysis. The objectives of this characterization were to evaluate potential water quality impacts at the point of dredging, the disposal suitability of any removed materials, and the chemical concentrations within and below the visibly contaminated zone. In accordance with the SAP, all samples were shipped to the laboratory and archived until evaluation of the boring logs was completed to determine which samples provided the most spatially and physically representative samples. A matrix summarizing the samples submitted for analysis is provided in Table 3. All samples were collected and analyzed in accordance with the EPA-approved Quality Assurance Project Plan (QAPP), which is an appendix to the RAWP (Anchor 2004a).

2.2.1 Elutriate Testing

To determine the potential effects on ambient water quality during the removal activities, two samples were collected from both the surface tar body (stations RAA-11 and RAA-13) and visibly contaminated zones (stations RAA-03 and RAA-11) (see Figure 2) and analyzed using the U.S. Army Corps of Engineers (USACE) Dredging Elutriate Test (DRET) method. The elutriate water samples obtained from the DRET procedures were analyzed for Semi-Volatile Organic Compounds (SVOCs) by EPA Method 8270, Volatile Organic Compounds (VOCs) by EPA Method 8260, total petroleum hydrocarbons (TPH), total and amenable cyanide by EPA Method 9010, and total and dissolved arsenic, chromium, copper, nickel, lead and zinc by EPA Method 6010. The draft unvalidated analytical results were compared to the Oregon Department of Environmental Quality (DEQ) Level II Screening Level Values (DEQ 2001) for surface water ecological exposures and the EPA National Recommended Water Quality Criteria (EPA 2002) (Table 4). Note that some or all of these draft results may change once data validation has been completed.

Chemicals were detected in elutriate water from both visually contaminated and tar body samples. For tar body samples, chemicals detected above relevant criteria included several PAHs and BTEX compounds (except xylene, which has no relevant criterion). It was noted during elutriate testing that a sheen was visible at the surface of the test vessel after the elutriate procedure was conducted. The presence of these chemicals in the elutriate test water is consistent with the presence of such a visible sheen. These laboratory observations are also consistent field observations of some sheening that occurred during design characterization sampling. The environmental controls that would limit the loss of such chemicals during removal are discussed in Section 4.1.5, and includes silt curtains with absorbent booms, which will remove the majority of any sheen (and the associated chemicals) present in the water during construction. In addition, cyanide was detected in the two tar body samples, but these detections were exactly at the method reporting limit. Consequently, the accuracy of these results may be in question and will need to be verified during data validation.

For visually contaminated samples, similar PAHs and BTEX compounds were detected above relevant criteria, but generally at lesser concentrations than observed for tar body samples. In addition, copper and lead were detected in the visually contaminated samples at levels just above relevant criteria. Detections of metals in elutriate tests for even relatively clean sediments are not unusual occurrences, particularly for copper. It is notable that the concentrations of copper and lead in the visually contaminated bulk sediments are quite low, with copper ranging from 14 to 27 mg/kg and lead ranging from 10 to 26 mg/kg as compared to DMEF criteria of 390 and 450 mg/kg, respectively. Often sediment dredging is conducted where some metals detections have occurred in elutriate tests. This is particularly true when the elutriate results are only slightly above water criteria, as they are in this case. In all dredging operations, substantial dilution occurs at relatively small distances from a dredge, thus any metals concentrations above criteria in the water column during actual dredging would be expected to be confined to a relatively small area immediately around the dredge. Environmental controls, such as containment barriers discussed in Section 4.1.5, will further limit the movement of any water containing these metals to wider areas.

2.2.2 Disposal Suitability

In accordance with the RAWP, samples of the tar body were analyzed following the Toxicity Characteristic Leaching Procedure (TCLP) to profile the material for disposal. The results of the analyses will be evaluated to help determine appropriate disposal locations. The results are presented in Table 5.

Results in Table 5 are compared to hazardous waste criteria promulgated with the TCLP test method. The two tar body samples had benzene results greater than the relevant criterion. As noted in the RAWP, Manufactured Gas Plant (MGP) waste is exempt from designation as hazardous waste. Because benzene is clearly associated with the MGP waste throughout the Gasco site, these results indicate that the tar body material can be disposed of in Subtitle D (non-hazardous) waste landfill. In addition, none of the results for the visually contaminated samples exceeded any TCLP criteria. Consequently, these sediments can also be disposed of in a non-hazardous landfill.

2.2.3 General Chemical Characterization

Select samples of the visually contaminated and visually uncontaminated sediments underneath the tar body were analyzed for bulk sediment chemistry. The purpose of collecting these data was to understand the concentrations of chemicals in sediments that might be incidentally removed with the tar due to design or construction logistical considerations, as well as sediments that might remain after the tar is removed. The chemistry results are presented in Table 6.

The visually contaminated sediments have relatively high organic carbon content (likely associated with the presence of oil and tar blebs) and TPH and PAH concentrations, whereas the visually uncontaminated sediments contain relatively normal levels of organic carbon for river sediments and substantially less TPH and PAH. Neither sediment zone has elevated levels of metals. Cyanide was detected in visually contaminated sediments. Cyanide was undetected in seven out of 11 visually uncontaminated sediment samples and was detected at low levels below the detection limit only in the remaining four of these samples. Most volatile chemicals were undetected in both sediment layers, except BTEX compounds, which were often detected in the visually contaminated sediments. It is notable that BTEX compounds were undetected in deeper visually uncontaminated sediment layer with only a few low level exceptions.

One of the removal action objectives identified in the SOW is to remove the surface tar body to a depth that leaves a surface of lesser total polycyclic aromatic hydrocarbons (TPAH) concentrations. The delineation of the tar body is based on visible criteria, and the removal of the tar body will achieve this objective. The primary factors in identifying dredge prism to achieve this objective are the vertical extent of the tar body, based on descriptions of the sediment cores, and slope stability for dredging. The dredge prism based on these considerations is shown in Figure 4 and is described in more detail in Section 4.

A comparison of the tar body TPAH concentrations to the concentrations in sediments that would comprise the new sediment surface after removal based on the dredge prism is shown in Table 7. The new surface would include both visually contaminated and

visually uncontaminated materials based on the dredge prism shown in Figure 4. The results for samples representative of this new surface as shown in Table 7 range from less than 0.01 percent to 2.04 percent TPAH with an average of 0.67 percent TPAH, while the tar body itself is about 2.64 percent TPAH. Consequently, the SOW objective of achieving lesser concentrations of TPAH is achieved by the proposed dredge prism.

2.3 Cultural Resources Characterization

Archeological Investigations Northwest, Inc. (AINW) determined that sediment cores advanced within 50 feet of the water line as shown on Figure 2 should be inspected by ANIW for evidence of cultural resources at the site. AINW was on site to evaluate each of those cores. No evidence was found to indicate that there are cultural resources at the Site. AINW will continue the cultural resources characterization per the RAWP and this information will be presented in the final design documents.

3 EVALUATION OF DESIGN OPTIONS

This section discusses various design options that were considered prior to preliminary design. The recommended approach for removal is described in more detail in Section 4.

The major design components of the removal action are:

- Removal of the surface tar body
- Transportation and disposal
- Cover or Pilot Capping
- Environmental controls

Various options for implementing the components of the removal action have been considered. The options were discussed in the interim submittal on preliminary design (Anchor 2004b). Subsequent to this document the evaluation of design options was refined based on the results of the design characterization and a recommended alternative was selected (and is presented in more detail in Section 4). As part of the final design, the details of the recommended action will be further refined based on additional evaluation of the characterization data and input from the selected construction contractor and subcontractors. The most recent evaluation of design options, which relies heavily on the previously submitted information, is described in the following sections.

3.1 Removal

The interim submittal on preliminary design described how a range of sediment removal technologies were considered for this project and narrowed down to a barge-mounted mechanical dredge, such as a clamshell dredge, or a barge-mounted excavator. Conventional land-based excavators and hydraulic dredges were eliminated from further consideration.

Although much of the surface tar body was exposed during the low water levels that prevailed during the design characterization, higher water levels are expected during the winter construction window. Under such water level conditions, the tar body will likely extend well beyond 100 feet into the water from the mean water line, as well as 20 to 30 feet below the water surface during the removal. Conventional excavators will likely have difficulty reaching the full tar body from shore. A "landside" excavation would likely

require operating equipment on top of the tar body for some of the removal. The tar body strength was observed to be weak and soft during the design characterization; operating equipment on the tar body will likely be impractical or may spread contamination unnecessarily. Also, for underwater operation, conventional excavators tend to resuspend more sediment than clamshell buckets or hydraulic dredges.

Design characterization has confirmed that the volume of surface tar and associated sediments proposed for removal is approximately 8,000 to 9,500 cubic yards. Due to this small volume, hydraulic dredges are not cost effective for this project. In addition, hydraulic dredges require a significant amount of water (4 or 5 parts water to 1 part sediment) to transport the sediment. Using hydraulic dredging would require extensive dewatering of the dredged material and treatment of the water in a large upland facility.

A clamshell dredge on a barge is the primary alternative identified at this time for removing the material. The primary consideration in the selection of the dredging technology is the consistency of the tar body. The design characterization found that most of the surface tar body is weak and soft. Although the strength of the material was not quantified during the investigation, the direct-push core barrel often advanced under its own weight without applying additional force. Samplers were pushed by hand several feet into the sediment/tar body. A clamshell bucket should be able to penetrate the material to be removed.

3.2 Bathymetric Low Spot Options

The third objective stated in the SOW for the removal action is:

> "If technically appropriate based on the design characterization study, field observations or other data, creation of a bathymetric 'low spot' after removal has occurred such that potential seepage of material may be captured in a localized area for future response."

The design characterization visual observations found no oil or semi-mobile tar material in the borings along the shoreline. Based on this information, it appears unlikely that any seepage would occur post-removal. However, the shape of the tar body and slope stability considerations necessitate a relatively deep cut (as much as 20 feet in some locations) as

shown in Figures 4 and 5, which will result in a bathymetric low spot along the submerged shoreline area of the river. Currently, both cover and capping options would fill this low spot only slightly with about 1 or 2 feet of cap or cover material. Consequently, in the unlikely event that seepage occurs, it will be observable and relatively confined within this low spot and could be removed as needed.

3.3 Transportation and Disposal

The selection of the transportation method is closely linked to the selection of the sediment removal and disposal methods. The removal will likely be performed using barge-mounted equipment and the sediment will be loaded initially onto barges. From this point the options for transport and disposal are still relatively open and will be refined more in Final Design. Some of the potential options still under consideration are described below.

The material will be transported by barge if the disposal facility has the capability to receive material by barge (Roosevelt Landfill) and if this combination of transportation and disposal is the most cost effective. Alternatively, if the disposal facility can only receive material by truck or rail, then the material will be transported by barge to a facility where it can be off-loaded from the barge and transferred to trucks or rail cars.

Preliminarily, the most cost effective option for transportation and disposal appears to be loading the material onto rail cars in or near Portland if the construction contractor can identify a facility that can be used for the transfer. Additional sediment handling, such as the addition of drying agents, may be required if the material is fine grained. For any mode of transportation, sufficient capacity is required to complete the removal action within the construction window.

Several landfills are being considered as the primary disposal alternatives including the Columbia Ridge landfill in Oregon and the Roosevelt landfill in Washington. Roosevelt Landfill has the advantage of being able to receive sediments by barge, but both Columbia Ridge and Roosevelt offer competitive costs, particularly for transport by rail. A facility in or near Portland for transferring the material from barge to rail has yet to be identified.

3.4 Cover/Pilot Capping Options

The primary considerations for cover or pilot capping alternatives are protection of potential receptors in the interim and consistency with any additional remedial action that may be selected following the completion of the remedial investigation and feasibility study for the Portland Harbor Superfund site. Given that the current action is a time-critical removal action, long-term protection of receptors is not a consideration, as risk has not been assessed. Long-term protection will be evaluated as any future remedial action is considered.

The current recommended design concept for cover placement would be spreading a 1-foot layer of medium sand over the area. An engineered pilot cap, consisting of a 1-foot-thick cover of fine to medium sand with 6 inches of overlying gravel material for stability is also being considered. The grain size of cover or capping material will be selected to provide a stable barrier over the short-term. Based on the grain size of the sediment at the Site (silt) and depositional history (minimal net bedload change) over the last several years, a cover of fine to medium sand may be stable for many years. Under the pilot capping alternative, an overlying gravel layer may be added to ensure that the pilot cap is stable throughout the term of pilot monitoring and to mimic a likely full scale design. Note that long-term protection is an objective of the remedial action, whereas the removal action is intended to provide immediate mitigation of potential hazards at the Site and be consistent with options that will be considered for the remedial action. Regardless, the removal of the tar body will result in immediate reduction in risk in the river, as determined by the EPA designation of the tar body as a time critical early action.

3.5 Water Quality Control Measures

Potential effects to water quality were assessed based on the results of dredging elutriate tests presented in Section 2.2.1. The test results indicate that some exceedances of relevant water quality criteria within containment barriers and close to the dredge are likely. However, with temporary containment barriers (i.e., silt curtains) and associated controls, there should be little if any more widespread impact to water quality further from the dredge operation. In addition, minimal sheens were observed during the design characterization sampling. The sheens were associated with coring and placement of spuds from the sampling barge. They tended to be small and dissipated relatively rapidly. Based

on the field observations and DRET results, it appears that use of mobile containment barriers (e.g., silt curtains) and oil absorbent booms, rather than sheet pile walls for example, would be most appropriate for this removal action.

A containment barrier (e.g., silt curtains) and floating boom are intended to contain sediment and oil that escape the immediate vicinity of the dredge. In addition, operational controls as described in the Removal Action Environmental Protection Plan (RAEPP) – Appendix E will be conducted. Dredges that seal to minimize the release of sediment will be selected if they have the capability to penetrate the tar body and it appears that they could provide a substantial reduction in sediment resuspension and loss. An additional consideration is the selection of bucket size. Larger buckets lose a smaller proportion of the sediment dredged. Regardless of the installation of controls around the removal site and the selection of equipment, water quality will be monitored at selected locations outside of the containment system (i.e., in the river). Environmental controls, including identification of specific best management practices (BMP), are described in the RAEPP (Appendix E); water quality monitoring is described in the WQMP (Appendix D).

4 REMOVAL ACTION PROJECT PLAN

4.1 Sequence of Activities

The following subsections describe the currently anticipated activities that will be performed to implement the removal action. The details provided in this document are preliminary and subject to refinement during the final design.

4.1.1 Pre-Removal Activities

Once NW Natural receives EPA approval of the final design, the construction contractor will prepare to mobilize to the Site. As described in the RAWP, NW Natural will provide the 30-day notification required by Section 5 of the SOW to EPA before EPA approves the final design. The construction contractor will mobilize equipment, set up environmental controls (described in the RAEPP, Appendix E), and set up support equipment at the Site prior to holding the preconstruction meeting. The preconstruction meeting will be held before the beginning of any removal activities work. At the preconstruction meeting, Anchor and the construction contractor will:

- Review methods and individual responsibilities for documenting and reporting data and compliance with specifications and plans including methods for processing design changes and securing EPA review and approval of such changes as necessary.
- Review methods for distributing and storing documents and reports.
- Review work area security and safety protocols, as appropriate. The CHASP (Appendix B) will be reviewed in detail; all personnel will have an opportunity to raise questions about the removal plan and the health and safety protocol, and all personnel who will be working in the exclusion zone will sign the acknowledgement of familiarity with the requirements of the CHASP.
- Demonstrate that construction management is in place, and discuss any appropriate modifications of the CQAP (Appendix C) to ensure that project specific considerations are addressed.
- Discuss methods for direct measurement, including confirmation sampling of construction work to be used to ensure performance standards are met. The responsibilities of the construction contractor to perform construction quality control, and the responsibilities of Anchor to perform construction quality assurance will be reviewed.

- If requested by EPA, conduct a Removal Action Area tour with EPA in the project area to verify that the design criteria, plans, and specifications are understood and to review material and equipment storage locations, as appropriate.

After the preconstruction meeting, the following general sequence of activities will occur:

- Set up of location controls (e.g., station lines and staff gauge)
- Mobilization of equipment
- Removal of existing pilings in the removal action area
- Set up of containment barriers and oil booms
- Dredging

4.1.2 Removal

The preliminary removal plan, based on field observations from the design characterization and previous investigations, are shown on Figures 4 and 5. The preliminary estimate of the volume of material to be removed is 8,000 to 9,500 cubic yards including an allowable overdredge of 6 inches. The dredge plan assumes 2 horizontal to 1 vertical (2H:1V) slopes based on observed surface conditions and existing slope angles. To effectively remove the deeper outer limits of the surface tar body and maintain stable dredge slopes, significant overdredging below the surface tar body is required (see Figures 4 and 5). This design results in a bathymetric low spot (even after cover or capping as described in Section 4.1.4) that can be monitored for any seepage that may occur (although seepage is not expected based on core field observations). During final design, the construction contractor will work with the design engineer to minimize the amount of excessive overdredging required.

The construction contractor will be required to complete the removal action working from the slope crest downward. For the dredge prism shown in Figure 4, the entire area to be removed will be under water during the December-January timeframe given typical river levels for this time of year. The full width of the cut will be made before moving downwards. This will prevent oversteepening of the slope and possible

instability. Environmental control requirements the construction contractor will follow are described in the RAEPP (Appendix E).

The construction contractor will be responsible for providing the equipment and labor to remove the specified material within the allowed timeframe and without creating unacceptable water quality impacts from the removal area. The construction contractor will demonstrate, through survey data, or other approved means, that the specified material has been removed. At the end of the removal, the construction contractor will perform a bathymetric survey to document conditions at the Site prior to placing the cover or pilot cap.

Anchor will perform water quality monitoring, review the construction contractor's operations and data to monitor compliance with the design, and review bathymetry results prior to the contractor leaving site to verify the appropriate dredge prism was removed.

The responsibilities of the construction contractor and Anchor and the methods of monitoring compliance with the design are described in greater detail in the CQAP (Appendix C). The CQAP also requires the contractor to prepare a separate quality control plan, which will propose specific measurements and methods to confirm that removal objectives are being achieved during the course of the removal action. Water quality monitoring is described in the CWQMP (Appendix D). All of the field work will be performed in compliance with the CHASP (Appendix B).

4.1.3 Transportation and Disposal

As the construction contractor removes the tar body and any excess sediment, it will load the material into barges as described in the TDP (Appendix A). The approximate volume of material loaded onto the barges and the date of the removal operation represented by the material removed will be recorded in the field log. The sediment will be dewatered, if necessary. The barges will be taken to facilities for transloading the material to trucks or rail cars or delivered to the disposal facility, if the disposal facility has water access. If necessary, the material may be further dewatered or treated for additional transportation and disposal. Whether the barges are taken to a transloading

facility or disposal facility, the construction contractor will relinquish control of the material to the disposal contractor. The volume or weight of the material will be recorded onto a weigh ticket when the material is loaded on land transport, if applicable. The disposal facility will verify receipt of the shipment and record the time that the shipment is received at the disposal facility. The disposal facility will also record the weight of the shipment. The weekly progress reports will contain a summary of the material removed from the Site and received at the disposal facility.

4.1.4 Cover/Pilot Capping

The construction contractor will be responsible for providing cover or pilot capping material that meets the design specification and placing the material as specified in the design. At this time the material is expected to meet the following:

- Clean sand or gravelly sand
- Gravel (for additional surface layer under pilot capping option only)
- Free of large organic or other debris or waste
- Chemical concentrations below the criteria of the Dredge Material Evaluation Framework (DMEF; USACE et al. 1998).

The construction contractor will identify the source of the cover/pilot capping material and provide test results, to demonstrate that the material meets the specification. As material is received at the Site, the construction contractor will provide documentation of the number of shipments received and the weight or volume of material in each shipment. The construction contractor will place the cover/pilot capping material in 6-inch lifts. The material will be placed mechanically from a barge using a clamshell bucket. The bucket will be cracked above the water surface while moving side to side to spread the material. The material will be placed with sufficient control to meet the design thickness of the cover. Lead line measurements as well as set volume or tonnage over the surface area will be used to verify adequate coverage during the placement operation. The environmental controls and BMPs described in the RAEPP (Appendix E) will be used during cover placement to minimize potential water quality impacts; these include use of a containment barrier such as a silt curtain.

Following the placement of the cover/pilot cap, the construction contractor will perform a bathymetric survey to document that the cover meets the specification and provide a record of the as-built contour of the completed removal action. Anchor will monitor the placement of the cover/pilot cap. The CQAP (Appendix C) provides specific details about the responsibilities for quality control and quality assurance during the placement of the cover/pilot cap.

4.1.5 Environmental Controls

Environmental controls will be implemented during the removal of tar body and any associated sediment, dewatering the material following removal, transfer of material to upland transport, and the placement of the cover/pilot cap. Environmental controls will include the use of containment barriers (e.g., silt curtains) and absorbent booms to control the spread of potentially contaminated material as well as the implementation of operational BMPs to minimize the release of contaminated material. The construction contractor will be responsible for implementing the environmental controls identified in the RAEPP (Appendix E). Anchor will monitor the construction contractor's performance for adherence to the design, including the RAEPP. Anchor will also be responsible for monitoring water quality in accordance with the CWQMP (Appendix D) and notifying EPA and the contractor in the event of any water quality exceedances that require implementation of additional environmental controls or BMPs.

4.2 Notifications and Reporting

The Order imposes several requirements for notification for the removal action.

- NW Natural will notify EPA, in accordance with Section VII (Paragraph 11) of the Order, of the names and qualifications of contractors and subcontractors that will be used to perform the removal action. Notification of the selection of contractors is required at least 20 days before the contractors begin work.
- Prior to shipping any material off-site for disposal, NW Natural will notify EPA of the intended shipment and receive EPA's certification that the intended disposal facility is operating in compliance with the "Off-Site Rule" (40 CFR 300.440).
- Prior to shipping any material out of state for disposal, NW Natural will notify the appropriate state agency contact of the intended off-site shipments. A copy of the notification will be provided to EPA. The notice will include the identity of the

disposal facility, the type and quantity of material, the schedule of the shipments, and the method of transportation.

- NW Natural will notify EPA, in accordance with Section II.5 of the SOW, 30 days prior to beginning removal action field work. As noted in the Project Schedule and Section 4.1.1 of the RAPP, this notification will be made before EPA approves the final design in anticipation that approval of the design will not affect the schedule for beginning the removal action. However, removal action field work will not begin prior to EPA approval of final design documents.
- NW Natural will notify EPA, in accordance with Section II.5 of the SOW, within 7 days of making a preliminary determination that construction is complete. EPA and NW Natural will agree to a time for a final inspection and/or meeting. Within 14 days of the final inspection/meeting, NW Natural will send a letter to EPA confirming that the removal action is complete and responding to any issues raised by EPA in the final inspection/meeting.

During removal action field work, NW Natural will submit weekly progress reports to EPA electronically, in accordance with Section II.5 of the SOW. The reports will contain:

- A summary of the work performed during the week
- Identification of any problems encountered
- Identification of proposed solutions to any problems
- Results of water quality monitoring
- A summary of work to be performed during the following week
- Identification of the disposal facility to receive material from the removal action

Within 60 days of completing the removal action field work, NW Natural will submit the Removal Action Completion Report (RACR) to EPA, in accordance with Section II.6 of the SOW, to document the successful completion of the removal action. The RACR will contain:

- A statement that the Removal Action was constructed in accordance with the design and specifications. If applicable, design modifications will be identified in the RACR.
- As-built drawings, signed and stamped by a professional engineer, that document the area and depth of the removal of tar and the dimensions of the cap.

- A summary of the volume and types of materials removed from the Site and final disposition of those materials.
- A presentation of the analytical results of all sampling and analyses performed (including a map showing the locations of any confirmatory samples), and accompanying appendices containing all relevant documentation generated during the Removal Action (e.g., manifests and permits). All analytical data collected during project implementation will be provided electronically to EPA.
- The final Performance Monitoring and Water Quality Monitoring report.
- A description of any institutional controls that are in place, or engineering controls that are necessary to sustain the integrity of the removal action, along with copies of any agreements or other documents used to establish and implement such controls.

The draft MARP, as required by Section II.7 of the SOW, will be provided to EPA within 60 days of receiving approval of the final design. An outline of the MARP is provided as Appendix F. The outline of the MARP will be modified, as necessary, to reflect modifications of the design. The final MARP will be submitted to EPA within 60 days of completing the removal action or receiving comments on the draft MARP, whichever is later.

5 REFERENCES

Anchor Environmental, L.L.C., 2004a. "NW Natural "Gasco Site Removal Action Work Plan." Prepared for NW Natural. August 2004.

Anchor Environmental, L.L.C., 2004b. "Interim Deliverable on Preliminary Design, NW Natural "Gasco" Site Removal Action." Prepared for NW Natural. July 2004.

Oregon Department of Environmental Quality (ODEQ), 2001. Guidance for Ecological Risk Assessment, Level II Screening Level Values, December 2001.

USACE, USEPA, Washington Department of Ecology, and DEQ. 1998. Dredge Material Evaluation Framework Lower Columbia River Management Area. Public Review Draft. Portland, Oregon.

U.S. Environmental Protection Agency (EPA), 2002. National Recommended Water Quality Criteria. EPA-822-R-02-0417, November 2002.

U.S. Environmental Protection Agency (EPA), 2004a. Administrative Order on Consent for Removal Action between NW Natural and the U.S. Environmental Protection Agency. April 28, 2004.

U.S. Environmental Protection Agency (EPA), 2004b. June 10, 2004 Letter to NW Natural, Subject: "Draft Northwest Natural "GASCO" Site Removal Action Work Plan, dated May 2004."

TABLES

Table 1
Lateral and Vertical Extents of the Tar Body Zone

Station ID	Mudline Elevation of Core in feet NAVD 88	Tar Body					
		Tar Observed at Surface (upper foot)?	Depth to Tar Body Bottom in feet	Depth to Bottom with Recovery Correction	Assumed Thickness in feet	Bottom Elevation in feet (1)	Core Log Notes
Removal Action Design Characterization Sampling							
RAA-01	5.85	No	0.0	0.0	0.0	NA	Sand saturated with sticky oil at surface, but no tar body (1.5 of 5 ft recovered). Next core showed no tar, so assumed no tar present.
RAA-02	3.40	Yes	0.5	4.0	4.0	-0.6	Sandy tar in 0.5 of 4 ft recovered. No recovery until 10 ft. Assumed entire 4 foot of first core contains tar.
RAA-03	-18.30	Yes	1.5	8.0	7.8	-26.3	Black firm tar layers in top 0.2 to 1.5 (of 1.5 ft recovered). No recovery to 8 ft, where no tar present, so assumed 7.8 ft of tar.
RAA-04	7.85	Yes	1.0	2.0	2.0	5.9	Sandy tar in top 1 ft (2.5 of 5 ft recovered). No tar observed below 1 ft, so 2 ft of tar assumed with recovery correction.
RAA-05	5.65	Yes	1.3	2.8	2.8	2.8	Tar in top 1.3 ft (2.3 of 5 ft recovered). No tar observed below 1.5 ft, so 2.8 ft of tar observed with recovery correction.
RAA-06	2.45	Yes	1.3	3.0	2.5	-0.5	Tar with silty sand from 0.5 to 1.3 ft (2.2 of 5 ft recovered). No tar below 1.3 ft, so assumed 2.5 ft of tar with correction factor.
RAA-07	-7.10	No Recovery	13.0	13.0	13.0	-20.1	No recovery in first 5 ft. Layer tar found in 6 to 12 ft with 70% recovery throughout. No tar observed below 13 ft, so assumed 13 ft of tar.
RAA-08	8.85	No	0.0	0.0	0.0	NA	Sand with oil/tar saturation found at 1-2 ft and 6-7.5 ft.
RAA-09	6.65	Yes	1.5	4.0	4.0	2.7	1.5 feet of tar observed in 0 to 4 foot core with 1.5 feet recovery, SAND observed in drive shoe; in a second boring at same location, 1.8 feet of tar observed in 0 to 5 foot core with 2 feet recovery. Tar body assumed less than 4 feet.
RAA-10	3.55	No	0.0	0.0	0.0	3.6	No tar found, but because this station is in center of tar body, may want to assume some depth of removal.
RAA-11	5.45	Yes	1.1	1.7	1.7	3.8	Tar found in top 1.1 feet (3.3 of 5 ft recovered) with no tar below, so assumed 1.7 ft of tar with recovery correction.
RAA-12	4.05	No	0.0	0.0	0.0	NA	No tar found in 1.5 of 5 ft recovered. Very fine (0.1 ft) tar layer found at 12 ft, otherwise silt with oil or sheen.
RAA-13	-12.05	No Recovery	10.0	10.0	10.0	-22.1	No recovery to 7 ft but noted oil/tar on core tube. Tar observed at 8-10 ft, with silt and sand below, so assumed 10 ft of tar.
RAA-14	-23.50	Yes	1.1	?	10.0	-33.5	Tar observed in top 1.1 ft (6, 0.1 ft lenses). No recovery to 10 ft. Last tar observed at 13.5 ft, so assumed 10 ft thick tar.
RAA-15	10.85	No	0.0	0.0	0.0	NA	No tar observed.
RAA-16	4.45	No	0.0	0.0	0.0	NA	No tar observed.
RAA-17	4.15	No	0.0	0.0	0.0	NA	No tar observed.
RAA-18	10.60	No	0.0	0.0	0.0	NA	No tar observed.
RAA-19	11.23	No	7.3	10.0	5.0	1.2	No tar observed in top 2.5 of 5ft recovered. 2 ft thick layer of tar is at least 5 feet beneath mudline.
RAA-20	11.60	No	2.3	4.6	1.6	7.0	No tar observed in top 1.5 ft (2.5 of 5 ft recovered). 0.8 ft thick layer of tar observed is at least 1.5 ft beneath mudline.
Historical Sediment Characterization Results in Tar Body Vicinity							
AN2-1		No	5.9	5.9	1.7		1.7 ft of tar observed 4.2 ft below mudline (not continuous)
AN2-2		No	5.6	5.6	3.8		3.8 ft of tar observed at 1.8 ft below mudline (not continuous)
AN2-3		No	5.1	5.1	2.2		2.2 ft of tar observed at 2.9 ft below mudline (1.1 ft gap of sediments between two tar layers)
AN2-4		No	6.6	6.6	3.9		2 segments - 2.3 ft of tar observed 2.7 ft below mudline, and 0.6 ft of tar observed at 6 ft below mudline

Table 2
Lateral and Vertical Extents of Visibly Contaminated Zone

Core ID	Mudline Elevation of Core in feet NAVD 88	Visually Contaminated Sediments				
		Depth to Bottom VC in feet	Depth to Bottom VC with Recovery Correction	Assumed VC Thickness in feet)	Bottom Elevation VC in feet NAVD 88	Core Log Notes
Removal Action Design Characterization Sampling						
RAA-01	5.9	5.3	5.4	5.4	0.4	
RAA-02	3.4	17.5	18.6	14.6	-15.2	
RAA-03	-18.3	13.0	13.0	5.0	-31.3	
RAA-04	7.9	6.0	6.0	4.0	1.9	
RAA-05	5.7	10.0	10.0	7.2	-4.4	
RAA-06	2.5	18.0	18.0	15.0	-15.6	
RAA-07	-7.1	15.5	16.0	3.0	-23.1	
RAA-08	8.9	6.5	8.8	8.8	0.1	
RAA-09	6.7	16.0	16.0	12.0	-9.4	
RAA-10	3.6	12.0	12.5	12.5	-9.0	
RAA-11	5.5	12.0	12.5	10.8	-7.1	
RAA-12	4.1	18.0	18.0	18.0	-14.0	
RAA-13	-12.1	18.5	18.5	8.5	-30.6	
RAA-14	-23.5	13.5	13.5	3.5	-37.0	
RAA-15	10.9	6.0	6.3	6.3	4.9	Some sheen in possible sluff at 6 ft (only 1ft thick)
RAA-16	4.5	10.0	10.0	10.0	-5.6	
RAA-17	4.2	13.0	13.0	13.0	-8.9	
RAA-18	10.6	0.0	0.0	0.0	10.6	
RAA-19	11.2	5.0	5.0	5.0	6.2	VC above tar layer
RAA-20	11.6	5.6	5.6	1.0	6.0	
Historical Sediment Characterization Results in Tar Body Vicinity						
AN2-1	NA	8.0	8.0	2.1	NA	
AN2-2	NA	1.8	1.8	1.8	NA	VC above tar layer
AN2-3	NA	NA	NA	NA	NA	No visual contamination outside tar layers
AN2-4	NA	10.0	10.0	3.0	NA	VC above and below tar, only bottom shown

VC= visibly contaminated

Table 3
Sample Analytical Summary Matrix

Sample ID	Sediment Zone	Sediments							
		TCLP, DRET	Metals, Grainsize	Atterberg Limits, #200 Wash	SVOCs, TPH, TOC, TS, Cn (EPA List)	SVOCs, TPH, TOC, TS, Cn (PAHs)	VOCs (EPA List)	VOCs (BTEX)	Archived Volume
RAA-01SD-0005	VC								1x16-oz
RAA-01SD-0520	VU			X					1x2-oz, 1x8-oz, 1x16-oz
RAA-02SD-0004	TB								1x16-oz
RAA-02SD-1019	VC		X	X	X		X		
RAA-03SD-0002	TB								1x16-oz
RAA-03SD-0513	VC	X							1x2-oz, 2x8-oz
RAA-03SD-1323	VU								1x2-oz, 2x8-oz, 1x16-oz
RAA-04SD-0002	TB								1x16-oz
RAA-04SD-0506	VC					X		X	
RAA-04SD-0620	VU			X				X	1x8-oz, 1x16-oz
RAA-05SD-0203	TB								1x16-oz
RAA-05SD-0410	VC								1x2-oz, 1x8-oz
RAA-05SD-1020	VU		X			X			1x8-oz
RAA-06SD-0304	TB								1x16-oz
RAA-06SD-0407	VC							X	
RAA-06SD-0415	VC		X			X			1x16-oz
RAA-06SD-1520	VU		X		X		X		1x8-oz
RAA-07SD-0511	TB								1x16-oz
RAA-07SD-1117	VC								1x2-oz, 2x8-oz
RAA-07SD-1720	VU								1x2-oz, 1x8-oz, 1x16-oz
RAA-08SD-0407	VC								1x16-oz
RAA-08SD-0720	VU		X			X		X	1x8-oz
RAA-09SD-0005	TB								1x16-oz
RAA-09SD-0516	VC		X		X		X		1x8-oz, 1x16-oz
RAA-09SD-1635	VU								1x2-oz, 2x8-oz, 1x16-oz
RAA-10SD-0010	VC								1x2-oz, 2x8-oz, 2x16-oz
RAA-10SD-1020	VU		X	X	X		X		
RAA-11SD-0204	TB	X							

Table 3
Sample Analytical Summary Matrix

Sample ID	Sediment Zone	Sediments							
		TCLP, DRET	Metals, Grainsize	Atterberg Limits, #200 Wash	SVOCs, TPH, TOC, TS, Cn (EPA List)	SVOCs, TPH, TOC, TS, Cn (PAHs)	VOCs (EPA List)	VOCs (BTEX)	Archived Volume
RAA-11SD-0413	VC	X							1x2-oz, 2x8-oz, 1x16-oz
RAA-11SD-1320	VU		X			X		X	1x8-oz
RAA-61SD-1320	VU		X			X		X	
RAA-12SD-1015	VC								1x2-oz
RAA-12SD-1018	VC								2x8-oz, 2x16-oz
RAA-12SD-1820	VU		X		X		X		
RAA-13SD-0911	TB	X							
RAA-13SD-1115	VC		X		X		X		
RAA-13SD-1522	VU								1x2-oz, 2x8-oz, 1x16-oz
RAA-14SD-1014	VC		X	X		X		X	
RAA-14SD-1420	VU		X		X		X		1x8-oz
RAA-15SD-0506	VC								1x2-oz
RAA-15SD-0615	VU								1x2-oz, 2x8-oz, 1x16-oz
RAA-16SD-0005	VC								1x2-oz
RAA-16SD-0010	VC								2x8-oz, 2x16-oz
RAA-16SD-1020	VU								2x8-oz, 1x16-oz
RAA-17SD-0010	VC		X	X	X		X		1x16-oz
RAA-17SD-1420	VU		X		X		X		1x8-oz
RAA-18SD-0020	VU			X					1x2-oz, 1x8-oz, 1x16-oz
RAA-19SD-0609	TB								1x16-oz
RAA-19SD-0920	VU		X	X		X		X	
RAA-20SD-0405	TB								1x16-oz
RAA-20SD-0506	VC							X	
RAA-20SD-0620	VU			X					1x8-oz, 1x16-oz
RAA-RB-040722	Rinsate Blank		X		X		X		

Table 4
Elutrate Testing Analytical Summary
Draft-Unvalidated Results

Location ID Sample ID Sample Date Depth Interval Sediment Zone	Units	ODEQ Freshwater	EPA AWQC	RAA-03 RAA-03SD- 7/21/2004 5-13 ft Visually Cont.	RAA-11 RAA-11SD- 7/22/2004 2-4 ft Tar Body	RAA-11 RAA-11SD- 7/22/2004 4-13 ft Visually Cont.	RAA-13 RAA-13SD- 7/20/2004 9-11 ft Tar Body
Sheen Visible in Elutriate Test Vessel?		NA	NA	No	Yes	No	Yes
Conventionals							
Cyanide	mg/l	0.0052	0.0052	0.01 U	**0.01 ***	0.01 U	**0.01 ***
Metals							
Arsenic (dissolved)	ug/l	150	150	**2.3**	**0.7**	**0.5**	**0.8**
Arsenic (total)	ug/l	150	150	**3.5**	**0.8**	**0.8**	**1**
Chromium (dissolved)	ug/l	--	--	**0.31 B**	**0.4**	**0.32 B**	**0.35 B**
Chromium (total)	ug/l	--	--	**5.39**	**1.08**	**1.09**	**1.53**
Copper (dissolved)	ug/l	9	9	**13.1 ***	**1.66**	**2.27**	**1.06**
Copper (total)	ug/l	9	9	**16.5 ***	**2.07**	**2.29**	**3.77**
Lead (dissolved)	ug/l	2.5	2.5	**0.12**	**0.06**	**0.12**	**0.09**
Lead (total)	ug/l	2.5	2.5	**7.46 ***	**0.92**	**3.11 ***	**2.32**
Nickel (dissolved)	ug/l	52	52	**0.7**	**1.2**	**1.4**	**1.2**
Nickel (total)	ug/l	52	52	**4.4**	**1.9**	**2.1**	**2.1**
Zinc (dissolved)	ug/l	120	120	**2.7**	**1.2**	**1.5**	**2.7**
Zinc (total)	ug/l	120	120	**16.5**	**3.7**	**4.1**	**7.3**
Total Petroleum Hydrocarbons (TPH)							
TPH - Diesel Range	ug/l	--	--	**430 Z**	**17000 DZ**	**240 J**	**13000 DZ**
TPH - Residual Range	ug/l	--	--	**280 J**	**400 J**	**99 J**	**790 Z**
Semi-Volatile Organic Compounds (SVOC)							
1,2,4-Trichlorobenzene	ug/l	110	--	0.20 U	3.9 U	0.20 U	20 U
1,2-Dichlorobenzene	ug/l	14	--	0.20 U	3.9 U	0.20 U	3.9 U
1,3-Dichlorobenzene	ug/l	71	--	0.20 U	3.9 U	0.20 U	3.9 U
1,4-Dichlorobenzene	ug/l	15	--	0.20 U	3.9 U	0.20 U	3.9 U
2,4,5-Trichlorophenol	ug/l	--	--	0.48 U	9.6 U	0.48 U	9.6 U
2,4,6-Trichlorophenol	ug/l	970	--	0.48 U	9.6 U	0.48 U	9.6 U
2,4-Dichlorophenol	ug/l	3650	--	0.48 U	9.6 U	0.48 U	48 U
2,4-Dimethylphenol	ug/l	42	--	2.0 U	**14 JD**	2.0 U	200 U
2,4-Dinitrophenol	ug/l	--	--	3.9 U	77 U	3.9 U	77 U
2,4-Dinitrotoluene	ug/l	230	--	0.20 U	3.9 U	0.20 U	3.9 U
2,6-Dinitrotoluene	ug/l	230	--	0.20 U	3.9 U	0.20 U	3.9 U
2-Chloronaphthalene	ug/l	--	--	0.20 U	3.9 U	0.20 U	3.9 U
2-Chlorophenol	ug/l	2000	--	0.48 U	9.6 U	0.48 U	9.6 U
2-Methylnaphthalene	ug/l	--	--	**0.030 J**	**470 D**	**0.050 J**	**710 D**
2-Methylphenol	ug/l	--	--	0.48 U	**3.3 JD**	0.48 U	**1.6 JD**
2-Nitroaniline	ug/l	--	--	0.20 U	3.9 U	0.20 U	3.9 U
2-Nitrophenol	ug/l	--	--	0.48 U	9.6 U	0.48 U	48 U
3,3'-Dichlorobenzidine	ug/l	--	--	2.0 U	39 U	2.0 U	39 U
3-Nitroaniline	ug/l	--	--	0.96 U	20 U	0.96 U	20 U
4,6-Dinitro-2-methylphenol	ug/l	--	--	2.0 U	39 U	2.0 U	39 U
4-Bromophenylphenylether	ug/l	1.5	--	0.20 U	3.9 U	0.20 U	3.9 U
4-Chloro-3-methylphenol	ug/l	--	--	**0.057 J**	9.6 U	**0.076 J**	48 U
4-Chloroaniline	ug/l	--	--	0.20 U	3.9 U	0.20 U	20 U
4-Chlorophenyl-phenylether	ug/l	--	--	0.20 U	3.9 U	0.20 U	3.9 U
4-Methylphenol	ug/l	--	--	0.48 U	**15 D**	0.48 U	**12 D**
4-Nitroaniline	ug/l	--	--	0.96 U	20 U	0.96 U	20 U
4-Nitrophenol	ug/l	--	--	2.0 U	39 U	2.0 U	39 U
Acenaphthene	ug/l	520	--	**64 D**	**150 D**	**6.7**	**440 D**
Acenaphthylene	ug/l	--	--	**1.7**	**390 D**	**0.48**	**140 D**
Anthracene	ug/l	13	--	**0.12 J**	**41 D ***	**1.2**	**58 D ***
Benzo(a)anthracene	ug/l	0.027	--	**0.78 ***	**4.8 D ***	**0.76 ***	**19 D ***
Benzo(a)pyrene	ug/l	0.014	--	**0.55 ***	**4.6 D ***	**1.0 ***	**24 D ***
Benzo(b)fluoranthene	ug/l	--	--	**0.61**	**4.5 D**	**1**	**22 D**

Table 4
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Draft-Unvalidated Results

Location ID Sample ID Sample Date Depth Interval Sediment Zone	Units	ODEQ Freshwater	EPA AWQC	RAA-03 RAA-03SD- 7/21/2004 5-13 ft Visually Cont.	RAA-11 RAA-11SD- 7/22/2004 2-4 ft Tar Body	RAA-11 RAA-11SD- 7/22/2004 4-13 ft Visually Cont.	RAA-13 RAA-13SD- 7/20/2004 9-11 ft Tar Body
Benzo(g,h,i)perylene	ug/l	--	--	**0.39**	**3.8 JD**	**1**	**20 D**
Benzo(k)fluoranthene	ug/l	--	--	**0.21**	**1.4 JD**	**0.39**	**6.9 D**
Benzoic acid	ug/l	42	--	**1.9 J**	96 U	**2.1 J**	480 U
Benzyl alcohol	ug/l	8.6	--	4.8 U	96 U	4.8 U	96 U
bis(2-Chloroethoxy)methane	ug/l	--	--	0.20 U	3.9 U	0.20 U	20 U
bis(2-Chloroethyl)ether	ug/l	--	--	0.20 U	3.9 U	0.20 U	3.9 U
bis(2-chloroisopropyl)ether	ug/l	--	--	0.20 U	3.9 U	0.20 U	3.9 U
bis(2-Ethylhexyl)phthalate	ug/l	3	--	2.0 U	39 U	2.0 U	39 U
Butylbenzylphthalate	ug/l	19	--	**0.028 J**	3.9 U	**0.027 J**	3.9 U
Chrysene	ug/l	--	--	**0.81**	**7.4 D**	**2.1**	**24 D**
Dibenzo(a,h)anthracene	ug/l	--	--	**0.037 J**	3.9 U	**0.086 J**	**1.8 JD**
Dibenzofuran	ug/l	3.7	--	**0.044 J**	**23 D ***	**0.072 J**	**28 D ***
Diethylphthalate	ug/l	210	--	**0.27**	3.9 U	**0.52**	3.9 U
Dimethylphthalate	ug/l	3	--	0.20 U	3.9 U	0.20 U	3.9 U
Di-n-butylphthalate	ug/l	--	--	**0.091 J**	3.9 U	**0.15 J**	3.9 U
Di-n-octylphthalate	ug/l	708	--	0.39 U	7.7 U	0.39 U	7.7 U
Fluoranthene	ug/l	6.16	--	**19 D ***	**56 D ***	**6.3 ***	**110 D ***
Fluorene	ug/l	3.9	--	**0.078 J**	**130 D ***	**0.32**	**150 D ***
Hexachlorobenzene	ug/l	--	--	0.20 U	3.9 U	0.20 U	3.9 U
Hexachlorobutadiene	ug/l	9.3	--	0.20 U	3.9 U	0.20 U	20 U
Hexachlorocyclopentadiene	ug/l	5.2	--	0.96 U	20 U	0.96 U	20 U
Hexachloroethane	ug/l	540	--	0.20 U	3.9 U	0.20 U	3.9 U
Indeno(1,2,3-cd)pyrene	ug/l	--	--	**0.36**	**3.2 JD**	**0.83**	**17 D**
Isophorone	ug/l	2340	--	0.20 U	3.9 U	0.20 U	20 U
Naphthalene	ug/l	620	--	**0.078 J**	**6900 D ***	**0.27**	**11000 D ***
Nitrobenzene	ug/l	540	--	0.20 U	3.9 U	0.20 U	3.9 U
N-Nitroso-di-n-propylamine	ug/l	117	--	0.20 U	3.9 U	0.20 U	3.9 U
n-Nitrosodiphenylamine	ug/l	210	--	0.20 U	3.9 U	0.20 U	3.9 U
Pentachlorophenol	ug/l	15	15	**0.072 J**	20 U	**0.071 J**	**2.0 JD**
Phenanthrene	ug/l	6.3	--	**0.49**	**280 D ***	**1**	**300 D ***
Phenol	ug/l	110	--	**0.10 J**	**8.9 JD**	**0.17 J**	**2.5 JD**
Pyrene	ug/l	--	--	**20 D**	**58 D**	**6**	**110 D**
Volatile Organic Compounds (VOC)							
1,1,1-Trichloroethane	ug/l	11	--	0.50 U	0.50 U	0.50 U	0.50 U
1,1,2,2-Tetrachloroethane	ug/l	2400	--	0.50 U	0.50 U	0.50 U	0.50 U
1,1,2-Trichloroethane	ug/l	9400	--	0.50 U	0.50 U	0.50 U	0.50 U
1,1,2-Trichlorotrifluoroethane	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
1,1-Dichloroethane	ug/l	47	--	0.50 U	0.50 U	0.50 U	0.50 U
1,1-Dichloroethene	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
1,2,3-Trichlorobenzene	ug/l	--	--	2.0 U	2.0 U	2.0 U	2.0 U
1,2,4-Trichlorobenzene	ug/l	110	--	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dibromo-3-chloropropane	ug/l	--	--	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichlorobenzene	ug/l	14	--	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dichloroethane	ug/l	20000	--	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dichloropropane	ug/l	5700	--	0.50 U	0.50 U	0.50 U	0.50 U
1,3-Dichlorobenzene	ug/l	71	--	0.50 U	0.50 U	0.50 U	0.50 U
1,4-Dichlorobenzene	ug/l	15	--	0.50 U	0.50 U	0.50 U	0.50 U
2-Butanone (MEK)	ug/l	14000	--	20 U	20 U	20 U	20 U
2-Hexanone	ug/l	99	--	20 U	20 U	20 U	20 U
4-Methyl-2-pentanone (MIBK)	ug/l	170	--	20 U	20 U	20 U	20 U
Acetone	ug/l	1500	--	**24**	**53**	**25**	**8.4 J**
Benzene	ug/l	130	--	0.50 U	**810 D ***	**0.26 J**	**220 D ***
Bromochloromethane	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U

Table 4
Elutrate Testing Analytical Summary
Draft-Unvalidated Results

Location ID Sample ID Sample Date Depth Interval Sediment Zone	Units	ODEQ Freshwater	EPA AWQC	RAA-03 RAA-03SD- 7/21/2004 5-13 ft Visually Cont.	RAA-11 RAA-11SD- 7/22/2004 2-4 ft Tar Body	RAA-11 RAA-11SD- 7/22/2004 4-13 ft Visually Cont.	RAA-13 RAA-13SD- 7/20/2004 9-11 ft Tar Body
Bromodichloromethane	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
Bromoform	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
Bromomethane	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
Carbon disulfide	ug/l	0.92	--	0.50 U	0.53	0.50 U	0.50 U
Carbon tetrachloride	ug/l	74	--	0.50 U	0.50 U	0.50 U	0.50 U
Chlorobenzene	ug/l	50	--	0.50 U	0.50 U	0.50 U	**0.35 J**
Chloroethane	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
Chloroform	ug/l	1240	--	0.50 U	0.50 U	0.50 U	0.50 U
Chloromethane	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
cis-1,2-Dichloroethene	ug/l	590	--	0.50 U	0.50 U	0.50 U	0.50 U
cis-1,3-Dichloropropene	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
Cyclohexane	ug/l	--	--	1.0 U	1.0 U	1.0 U	1.0 U
Dibromochloromethane	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
Dichlorodifluoromethane	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
Dichloromethane	ug/l	2200	--	**0.66 J**	**0.67 J**	**0.53 J**	**0.90 J**
Ethylbenzene	ug/l	7.3	--	0.50 U	**62 D ***	0.50 U	**290 D ***
Isopropylbenzene	ug/l	--	--	2.0 U	**23**	**2.0 U**	**14**
m,p-Xylenes	ug/l	--	--	0.50 U	**210 D**	0.50 U	**210 D**
Methyl acetate	ug/l	--	--	1.0 U	1.0 U	1.0 U	1.0 U
Methyl cyclohexene	ug/l	--	--	1.0 U	1.0 U	1.0 U	1.0 U
Methyltert-butylether	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
o-Xylene	ug/l	--	--	0.50 U	**100 D**	0.50 U	**120 D**
Styrene	ug/l	--	--	0.50 U	**38**	0.50 U	0.50 U
Tetrachloroethene	ug/l	840	--	0.50 U	0.50 U	0.50 U	0.50 U
Toluene	ug/l	9.8	--	0.50 U	**320 D ***	0.50 U	**160 D ***
trans-1,2-Dichloroethene	ug/l	590	--	0.50 U	0.50 U	0.50 U	0.50 U
trans-1,3-Dichloropropene	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
Trichloroethene	ug/l	--	--	0.50 U	**0.15 J**	0.50 U	**0.17 J**
Trichlorofluoromethane	ug/l	--	--	0.50 U	0.50 U	0.50 U	0.50 U
Vinyl chloride	ug/l	1300	--	0.50 U	0.50 U	0.50 U	0.50 U

Note:

D The reported result is from a dilution.

J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

U The compound was analyzed for, but was not detected at or above the MRL/MDL..

Z The chromatographic fingerprint does not resemble a petroleum product.

***** The result is greater than the criteria value.

Table 5
Toxicity Characteristic Leaching Procedure Analytical Summary and Comparison to Criteria
Draft-Unvalidated Data

Location ID Sample ID Sample Date Depth Interval Sediment Zone	Units	TCLP Criteria	RAA-03 RAA-03SD-0513 7/21/2004 5-13 ft Visually Cont.	RAA-11 RAA-11SD-0204 7/22/2004 2-4 ft Tar Body	RAA-11 RAA-11SD-0413 7/22/2004 4-13 ft Visually Cont.	RAA-13 RAA-13SD-0911 7/20/2004 9-11 ft Tar Body
Metals						
Arsenic	mg/l	5	**0.03 B**	0.1 U	0.1 U	0.1 U
Barium	mg/l	100	**1.5**	**0.6 B**	**0.6 B**	**0.5 B**
Cadmium	mg/l	1	0.01 U	0.01 U	0.01 U	0.01 U
Chromium	mg/l	5	0.01 U	**0.004 B**	**0.003 B**	**0.003 B**
Lead	mg/l	5	0.05 U	0.05 U	0.05 U	0.05 U
Selenium	mg/l	1	0.1 U	0.1 U	0.1 U	0.1 U
Silver	mg/l	5	0.02 U	0.02 U	0.02 U	0.02 U
Mercury	mg/l	0.2	0.001 U	0.001 U	0.001 U	0.001 U
Pesticides						
Chlordane	mg/l	0.03	0.0050 U	0.0050 U	0.0050 U	0.0050 U
Endrin	mg/l	0.02	0.00050 U	0.00050 U	0.00050 U	0.00050 U
gamma-BHC (Lindane)	mg/l	0.4	0.00050 U	0.00050 U	0.00050 U	0.00050 U
Heptachlor	mg/l	0.008	0.00050 U	0.00050 U	0.00050 U	0.00050 U
Heptachlor Epoxide	mg/l	--	0.00050 U	0.00050 U	0.00050 U	0.00050 U
Methoxychlor	mg/l	10	0.0010 U	0.0010 U	0.0010 U	0.0010 U
Toxaphene	mg/l	0.5	0.010 U	0.010 U	0.010 U	0.010 U
2,4-D	ug/l	10000	100 U	100 U	100 U	100 U
Silvex	ug/l	1000	20 U	20 U	20 U	20 U
Semi-Volatile Organic Compounds (SVOC)						
1,4-Dichlorobenzene	ug/l	7500	--	--	--	--
2,4,5-Trichlorophenol	mg/l	400	0.10 U	0.10 U	0.10 U	0.10 U
2,4,6-Trichlorophenol	mg/l	2	0.10 U	0.10 U	0.10 U	0.10 U
2,4-Dinitrotoluene	mg/l	0.13	0.10 U	0.10 U	0.10 U	0.10 U
2-Methylphenol	mg/l	200	0.10 U	**0.022 J**	0.10 U	0.10 U
4-Methylphenol	mg/l	200	0.10 U	**0.083 J**	0.10 U	0.10 U
Hexachlorobenzene	mg/l	0.13	0.10 U	0.10 U	0.10 U	0.10 U
Hexachlorobutadiene	mg/l	0.5	0.10 U	0.10 U	0.10 U	0.10 U
Hexachloroethane	mg/l	3	0.10 U	0.10 U	0.10 U	0.10 U
Nitrobenzene	mg/l	2	0.10 U	0.10 U	0.10 U	0.10 U
Pentachlorophenol	mg/l	100	0.25 U	0.25 U	0.25 U	0.25 U
Pyridine	mg/l	2	0.50 U	0.50 U	0.50 U	0.50 U
Volatile Organic Compounds (VOC)						
1,1-Dichloroethene	mg/l	0.7	0.20 U	0.20 U	0.20 U	0.20 U
1,2-Dichloroethane	mg/l	0.5	0.20 U	0.20 U	0.20 U	0.20 U
1,4-Dichlorobenzene	mg/l	7.5	0.20 U	0.20 U	0.20 U	0.20 U
2-Butanone (MEK)	mg/l	200	8.0 U	8.0 U	8.0 U	8.0 U
Benzene	mg/l	0.5	0.20 U	**30 ***	**0.45**	**3.3 ***
Carbon tetrachloride	mg/l	0.5	0.20 U	0.20 U	0.20 U	0.20 U
Chlorobenzene	mg/l	100	0.20 U	0.20 U	0.20 U	0.20 U
Chloroform	mg/l	6	0.20 U	0.20 U	0.20 U	0.20 U
Tetrachloroethene	mg/l	0.7	0.20 U	0.20 U	0.20 U	0.20 U
Trichloroethene	mg/l	0.5	0.20 U	0.20 U	0.20 U	0.20 U
Vinyl chloride	mg/l	0.2	0.080 U	0.080 U	0.080 U	0.080 U

Notes:

B The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

U The compound was analyzed for, but was not detected at or above the MRL/MDL.

***** The result is greater than the criteria value.

Table 6
Comparison Analytical Results for Visually Contaminated Visually Uncontaminated Zones
Draft-Unvalidated Data

Location ID		RAA-02	RAA-04	RAA-06	RAA-06	RAA-09	RAA-13	RAA-14	RAA-17	RAA-20	RAA-04	RAA-05	RAA-06
Sample ID		RAA-02SD-1019	RAA-04SD-0506	RAA-06SD-0415	RAA-06SD-0407	RAA-09SD-0516	RAA-13SD-1115	RAA-14SD-1014	RAA-17SD-0010	RAA-20SD-0506	RAA-04SD-0620	RAA-05SD-1020	RAA-06SD-1520
Sample Date		7/20/2004	7/21/2004	7/20/2004	7/20/2004	7/19/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004	7/21/2004	7/22/2004	7/20/2004
Depth Interval		10-19 ft	5-6 ft	4-15 ft	4-7 ft	5-16 ft	11-15 ft	10-14 ft	0-10 ft	5-6 ft	6-20 ft	10-20 ft	15-20 ft
Sediment Zone	Unit	VC	VC	VC	VC	VC	VC	VC	VC	VC	VU	VU	VU
Conventionals													
Total Organic Carbon	%	10.2	8.96 X	3.68	--	6.46	13.2	14.2	5.87	--	--	1.63	1.39
Total Solids	%	61.6	74.8	68.7	70.8	73.7	69.1	61.5	62	66.9	63.9	66.2	66.6
Cyanide	mg/kg	0.08 J	1.7	0.17 J	--	0.8	0.7	0.8	0.14 J	--	--	0.2 U	0.2 U
Percent fines	%	69.7	--	26.67	--	9.89	17.88	52.9	48.64	--	--	57.7	46.3
Metals													
Arsenic	mg/kg	3	--	2.3	--	1.9	1.7	2.8	3	--	--	2.5	2.7
Chromium	mg/kg	19.8	--	18.3	--	14.9	11.6	18	18.6	--	--	19.2	17.7
Copper	mg/kg	27.1	--	19.4	--	15.8	14.1	26.9	26.3	--	--	23.7	22.6
Lead	mg/kg	26.1	--	20	--	10.2	9.83	18.5	19.8	--	--	10.7	14
Nickel	mg/kg	19.6	--	19.6	--	19.5	15.8	20.8	20.4	--	--	19	18.2
Zinc	mg/kg	64.1	--	50.2	--	41.5	43.8	79.9	64.5	--	--	51.3	53.8
Total Petroleum Hydrocarbons (TPH)													
TPH - Diesel Range	mg/kg	8800 Z	26000 DZ	2800 Z	--	15000 Z	17000 Z	51000 DZ	3400 Z	--	--	190 Y	130 Y
TPH - Residual Range	mg/kg	8100 Z	14000 DZ	2800 Z	--	9100 Z	11000 Z	24000 DZ	3600 Z	--	--	420 O	300 O
Semivolatile Organic Compounds (SVOC)													
2,4,5-Trichlorophenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2,4,6-Trichlorophenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2,4-Dichlorophenol	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
2,4-Dimethylphenol	ug/kg	25000 U	--	--	--	10000 U	50000 U	--	4000 U	--	--	--	50 U
2,4-Dinitrophenol	ug/kg	100000 U	--	--	--	40000 U	20000 U	--	16000 U	--	--	--	200 U
2,4-Dinitrotoluene	ug/kg	5000 U	--	--	--	2000 U	1300 Ui	--	800 U	--	--	--	10 U
2,6-Dinitrotoluene	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2-Chloronaphthalene	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2-Chlorophenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2-Methylnaphthalene	ug/kg	65000 D	510000 D	7500 D	--	210000 D	440000 D	1600000 D	11000 D	--	--	260 D	7.2 J
2-Methylphenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
2-Nitroaniline	ug/kg	10000 U	--	--	--	4000 U	2000 U	--	1600 U	--	--	--	20 U
2-Nitrophenol	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
3,3'-Dichlorobenzidine	ug/kg	50000 U	--	--	--	20000 U	10000 U	--	8000 U	--	--	--	100 U
3-Nitroaniline	ug/kg	10000 U	--	--	--	4000 U	2000 U	--	1600 U	--	--	--	20 U
4,6-Dinitro-2-methylphenol	ug/kg	50000 U	--	--	--	20000 U	10000 U	--	8000 U	--	--	--	100 U
4-Bromophenylphenylether	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
4-Chloro-3-methylphenol	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
4-Chloroaniline	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
4-Chlorophenyl-phenylether	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
4-Methylphenol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	63
4-Nitroaniline	ug/kg	10000 U	--	--	--	4000 U	2000 U	--	1600 U	--	--	--	20 U
4-Nitrophenol	ug/kg	50000 U	--	--	--	20000 U	10000 U	--	8000 U	--	--	--	100 U
Acenaphthene	ug/kg	200000 D	710000 D	47000 D	--	230000 D	830000 D	1400000 D	61000 D	--	--	1000 D	100
Acenaphthylene	ug/kg	9900 D	99000 D	3000 D	--	170000 D	140000 D	190000 D	3400 D	--	--	120 D	36
Anthracene	ug/kg	95000 D	400000 D	28000 D	--	160000 D	420000 D	550000 D	32000 D	--	--	780 D	110
Benzo(a)anthracene	ug/kg	89000 D	290000 D	24000 D	--	130000 D	340000 D	410000 D	29000 D	--	--	940 D	280
Benzo(a)pyrene	ug/kg	130000 D	340000 D	35000 D	--	170000 D	450000 D	500000 D	43000 D	--	--	1800 D	610 D
Benzo(b)fluoranthene	ug/kg	110000 D	200000 D	20000 D	--	150000 D	390000 D	290000 D	37000 D	--	--	1100 D	540 D
Benzo(g,h,i)perylene	ug/kg	120000 D	260000 D	33000 D	--	140000 D	370000 D	390000 D	38000 D	--	--	2000 D	680 D
Benzo(k)fluoranthene	ug/kg	36000 D	210000 D	21000 D	--	48000 D	130000 D	330000 D	10000 D	--	--	980 D	140 D
Benzoic acid	ug/kg	100000 U	--	--	--	40000 U	200000 U	--	16000 U	--	--	--	200 U
Benzyl alcohol	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
bis(2-Chloroethoxy)methane	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
bis(2-Chloroethyl)ether	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
bis(2-chloroisopropyl)ether	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
bis(2-Ethylhexyl)phthalate	ug/kg	100000 U	--	--	--	810 JD	20000 Ui	--	16000 U	--	--	--	8.7 J
Butylbenzylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Chrysene	ug/kg	110000 D	380000 D	30000 D	--	170000 D	420000 D	500000 D	35000 D	--	--	1300 D	380
Dibenzo(a,h)anthracene	ug/kg	12000 D	22000 D	2000 D	--	17000 D	48000 D	33000 D	4100 D	--	--	110 D	39 JD
Dibenzofuran	ug/kg	5600 D	56000 D	1700 D	--	17000 D	40000 D	81000 D	1800 D	--	--	36 D	3.4 J
Diethylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Dimethylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Di-n-butylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Di-n-octylphthalate	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Fluoranthene	ug/kg	330000 D	1100000 D	97000 D	--	520000 D	1300000 D	1600000 D	120000 D	--	--	4500 D	1300 D
Fluorene	ug/kg	60000 D	360000 D	15000 D	--	140000 D	340000 D	590000 D	20000 D	--	--	360 D	34
Hexachlorobenzene	ug/kg	--	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Hexachlorobutadiene	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
Hexachlorocyclopentadiene	ug/kg	25000 U	--	--	--	10000 U	5000 U	--	4000 U	--	--	--	50 U

Table 6
Comparison Analytical Results for Visually Contaminated Visually Uncontaminated Zones
Draft-Unvalidated Data

Location ID Sample ID Sample Date Depth Interval Sediment Zone	Unit	RAA-02 RAA-02SD-1019 7/20/2004 10-19 ft VC	RAA-04 RAA-04SD-0506 7/21/2004 5-6 ft VC	RAA-06 RAA-06SD-0415 7/20/2004 4-15 ft VC	RAA-06 RAA-06SD-0407 7/20/2004 4-7 ft VC	RAA-09 RAA-09SD-0516 7/19/2004 5-16 ft VC	RAA-13 RAA-13SD-1115 7/20/2004 11-15 ft VC	RAA-14 RAA-14SD-1014 7/20/2004 10-14 ft VC	RAA-17 RAA-17SD-0010 7/22/2004 0-10 ft VC	RAA-20 RAA-20SD-0506 7/22/2004 5-6 ft VC	RAA-04 RAA-04SD-0620 7/21/2004 6-20 ft VU	RAA-05 RAA-05SD-1020 7/22/2004 10-20 ft VU	RAA-06 RAA-06SD-1520 7/20/2004 15-20 ft VU
Hexachloroethane	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Indeno(1,2,3-cd)pyrene	ug/kg	100000 D	220000 D	28000 D	--	130000 D	330000 D	330000 D	31000 D	--	--	1700 D	530 D
Isophorone	ug/kg	5000 U	--	--	--	2000 U	10000 U	--	800 U	--	--	--	10 U
Naphthalene	ug/kg	640000 D	1600000 D	26000 D	--	1400000 D	3200000 D	6300000 D	96000 D	--	--	1100 D	56
Nitrobenzene	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
N-Nitroso-di-n-propylamine	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
n-Nitrosodiphenylamine	ug/kg	5000 U	--	--	--	2000 U	1000 U	--	800 U	--	--	--	10 U
Pentachlorophenol	ug/kg	50000 U	--	--	--	20000 U	10000 U	--	8000 U	--	--	--	100 U
Phenanthrene	ug/kg	440000 D	2200000 D	150000 D	--	910000 D	2200000 D	3200000 D	150000 D	--	--	4000 D	660 D
Phenol	ug/kg	15000 U	--	--	--	6000 U	3000 U	--	2400 U	--	--	--	8.4 J
Pyrene	ug/kg	400000 D	1500000 D	150000 D	--	590000 D	1400000 D	2200000 D	140000 D	--	--	5700 D	1600 D
Volatile Organic Compounds (VOC)													
1,1,1-Trichloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1,2,2-Tetrachloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1,2-Trichloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1,2-Trichlorotrifluoroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1-Dichloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,1-Dichloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,2,3-Trichlorobenzene	ug/kg	--	--	--	--	--	--	--	3200 U	--	--	--	--
1,2,4-Trichlorobenzene	ug/kg	33 U	--	--	--	120 U	150 U	--	800 U	--	--	--	10 U
1,2-Dibromo-3-chloropropane	ug/kg	33 U	--	--	--	120 U	150 U	--	3200 U	--	--	--	30 U
1,2-Dichlorobenzene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,2-Dichloroethane	ug/kg	6.1 J	--	--	--	140	36 U	--	800 U	--	--	--	7.5 U
1,2-Dichloropropane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,3-Dichlorobenzene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
1,4-Dichlorobenzene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
2-Butanone (MEK)	ug/kg	33 U	--	--	--	120 U	150 U	--	32000 U	--	--	--	30 U
2-Hexanone	ug/kg	33 U	--	--	--	120 U	150 U	--	32000 U	--	--	--	30 U
4-Methyl-2-pentanone (MIBK)	ug/kg	33 U	--	--	--	120 U	150 U	--	32000 U	--	--	--	30 U
Acetone	ug/kg	33 U	--	--	--	58 J	150 U	--	32000 U	--	--	--	61
Benzene	ug/kg	290	17000	190	1200	6700	620	18000	800 U	400	2.2 J	--	7.5 U
Bromochloromethane	ug/kg	--	--	--	--	--	--	--	800 U	--	--	--	--
Bromodichloromethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Bromoform	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Bromomethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Carbon disulfide	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Carbon tetrachloride	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Chlorobenzene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Chloroethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Chloroform	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Chloromethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
cis-1,2-Dichloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
cis-1,3-Dichloropropene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Cyclohexane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	1600 U	--	--	--	7.5 U
Dibromochloromethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Dichlorodifluoromethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Dichloromethane	ug/kg	17 U	--	--	--	7.0 J	12 J	--	3200 U	--	--	--	1.7 J
Ethylbenzene	ug/kg	53	7100	120	370	780	130	31000	1600	1300	7.8 U	--	7.5 U
Isopropylbenzene	ug/kg	3.5 J	--	--	--	72 J	19 J	--	190 J	--	--	--	30 U
m,p-Xylenes	ug/kg	25	6900	32	120	580	200	21000 Ui	800 U	570	7.8 U	--	7.5 U
Methyl acetate	ug/kg	8.1 U	--	--	--	28 U	36 U	--	1600 U	--	--	--	7.5 U
Methyl cyclohexene	ug/kg	8.1 U	--	--	--	6.7 J	36 U	--	1600 U	--	--	--	7.5 U
Methyltert-butylether	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
o-Xylene	ug/kg	13	4800	49	170	350	100	11000	330 J	700	7.8 U	--	7.5 U
Styrene	ug/kg	8.1 U	--	--	--	60	36 U	--	800 U	--	--	--	7.5 U
Tetrachloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Toluene	ug/kg	3.2 J	1300	11	54	1500	56	3800	800 U	100 J	7.8 U	--	7.5 U
trans-1,2-Dichloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
trans-1,3-Dichloropropene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Trichloroethene	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Trichlorofluoromethane	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U
Vinyl Acetate	ug/kg	33 U	--	--	--	120 U	150 U	--	--	--	--	--	30 U
Vinyl chloride	ug/kg	8.1 U	--	--	--	28 U	36 U	--	800 U	--	--	--	7.5 U

Table 6
Comparison Analytical Results for Visually Contaminated Visually Uncontaminated Zones
Draft-Unvalidated Data

Location ID	RAA-08	RAA-10	RAA-11	RAA-11	RAA-12	RAA-14	RAA-17	RAA-19
Sample ID	RAA-08SD-0720	RAA-10SD-1020	RAA-11SD-1320	RAA-61SD-1320	RAA-12SD-1820	RAA-14SD-1420	RAA-17SD-1420	RAA-19SD-0920
Sample Date	7/21/2004	7/19/2004	7/22/2004	7/22/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004
Depth Interval	7-20 ft	10-20 ft	13-20 ft	13-20 ft	18-20 ft	14-20 ft	14-20 ft	9-20 ft
Sediment Zone	VU	VU	VU	VU	VU	VU	VU	VU
Conventionals								
Total Organic Carbon	0.84 X	4.87	1.35	1.52	2.76	0.36	1.65	0.83
Total Solids	67.8	65.5	66.4	65.3	62.6	72	62.3	69.3
Cyanide	0.04 J	0.1 J	0.2 U	0.2 U	0.09 J	0.06 J	0.3	0.2 U
Percent fines	52.5	71.4	53.7	54.6	79.9	27.14	64.04	49.5
Metals								
Arsenic	1.9	2.5	2.9	2.9	2.9	2.3	3.2	1.8
Chromium	17.7	18.3	18	18.5	20.3	17.3	21.5	18.3
Copper	21.4	25.9	23.3	23.4	28.6	18.6	26.8	21.8
Lead	4.59	16	12.8	12.8	19	3.47	15	4.68
Nickel	18.8	18.4	18	18.7	18.9	20.5	20.6	19.8
Zinc	43.3	56.5	51.2	52.1	65.1	42.4	57.6	44.6
Total Petroleum Hydrocarbons (TPH)								
TPH - Diesel Range	17 J	2800 Z	190 Y	160 Y	510 Z	24 U	180 Y	23 U
TPH - Residual Range	39 J	2700 Z	340 O	300 O	760 Z	49 J	370 O	31 J
Semivolatile Organic Compounds (SVOC)								
2,4,5-Trichlorophenol	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2,4,6-Trichlorophenol	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2,4-Dichlorophenol	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2,4-Dimethylphenol	--	5100 U	--	--	5000 U	50 U	40 U	--
2,4-Dinitrophenol	--	21000 U	--	--	20000 U	200 U	160 U	--
2,4-Dinitrotoluene	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2,6-Dinitrotoluene	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2-Chloronaphthalene	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2-Chlorophenol	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2-Methylnaphthalene	140	31000 D	440 D	850 D	2300 D	39	160	15
2-Methylphenol	--	1100 U	--	--	1000 U	10 U	8.0 U	--
2-Nitroaniline	--	2100 U	--	--	2000 U	20 U	16 U	--
2-Nitrophenol	--	1100 U	--	--	1000 U	10 U	8.0 U	--
3,3'-Dichlorobenzidine	--	11000 U	--	--	10000 U	100 U	80 U	--
3-Nitroaniline	--	2100 U	--	--	2000 U	20 U	16 U	--
4,6-Dinitro-2-methylphenol	--	11000 U	--	--	10000 U	100 U	80 U	--
4-Bromophenylphenylether	--	1100 U	--	--	1000 U	10 U	8.0 U	--
4-Chloro-3-methylphenol	--	1100 U	--	--	1000 U	10 U	8.0 U	--
4-Chloroaniline	--	1100 U	--	--	1000 U	10 U	8.0 U	--
4-Chlorophenyl-phenylether	--	1100 U	--	--	1000 U	10 U	8.0 U	--
4-Methylphenol	--	1100 U	--	--	1000 U	10 U	51	--
4-Nitroaniline	--	2100 U	--	--	2000 U	20 U	16 U	--
4-Nitrophenol	--	11000 U	--	--	10000 U	100 U	80 U	--
Acenaphthene	200	120000 D	1600 D	1900 D	14000 D	150	120000 D	370
Acenaphthylene	90	4900 D	200 D	290 D	640 JD	12	57	8
Anthracene	140	63000 D	960 D	1000 D	9600 D	56	56000 D	9.4
Benzo(a)anthracene	140	50000 D	910 D	1100 D	7900 D	42	78000 D	16
Benzo(a)pyrene	200	67000 D	1800 D	2100 D	11000 D	60	130000 D	22
Benzo(b)fluoranthene	120	58000 D	1100 D	1200 D	9900 D	53	110000 D	16
Benzo(g,h,i)perylene	160	63000 D	2200 D	2600 D	11000 D	56	130000 D	21
Benzo(k)fluoranthene	110	17000 D	900 D	1100 D	2900 D	16	260	13
Benzoic acid	--	21000 U	--	--	20000 U	200 U	160 U	--
Benzyl alcohol	--	1100 U	--	--	1000 U	10 U	8.0 U	--
bis(2-Chloroethoxy)methane	--	1100 U	--	--	1000 U	10 U	8.0 U	--
bis(2-Chloroethyl)ether	--	1100 U	--	--	1000 U	10 U	8.0 U	--
bis(2-chloroisopropyl)ether	--	1100 U	--	--	1000 U	10 U	8.0 U	--
bis(2-Ethylhexyl)phthalate	--	21000 U	--	--	20000 U	37 J	8.3 J	--
Butylbenzylphthalate	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Chrysene	160	63000 D	1300 D	1500 D	10000 D	80	93000 D	23
Dibenzo(a,h)anthracene	17	7100 D	97 D	110 D	860 JD	5.4 J	100	1.6 J
Dibenzofuran	18	3700 D	64 D	97 D	370 JD	5.4 J	25	1.3 J
Diethylphthalate	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Dimethylphthalate	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Di-n-butylphthalate	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Di-n-octylphthalate	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Fluoranthene	410	200000 D	5000 D	5600 D	33000 D	150	310000 D	47
Fluorene	120	44000 D	510 D	750 D	5600 D	45	300	12
Hexachlorobenzene	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Hexachlorobutadiene	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Hexachlorocyclopentadiene	--	5100 U	--	--	5000 U	50 U	40 U	--

Table 6
Comparison Analytical Results for Visually Contaminated Visually Uncontaminated Zones
Draft-Unvalidated Data

Location ID	RAA-08	RAA-10	RAA-11	RAA-11	RAA-12	RAA-14	RAA-17	RAA-19
Sample ID	RAA-08SD-0720	RAA-10SD-1020	RAA-11SD-1320	RAA-61SD-1320	RAA-12SD-1820	RAA-14SD-1420	RAA-17SD-1420	RAA-19SD-0920
Sample Date	7/21/2004	7/19/2004	7/22/2004	7/22/2004	7/20/2004	7/20/2004	7/22/2004	7/22/2004
Depth Interval	7-20 ft	10-20 ft	13-20 ft	13-20 ft	18-20 ft	14-20 ft	14-20 ft	9-20 ft
Sediment Zone	VU	VU	VU	VU	VU	VU	VU	VU
Hexachloroethane	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Indeno(1,2,3-cd)pyrene	160	52000 D	1800 D	2100 D	8900 D	47	110000 D	16
Isophorone	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Naphthalene	650	140000 D	1500 D	2800 D	2000 D	220	93000 D	36 B
Nitrobenzene	--	1100 U	--	--	1000 U	10 U	8.0 U	--
N-Nitroso-di-n-propylamine	--	1100 U	--	--	1000 U	10 U	8.0 U	--
n-Nitrosodiphenylamine	--	1100 U	--	--	1000 U	10 U	8.0 U	--
Pentachlorophenol	--	11000 U	--	--	10000 U	100 U	80 U	--
Phenanthrene	640	280000 D	4200 D	5200 D	44000 D	260	320000 D	47
Phenol	--	3100 U	--	--	3000 U	5.4 J	11 J	--
Pyrene	480	230000 D	6100 D	7500 D	39000 D	170	380000 D	64
Volatile Organic Compounds (VOC)								
1,1,1-Trichloroethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1,2,2-Tetrachloroethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1,2-Trichloroethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1,2-Trichlorotrifluoroethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1-Dichloroethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,1-Dichloroethene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,2,3-Trichlorobenzene	--	--	--	--	--	--	32 U	--
1,2,4-Trichlorobenzene	--	31 U	--	--	32 U	10 U	8.0 U	--
1,2-Dibromo-3-chloropropane	--	31 U	--	--	32 U	28 U	32 U	--
1,2-Dichlorobenzene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,2-Dichloroethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,2-Dichloropropane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,3-Dichlorobenzene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
1,4-Dichlorobenzene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
2-Butanone (MEK)	--	31 U	--	--	14 J	28 U	32 U	--
2-Hexanone	--	31 U	--	--	32 U	28 U	32 U	--
4-Methyl-2-pentanone (MIBK)	--	31 U	--	--	32 U	28 U	32 U	--
Acetone	--	24 J	--	--	69	24 J	47	--
Benzene	2.9 J	23	7.5 U	1.3 J	8.0 U	3.6 J	7.9 U	9.2
Bromochloromethane	--	--	--	--	--	--	7.9 U	--
Bromodichloromethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Bromoform	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Bromomethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Carbon disulfide	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Carbon tetrachloride	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Chlorobenzene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Chloroethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Chloroform	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Chloromethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
cis-1,2-Dichloroethene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
cis-1,3-Dichloropropene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Cyclohexane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Dibromochloromethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Dichlorodifluoromethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Dichloromethane	--	1.8 J	--	--	3.1 J	1.7 J	2.9 J	--
Ethylbenzene	7.4 U	25	7.5 U	7.6 U	8.0 U	1.5 J	7.9 U	7.2 U
Isopropylbenzene	--	4.1 J	--	--	1.8 J	3.4 J	32 U	--
m,p-Xylenes	7.4 U	10	7.5 U	7.6 U	2.9 J	7.0 U	7.9 U	7.2 U
Methyl acetate	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Methyl cyclohexene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Methyltert-butylether	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
o-Xylene	7.4 U	11	7.5 U	7.6 U	1.5 J	7.0 U	7.9 U	1.0 J
Styrene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Tetrachloroethene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Toluene	1.9 J	2.5 J	7.5 U	7.6 U	8.0 U	7.0 U	7.9 U	7.2 U
trans-1,2-Dichloroethene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
trans-1,3-Dichloropropene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Trichloroethene	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Trichlorofluoromethane	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--
Vinyl Acetate	--	31 U	--	--	32 U	28 U	--	--
Vinyl chloride	--	7.6 U	--	--	8.0 U	7.0 U	7.9 U	--

Notes:
D The reported result is from a dilution.
J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
U The compound was analyzed for, but was not detected at or above the MRL/MDL.
Z The chromatographic fingerprint does not resemble a petroleum product.

VC Visually Contaminated
VU Visually Uncontaminated

Table 7
Comparison of TPAH Concentrations in Tar Body and New Sediment Surface
Draft-Unvalidated Data

	Tar Body	Post-Dredge Surface Concentrations							
Location ID	**SD-7**	**RAA-02**	**RAA-04**	**RAA-06**	**RAA-09**	**RAA-10**	**RAA-11**	**RAA-13**	**RAA-14**
Sample ID	**SD-7-1**	**RAA-02-1019**	**RAA-04-0506**	**RAA-06-1520**	**RAA-09-0516**	**RAA-10-1020**	**RAA-11-1320**	**RAA-13-1115**	**RAA-14-1014**
Sample Reference	**Hahn 1996**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**	**Anchor 2004**
Depth Interval	**0-15 cm**	**10 - 19 ft**	**5 - 6 ft**	**15 - 20 ft**	**5 - 16 ft**	**10 - 20 ft**	**13 - 20 ft**	**11 - 15 ft**	**10 - 14 ft**
Sediment Zone	**Tar Body**	**Visual. Cont.**	**Visual. Cont.**	**Visual. Uncont.**	**Visual. Cont.**	**Visual. Uncont.**	**Visual. Uncont.**	**Visual. Cont.**	**Visual. Cont.**
Total PAH[a] (mg/kg)	26,408	2,947	10,401	7.10	5,285	1,490	38	12,748	20,413
Total PAH[a] (%)	2.64%	0.29%	1.04%	0.00%	0.53%	0.15%	0.00%	1.27%	2.04%

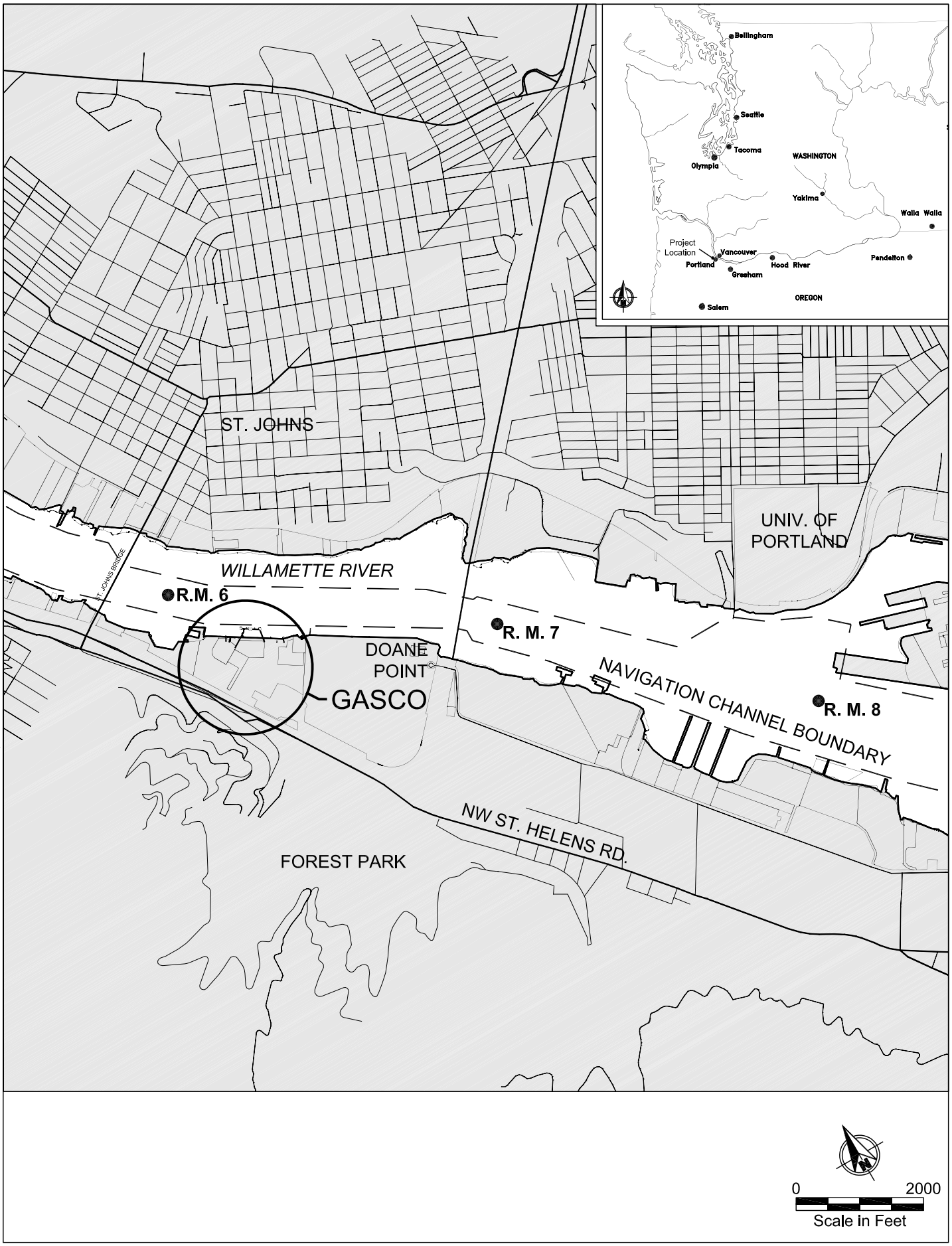
Notes:

[a] - Total PAH concentrations calculated as sum of 17 PAHs (undetected assumed to be zero)

D- Sample has undergone dilution

J- Analyte value is an estimate

FIGURES



Aug 20, 2004 2:10pm sdekleva K:\Jobs\000029-GASCO\00002902\00002902-01.dwg FIG 1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Vicinity Map
Northwest Natural "Gasco" Site

Legend

RAA-10 Design Characterization Sediment Core Location (Anchor 2004)

AN-1-1 Previous Sediment Core Location (Anchor 2001)

MW 5-32 Upland RI/FS Samples (HAI 1998)

SS-5 Previous Soil Sample Location (HAI 1998)

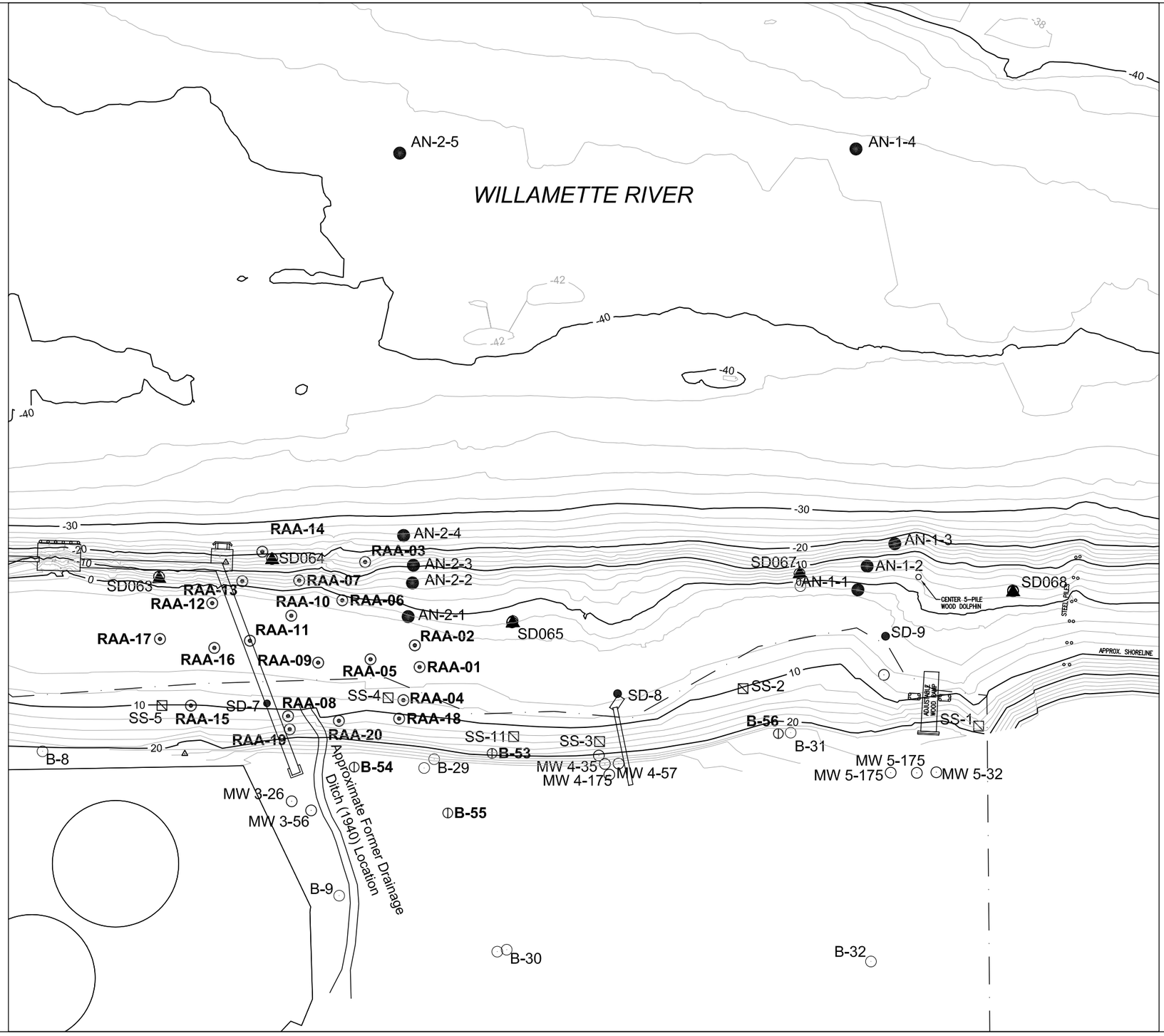
SD063 Previous Sediment Core Location (Weston 1998)

B-53 Upland Source Boring Location (HAI 2004)

Property Line

Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study.
2. Horizontal Datum: Oregon State Plane North NAD83 (feet).
3. Vertical Datum: NAVD88 (feet).
4. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.
5. RAA-19 location approximate pending final survey results.



0 100
Scale in Feet

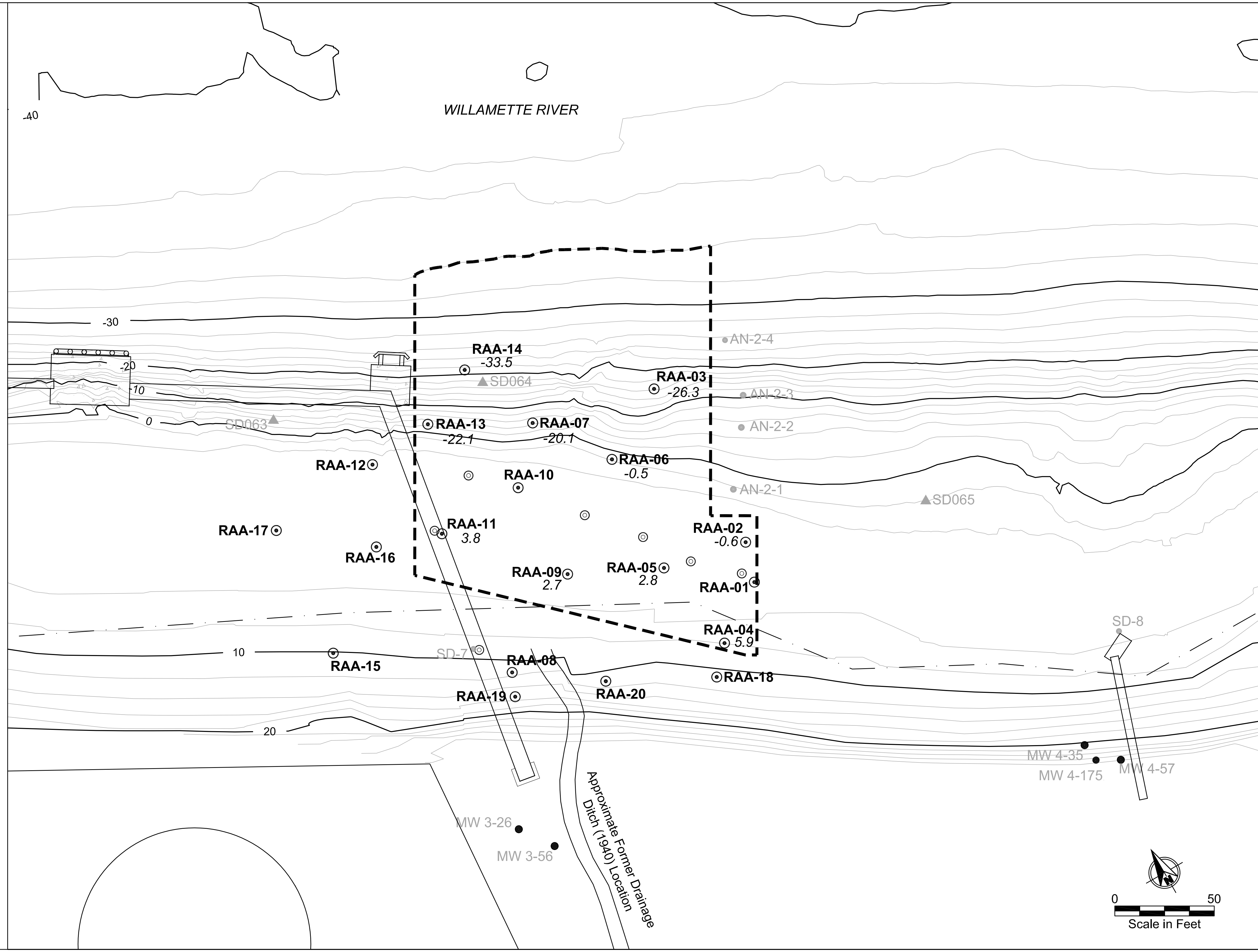
Sep 07, 2004 9:19am sdekleva K:\Jobs\000029-GASCO\00002902\00002902-27.dwg 100scale

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
Summary of Sampling Locations in Vicinity of Tar Body
NW Natural "Gasco" Site

Legend:

- RAA-01 — Design Characterization Sediment Core Location (Anchor 2004)
- Lateral Extents of Tar Body in Removal Action Area
- -33.5 — Bottom Elevation of Surface Tar Body in Removal Action Area (Feet, NAVD88)
- Pile Location (surveyed August 2004)
- Property Line
- AN-1-1 — Previous Sediment Core Location (Anchor 2001)
- SD063 — Previous Sediment Core Location (Weston 1998)



Notes:

1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study.
2. Horizontal Datum: Oregon State Plane North NAD83 (feet).
3. Vertical Datum: NAVD88 (feet).
4. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.
5. RAA-19 location approximate pending final survey results.

Sep 07, 2004 9:21am sdekleva K:\Jobs\000029-GASCO\00002902\00002902-30.dwg Fig3

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 3

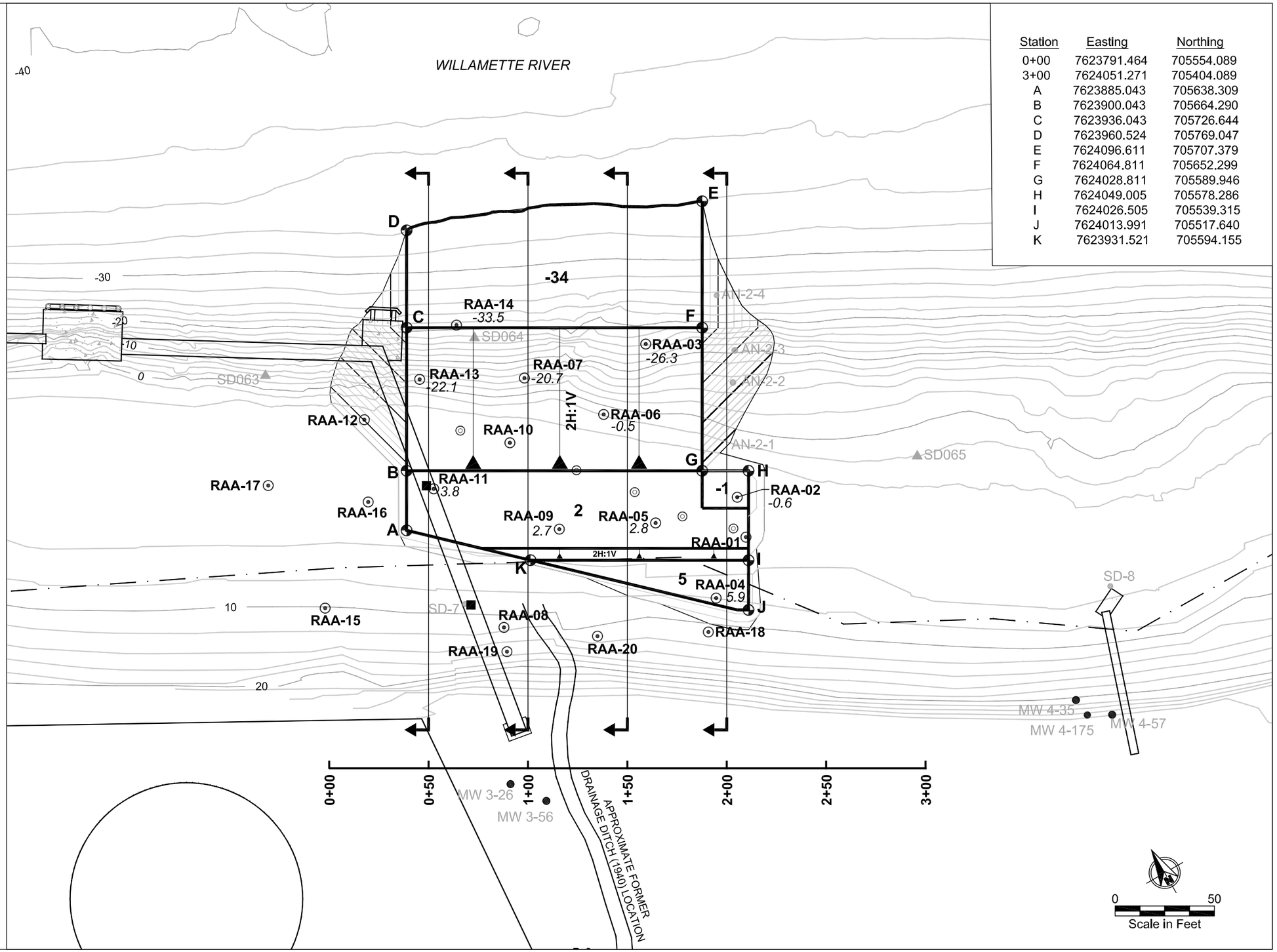
Lateral and Vertical Extents of Surface Tar Body in Removal Action Area

NW Natural "Gasco" Site

Legend:

- **-34** Dredge Prism and Dredge Elevation
- **RAA-01** Sample Location and Number (July 2004, Anchor)
- *-33.5* Bottom Elevation of Surface Tar Body in Removal Action Area (Feet, NAVD88)
- Pile Location (To be removed before dredging)
- Property Line
- Support Pile Locations (to be protected during dredging)
- AN-1-1 Previous Sediment Core Location (Anchor 2001)
- SD063 Previous Sediment Core Location (Weston 1998)

Station	Easting	Northing
0+00	7623791.464	705554.089
3+00	7624051.271	705404.089
A	7623885.043	705638.309
B	7623900.043	705664.290
C	7623936.043	705726.644
D	7623960.524	705769.047
E	7624096.611	705707.379
F	7624064.811	705652.299
G	7624028.811	705589.946
H	7624049.005	705578.286
I	7624026.505	705539.315
J	7624013.991	705517.640
K	7623931.521	705594.155



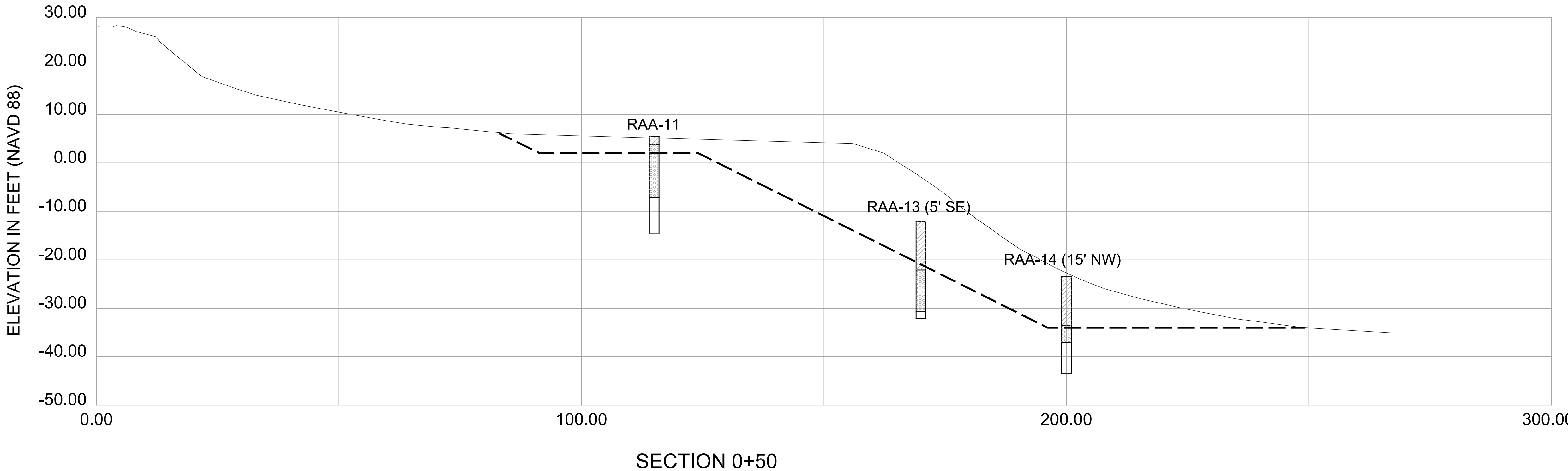
Notes:

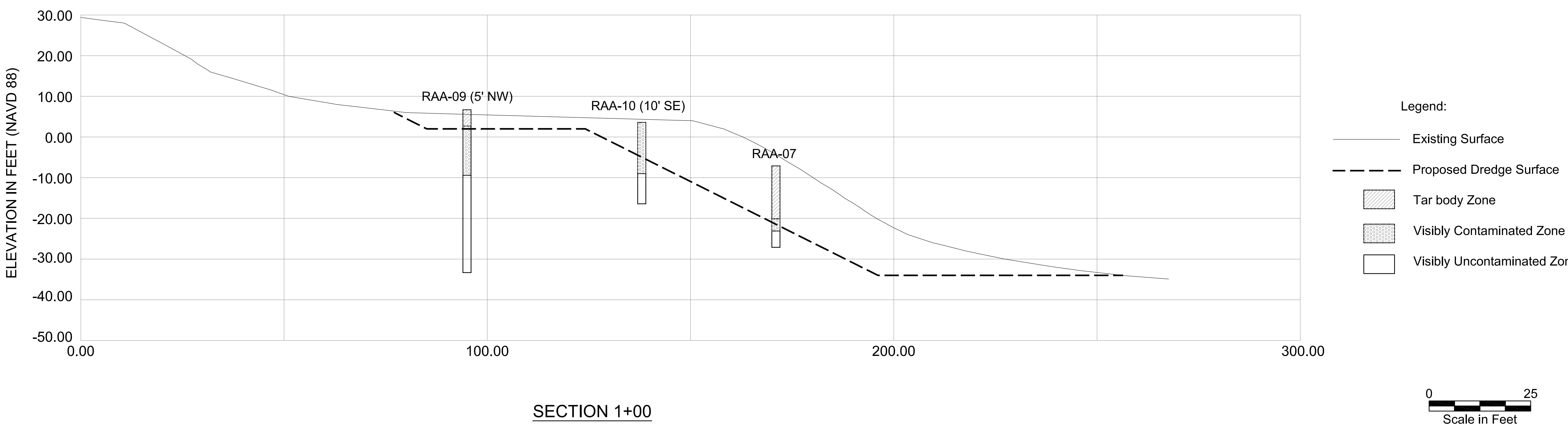
1. Bathymetric contours provided by the Lower Willamette Group as part of the Portland Harbor Superfund Site study.
2. Horizontal Datum: Oregon State Plane North NAD83 (feet).
3. Vertical Datum: NAVD88 (feet).
4. Former Drainage Ditch location from Phase 1 Remedial Investigation Summary Report, Hahn & Associates, 1998.
5. RAA-19 location approximate pending final survey results.

Sep 07, 2004 3:03pm sdekleva K:\Jobs\000029-GASCO\00002902\000002902-32.dwg DredgePlan

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 4
Preliminary Dredge Plan and Cross Section Locations
NW Natural "Gasco" Site





K:\Jobs\000029-GASCO\00002902\00002902-32.dwg Xsec

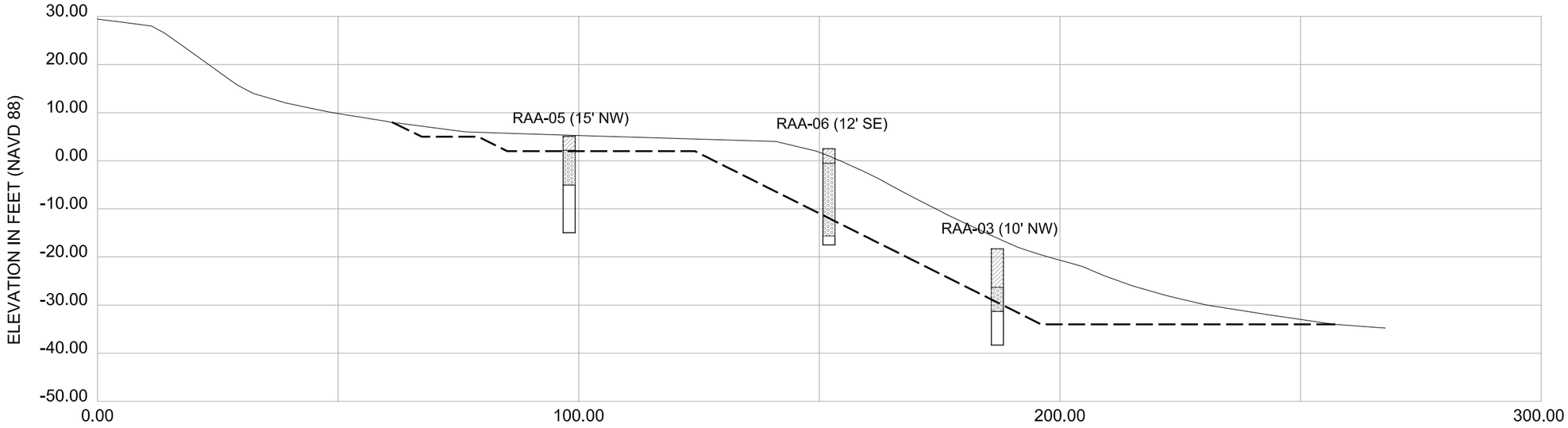
Sep 07, 2004 9:23am sdekleva

ANCHOR ENVIRONMENTAL, L.L.C.

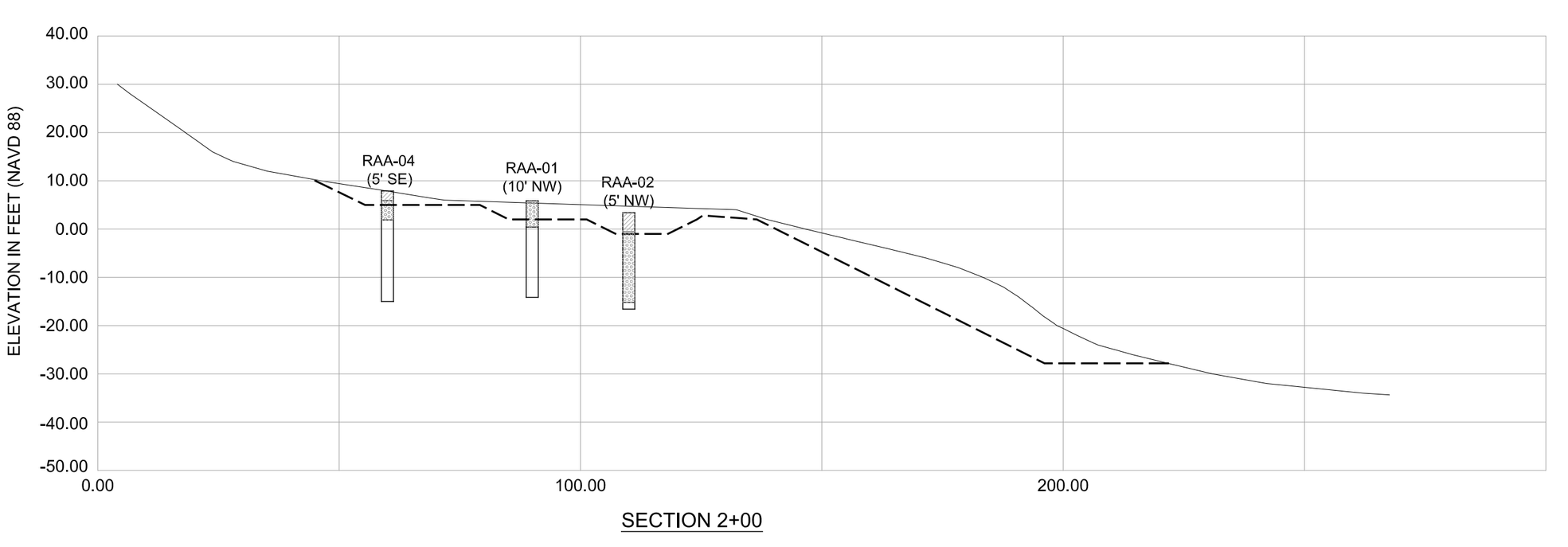
Figure 5a

Preliminary Cross Sections at Stations 0+50 and 1+00

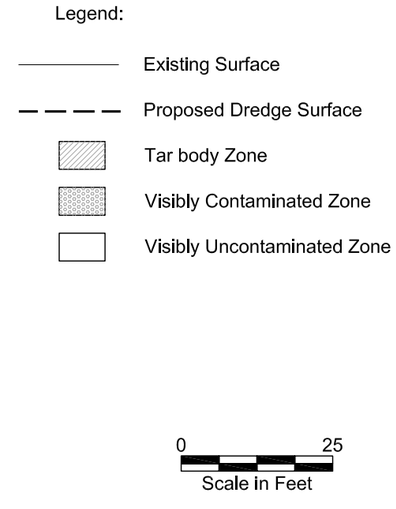
NW Natural "Gasco" Site



SECTION 1+50



SECTION 2+00



Sep 07, 2004 3:13pm sdekleva K:\Jobs\000029-GASCO\00002902\00002902-32.dwg Xsec2

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 5b
Preliminary Cross Sections at Stations 1+50 and 2+00
NW Natural "Gasco" Site

APPENDIX A

TRANSPORTATION AND DISPOSAL PLAN

APPENDIX A

TRANSPORTATION AND DISPOSAL PLAN
DRAFT PRELIMINARY DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for

U.S. Environmental Protection Agency, Region 10

1200 Sixth Avenue

Seattle, Washington 98101

Prepared by

Anchor Environmental, L.L.C.

6650 SW Redwood Lane, Suite 110

Portland, Oregon 97224

On Behalf of

Northwest Natural

220 NW Second Avenue

Portland, Oregon 97209

September 2004

Table of Contents

1 INTRODUCTION

The Draft Transportation and Disposal Plan (TDP) is an appendix to the Draft Remedial Action Project Plan (RAPP) and one of the draft preliminary design documents submitted to U.S. Environmental Protection Agency (EPA) for the removal action at the "Gasco" Site (Site). The Statement of Work (SOW) for the Project indicates that a TDP will be developed for any material that is to be removed from the Site. The purpose of this document is to address the following information:

- Details regarding the transportation of waste materials including transloading, stockpiling, dewatering, and overland transport
- The source and transport of imported cover/cap materials as anticipated at this time
- Precautions that will be used to transport and dispose of the material
- Contingencies for any spills that might occur
- Details regarding the disposal of waste materials including identification of preferred landfills

2 TRANSPORTATION

As explained in the RAPP, the transportation plan presented in this section is assumed based upon available information. Several variables have not been decided, which will affect final TDP details, such as the modes of transportation available to move waste material to the disposal facility. Therefore, alternatives will be presented in the text below as necessary.

2.1 Transloading

A barge-mounted mechanical dredge with a standard clamshell bucket will excavate and load sediment onto a receiving barge. Sediment will be loaded onto the barge, and excess water (return water) will be discharged while loading takes place. Environmental protection measures during this process are described in the Removal Action Environmental Protection Plan (RAEPP) – Appendix E. From this point, one of two alternatives will proceed. In the first alternative, the receiving barge is pushed to a dock (transfer facility) for off-loading. The location of the transfer facility has not yet been determined. Once the receiving barge is properly secured at the facility, a land-based crane-mounted clamshell bucket will off-load sediment from the barge directly into trucks or rail cars. Under this assumption, waste material will not be stockpiled on the Site. The trucks or rail cars will be filled to a pre-determined capacity, at which time they will transport the waste material directly to the selected upland disposal facility. In the second alternative, the receiving barge will be transported directly to the disposal facility, where the material will be off-loaded and placed into disposal cells.

2.2 De-watering

It is estimated that the dredged material including both tar and visually contaminated sediments will be approximately 50 percent water by volume. The amount of dewatering necessary to dispose of this waste material will depend upon the final disposal facility, the grain size of the waste material, the mode of transport, and cost. The preferred landfills can both accept wastes with free liquid; however, the construction contractor may need to provide some solidification to enable overland transport by truck. Transport by rail may not require drying agent to be added, but will reduce flexibility in a schedule already constrained by a 2 month in-water work window. If de-watering becomes necessary, waste material will be placed upon a curbed, drained, concrete pad in the transfer area to settle. Any water that runs off will be collected and either discharged to a sanitary sewer

(assuming appropriate permits can be obtained from the City) or chemically tested, and treated if necessary, prior to discharge back to the river (see RAEPP – Appendix E for details).

3 IMPORTED MATERIAL

It is currently planned that a clean sand cover or pilot cap will be placed over the dredged area. The details of the cover/pilot cap placement and the source of cover material will be determined in the final design. The amount of material for the cover/cap material is currently estimated to be approximately 1,000 cubic yards. The expected source of material will likely be a sand and gravel quarry. Likely potential sources within reasonable distance of the Site include:

- Avery Pit, operated by Ross Island Sand and Gravel
- Angel Quarry, operated by Morse Bros, Inc.
- Glacier Northwest facilities

The sand (or similar) cover/cap material will most likely be transported by barge from off-site, and then off-loaded and placed immediately by the barge-mounted clamshell bucket. The barge will be located within a silt curtain during cover/cap placement to contain suspended sediments. It is not anticipated that stockpiling of the imported material will be necessary.

4 ENVIRONMENTAL PROTECTION

Precautions to protect natural resources will be implemented throughout the removal action, including during transportation and the management of return water. Best management practices (BMPs) for these processes, and contingencies for potential spills, are mentioned below, but are discussed in greater detail in the Removal Action Environmental Project Plan (RAEPP).

4.1 Spill Prevention

BMPs will be implemented during transport to prevent accidental spills on land. The BMPs are described in greater detail the RAEPP. If appropriate to the selected mode of transportation, BMPs for transport may include maximum fill levels and/or solidification to prevent "sloshing" within trucks or containers, impermeable liners to prevent leaks in trucks or containers, and decontamination by brushing or washing all vehicles before they leave the Site.

Steel spill aprons will protect against accidental discharge while off-loading sediment from barges. Return water and storm-water will also be contained and collected in the upland transfer facility and discharged either to a sanitary sewer (assuming appropriate permits can be obtained from the City), or treated as necessary prior to discharge to the river. Discharges to the river will need to meet the substantive requirements of ARARs relevant to water quality as list in the RAWP. The details of any needed treatment system will be determined based on the results of the dredging elutriate test (DRET). If the DRET results indicate that the constituents of interest will not dissolve into water at concentrations greater than applicable water quality standards, the preferred alternative is to discharge the return water after recovering solids.

4.2 Contingencies for Spills

The transportation company will be informed that they are hauling a hazardous substance and will be required to submit a contingency plan for spill control. In the event that a spill occurs, the national response center and the Oregon Department of Environmental Quality (DEQ) will be notified, and containment and cleanup efforts will begin immediately, be completed as soon as possible, and take precedence over normal work. Cleanup will include proper disposal of spilled and clean-up materials.

4.3 Stockpiling

It is not currently anticipated that stockpiling waste material or clean imported material will be necessary. However, if a change in plans necessitates this practice, BMPs such as covering stockpiles with plastic sheeting will be implemented to protect against erosion from contact with stormwater. Any run-off from the plastic sheeting will be collected by the return water and stormwater containment system of the upland transfer facility and handled as described above.

5 DISPOSAL

The following sections will provide detail regarding the selection of preferred disposal facilities, waste profiling for disposal, and the administrative requirements for documenting and tracking the disposal process.

5.1 Identification of Preferred Disposal Facilities

Based upon characterization of the waste material and other factors such as de-watering, the preferred disposal facility locations are Waste Management's Columbia Ridge landfill in Arlington, Oregon, and Rabanco's Roosevelt landfill across the river in Roosevelt, Washington. Both are subtitle D, non-hazardous facilities that can accept waste material and free liquid by truck or rail. Roosevelt landfill provides the opportunity to transport waste material by barge.

5.2 Waste Profiling

Sediment cores were collected from the Site on July 19 to 22, 2004. As approved by EPA, specific samples were analyzed for total petroleum hydrocarbons (TPH), toxicity characteristic leaching procedure (TCLP), and benzene. The results of the analyses are described in the RAPP and indicate that only benzene in tar body samples exceed the criteria promulgated with the TCLP testing procedures. Benzene is a common component of Manufactured Gas Plant (MGP) wastes throughout the site. Because the tar is an MGP waste, it is not subject to regulation as hazardous under Federal rules (40 CFR 261.24, as amended March 13, 2002 in Federal Register Vol. 67, page 11254). In addition, the visually contaminated sediments had no exceedances of the TCLP criteria for any chemical. Consequently, both tar and visually contaminated sediments are suitable for disposal at a Subtitle D (non-hazardous) waste landfill.

Based on the source, location, consistency, and expected water content of the removed material, both Waste Management, Inc., and Rabanco have indicated that they can accept material from the site. In addition, both companies have indicated they would need to obtain the results of the waste profiling, as discussed above and work with Anchor to determine the final suitability of the material for disposal in either a Subtitle C or D type landfill. As noted above, it is anticipated that the material is suitable for disposal in Subtitle

D landfills. The waste profile results will be forwarded to the disposal companies and further discussions to confirm this conclusion are underway.

5.3 Compliance Status

Materials shipped off-site as part of the removal action will be sent to facilities operating in accordance with the "Off-Site Rule," as per 40 CFR 300.440. Prior to shipping materials off-site, NW Natural will notify EPA of the intended shipment and will receive EPA's certification that the intended disposal facility is acceptable pursuant to the Off-Site Rule.

5.4 Out-of-State Disposal Notification

One of the potential disposal facilities, Roosevelt landfill, is located outside the state of Oregon. Prior to shipping any material out of state for disposal, NW Natural will notify the appropriate state agency contact of the intended off-site shipments. A copy of the notification will be provided to EPA. The notice will include the identity of the disposal facility, the type and quantity of material, the schedule of the shipments, and the method of transportation.

5.5 Documentation and Tracking

Accurate documentation of transport and disposal will be collected and tracked during the transportation process. The approximate volume of material loaded onto the receiving barge and the date of the removal operation will be recorded in the field log. Weigh tickets from the truck scales, and bills of lading indicating cargo contents, weight, and date, will be collected for each overland trip transporting waste for disposal. The disposal facility will verify receipt of the contents and record the weight and the time that it is received. These records will be tracked during the process and then compiled into a spreadsheet which will be reflected in the weekly progress reports.

APPENDIX B

CONSTRUCTION HEALTH AND SAFETY PLAN

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CONSTRUCTION HEALTH AND SAFETY PLAN
DRAFT PRELIMINARY DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for

U.S. Environmental Protection Agency, Region 10

1200 Sixth Avenue

Seattle, Washington 98101

Prepared by

[Insert Contractor Here]

On behalf of

NW Natural

220 NW Second Avenue

Portland, Oregon 97209

September 2004

Table of Contents

List of Tables

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List of Attachments

SITE/PROJECT OVERVIEW

Site Name – Gasco Site

Location – Willamette River, Portland, Oregon

Client – NW Natural

Types of Land Based Facilities – Fuel Oil Distribution

Removal Action Activities – In-water removal of the tar body, marine-based surveys, and sediment and water quality sampling

Potential Site Contaminants – Metals, cyanide, volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAHs)

Potential Routes of Entry – Inhalation, dermal contact, ingestion

Protective Measures – Safety glasses, gloves, protective clothing, and possibly air-purifying respirators

Monitoring Equipment – Photo-ionization detector (PID) meter

1 EXPLANATORY STATEMENT

This Draft Construction Health and Safety Plan (CHASP) is an appendix to the Draft Remedial Action Project Plan (RAPP) and one of the draft preliminary design documents submitted to U.S. Environmental Protection Agency (EPA) for the removal action at the "Gasco" Site (Site). In its final form, this CHASP will be written, developed, and maintained for the duration of the project by the selected construction contractor. At this stage in the design process, a construction contractor has not been selected. Consequently, this preliminary document represents a detailed outline and example of the type of information that would normally be expected for a CHASP for this project. It is being provided so that EPA can determine the expected content of the final CHASP as required under the Statement of Work (SOW). This example CHASP will be provided to the selected contractor for development of its own final CHASP. The final CHASP will cover all health and safety activities during construction including activities that may be required by consultants (e.g., Anchor) or subcontractors.

1.1 Regulatory Compliance

NW Natural entered into an Administrative Order on Consent (Order) with the EPA on April 28, 2004 to perform a removal action at the Gasco site (Site; EPA 2004). This document provides example content that addresses the requirement of Section VIII.17 of the Order to submit a site-specific CHASP. The objective of the CHASP is to ensure the protection of health of all site workers and the community during the performance of all work under the Order and SOW, including construction, construction monitoring, and long-term monitoring activities. The CHASP is prepared in accordance with EPA's Standard Operating Safety Guide (PUB 9285.1-03, PB 92-963414, June 2002) and complies with all currently applicable Occupational Safety and Health Administration (OSHA) regulations identified in 29 C.F.R. Part 1910. The site-specific plan meets all applicable regulatory requirements. Field activities covered under this CHASP include construction activities associated with the removal action, water quality monitoring during construction, and long-term monitoring activities following completion of the removal action.

1.2 CHASP Distribution

The CHASP will be made available to all personnel and subcontractors involved in the implementation of the Removal Action. This CHASP will be written, developed, maintained, and implemented by the construction contractor and will cover all activities

conducted by the construction contractor, Anchor, and all subconsultants and subcontractors. For subcontractors, this CHASP represents minimum safety procedures. Subcontractors are responsible for all of the safety guidelines addressed in this CHASP, as well as any other general safety and health practices not addressed in this CHASP.

By signing the documentation form provided with this plan (Attachment B-1), project workers certify their understanding and agreement to comply with the plan. Anchor and its subconsultants are independently responsible for the health and safety of their own employees on the project; however, subcontract employees will be required to review this plan and sign the documentation form provided to them.

2 PROJECT ORGANIZATION AND RESPONSIBILITIES

Per Section 1, this text provides example content for Section 2.

All employees and workers on this project are expected to maintain vigilance at all times to ensure that the work is conducted in a safe and efficient manner. To provide an organizational structure that supports this objective, the following individuals are assigned specific responsibilities and lines of communication for the duration of this project. Note, this structure/nomenclature is based on previous project experience and may change slightly following coordination with the construction contractor.

2.1 Project Manager

[insert name here] is the designated Project Manager (PM) for this project. The PM is responsible for overall administration of the project. The PM's duties include project planning, budgeting, communications, and coordination. The PM is also responsible for ensuring that adequate personnel and equipment are available to complete the project safely. The PM may delegate all or part of his or her authority and responsibility to other designated field representatives.

2.2 Project Health and Safety Manager

The construction contractor Health and Safety Manager (HSM) has the responsibility and authority to oversee the development, revision, and approval of this site CHASP and to audit implementation of the plan in the field. The HSM is also responsible for reviewing health and safety issues that may arise during the project, approving Site Safety Officer (SSO) assignments and project responsibilities, coordinating changes in personal protective equipment (PPE) requirements with the SSO, conducting major accident investigations, and conducting periodic site audits and inspections. The HSM assigned to this project is [insert name here]. The HSM or his/her designated representative has discretionary authority to stop work on this project. This project may not start until the HSM has approved this site-specific CHASP.

2.3 Site Safety Officer

[insert name here] is the designated SSO. He/she is responsible for verification and overall compliance with this CHASP. The SSO's duties include, but are not limited to 1) on-site

monitoring to determine appropriate levels and use of PPE; 2) site surveillance, hazard identification, and health risk analysis; 3) implementation of procedures and programs to eliminate risk to site personnel, including initiating changes to the CHASP; 4) implementation of site control measures; 5) assisting in conducting and documenting daily health and safety briefings; 6) maintaining health and safety field log books; 7) providing summaries of field operations and progress to HSM; and 8) instructing all site personnel on the content of this CHASP.

The SSO reports directly to the PM or a designated representative. Through the PM, the SSO also reports to the HSM. Depending upon the level of activity in the field, the HSM may re-assign the duties of the SSO to another qualified member of the field team in order to ensure adequate oversight of health and safety issues.

2.4 Field Operation Leads

The Field Operations Leads (FOLs), to be assigned by the PM, are responsible for the day-to-day activities in the field for their respective operations units. They will coordinate directly with the project's Technical Leads and the Project Manager, to implement all operations aspects of the project planning documents (i.e., CHASP, Construction Quality Assurance Plan [CQAP], Water Quality Monitoring Plan [WQMP], and Removal Action Environmental Protection Plan [RAEPP]). They will maintain the site logbook, the official record of daily site activities.

3 HAZARD EVALUATION AND CONTROL MEASURES

Per Section 1, this text provides example content for Section 3.

This section covers potential chemical and physical hazards that may be associated with the proposed field activities, and presents control measures to address these potential hazards. Recent design characterization sampling identified the presence of VOCs, TPH, PAHs, and cyanide in sediments in the removal action area (see Removal Action Project Plan [RAPP] for details).

Confined space entry will not be necessary for this project; therefore, hazards associated with this activity are not discussed in this CHASP.

3.1 Exposure Routes

Potential routes of exposure to the chemicals include inhalation, dermal contact, and ingestion of dust, mist, gas, vapor, or liquid. Sediment samples are handled wet, so inhalation is not expected to be a route of exposure for most chemicals. The anticipated primary route of exposure for these chemicals would be via skin contact/absorption. Exposure will be minimized by using safe work practices and by wearing the appropriate PPE. Further discussion of PPE requirements is presented in Section 6.

3.1.1 Inhalation

Inhalation of particulates, dust, mist, gas, or vapor during construction activities is possible. Whenever possible, the construction equipment manipulating contaminated sediment will be oriented so that personnel are upwind of the work location. An organic vapor monitor (OVM) will be used to monitor ambient air and the breathing zone within the work area for organic compounds. Section 7.2 describes OVM action levels and response procedures.

3.1.2 Dermal Contact

Dermal contact with potentially contaminated soil, sediment, or groundwater during shoreline and vessel-based operations is possible. Direct contact will be minimized through the use of appropriate PPE and decontamination procedures.

3.1.3 Ingestion

Ingestion of contaminants is a less likely route of exposure than inhalation or dermal contact for many of the contaminants of concern. Direct ingestion of contaminants can occur by inhaling airborne dust, mist, or vapors or swallowing contaminants trapped in the upper respiratory tract. Indirect ingestion can occur by introducing the contaminants into the mouth by way of food, tobacco, fingers, or other carriers. Although ingestion of contaminants can occur, proper decontamination/contamination reduction procedures should eliminate the probability of this route of exposure.

3.2 Chemical Hazards

Contaminants of concern at the Site include cyanide (at low levels), VOCs, TPH, and PAHs (see RAPP for details). Low levels of metals, typical for uncontaminated soils, are also present in the sediment samples. As a precaution, metals in sediments are assumed to present a potential chemical hazard for the purposes of this CHASP only. In addition, there is some potential for exposure to hydrogen sulfide gas from native sediments and hexane, which in rare cases, may be used as decontamination liquid. Human health hazards of these chemicals are discussed below. This information covers potential toxic effects that might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean that such effects will occur from the planned site activities. In general, the chemicals that may be encountered at this site are not expected to be present in concentrations that would produce significant exposures. The types of planned work activities, established safe work practices, and PPE will limit potential exposures at this site.

3.2.1 Cyanide

Cyanide most commonly occurs as hydrogen cyanide and its salts—sodium and potassium cyanide. Cyanides are readily absorbed by the inhalation, oral, and dermal routes of exposure. The central nervous system is the primary target organ for cyanide toxicity. Neurotoxicity has been observed in humans and animals following ingestion and inhalation of cyanides. Cardiac and respiratory effects, possibly central nervous system-mediated, have also been reported. Short-term exposure to high concentrations produces almost immediate collapse, respiratory arrest, and death. Symptoms resulting from chronic exposure to lower concentrations include breathing difficulties, nervousness, vertigo, headache, nausea, vomiting, precordial pain, and

electrocardiogram abnormalities. Thyroid toxicity has been observed in humans and animals following oral and inhalation exposure to cyanides.

3.2.2 Metals

The primary exposure routes for metals during coring activities are inhalation or ingestion of dust particles. Metal may also be indirectly ingested. A secondary route of exposure to metals is dermal contact. The target organs primarily affected by prolonged exposure to metals are the respiratory tract, gastrointestinal tract, central nervous system, kidneys, and liver.

Prolonged exposure to metals through any of the potential routes of exposure is not expected. Skin will be washed immediately when exposed to soil, sediment, dust, or water potentially impacted by metals.

3.2.3 Total Petroleum Hydrocarbons/Volatile Organic Compounds

Petroleum hydrocarbons likely at the site include tar and oil related materials in sediments and soils, which contain benzene and aromatic hydrocarbons. Gasoline, diesel, fuel, and waste oil, and heavier hydrocarbons such as grease may also be present associated with sampling equipment. Volatile components of gasoline include benzene, toluene, ethylbenzene, and xylenes (BTEX). The primary exposure routes for petroleum hydrocarbons during coring activities are inhalation, dermal contact, and ingestion of contaminated soil, sediment, dust, or water. Lighter petroleum hydrocarbons such as gasoline and benzene readily volatilize and are primarily an inhalation concern, whereas the primary route of exposure to heavier petroleum hydrocarbons such as aromatic hydrocarbons, oil, and grease is dermal contact. The target organs primarily affected by prolonged exposure to petroleum hydrocarbons are the respiratory system, central nervous system, kidneys, liver, and skin. Prolonged dermal contact with petroleum hydrocarbons can cause irritation or dermatitis. The BTEX compounds are known or suspected human carcinogens. An OVM equipped with a PID will be used to monitor ambient air and the breathing zone for VOCs such as benzene and naphthalene (an aromatic hydrocarbon). Respiratory protection will be employed if elevated levels of organic compounds are measured by the OVM, if odors are present or other conditions warrant its use.

Petroleum hydrocarbons such as gasoline are also flammable and can be a physical hazard when present in high concentrations. Physical hazards associated with flammable compounds are addressed in Section 4.3.9. Combustion of petroleum hydrocarbons can produce carbon dioxide, carbon monoxide, aldehydes, fumes, smoke (particulate matter), and other products of incomplete combustion. Intentional and inadvertent combustion of petroleum hydrocarbons is not expected during construction activities; however, personnel will be removed from the area should a fire occur.

3.2.4 Polycyclic Aromatic Hydrocarbons

PAHs are petroleum hydrocarbons which are relatively nonvolatile due to their large molecular structure and high molecular weight. Consequently, the primary route of exposure to PAHs is through dermal contact. PAHs may also be indirectly ingested as described in Section 3.3.9. Inhalation of PAHs is unlikely due to their nonvolatile nature. Dermal or eye contact with PAHs can cause irritation or burning. PAHs can cause direct toxicity through a variety of organs. In addition, some PAHs have been linked to cancer after very high level and/or long term exposures.

3.2.5 Hydrogen Sulfide

Hydrogen sulfide is a naturally occurring gas often associated with organic clay and peat. Hydrogen sulfide gas is potentially toxic through inhalation, ingestion, and contact with the skin and eyes. Inhalation can result in respiratory irritation, rhinitis, and edema of the lungs. Inhalation of hydrogen sulfide gas can result in headache, dizziness, and agitation. Acute exposure at high concentrations may result in coma and death as a result of respiratory failure. Hydrogen sulfide gas has a distinct rotten egg odor, and will be noted if encountered in the field.

3.2.6 Hexane

If necessary to achieve adequate decontamination of equipment, a hexane rinse may be applied to remove hydrocarbon-type compounds. Exposure to high concentrations of hexane usually occurs by inhalation. Effects of inhalation may be slow and shallow breathing, possible tachycardia, vertigo or giddiness, nausea, and vomiting. Dermal

exposure may result in dermatitis or conjunctival irritation. Eye exposure will cause irritation and requires irrigation.

3.3 Physical Hazards

3.3.1 Slips, Trips, and Falls

As with all construction work, caution should be exercised to prevent slips on slick surfaces. In particular, working from a floating platform (e.g., dredging vessel and sediment and water quality monitoring vessels) requires careful attention to minimize the risk of falling down or falling overboard. The same care should be used in rainy conditions. Wearing boots with good tread, made of material that does not become overly slippery when wet, can minimize slips. Caution should also be exercised for any movement along the shoreline given the rocks can be slippery when wet.

Trips are always a hazard on the uneven floating platform or in a cluttered work area. The deck of the vessel may have numerous stationary fittings and tie-downs that present potential tripping hazards. Personnel will keep work areas as free as possible from items that interfere with walking and will be aware of stationary obstacles on deck. Caution should also be exercised for any movement along the shoreline given the rocks create an uneven surface and can be unstable.

Falls may be avoided by working as far away from exposed edges as possible. For this project, the potential for falling is associated primarily with working from the dredging vessel, performing water quality sampling, boarding and disembarking the vessel at the dock, and while walking along the shoreline composed of loose rocks, if applicable. Personnel shall keep walkways and work areas clear when possible and use caution if/when walking along the shoreline.

3.3.2 Vessel-Based Activities

It is anticipated that the removal action activities will be conducted from the waterside using a floating platform. All activities performed from a vessel will be performed using basic principles of water safety, including, but not limited to, the following:

- Use Coast Guard-approved life jackets or other approved flotation garments or devices for all off-shore activities.

- Avoid standing near edge of boat; if work must be conducted over edge, secure workers with lifeline.
- Avoid work on stormy days or in large waves.
- Use caution when transferring from land to water. Make sure barges and boats are firmly secured to dock or pier before boarding or disembarking.
- Follow all Coast guard rules for safe boating.

3.3.3 Water Quality and Other Monitoring Activities

Samples may be collected for a variety of monitoring purposes. Prior to initiation of any sampling, there will be a training session for all field personnel pertaining to the use and safety considerations for the sampling device(s), including, but not limited to, the following:

- Wear appropriate personal protective equipment in the exclusion zones.
- Do not place hands or fingers near moving parts of the sampler.
- Do not leave sampling equipment suspended when not in use or between deployments. Always secure equipment on the deck prior to moving the vessel.
- Do not handle sampling equipment or samples with ungloved hands.
- Never lift a non-manually operated sampler or other pieces of heavy equipment without the aid of a winch or other lifting device.
- Follow proper decontamination procedures when leaving the exclusion zone.

Water quality monitoring will be conducted using a variety of electronic meters (e.g., turbidimeter, dissolved oxygen meter, etc.) deployed from a skiff. The crew performing the water quality monitoring should always don appropriate PPE (e.g., gloves and protective eye wear), follow safe boating practices, and retrieve the meters from the water column between deployments and when not in use.

3.3.4 Heavy Construction Equipment

[To be filled in by Contractor]

3.3.5 Manual Lifting

Equipment associated with the removal and sampling activities must be lifted and carried both aboard the vessel and along the shoreline. Back strain can result if lifting is

done improperly. During any manual handling tasks, personnel should lift with the load supported by their legs and not their backs. For heavy loads, an adequate number of people will be used, or if possible, a mechanical lifting/handling device.

3.3.6 Heat Stress

Scheduled sampling operations will occur in December/January, so high temperatures are unlikely. The potential for heat stress may occur if impermeable PPE is worn or if strenuous work is performed under hot conditions with inadequate water. When the core body temperature rises above 100.4° F, the body cannot sweat to cool down, and heat stress can occur. Heat stress may be identified by the following symptoms: dizziness, profuse sweating, skin color change, vision problems, confusion, nausea, fatigue, fainting, and clammy skin. Personnel exhibiting such symptoms will be removed to a cool shady area, given water, and allowed to rest. Fresh drinking water will be provided aboard the vessel. All field team members will monitor their own condition and that of their co-workers to detect signs of heat stress.

3.3.7 Hypothermia

Hypothermia is abnormal lowering of the core body temperature caused by exposure to a cold environment. Wind chill as well as wetness or water immersion can play a significant role. Typical signs of hypothermia include fatigue, weakness, lack of coordination, apathy, and drowsiness. Confusion is a key symptom of hypothermia. Shivering and pallor are usually absent, and the face may appear puffy and pink.

Body temperatures below 90° F require immediate treatment to restore the temperature to normal. Current medical practice recommends slow warming of the individual followed by professional medical care. Moving the person to a sheltered area and wrapping them in a blanket can accomplish the first portion of the task. If possible, the person should be placed in a warm room. In emergency situations where body temperature falls below 90° F and shelter is not available, a sleeping bag, blankets, and body heat from another individual can be used to help raise body temperature.

3.3.8 Falling Overboard

Monitoring and construction will be done from vessels. As with any work from a floating platform, there is a chance of falling overboard. A PFD for each crew person will be available in the boat at all times. PFDs will be worn while working from the vessel. If a person is knocked unconscious following falling overboard, the respondent should immediately follow the procedures summarized in Section 11.7.

3.3.9 Weather

In general, field team members will be equipped for the normal range of weather conditions. The SSO will be aware of current weather conditions, and of the potential for those conditions to pose a hazard to the field crew. Some conditions that might force work stoppage are electrical storms, high winds, or high waves resulting from winds.

3.3.10 Flammable Hazards

Petroleum hydrocarbons are flammable in moderate to high concentrations. Therefore smoking, open flames, and unprotected ignition sources will not be allowed in the work area. An OVM will be used to measure concentrations of organic vapors (i.e., benzene) in the work area. If elevated OVM measurements persist, work will be suspended until corrective measures are taken to ensure a safe work environment.

3.4 Activity Hazard Analysis

The activity hazard analysis summarizes the field activities to be performed during the removal action activities, outlines the hazards associated with each activity, and presents controls that can reduce or eliminate the risk of the hazard occurring.

Table B-1 presents the activity hazard analysis for the following activities:

- Water-based removal activities
- Water quality and other monitoring
- Sample handling, packaging, processing, and shipping
- Equipment decontamination

4 WORK ZONES AND ACCESS CONTROL

Per Section 1, this text provides example content for Section 4.

The dredging vessel captain, monitoring vessel field leader, if applicable, and SSO will delineate the boundaries of the various in-water and shoreline work zones and will inform the field crews of the arrangement. The purpose of the zones is to limit the migration of sample material out of the zones and to restrict access to active work areas by defining work zone boundaries.

4.1 Work Zones

4.1.1 Dredging and Cover/Cap Placement Vessels

[Contractor fill in]

4.2 Decontamination Area

A station will be set up for decontaminating sample processing equipment and personnel gear such as boots or PPE. The station will have the buckets, brushes, soapy water, rinse water, or wipes necessary to perform decontamination operations. Plastic bags will be provided for expendable and disposable materials. The decontamination fluids will be stored in sealable containers and will be disposed of in accordance with the procedures presented in Section 8.3.

4.3 Access Control

Security and control of access to the various vessels and onshore area will be the responsibility of the captain(s) and SSO. Additional security measures may be placed into effect by NW Natural, as required by national security threat levels determined by the federal government. Access to the vessel and onshore areas will only be granted to necessary project personnel and authorized visitors. Any security or access control problems will be reported to the client or appropriate authorities.

5 SAFE WORK PRACTICES

Per Section 1, this text provides example content for Section 3.

Following common sense rules will minimize the risk of exposure or accidents at a work site. These general safety rules will be followed on site:

- Always use the buddy system
- Be aware of overhead and underfoot hazards at all times
- Do not eat, drink, smoke, or perform other hand-to-mouth transfers in the work zones
- Get immediate first aid for all cuts, scratches, abrasions, or other minor injuries
- Report all accidents and close calls, no matter how minor, to the SSO
- Be alert to your own and other workers' physical condition
- Do not climb over or under obstacles of questionable stability
- Make eye contact with equipment operators before moving into the range of their equipment
- Work under adequate lighting at all times

6 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT

Per Section 1, this text provides example content for Section 6.

Appropriate PPE will be worn as protection against potential hazards. In addition, a personal flotation device (PFD) will be required when working onboard the floating platforms. Prior to donning PPE, the workers will inspect their equipment for any defects that might render the equipment ineffective.

Field work will be conducted in Level D, modified Level D, or Level C PPE as discussed below. Situations requiring PPE beyond Level C are not anticipated for this project. Should the SSO determine that PPE beyond Level C is necessary at a given sampling station, the SSO will notify the HSM to select an appropriate corrective action.

6.1 Level D Personal Protective Equipment

Workers performing general activities in which skin contact with contaminated materials is unlikely and in which inhalation risks are not expected will wear Level D PPE. Level D PPE includes the following:

- Cotton overalls or lab coats
- Chemical-resistant, steel-toed boots
- Leather, cotton, or chemical-resistant gloves, as the type of work requires
- Safety glasses
- Hard hat (if overhead hazard exists)
- Hearing protection, if necessary

6.2 Modified Level D Personal Protective Equipment

Workers performing activities where skin contact with contaminated materials is possible will wear chemical-resistant outer gloves and an impermeable outer suit. The type of outerwear will be chosen according to the types of chemical contaminants that might be encountered. Modified Level D PPE includes the following:

- Outer garb such as rain gear or rubber or vinyl aprons
- Chemical-resistant steel-toed boots
- Surgical rubber inner gloves
- Chemical-resistant outer gloves

- Safety glasses (or face shield, if significant splash hazard exists)
- Hard hat (if overhead hazard exists)
- Hearing protection, if necessary

6.3 Level C Personal Protective Equipment

If elevated (see Section 7.2) concentrations of vapors are measured with the OVM, significant contaminant odors are noted, or significant amounts of airborne particulate matter are generated, health and safety requirements may be upgraded to Level C if implementation of engineering controls (i.e., fans) do not decrease the airborne concentrations to acceptable levels. Level C PPE includes the equipment listed under modified Level D plus the following:

- Half-face or full face respirator
- Organic vapor/acid gas cartridges, if appropriate
- Particulate filter cartridge, if appropriate

6.4 Safety Equipment

In addition to PPE that will be worn by shipboard personnel, basic emergency and first aid equipment will also be provided. Equipment will include:

- A copy of this CHASP
- PFD
- First aid kit adequate for the number of personnel
- Emergency eyewash

The construction contractor will provide this equipment, which must be at the location(s) where field activities are being performed. Equipment will be checked daily to ensure its readiness for use.

7 MONITORING PROCEDURES FOR SITE ACTIVITIES

Per Section 1, this text provides example content for Section 7.

A monitoring program that addresses the potential site hazards will be maintained. The monitoring program includes self-monitoring by the field crew and monitoring with instruments.

7.1 Crew Self Monitoring

All personnel will be instructed to look for and inform each other of any deleterious changes in their physical or mental condition during the performance of all field activities. Examples of such changes are as follows:

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory system
- Changes in complexion or skin color
- Changes in apparent motor coordination
- Increased frequency of minor mistakes
- Excessive salivation or changes in papillary response
- Changes in speech ability or speech pattern
- Symptoms of heat stress or heat exhaustion (Section 3.3.6)
- Symptoms of hypothermia (Section 3.3.7)

If any of these conditions develop, the affected person(s) will be moved from the immediate work location and evaluated. If further assistance is needed, personnel at the local hospital will be notified, and an ambulance will be summoned if the condition is thought to be serious. If the condition is the result of sample collection or processing activities, procedures and/or PPE will be modified to address the problem.

7.2 Instrumental Air Monitoring

A portable field PID, calibrated with isobutylene gas, will be used to monitor the concentrations of organic gases or vapors in ambient air and in the breathing zone during coring operations. If the PID readings consistently measure organic compounds at concentrations above 10 parts per million by volume (ppmv) in the breathing zone for 10 minutes, then work will stop and engineering controls (e.g., use of fans) will be applied to maintain levels below 10 ppmv.

7.3 Medical Monitoring

[Insert if Applicable to Contractor]

8 DECONTAMINATION

Per Section 1, this text provides example content for Section 8.

Decontamination is necessary to prevent the migration of contaminants from the work zone(s) into the surrounding environment and to minimize the risk of exposure of personnel to contaminated materials that might adhere to PPE. The following sections discuss personnel and equipment decontamination. The following supplies will be available to perform decontamination activities:

- Wash and rinse buckets
- Tap water and phosphate-free detergent
- Scrub brushes
- Distilled/deionized water
- Deck pump with pressurized freshwater hose (aboard the vessel)
- Paper towels and plastic garbage bags

8.1 Minimization of Contamination

The following measures will be observed to prevent or minimize exposure to potentially contaminated materials:

Personnel

- Do not walk through spilled sediment or dredged material
- Do not handle, touch, or smell sediment or dredged material directly
- Make sure PPE has no cuts or tears prior to use
- Protect and cover any skin injuries
- Stay upwind of airborne dusts and vapors
- Do not eat, drink, chew tobacco, or smoke in the work zones

Sampling Equipment and Vessel

- Use care to avoid getting sampled media in the navigational/sample packaging area of the vessel
- Place clean equipment on a plastic sheet to avoid direct contact with contaminated media

- Keep contaminated equipment and tools separate from clean equipment and tools
- Clean up spilled material immediately to avoid tracking around the vessel

8.2 Personal Decontamination

The SSO will ensure that all site personnel are familiar with personnel decontamination procedures. Personnel will perform decontamination procedures, as appropriate, when exiting work areas. Following is a description of the procedure:

Decontamination Procedure

- Wash and rinse outer gloves and boots in portable buckets
- If suit is heavily soiled, rinse it off
- Remove outer gloves, inspect and discard if damaged, leave inner gloves on
- Remove inner gloves and wash hands if taking a break
- Don necessary PPE before returning to work
- Dispose of soiled PPE before leaving for the day

8.3 Handling of Work-Derived Waste

All remaining trace sediment/dredge materials, fluids used for decontamination of equipment, and disposable wastes (e.g., gloves, paper towels, foil, etc.) will be placed into appropriate containers and staged on-site for disposal. Sediments remaining following collection and processing will be placed into sealable containers and disposed offsite. The decontamination fluids will be stored in sealable containers and will be disposed based on the amount of visibly apparent oil. If the fluid contains only a small amount of visibly apparent oil it will be transferred into an on-site 250-gallon aboveground storage tank (AST) for treatment via the Gasco facility carbon treatment unit. Alternatively, fluids containing a visibly apparent amount of oil will be transferred into a 500-gallon AST located at the MW-6 dense non-aqueous phase liquid (DNAPL) extraction system. All disposable wastes will be placed into two heavy duty plastic bags (i.e., double-bagged) and disposed at a permitted solid waste disposal facility.

9 TRAINING REQUIREMENTS

Per Section 1, this text provides example content for Section 9.

Many of the work tasks require that workers come in contact with potentially hazardous materials and [enter construction conditions here]. It is not anticipated that personnel will routinely contact hazardous concentrations of contaminants in removed material, so training will consist of site-specific instruction for all personnel and oversight of inexperienced personnel for one working day. [Insert any construction conditions that require specific health and safety training.] The following sections describe the general training requirements for work at this site.

9.1 Project Specific Training – Construction Monitoring Activities

All field personnel must read this CHASP and be familiar with its contents before beginning work. They shall acknowledge reading the CHASP by signing the field team CHASP review form contained in Attachment B-1. The form will be kept in the project files.

The SSO or a designee will provide and document project-specific training during the project kickoff meeting and whenever new crew arrives for field work. Field personnel will not be allowed to begin work until project-specific training is completed and documented by the SSO. Training will address the CHASP and all health and safety issues and procedures pertinent to field operations. Training will include, but will not be limited to, the following topics:

- Activities with the potential for chemical exposure
- Activities that pose physical hazards and actions to control the hazards
- Vessel access control and procedures
- Use and limitations of PPE
- Decontamination procedures
- Emergency procedures
- Use and hazards of sampling equipment
- Location of emergency equipment on the vessel
- Vessel safety practices

In addition, since field activities are occurring within the Portland Harbor Superfund Site, all workers must have 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training in accordance with OSHA, and an updated 8-hour refresher training certification, if applicable.

9.2 Project Specific Training – Construction Implementation

[To be inserted by contractor.]

9.3 Site Specific Safety and Hazard Awareness Briefing

Site specific safety and hazard awareness briefing shall be required for all workers and other people entering the site. Briefings will inform these individuals of the chemical hazards of the sediment, construction hazards, and define appropriate protections to minimize potential exposure to risks. A written record of the date(s) and time(s) of such training and of the attendees is required. [May be revised based on Contractor.]

9.4 Regular Safety Briefings

The SSO or a designee will present safety briefings before the start of each day's activities. These safety briefings will outline the activities expected for the day, update work practices and hazards, address any specific concerns associated with the work location, and review emergency procedures and routes. The safety briefings will be documented in the logbook.

10 RECORDING AND RECORD KEEPING

Per Section 1, this text provides example content for Section 10.

The SSO or a designee will record health- and safety-related details of the project in the field logbook. The logbook must be bound and the pages must be numbered consecutively. Entries will be made with indelible ink. At a minimum, each day's entries must include the following information:

- Project name or location
- Names of all personnel
- Level of PPE worn and any other specifics regarding PPE
- Weather conditions
- Type of field work being performed

The person maintaining the entries will initial and date the bottom of each completed page. Blank space at the bottom of an incompletely filled page will be lined out. Each day's entries will begin on the first blank page after the previous work day's entries.

As necessary, other documentation will be obtained or initiated by the SSO. Other documentation may include field change requests, medical and training records, exposure records, accident/incident report forms, OSHA Form 200s, and material safety data sheets.

11 EMERGENCY RESPONSE PLAN

Per Section 1, this text provides example content for Section 11.

As a result of the health and safety hazards associated with the field sampling and sample handling activities, the potential exists for an emergency situation to occur. Emergencies may include personal injury, exposure to hazardous substances, fire, explosion, or release of toxic or non-toxic substances (spills). OSHA regulations require that an emergency response plan be available for use onboard to guide actions in emergency situations.

Onshore organizations will be relied upon to provide response in emergency situations. The local fire department and ambulance service can provide timely response. Construction contractor personnel will be responsible for identifying an emergency situation, providing first aid if applicable, notifying the appropriate personnel or agency, and evacuating any hazardous area. Shipboard personnel will attempt to control only very minor hazards that could present an emergency situation, such as a small fire, and will otherwise rely on outside emergency response resources.

The following sections address pre-emergency preparation, identify individual(s) who should be notified in case of emergency, provide a list of emergency telephone numbers, offer guidance for particular types of emergencies, and provide directions and a map for getting from any sampling location to a hospital.

11.1 Pre-Emergency Preparation

Before the start of field activities, the SSO will ensure that preparation has been made in anticipation of emergencies. Preparatory actions include the following:

- Meeting with the captain and equipment handlers concerning the emergency procedures in the event that a person is injured. Appropriate actions for specific scenarios will be reviewed. These scenarios will be discussed and responses determined before the sampling event commences.
- A training session given by the captain(s) informing all field personnel of emergency procedures, locations of emergency equipment and their use, and proper evacuation procedures.

- A training session given by senior staff operating field equipment, to apprise field personnel of operating procedures and specific risks associated with that equipment.
- Ensuring that field personnel are aware of the existence of the emergency response plan, its location as Section 11 of the CHASP, and ensuring that a copy of the CHASP accompanies the field team(s).

11.2 Site Emergency Coordinator

The SSO will serve as the Project Emergency Coordinator (PEC) in the event of an emergency. For this project, the PEC is [insert name here]. The SSO will designate a replacement for times when the PEC is not onboard or is not serving as the PEC. The designation will be noted in the logbook. The PEC will be notified immediately when an emergency is recognized. The PEC will be responsible for evaluating the emergency situation, notifying the appropriate emergency response units, coordinating access with those units, and directing interim actions onboard before the arrival of emergency response units. The PEC will notify the HSM and the PM as soon as possible after initiating an emergency response action.

11.3 Emergency Response Contacts

All personnel must know who to notify in the event of an emergency situation, even though the SSO has primary responsibility for notification. Table B-2 lists the names and phone numbers for emergency response services and individuals.

11.4 Recognition of Emergency Situations

Emergency situations will generally be recognizable by observation. An injury or illness will be considered an emergency if it requires treatment by a medical professional and cannot be treated with simple first-aid techniques.

11.5 Decontamination

In the case of evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. If an injured individual is also heavily contaminated and must be transported by emergency vehicle, the emergency response team will be told of the type of contamination. To the extent possible,

contaminated PPE will be removed, but only if doing so does not exacerbate the injury. Plastic sheeting will be used to reduce the potential for spreading contamination to the inside of the emergency vehicle.

11.6 Fire

Shipboard personnel will attempt to control only small fires, should they occur. If an explosion appears likely, personnel will follow evacuation procedures specified by the captain in the training session. If a fire cannot be controlled with a fire extinguisher on board that is part of the required safety equipment, personnel will either withdraw from the vicinity of the fire or use additional fire fighting equipment, or evacuate the boat as specified by the captain in the training session.

11.7 Falling Overboard

In the event that a field crew member falls overboard, the captain of the vessel will be immediately notified and at least one member of the crew will maintain visible contact with the person overboard. The captain will maneuver the boat heading against the wind to a position close enough so that a crew member can throw a life ring near the person overboard. If the person overboard is unconscious, the captain will maneuver close enough so that the crew can physically recover the person. The crew members will then follow the procedures laid out in Section 11.8. All crew members will wear a coast guard-approved PFD while working on the vessels to minimize the chances of drowning.

11.8 Personal Injury

In the event of serious personal injury, including unconsciousness, possibility of broken bones, severe bleeding or blood loss, burns, shock, or trauma, the first responder will immediately do the following:

- Administer first aid, if qualified
- If not qualified, seek out an individual who is qualified to administer first aid, if time and conditions permit
- Notify the PEC of the incident, the name of the individual, the location, and the nature of the injury

The PEC will immediately do the following:

- Notify the captain and the appropriate emergency response organization
- Assist the injured individual
- Follow the emergency procedures for retrieving or disposing equipment reviewed in the training session, and leave the site en route to the predetermined land-based emergency pick-up
- Designate someone to accompany the injured individual to the hospital
- If an emergency situation (i.e., broken bones or injury where death is imminent without immediate treatment) occurs, the SSO or captain will call 911 and arrange to meet the response unit at the nearest accessible dock
- Notify the HSM and the PM

If the PEC determines that emergency response is not necessary, he may direct someone to decontaminate and transport the individual by vehicle to the nearest hospital. Directions and a map showing the route to the hospital are in Section 11.10.

If a worker leaves the ship to seek medical attention, another worker should accompany him or her to the hospital. When in doubt about the severity of an injury or exposure, always seek medical attention as a conservative approach and notify the PEC.

The PEC will have responsibility for completing all accident/incident field reports, OSHA Form 200s, and other required follow-up forms.

11.9 Overt Personal Exposure or Injury

If an overt exposure to toxic materials occurs, the first responder to the victim will initiate actions to address the situation. The following actions should be taken, depending on the type of exposure:

Skin Contact

- Wash/rinse the affected area thoroughly with copious amounts of soap and water
- If eye contact has occurred, eyes should be rinsed for at least 15 minutes using the eyewash that is part of the emergency equipment onboard and in the lab
- After initial response actions have been taken, seek appropriate medical attention

Inhalation

- Move victim to fresh air
- Seek appropriate medial attention

Ingestion

- Seek appropriate medical attention

Puncture Wound or Laceration

- Seek appropriate medical attention

11.10 Spills and Spill Containment

Sources of bulk chemicals are not expected to be used during this project. Accordingly, a spill containment procedure is not required for this project.

11.11 Emergency Route to the Hospital

The name, address, and telephone number of the hospital that will be used to provide medical care is as follows:

Legacy Good Samaritan Hospital and Medical Center
1015 NW 22nd Avenue
Portland, Oregon 97210
(503) 413-7711

Figure B-1 is a map of the route from the project site (7900 NW St. Helens Road, Portland, Oregon, 97210) to the Legacy Good Samaritan Hospital and Medical Center. Directions are as follows (travel time is approximately 11 minutes):

1. Start out going Southeast on NW ST HELENS RD/LOWER COLUMBIA RIVER HWY/US-30 toward NW BRIDGE AVE/US-30 BYP W/ST JOHN BRIDGE. Continue to follow NW ST HELENS RD/US-30.
2. Turn SLIGHT RIGHT onto NW ST HELENS RD/COLUMBIA RIVER HWY/US-30. Continue to follow COLUMBIA RIVER HWY/US-30.
3. Turn SLIGHT RIGHT onto NW WARDWAY ST. Turn LEFT on MARIONA ST.
4. NW WARDWAY ST becomes NW VAUGHN ST. Turn LEFT onto JAMES ST.

5. Turn RIGHT onto NW 23RD AVE.
6. Turn LEFT onto NW NORTHRUP ST.
7. Turn RIGHT onto NW 22nd Ave.
8. End at 1015 NW 22nd Ave.

12 HEALTH AND SAFETY PLAN APPROVAL RECORD

By their signature, the undersigned certify that this CHASP is approved and that it will be used to govern health and safety aspects of fieldwork conducted by Anchor personnel to investigate areas associated at the Site.

Project Health and Safety Manager (HSM)	Date
Site Safety Operator (SSO)	Date
Field Operation Lead (FOL)	Date
Field Operation Lead (FOL)	Date
Field Operation Lead (FOL)	Date
Field Operation Lead (FOL)	Date

13 REFERENCES

Anchor Environmental, L.L.C., 2001. "Northwest Natural 'Gasco' Site Ecological and Human Health Risk Assessment – Level II Screening Report." Prepared for Oregon Department of Environmental Quality, February 2001.

U.S. Environmental Protection Agency (EPA), 2004. Administrative Order on Consent for Removal Action between NW Natural and the U.S. Environmental Protection Agency. April 28, 2004.

TABLES

Table B-1
Activity Hazard Analysis

Activity	Hazard	Control
Water-based dredging activities	[Contractor fill in]	[Contractor fill in]
	[Contractor fill in]	[Contractor fill in]
	[Contractor fill in]	[Contractor fill in]
	[Contractor fill in]	[Contractor fill in]
	[Contractor fill in]	[Contractor fill in]
Potential confirmational surface sediment sample collection	Falling overboard	Avoid working near the edge of the vessel, if possible. Stay away from edge of barge deck and always wear coast guard-approved PFD.
	Cuts, amputations	Never place body parts within moving parts or the bite of the surface sampler while the sampler is armed.
	Back or muscle strain	Use appropriate lifting technique when handling sediment core tubes or any other pieces of potentially heavy equipment. Enlist help if necessary.
	Skin or eye contact with potentially contaminated sediments or liquids	Wear modified Level D PPE, including eye protection.
	Slipping/tripping on slick or uneven deck or on shoreline rocks	Wear steel-toed boots with gripping tread. Be aware of obstacles and wet patches on deck and select a path to avoid them. Use caution when walking along the shoreline.
	Injury from equipment falling or swinging	Wear a hard hat and steel-toed boots at all times; be in the appropriate position on deck when equipment is in operation.
	Fire	Avoid fueling operations near hot engines. Mop up any spilled flammable liquids and dispose of absorbent. No smoking or flame sources on the vessel. Evacuate the vessel according to procedures outlined in the training session given by the captain.
	Injury from winch line snapping	Ensure that winch line is not frayed.
Processing, packaging, and shipping samples, if applicable	Skin or eye contact with potentially contaminated solids, liquids, or sediments	Wear Level D or modified Level D PPE, including eye protection.
	Back strain	Use appropriate lifting technique when handling filled sample coolers, or seek help.

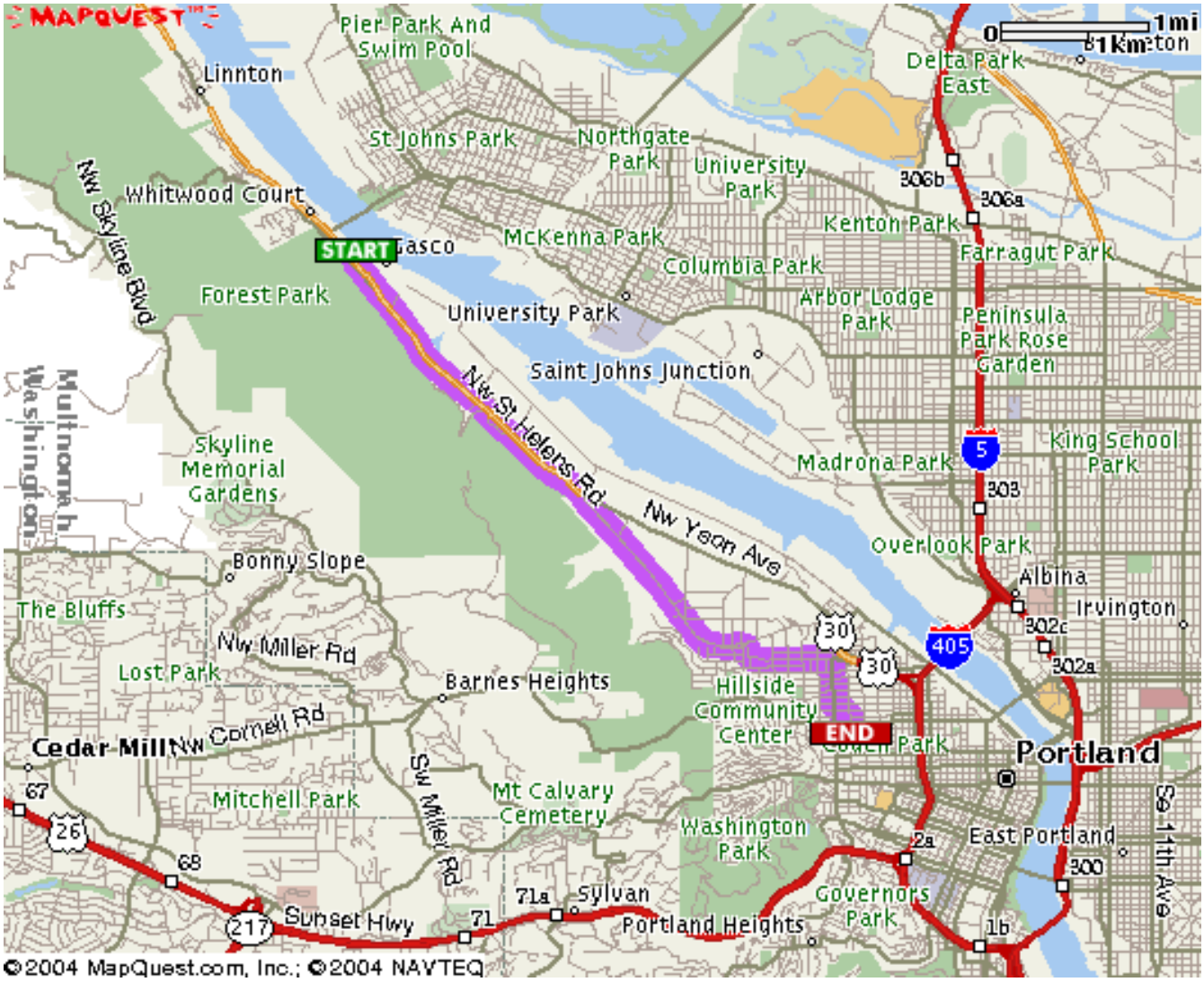
Table B-1
Activity Hazard Analysis

Activity	Hazard	Control
	Inhalation of vapors	Use an OVM, and benzene sample tubes as necessary, to determine if VOC levels remain below identified thresholds.
Water quality monitoring	Falling overboard	Avoid working near the edge of the vessel, if possible. Stay away from edge of barge deck and always wear coast guard-approved PFD.
	Skin or eye contact with potentially contaminated sediments or liquids	Wear modified Level D PPE, including eye protection.
	Slipping/tripping on slick or uneven deck or on shoreline rocks	Wear steel-toed boots with gripping tread. Be aware of obstacles and wet patches on deck and select a path to avoid them. Use caution when walking along the shoreline.
Sediment sampling and water quality monitoring equipment decontamination	Inhalation of, or eye contact with, airborne mists or vapors	Wear safety glasses. Perform decontamination activities outdoors or in a well-ventilated area. Stay upwind when spray-rinsing equipment.
	Skin contact with potentially contaminated materials	Wear modified Level D PPE.
	Ingestion of contaminated materials	Decontaminate clothing and skin prior to eating, drinking, smoking, or other hand-to-mouth activities. Follow the decontamination procedure for personal decontamination.

Table B-2
Emergency Response Contacts

Contact	Telephone Number
Emergency Numbers	
Ambulance	911
Police	911
Fire	911
Legacy Good Samaritan Hospital and Medical Center	(503) 413-7711
Emergency Responders	
U.S. Coast Guard Willamette River Station General information	(503) 240-9311 (503) 247-4018
National Response Center	(800) 424-8802
Emergency Contacts	
Construction Contractor Health and Safety Manager (HSM)	
TBD	XXXXXXX (office) XXXXXXX (cell)
Construction Contractor Site Safety Officer (SSO)	
TBD	XXXXXXX (office) XXXXXXX (cell)
Anchor Project Manager	
TBD	XXXXXXX (office) XXXXXXX (cell)
Field Operation Leads	
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
TBD	XXXXXXX (office) XXXXXXX (cell)
Water Quality Monitoring Vessel	
TBD	( ) (office) ( ) (cell)
TBD	( ) (office) ( ) (cell)
Upland Surveyor	
	( ) (office) ( ) (cell)
In-Water Bathymetry	
	( ) (office) ( ) (cell)

FIGURE



ANCHOR ENVIRONMENTAL, L.L.C.

Figure B-1
Hospital Map
NW Natural "Gasco" Site

ATTACHMENT B-1

SAFETY RECORD FORMS

FIELD TEAM HEALTH AND SAFETY PLAN REVIEW
[INSERT CONTRACTOR NAME HERE]

I have read a copy of the CHASP, which covers field activities that will be conducted to investigate specified areas at the Site, Portland, Oregon. I understand the health and safety requirements of the project, which are detailed in this CHASP.

Signature Date

Signature Date

Signature Date

Signature Date

Signature Date

APPENDIX C

CONSTRUCTION QUALITY ASSURANCE PLAN

APPENDIX C

CONSTRUCTION QUALITY ASSURANCE PLAN
DRAFT PRELIMINARY DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for

U.S. Environmental Protection Agency, Region 10

1200 Sixth Avenue

Seattle, Washington 98101

Prepared by

Anchor Environmental, L.L.C.

6650 SW Redwood Lane, Suite 110

Portland, Oregon 97724

On behalf of

NW Natural

220 NW Second Avenue

Portland, Oregon 97209

September 2004

Table of Contents

List of Figures

1 INTRODUCTION

This Draft Construction Quality Assurance Plan (CQAP) is an appendix to the Draft Remedial Action Project Plan (RAPP) and one of the draft preliminary design documents submitted to U.S. Environmental Protection Agency (EPA) for the removal action at the "Gasco" Site (Site). This document addresses the requirement of the Statement of Work (SOW, Appendix B of the Order) to submit a site-specific CQAP. The purpose of this CQAP is to identify the responsibilities of the construction contractor and Anchor Environmental, L.L.C. (Anchor) for performing the removal action and monitoring the performance of the removal action in accordance with the final design. This CQAP identifies the quality assurance (QA) measures to be used in construction management, including monitoring actions, reporting mechanisms, and documentation formats. In addition, this CQAP defines quality assurance methods and protocols to ensure that project personnel have a complete understanding of monitoring, feedback, and adjustment mechanisms.

At this stage in the design process, the construction contractor has not been selected and certain elements of the removal action design remain uncertain. Therefore, some sections of the CQAP are incomplete. However, it is anticipated that the document presented here will only require minimal revisions and will be finalized by the construction contractor as part of the final design submittal following additional coordination with the contractor and further refinement of the design.

As noted above the CQAP is an appendix to the RAPP, which provides an overview of the removal action design. Other appendices to the RAPP provide specific details of the removal action that are pertinent to the CQAP. These other documents, which are cited in the CQAP, include:

- Transportation and Disposal Plan (TDP, Appendix A to the RAPP)
- Construction Health and Safety Plan (CHASP, Appendix B to the RAPP)
- Construction Water Quality Monitoring Plan (WQMP, Appendix D to the RAPP)
- Removal Action Environmental Protection Plan (RAEPP, Appendix E to the RAPP)

The remaining sections of this CQAP discuss the following project elements:

- **Section 2.** The responsibilities and authorities of key project personnel, contractors, and all organizations involved in the construction or oversight of the removal action, including EPA and other agencies.
- **Section 3.** The qualifications of necessary personnel, the contractor, and subcontractors.
- **Section 4.** Removal action construction elements, including potential issues, monitoring requirements, and corrective actions.
- **Section 5.** Documentation requirements for construction QA activities, including daily summary reports, inspection data sheets, and filing system organization, as well as post-construction documentation.

2 PROJECT ORGANIZATION AND RESPONSIBILITIES

In accordance with the requirements of the SOW, the roles and responsibilities of the parties involved in the removal action are identified in this section. An organization chart representing specific project responsibilities, including project administration, management, and oversight is shown on Figure C-1.

2.1 U.S. Environmental Protection Agency

EPA is the regulatory authority and responsible agency for overseeing and authorizing the removal action. In this capacity, EPA will approve this CQAP and all other removal action submittals as defined in the SOW. EPA has designated Sean Sheldrake as On-Scene Coordinator (OSC) and Project Coordinator for the Gasco removal action. The OSC has the responsibility to monitor that the removal action is performed in accordance with Title 40, Part 300 of the *Code of Federal Regulations* (the National Contingency Plan) and that the removal action addresses the removal action objectives identified in the SOW. EPA and NW Natural will act in coordination to resolve any unforeseen problems that could change project components or the manner in which the construction is executed.

2.2 NW Natural

NW Natural is responsible for implementing the removal action in compliance with the Order. NW Natural has designated Robert Wyatt as the Project Coordinator.

2.3 Removal Action Construction Contractor

The removal action construction contractor will be identified following submittal of the preliminary design, early in the preparation of the final design. Several contractors with the necessary waterfront experience and capabilities to perform the work were contacted and will be asked to bid on the project.

The construction contractor will be required to perform the following construction activities: dredging; disposal, dewatering, and transportation of dredged sediments; and application of a submerged sand cover or pilot cap. These activities are to be performed in accordance with the project design, as approved by EPA. In addition, the construction contractor will be required to prepare a separate quality control plan, which will propose specific

measurements and methods to confirm that removal objectives are being achieved during the course of the removal action.

2.4 Subcontractors

The construction contractor may employ subcontractors to perform selected phases of the work for which the subcontractors have special expertise (e.g., transportation and disposal). The subcontractors will be responsible to the construction contractor for the quality of their work and for the health and safety of their project personnel in accordance with this CQAP and CHASP. The subcontractors' principals will designate job site superintendents or foremen with responsibility for seeing that the work is conducted in accordance with the contract requirements.

2.5 Consultants

NW Natural has selected Anchor as the supervising consultant for the removal action. Anchor is providing personnel to perform the Project Coordinator, Project Engineer, and Construction Quality Assurance Officer (CQAO) roles shown in Figure 1. Anchor's Project Coordinator is Carl Stivers with Rick Schwarz serving as the Project Engineer. A Construction Quality Assurance Officer (CQAO) will be selected after the construction contractor selection is made.

The Project Coordinator is responsible for Anchor's overall performance on the project, including achieving project objectives, schedule, and budget. The Project Coordinator is Anchor's primary point of contact for communication with NW Natural's Project Manager and EPA's OSC.

The Project Engineer is responsible for preparing the design of the removal action such that successful implementation of the design will result in achieving the removal action objectives identified in the SOW. During implementation of the removal action, the CQAO will refer potentially noncompliant construction to the Project Engineer. The Project Engineer is responsible for determining whether the allegedly noncompliant construction is acceptable within the design, unacceptable, or acceptable with a design modification. EPA will have final authority to approve design modifications proposed by the Project Engineer.

The CQAO is responsible for monitoring compliance with the design during implementation of the removal action. The CQAO will review documentation submitted by and work completed by the construction contractor for adherence to design requirements. The CQAO will also collect data and documentation required for weekly progress reports and the Removal Action Completion Report (RACR), and direct the collection of samples for water quality monitoring as described in the WQMP (Appendix D of the RAPP).

3 QUALIFICATIONS OF PERSONNEL WITH QA RESPONSIBILITIES

3.1 Construction Contractor and Subcontractors

The prospective construction contractor will demonstrate, through pre-qualifications conducted by NW Natural and Anchor, the expertise, experience, and capability to satisfactorily execute the removal action activities. The construction contractor will maintain, as part of its permanent organization, high-caliber, knowledgeable, and experienced key personnel. These individuals must have experience in the type of work being contracted. The journeyman operators, surveyors, and other construction contractor personnel performing key jobs must have demonstrated the ability and skills to satisfactorily perform those assignments. The contractor's superintendent(s) will be expected to have at least 10 years of experience in the type of work being contracted. In addition, the contractor must have documented qualifications and experience for performing the independent checks on the contractor's operations that are necessary to determine compliance with the contract provisions.

Any subcontractors utilized in the work must have demonstrated to the satisfaction of NW Natural and Anchor that they are qualified and have satisfactorily performed the type of work for which they will be engaged. The contractor is responsible for the performance of its subcontractors. All contractors and subcontractors will be required to have all health and safety training required by the CHASP. The contractor's qualifications will be submitted to EPA before the contractor begins work, as required by paragraph 11 of the Order.

3.2 Construction Quality Assurance Officer (Anchor)

The CQAO will have an engineering degree and at least 5 years of experience managing construction projects with similar QA requirements. Pertinent engineering and construction experience may be substituted for the engineering degree. The CQAO will be sufficiently familiar with the final design and the construction operations to recognize deviations from that design. The CQAO will also have the ability to manage and maintain the integrity of the data generated during the Project.

4 IMPLEMENTATION OF THE REMOVAL ACTION

NW Natural will implement the removal action, as detailed in the final design, to achieve the objectives of the Order. The major components of the removal action and the required notifications and reports are described in the RAPP, including:

- Major design components
  - Removal of the tar body
  - Transportation and disposal of removed material
  - Cover/cap placement
  - Environmental controls
- Notifications, meetings, and reports
  - Preconstruction notification
  - Preconstruction meeting
  - Weekly progress reports
  - Out-of-state waste shipment notification, if applicable
  - Removal action completion notification
  - Removal action completion inspection/meeting
  - Removal Action Completion Report

During the removal action, the construction contractor will implement quality control measures to determine that construction activities comply with the final design. The contractor will prepare a quality control plan for incorporation into the final design that will describe the methods and measurements that will be used to confirm attainment of the design objectives throughout the course of construction (including removal and cover/cap placement). The contractor will provide documentation to Anchor to demonstrate that the final design has been addressed. Anchor will monitor the contractor's activities and documentation for compliance with the final design. The inspection and verification activities are described in the following sections.

In addition, the CQAO will be responsible for identifying those field conditions that may warrant deviation from the final design. In such circumstances the CQAO will coordinate with the EPA project coordinator to identify and agree upon any necessary deviations to meet the overall objectives of the design. Any agreed upon deviations will be documented in the weekly progress reports to EPA.

4.1 Removal of the Tar Body

4.1.1 Description

This construction element includes the removal of the tar body within the dredge prism as depicted in the project final design. It also includes removal of pilings in the removal action area prior to dredging. As discussed in the RAPP, given the physical characteristics of the tar body material and Site-specific conditions, it is anticipated that the construction contractor will perform the dredging operations using a mechanical clamshell dredge (e.g., clamshell dredge) from a floating platform.

4.1.2 Verification Activities

Verification activities associated with the dredging activities include:

- Quality Control (QC) checks on the location (stationing, offset, and elevation) of each dredging activity within the dredge prism.
- Initial verification of compliance with specified dredging elevations within the dredge prism to verify that the target elevation has been reached and that contract dredging may stop.

Each of these activities is described in further detail below.

4.1.2.1 Verification of Dredging Locations

The construction contractor will be required to accurately locate and track the movement of its dredging equipment. The CQAO will work with the contractor's hydrographic survey crew to independently verify the dredge's horizontal position and dredging depth. This may be done by evaluating the contractor's daily QC surveys and/or positioning data, conducting independent surveys, or a combination of both methods. To ensure that the actual dredging depths are accurately determined, the contractor will be required to conduct daily bathymetric surveys. Prior to initiation of dredging, a surveyed tide board or gauge will be installed at the site to permit determination of elevation independent of tidal effects. Sediments will be removed to the full aerial extent as detailed in the final design.

4.1.2.2 Verification of Compliance with Specified Dredging Limits

The effectiveness of sediment removal will be verified by ensuring the construction contractor achieved compliance with the final design elevation(s) identified in the final design documents. Changes in the mudline elevation resulting from the removal action will be documented through hydrographic surveys. Potential hydrographic survey technologies include lead line surveys or surveys using electronic sounding devices (i.e., single beam surveys). Additional coordination with the contractor is required to determine what type of survey will be most applicable for the removal action. The contractor will perform daily surveys (or, if approved by the Project Engineer, less frequent) progress surveys to establish actual excavated depths and extent of dredging. If water depths prohibit surveying of portions of the dredge prism (i.e., along the shoreline), the elevation changes in these areas will be performed using standard terrestrial survey equipment. Additional requirements for the equipment and methods to be used for the progress surveys will be provided in the final design. The dredging and surveying process will occur until the final design elevation is achieved. If successive side-slope sloughing in a portion of the dredge prism occurs inhibiting the contractor from reaching the final design elevation, the Anchor Project Coordinator will notify the EPA OSC to discuss which further action, if any, may be necessary in that portion of the dredge prism.

4.1.3 Water Quality Monitoring

Anchor will monitor water quality during dredging and the subsequent application of a sand cover or pilot cap in order to provide ongoing assessment of water quality during these activities. The objectives of the monitoring program are to:

- Determine that water quality conditions meet the substantive requirements of the Clean Water Act Sections 401 and 404(b)(1)
- Allow for appropriate adjustment of construction activities in a manner that minimizes impact to the environment
- Document the results of the water quality monitoring.

The construction WQMP (Appendix D of the RAPP) provides specific details on the water quality monitoring parameters and performance criteria, monitoring locations,

sampling and analysis methods and equipment, monitoring schedule, QA/QC procedures, and corrective actions. Environmental controls and best management practices (BMPs) in the event that water quality monitoring indicates exceedances of specified trigger levels, are provided in the RAEPP (Appendix E of the RAPP).

4.2 Transport and Disposal of Dredge Material

Following dredging, the construction contractor will transport, dewater (if applicable), and dispose of the sediments at an appropriate disposal facility. It is anticipated that the dredged sediments will be placed into receiving barges using a mechanical clamshell bucket and shipped to an offloading facility. The description of the potential transport methods; potential issues, concerns, and solutions; environmental monitoring and corrective actions; and, a description of the equipment, monitoring and maintenance is discussed in the TDP (Appendix A of the RAPP).

The verification activities for determining that the material is transported to the disposal facility, per the final design, are described in the TDP. In summary, accurate documentation of transport and disposal will be collected and tracked during the transportation process. The approximate volume of material loaded onto the receiving barge and the date of the removal operation will be recorded in the field log. Weigh tickets from the truck scales, and bills of lading indicating cargo contents, weight, and date, will be collected for each overland trip transporting waste for disposal. The disposal facility will verify receipt of the contents and record the weight and the time that it is received. These records will be tracked during the process and then compiled into a spreadsheet which will be reflected in the weekly progress reports.

4.3 Placement of Sand Cover or Pilot Cap

4.3.1 Description

Following completion of dredging, a sandy (or similar) cover or pilot cap will be placed over the extents of the dredge prism to the specified depth. As discussed in the RAPP, placement of the material will likely be performed from a barge using mechanical methods (e.g., clamshell bucket). All cover/cap material will be evaluated prior to its placement to ensure compliance with the final design requirements and environmental

monitoring will be performed during placement to monitor potential water quality impacts (as described in the WQMP – Appendix D).

4.3.2 Verification Activities

Verification activities associated with the cover/capping activities include:

- Ensuring the cover/cap has the appropriate physical and chemical characteristics as per the final design.
- Achieving material placement over the required areas and to the required thickness as per the final design.

Each of these activities is described in further detail below.

4.3.2.1 Borrow Source and Materials Acceptability Criteria

The construction contractor shall supply sand (or similar) cover/cap material with physical properties meeting the quality, size, shape, and gradation identified in the final design. The contractor shall also perform characterization of all imported cover/cap material to ensure that the material is natural, native, virgin material; does not include debris or recycled materials; and meets the chemical concentration requirements of the RAEPP (Appendix E of the RAPP). The contractor will perform the following:

- Document origin of source of cover/cap material
- Document material sampling for physical and chemical characterization

Prior to any on-site placement of imported materials, the construction contractor will work with the Anchor Project Engineer to identify an appropriate source of cover/cap material. The contractor will identify the source and provide documentation of a site inspection and of material sampling and characterization (including physical and chemical testing) to ensure that the imported material will uniformly meet the physical specifications of its intended use. Potential sources of material in the lower Willamette River that will likely be used for this project are reviewed in the RAPP. Additional information about the source of the imported material and its characterization will be provided in the final design.

4.3.2.2 Placement Acceptability Criteria

To verify that the thickness of cover/cap material applied is in compliance with the final design, a minimum cover/cap thickness will be placed with an over-placement allowance to account for placement inaccuracies. The in situ thickness and extents of the applied cover/cap will be documented by verifying the material thickness visually or by conducting a post-placement hydrographic survey. Wherever the material thickness is less than the specified amount, the construction contractor will be required to add a sufficient amount of material to achieve the specified design thickness.

4.3.3 Water Quality Monitoring

Potential water quality impacts (e.g., elevated turbidity) will be monitored during cover/cap placement. The construction contractor will be required to place the cover/cap material following several standard environmental controls and BMPs as described in the RAEPP. Water quality monitoring during placement activities will be identical to the monitoring to be performed during dredging activities. Additional information on environmental controls during placement of the cover/cap is provided in the WQMP and RAEPP (Appendix D and E of RAPP, respectively).

4.4 Corrective Action Procedures

If any work is found to deviate from the final design (e.g., noncompliance with the final dredge elevation, water quality exceedences during dredging and placement of cover/cap, characteristics of the material), the CQAO will immediately bring the deviation to the attention of the construction contractor for correction. Such deviations that can not be immediately corrected will trigger the corrective action procedures described in this section.

If the construction contractor is unable to comply with the final design or disagrees that the work is out of specification, the CQAO will notify the Anchor Project Coordinator and request an interpretation from the Project Engineer regarding the acceptability of the work in question. The construction contractor, CQAO, and Project Engineer will reach agreement regarding resolution of the work. If the question arose as a result of differing interpretations of the final design or unexpected site conditions, the Project Engineer will issue a clarification or modification of the design. The issue will be brought to the immediate

attention of EPA, and prompt EPA approval of the clarification or modification will be requested. The approved clarification or modification will be summarized in the next Weekly Progress Report (described in Section 5) and noted in the RACR.

If the Project Engineer determines that the work questioned by the CQAO clearly deviates from the final design and is not necessitated by unexpected site conditions, the construction contractor will be required to correct any deficiency. The Project Engineer will have the authority to interpret the technical requirements of the design. The NW Natural Project Coordinator, with technical assistance from Anchor, will resolve contractual issues, if any arise, with the construction contractor.

In the particular case of deviation from the requirements for protection of environmental quality as determined by water quality monitoring, corrective actions will be implemented as described in the RAEPP. Upon receiving water quality monitoring results indicating an exceedence, the CQAO will immediately notify the construction superintendent to take corrective action. The CQAO will also notify the Anchor Project Coordinator and the EPA representative on-site, if one is present, as soon as possible of the water quality monitoring result and corrective actions being implemented.

5 DOCUMENTATION AND REPORTING

The construction contractor will be responsible for quality control during construction and the CQAO will be responsible for quality assurance (i.e., verifying that the required quality control measures have been implemented). The contractor superintendent and the CQAO will work closely on a daily basis during the removal action to complete the project as specified in the final design and to collect the documentation required by the Order. The following sections describe documentation that will be maintained by the contractor superintendent and CQAO.

During construction activities, the construction contractor will be required to provide a variety of documentation to the CQAO, including testing results of materials received, weigh tickets for shipments of materials removed, survey results, and documentation of pay items completed. The contractor will also maintain a daily log of activities, as described in Section 5.1.1. The CQAO will maintain a field log of daily activity and complete an internal weekly report. The contents of the log and report are described in Sections 5.1.2 and 5.1.3

Weekly progress reports and the RACR, which will be submitted to EPA, are described in the RAPP. The records described in this section will be maintained in the project files. Monitoring data will be provided electronically to EPA in the RACR.

5.1 Contractor's Daily Log

The contractor's daily log will record at a minimum:

- Identification of personnel on-site
- Activities completed
- Materials delivered/used
- Materials dredged/shipped off-site
- Surveys completed
- Problems encountered and resolution of problems
- Any EPA authorized deviations from the final design

5.2 Construction Quality Assurance Officer's Daily Field Log

The CQAO will maintain a daily field log to record observations, measurements, inspections completed, data received, communications with other members of the project team or EPA, problems encountered, and resolutions. The daily field log will be supported by submittals

received from the construction contractor, such as survey results and weigh tickets, chain of custody forms for water quality monitoring samples collected, laboratory data received, inspection reports, and written communication from members of the project team or EPA.

5.3 Weekly Summary Reports

The CQAO, in cooperation with the contractor superintendent, will prepare weekly summaries of progress. These summaries will facilitate the preparation of the Weekly Progress Report to EPA and the RACR. The weekly summary will identify progress organized by activity:

- Removal
  - Area worked (supported by contractor's log)
  - Volume of material removed (supported by contractor's log)
  - Surveys completed (supported by contractor's log)
  - Problems encountered
  - Corrective Actions

- Transportation and Disposal
  - Weight/volume of material shipped off-site (supported by trip tickets)
  - Mode(s) of transportation
  - Disposal confirmations received
  - Weight of cover/cap materials received (supported by trip tickets)
  - Problems encountered
  - Corrective Actions

- Cover/Pilot Cap
  - Area worked (supported by contractor's log)
  - Weight/volume of material placed
  - Problems encountered
  - Corrective Actions

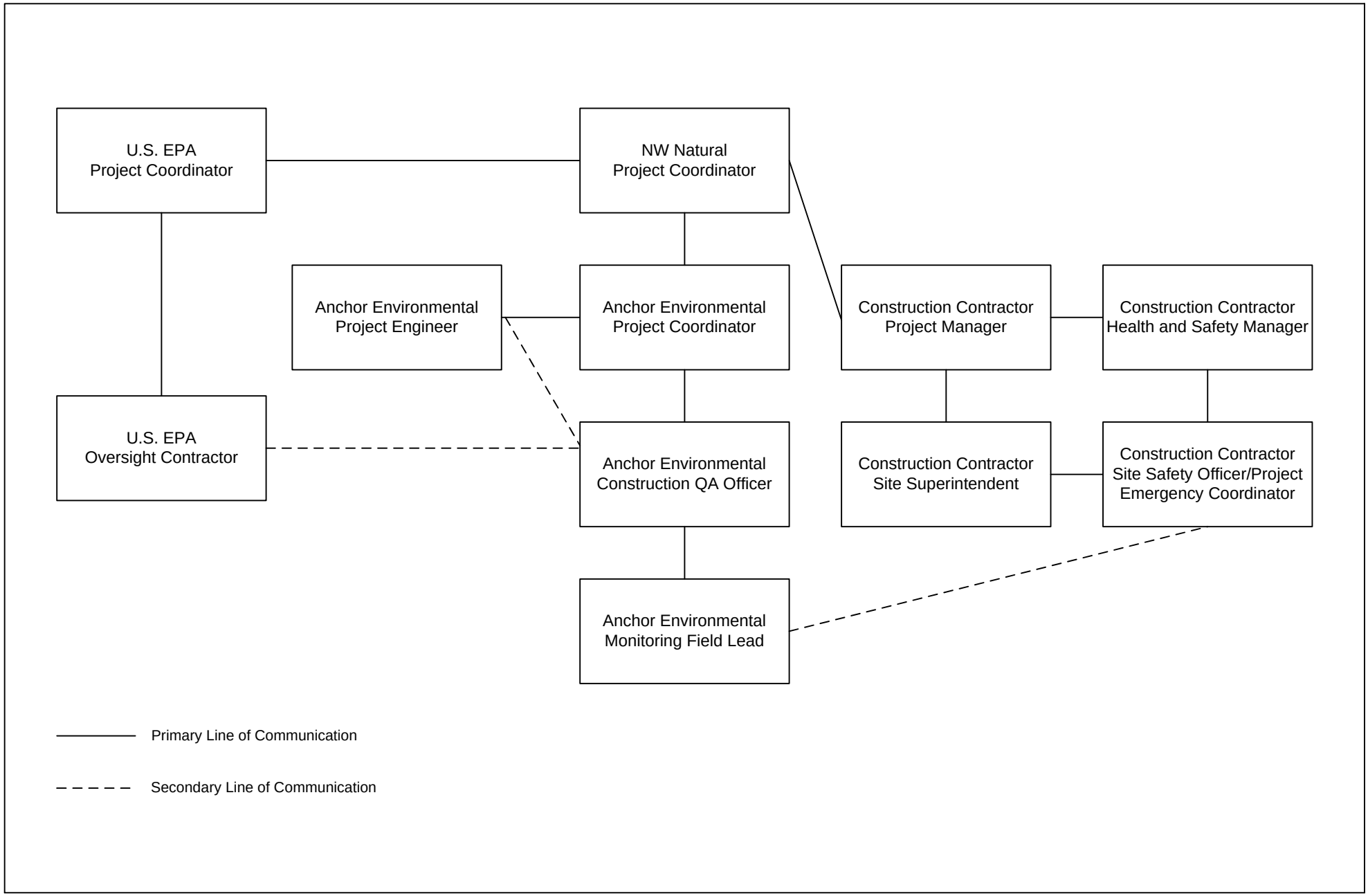
- Environmental Controls
  - Samples collected
  - Summary of analytical results

- Problems encountered
- Corrective Actions

6 REFERENCES

Anchor Environmental L.L.C. (Anchor). 2004. Field Sampling Plan – Northwest Natural "Gasco" Site, Removal Action Work Plan. Prepared by Anchor Environmental, June 2004.

FIGURES



ANCHOR ENVIRONMENTAL, L.L.C.

Figure C-1
Organization Chart
NW Natural "Gasco" Site

APPENDIX D

CONSTRUCTION WATER QUALITY MONITORING PLAN

APPENDIX D

CONSTRUCTION WATER QUALITY MONITORING PLAN
DRAFT PRELIMINARY DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for Submittal to

U.S. Environmental Protection Agency, Region 10

1200 Sixth Avenue

Seattle, Washington 98101

Prepared by

Anchor Environmental, L.L.C.

6650 SW Redwood Lane, Suite 110

Portland, Oregon 97224

On behalf of

NW Natural

220 NW Second Avenue

Portland, Oregon 97209

September 2004

Table of Contents

List of Attachments

1 INTRODUCTION

This document presents the Construction Water Quality Monitoring Plan (WQMP) for the "Gasco" Site (Site) Removal Action (Project) being conducted by NW Natural. It is one part of the Preliminary Design Submittal for the Project. The objective of water quality monitoring will be to determine whether potential water quality impacts occur near removal operations. The Removal Action Environmental Protection Plan (RAEPP) – Appendix E of the Preliminary Design Submittal will be used in conjunction with the WQMP. The RAEPP defines the water quality measurements and levels that will be used to determine water quality impacts and trigger additional protective measures, if necessary, based on the sampling performed per the WQMP. This WQMP presents the types, locations, frequency, equipment, and methods of measurements as well as data reporting that will be used in these RAEPP determinations.

Construction operations covered by this WQMP include dredging (and related activities such as piling removal or placement), barge dewatering, transfer of dredged materials to upland transport, upland dewater discharge to surface waters (if conducted), and placement of cover/cap material at the Site after dredging is complete. This WQMP fulfills the substantive requirements of Clean Water Act Section 401 and 404(b)(1) in terms of monitoring for compliance with these regulations. Determinations of compliance with the Clean Water Act and decisions regarding potential additional protective measures are presented in the RAEPP – Appendix E.

2 WATER QUALITY MONITORING

Monitoring methods (including parameters, locations/depths, frequency/schedule, background surveys, visual monitoring, and equipment) are consistent with the substantive requirements of a Section 401 Water Quality Certification in the State of Oregon. Appropriate methods were determined by reviewing recent Oregon water quality certificates for similar projects involving in-water work such as dredging and remediation of contaminated sediments in the Columbia and Lower Willamette Rivers.

2.1 Monitoring Parameters

Consistent with recent water quality certificates for contaminated and potentially uncontaminated sites in the area, the following parameters will be monitored near removal operations:

- Turbidity (in nephalometric turbidity units [NTU])
- Dissolved oxygen (in mg/L).

2.2 Monitoring Locations/Depths

Monitoring will take place near each of the following operations:

- Dredging/Piling Removal or Placement
- Barge dewatering
- Transfer of dredged material to upland transport
- Discharge of upland dewater to river water (if conducted)
- Placement of cover/cap

For all operations, water quality monitoring in the river will occur 100 feet directly upstream (for background conditions) and 100 feet directly downstream of the operation and/or point of discharge. Although the river is tidally influenced at this location, it is rare for it to undergo flow reversals due to tidal changes during winter higher flow conditions. If flow reversal is observed to occur during construction, then the sampling will be conducted down current and up current (for background conditions) as appropriate. For dredging operations, containment barriers (e.g., silt curtains) will be deployed around active dredging operations (see RAEPP – Appendix E for details). Where containment barriers are used, the locations for monitoring will be 100 feet upstream and downstream of the edge of the barrier. Depending on results of initial monitoring near other operations, containment

barriers may be deployed to reduce observed potential water quality impacts per the RAEPP. In these cases, the distance to the monitoring location will be the same as above, and measured from the edge of the barrier.

Sampling depths will be at the approximate top, middle, and bottom of the water column if the water depth permits collecting samples from three intervals separated by at least 5 feet from each other. Top and bottom samples will be taken 3 feet below the surface of the water and above the mudline, respectively. Thus, for water depths less than 16 feet, two samples will be taken; and for water depths less than 11 feet, one sample, at least 3 feet from the bottom will be taken.

2.3 Monitoring Frequency/Schedule

Turbidity and dissolved oxygen will be measured at least once every 4 hours during active in-water work (defined as the operations noted above). On any day active in-water work occurs, the first sample will be taken 4 hours after the initiation of the activity, and once at each 4-hour interval thereafter. If results exceed the triggers presented in the RAEPP, then these same parameters will be measured again within 30 minutes of determination of the exceedance. If the exceedance continues, procedures discussed in the RAEPP will be followed.

2.4 Background Survey

Initial background conditions for the Site will be established prior to the start of any active in-water work. A minimum of seven independent measurements (at all applicable water depths) will be made 100 feet upstream of the expected location of containment barriers around the work area over the course of a two-day period just prior to construction start. The 95th percentile upper confidence limit on the mean will be determined for these data, and be used to represent initial background conditions. Sampling event-specific background conditions will be determined from the upstream monitoring that takes place for each event (with an event defined as each sample collection at 4-hour intervals as described above). The use of initial and sampling-event-specific background in evaluating triggers for protective procedures is presented in the RAEPP.

2.5 Visual Monitoring

Visual monitoring will take place when the monitoring field leader is present on-site for the purposes of fulfilling the above regular monitoring requirements. At those times, the field leader will make observations as to the presence of any of the following outside containment barriers (where present):

- High turbidity that might reasonably result in exceedance of triggers in the RAEPP
- Sheens or other visible contamination in the water
- Distressed or dying fish
- Other visual indicators of potential water quality impacts

If such conditions are observed, monitoring for turbidity and dissolved oxygen following the above procedures will be conducted and procedures for protective measures as described in the RAEPP will be followed as needed.

2.6 Sampling and Analysis Methods and Equipment

Sampling will be conducted from a boat. Turbidity will be measured with a field nephalometer. Samples for turbidity measurement will be collected using a van Dorn bottle or similar device. Recovered water from the appropriate depth will be transferred immediately to the nephalometer container for immediate measurement. Turbidity measurements will follow Standard Method 2130 (AWWA 1998). Dissolved oxygen will be measured using a field probe deployed to the appropriate depth where both dissolved oxygen and temperature will be recorded. Dissolved oxygen measurements will follow Standard Method 4500-O (AWWA 1998).

2.6.1 Sample Location/Depth Determination

Distances from operations will be verified through global positioning system (GPS) readings or by ranging device such as a laser rangefinder. If GPS methods are used, one reading will be taken at or very near the operation or containment barrier around the operation (as applicable), and a second reading will be taken at the proposed sampling location. Actual GPS coordinates of the sampled location will be recorded. GPS accuracy should be plus or minus 30 feet.

Depth to the bottom will be determined using the van Dorn bottle or lead line. From this, the appropriate sampling depths will be determined. Both the depth to the bottom and the sampling depths will be recorded at each location sampled.

2.6.2 Monitoring Equipment Calibration

Monitoring equipment will be calibrated prior to its use in the monitoring program following manufacturers' instructions. The calibration will be conducted once at the beginning of each sampling day for all equipment. Where not covered by manufacturers' instructions, calibration procedures will follow Standard Methods 2130 (turbidity) and 4500-O (dissolved oxygen) (AWWA 1998).

For the nephalometer, at the end of each day of monitoring a post-calibration procedure will be performed by measuring one of the calibration standards (preferably the standard whose value is closest to the river values for that day). In addition, standards may be measured to check the calibration throughout the day, especially if higher or lower than expected turbidity values occur.

All calibration information will be recorded in the field notebook. Equipment that does not properly calibrate will not be used.

2.6.3 Measurement Documentation

Water quality monitoring data, station coordinates, water depths sampled, date, time, and other observations shown on the Water Quality Monitoring Form (Attachment D-1) will be immediately recorded on that form.

2.7 Quality Control and Assurance Procedures

General quality control and assurance procedures will follow the overall Project Quality Assurance Project Plan (QAPP), which is an appendix to the Removal Action Work Plan (RAWP) and amended to include the procedures described in Sections 2.6 and 2.7 of this WQMP. In addition, this section describes quality control and assurance procedures specific to this WQMP.

The following general quality control information will be collected:

- Names and affiliations of technical and support staff performing the monitoring (recorded on Monitoring Form, Attachment D-1)
- Locations and times for all samples (Monitoring Form, Attachment D-1)
- Daily calibration information for nephalometer and dissolved oxygen probe (field notebook)

Calibration of equipment will follow procedures noted above. The dissolved oxygen monitoring probe will be allowed to equilibrate before in situ measurements are collected to minimize measurement variability. For all measurements, unusual or questionable readings will be noted and duplicate readings made.

2.7.1 Reporting Limits

For turbidity measurements, reporting limits will follow Section 5 of the SM 2130 (AWWA 1998). For dissolved oxygen measurements, reporting will be to plus or minus 0.1 mg/L. Temperature will be reported to plus or minus 0.1° C.

2.7.2 Precision/Accuracy

Precision will be estimated through duplicate measurements of one in 20 field measurements by nephalometer and dissolved oxygen probe. For turbidity, the duplicate measurement will be accomplished by refilling the test container from the same van Dorn bottle sample and making another measurement. For dissolved oxygen, the probe will be retrieved to the boat and then immediately redeployed to the same depth for a second measurement. Duplicate measurements will provide an indication of field variability. Accuracy will be checked through calibration by measurement against known standards for turbidity and dissolved oxygen consistent with Standard Methods (AWWA 1998) as noted above.

2.8 Health and Safety Procedures

The health and safety procedures detailed in the Construction Health and Safety Plan (CHASP) – Appendix B of the RAPP, will be followed at all times by all personnel during monitoring activities. Appropriate health and safety procedures are described in detail in the CHASP.

3 WATER QUALITY NOTIFICATION AND REPORTING

3.1 Notification Requirements

The primary purpose of water quality monitoring during construction is to determine when water quality impacts may be occurring so that additional protection procedures and measures can be implemented, if necessary, as described in the RAEPP. Consequently, immediate notification of water quality measurements that exceed triggers in the RAEPP is necessary. Upon obtaining results that exceed any RAEPP trigger, the field leader will notify Construction Quality Assurance Officer (CQAO) as quickly as possible.

The CQAO will notify the Anchor Project Coordinator and the EPA field representative, if present on-site. Daily reporting to EPA's designated contact is described in the next section. In addition, implementation of RAEPP procedures due to water quality notifications may require additional contacts and discussions with EPA representatives, and these requirements are described in the RAEPP.

3.2 Reporting Requirements

Data will be collected and recorded in the field on the Water Quality Monitoring Form (Attachment D-1) as described in Section 2. These data will be reported to EPA in the following steps:

- Daily Reporting – Any exceedances of triggers specified in the RAEPP, will be reported verbally to EPA on a daily basis.
- Weekly Reporting – Results from each week's Water Quality Monitoring Forms will be compiled into a summary table with a comparison to RAEPP triggers and provided to EPA with the Weekly Progress Report described in the RAPP.
- Project Reporting – Once all construction is complete, results for the entire construction period will be compiled and reported to EPA along with supporting documentation in the Removal Action Completion Report (RACR).

Daily and weekly reporting will be conducted by the water quality monitoring field leader. All reporting will include both regularly schedule monitoring and any additional monitoring results that may have been required due to any trigger exceedances and resulting procedures described in the RAEPP.

After all construction is complete, the results of water quality monitoring will be provided to EPA in the draft RACR. The RACR, including the results of water quality monitoring, will be revised to address EPA comments and submitted as a final report. The water quality monitoring results section of the RACR will include:

- Any deviations from this WQMP and reasons for deviations
- Tabular summaries of all water quality monitoring data with comparisons to RAEPP triggers
- Narrative text on results of water quality monitoring related to each operation (e.g., dredging, barge dewatering, upland transfer, upland dewater discharge if applicable, and cover/pilot cap placement).
- Discussion of water quality trigger exceedances and any additional monitoring that may have resulted
- Data validation results based on calibration and precision/accuracy information including any data qualifications and reasons for those qualifications
- An appendix containing all completed water quality monitoring forms
- An appendix containing all calibration information

4 MONITORING PERSONNEL AND KEY CONTACTS

The following people will be responsible for water quality monitoring, notification communication, and data reporting described in this plan:

- Monitoring Field Leader – _____
- Monitoring personnel – _____,_____,_____
- CQAO – _____
- EPA Project Coordinator – Sean Sheldrake (for receipt of reports)

All monitoring personnel noted are experienced in the collection and measurement of water quality parameters.

As noted in previous sections, the field leader is responsible for:

- Visual water quality inspections
- Oversight of all water quality monitoring
- Verification that results are properly recorded and forms completely filled out
- Verification that appropriate calibration and quality control and assurance procedures are conducted
- Notification to CQAO in the event of water quality triggers are exceeded
- Daily and weekly reporting of water quality results to EPA's designated contact

Monitoring personnel are responsible for conduct of the water quality measurements, calibrations, quality assurance and quality control procedures, and recording of results as directed by the field leader.

The CQAO is responsible for acting upon water quality information as provided by the field leader as necessary to comply with the RAEPP.

5 REFERENCES

American Water Works Association (AWWA) 20th ed., 1998. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Water Pollution Control Federation, Washington, DC. U.S.

ATTACHMENT D-1

WATER QUALITY MONITORING FORM

ANCHOR ENVIRONMENTAL, L.L.C.

1423 3rd Ave., Suite 300
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287-9131
www.anchorenv.com

Water Quality Monitoring Form

Station ID		**Date**	**Time**
Project Name		**Project Number**	
Coordinates			
Lat/Northing:		Long/Easting:	
Weather/River Stage/Flow Observations: Status/Description of Operation at Time of Sampling:			
Depth to Bottom: _____ (m)			
	Dissolved Oxygen (mg/L)	Temperature (C)	Turbidity (NTU)
Depth 1: ____ (m)			
Depth 2: ____ (m)			
Depth 3: ____ (m)			
Other:			
Evidence of floating or suspended materials:			
Evidence of oil/hydrocarbon sheen:			
Discoloration and Turbidity:			
Color:			
Odor:			
Other Observations:			
Comments:			
Recorded by:		Other Monitoring Personnel:	

APPENDIX E

REMOVAL ACTION ENVIRONMENTAL PROTECTION PLAN

APPENDIX E

REMOVAL ACTION ENVIRONMENTAL PROTECTION PLAN
DRAFT PRELIMINARY DESIGN SUBMITTAL

REMOVAL ACTION
NW NATURAL "GASCO" SITE

Prepared for Submittal to

U.S. Environmental Protection Agency, Region 10

1200 Sixth Avenue

Seattle, Washington 98101

Prepared by

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Portland, Oregon 97224

On behalf of

NW Natural

220 NW Second Avenue

Portland, Oregon 97209

September 2004

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1 INTRODUCTION

This document presents the Removal Action Environmental Protection Plan (RAEPP) for the "Gasco" Site (Site) Removal Action (Project) being conducted by NW Natural. It is one part of the Preliminary Design Submittal for the Project. The objective of this RAEPP is to minimize potential short-term impacts to the environment during construction. The RAEPP identifies the environmental controls and Best Management Practices (BMPs) that will be implemented (as well as those additional controls that may be implemented should specific circumstances arise) to minimize adverse short-term impacts of the removal action. The RAEPP also defines the water quality measurements and levels that will be used to assess water quality impacts and trigger additional protective measures, if necessary. The Water Quality Monitoring Plan (WQMP)—Appendix D of the Preliminary Design Submittal will be used in conjunction with the WQMP. The WQMP describes the water quality measurements, monitoring methods, and data collected that will be used in the assessment process described in this RAEPP.

Construction operations covered by this RAEPP include dredging (and related activities such as piling removal or placement), barge dewatering, transfer of dredged materials to upland transport, discharge of upland dewater to surface waters (if necessary), and placement of cover or pilot cap at the Site after dredging is complete. Henceforth, these construction phases will be referred to as dredging, barge dewatering, transferring, upland dewatering, and cover/cap placement. These construction operations are described in detail in the Remedial Action Project Plan (RAPP) and Transportation and Disposal Plan (TDP).

2 ACTION TRIGGERS AND ENVIRONMENTAL CONTROLS REFINEMENT PROCESS

Section 3 of this RAEPP describes environmental controls and BMPs (hereafter referred to together as controls) that can be employed during construction to minimize short-term environmental impacts. There are two general types of environmental controls considered, which are defined as:

- Standard – controls that will be employed at all times during the applicable operation regardless of any water quality measurements or other observations regarding environmental impacts. These controls are intended to minimize those potential impacts that might otherwise be expected without such controls.
- Additional – controls that will be employed if and when certain specific conditions are measured (e.g., water quality results per the WQMP) or observed. These additional controls are intended to minimize any potential impacts if they occur despite the use of standard controls. Generally, additional controls are implemented in a step-wise and issue-specific fashion as may be needed to reduce any potential impacts that may be measured or observed.

The primary method of determining the need for additional controls is through results evaluation of the water quality measurements and observations described in the WQMP. The determination of the need for additional controls as described in this section is consistent with the substantive requirements of Clean Water Act, Section 401 Water Quality Certification in the State of Oregon. The evaluation methods and triggers for additional controls have been developed through review of recent water quality certificates issued for dredging and contaminated sediment remediation projects in the Columbia and Lower Willamette Rivers (see Section 5 for details).

2.1 Action Triggers

The water quality results that will trigger the implementation of additional environmental controls are shown in Table E-1. Should the results of the monitoring indicate an exceedance of any of the water quality triggers, the WQMP describes the additional monitoring, notification, and reporting requirements. The additional controls discussed in Section 3 will be implemented in a step- wise and issue-specific fashion until the exceedance is no longer observed.

In addition, when an exceedance is observed and additional controls are applied, monitoring will be conducted after the full resumption of the operation with the new controls in place. If exceedances continue to occur, the same process will be repeated after the implementation of another round of additional controls. This monitoring will be in addition to the standard monitoring frequency described in the WQMP.

Section 3 describes the additional controls that can be implemented to reduce potential water quality impacts that may be indicated by trigger exceedances.

Table E-1
Water Quality Triggers for Additional Environmental Controls

Parameter	Unit	Location	Trigger[a]
Turbidity	Nephalometric Turbidity Units (NTU)	100 feet downstream of operations[b]	> 5 NTU over background (where background <50 NTU) >10% over background (where background >50 NTU)[c]
Dissolved Oxygen (DO)	mg/L	100 feet downstream of operations[b]	<6.5 modify operations <6.0 cease operations[d]

a If monitoring results exceed trigger, then the same parameter will be measured within 30 minutes of the determination of the exceedance. If the exceedance continues, the additional controls discussed in Section 3 will be implemented.

b If a containment barrier is in place, sampling will occur 100 feet from edge of barrier. Although flow reversals due to tidal fluctuations are rare in winter months on this part of the river, if such reversals are observed, sampling will be conducted up current (background) and down current, as appropriate.

c Trigger is exceeded where downstream conditions exceed the specified amounts relative to both the event-specific background and the preconstruction background survey.

d If DO levels fall below 6.5 mg/L, additional controls discussed in Section 3 will be implemented. If DO levels fall below 6.0 mg/L, operations will cease until DO levels rise above 6.0 mg/L and additional controls discussed in Section 3 will be implemented before resumption of work.

In addition, the WQMP calls for visual monitoring of the project area during all operations. If any of the following are observed, this will also constitute a trigger for additional controls:

- Observations of high turbidity that might reasonably result in exceedance of triggers in Table E-1. (In this case, these visual observations will be first verified through additional monitoring and compared to the quantitative levels in Table E-1.)
- Sheens or other visible contamination in the water outside containment barriers
- Distressed or dying fish outside containment barriers.

Use of these action triggers allows, on a temporary basis (during construction), exceedances of the water quality levels described above within containment barriers and/or 100 feet from

barriers or operations. In addition, as noted in Table E-1, additional controls will be implemented if a second exceedance is observed 30 minutes after the first exceedance. This procedure allows temporary exceedances more than 100 feet from barriers or operations, but only for durations of 30 minutes or less.

2.2 Notification Requirements

EPA will be notified in the event of any water quality exceedances as specified in the WQMP. In addition, the Construction Quality Assurance Officer (CQAO) will notify EPA of any additional controls and monitoring that were triggered and employed to minimize potential water quality impacts. Notification will take place on the same day that such additional controls or monitoring were conducted as a part of the daily report.

3 ENVIRONMENTAL CONTROLS AND BEST MANAGEMENT PRACTICES

All operations will be conducted employing standard environmental controls and best management practices (controls) that minimize the potential for water quality impacts. Additional controls will be implemented where the water quality triggers defined in Section 2 have been exceeded. The standard and additional controls for each of the major operations for this removal action construction are discussed below. Under each operation, each potential control is identified as either a standard or additional control.

As noted in Section 2, the approach to employing additional controls is a step-wise procedure. Where a water quality exceedance occurs, every additional control is not employed simultaneously. Rather, the approach is to examine the current operations and observations of turbidity during those operations, and identify the most likely causes of the water quality exceedances measured. Thus, it may be possible to link exceedances to specific practices or issues associated with one aspect of the operation. In this case, a single additional control targeted to address the specific issue may eliminate the water quality problem. Where the implemented additional controls fail to improve water quality (as measured by additional monitoring events as noted in Section 2), then more broad scale or active control measures may be indicated.

3.1 General Spill Prevention and Response

For all operations described below, a spill response team will be notified and on standby over the course of the operations. If oil or oily material is escaping standard control measures described below, and/or a spill from construction equipment occurs, the spill response team will be immediately notified and deployed. The Oregon Department of Environmental Quality (DEQ) Spill Response Team (Northwest Region/Portland: (503) 229-5614) will also be notified.

Operations will cease until such time as the spill response team can limit, contain, or remove spilled or discharged materials from the Project area. In addition, extra absorbent pads will be present on site for all operations and will immediately be deployed under the above circumstances. Fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc., shall be checked regularly for drips or leaks, and shall be maintained in order to prevent spills into river water.

3.2 Dredging

A clamshell dredge will be used to remove the tar body using a water-based derrick. Dredged material will be placed in a barge for subsequent transport. Dredging methods are described in detail in the RAPP.

Dredging controls can be separated into three main categories: containment barriers, operational controls, and specialty dredging equipment. The efficacy of each of these controls is related to site-specific variables (e.g., sediment physical properties and water currents). Each of the types of controls is discussed more in the following sections. In addition, some removal and potential placement of temporary pilings may be necessary before and/or after dredging operations. Controls for piling operations are discussed in Section 3.2.4.

3.2.1 Containment Barriers

Containment barriers are placed around an in-water operation to limit the loss of resuspended sediments or other disturbed materials to wider areas. Common containment barriers include silt curtains, gunderbooms, and oil absorbent booms.

Silt Curtains (Standard Control) – Silt curtains will be employed to create a physical barrier around the dredge equipment to allow the suspended sediments to settle out of the water column in a controlled area. The silt curtain will completely close off the dredge equipment from the surrounding river water while it is in operation.

Standard silt curtains are typically constructed of flexible, reinforced, thermoplastic material with flotation in the upper hem and ballast in the lower hem. Standard silt curtains are typically deployed so that they reach part way to the bottom. A gunderboom is a type of silt curtain that is made of a permeable geotextile fabric that retains suspended sediments but allows water to pass through. This allows gunderbooms to be deployed to the bottom for complete vertical enclosure of the area. However, gunderbooms are subject to clogging with silt over time.

Some type of silt curtain (either standard or gunderboom type) will be placed in the water surrounding the dredge area, allowed to unfurl, and then anchored in place using anchor buoys. Because expected currents during construction may be too high for anchoring of the upstream edge of silt curtains to the bottom, the upstream edge may be held in place with temporary pilings or similar structures. This will ensure that the silt curtains will not be dragged by currents during construction. The need for additional securing of silt curtains will be determined for final design by evaluating expected currents in this area in the December-January construction window.

Oil Booms (Standard Control) – Oil absorbent booms float on the surface of the water and absorb oily products that may float on the surface of the water. They will be deployed inside the silt curtains so that oily material from the tar body will be captured. Oil booms also provide protection against any potential spills from construction equipment. If boom pads become saturated, they will be replaced with fresh pads, and the oily pads will be disposed of in an appropriate upland facility.

3.2.2 Operational Controls

Operational controls are methods of using and deploying dredging equipment that can minimize the resuspension and loss of materials to the water column. Types of dredging operational controls are discussed below.

No Multiple Bites (Standard Control) – When the clamshell bucket takes multiple bites, the bucket loses sediment as it is reopened for subsequent bites. Sediment is also released higher in the water column, as the bucket is raised, opened, and lowered. Multiple bite techniques will not be allowed on the project.

No Bottom Stockpiling (Standard Control) – Bottom stockpiling is when material is dredged and then temporarily placed on the bottom prior to final removal to the barge. This increases the handling of the sediment with each step potentially causing more material loss to the water column. Bottom stockpiling will not be allowed on the project.

Increased Cycle Time (Additional Control) – Cycle time refers to the time it takes for the bucket to be deployed, recovered, moved to and from the haul barge, and returned to

the sediment bed. Longer cycle time is achieved by reducing the velocity of either the ascending loaded bucket or descending empty bucket through the water column. Limiting ascension velocity can reduce the potential for washing of sediment from the bucket. In addition, pausing at the surface of the water before movement through the air and to the barge can also reduce the amount of water laden sediment that washes from the bucket. Limiting the descending velocity reduces the impact of the bucket on the bottom, which can cause resuspension. However, limiting the velocity of the descending bucket reduces the volume of sediment that is picked up with each bite and requires more total bites to remove the same material, which can cause more overall resuspension. Consequently, if needed, descending velocity should only be limited to the extent that relatively full buckets can be obtained for each bite. Sediment resuspension can also be reduced by pausing the bucket at bottom after impact and before digging.

Reduce or Stop Dredging during Peak Currents (Additional Control) – Because of the short construction window, dredging will initially proceed at all times of the day. However, high flows or tidal exchange periods can result in higher currents that carry any resuspended material further downstream. If it is found that water quality exceedances occur during periods of higher currents, an additional control may be to reduce the amount or rate of dredging or completely stop dredging until current velocities decrease.

Decreased Swing Distance to Barge (Additional Control) – The closer the barge is to the dredge, the less time the bucket remains over water where it could potentially lose sediments. However, in some cases, a more distant barge may have logistical or even other water quality related advantages. For example, having the barge outside the silt curtain area eliminates the need for opening and closing the silt curtains, which can allow suspended material inside the silt curtain to escape.

Pausing before Opening or Moving Silt Curtains (Additional Control) – If the haul barge is deployed inside the silt curtain, at some point the curtains must be opened to allow the full barge to move away. In addition, it may become necessary to move silt curtains at times to increase coverage or allow dredging of a new area. Before silt

curtains are opened or moved, dredging operations should cease for some period of time to allow some resettling of suspended sediments within the silt curtain area. The appropriate period can vary depending on the silt content and other properties of the sediment and can be judged through visual observations or turbidity measurements, if necessary. Regardless, the intention of this control is not to achieve pristine or clear water within the silt curtain area, which may take hours or even days. Rather, it is intended to simply to allow some gross settling of larger grain size materials.

3.2.3 Specialty Dredging Equipment (Additional Controls)

Specialty dredging equipment and techniques are designed to further reduce the creation of and impacts from resuspended sediments. Because of the other standard controls that will be employed during dredging, specialty dredging equipment is not expected to be needed. However, in the event that frequent water quality exceedances are occurring and other additional controls are not effective, the following specialty equipment may be considered:

- **Closed or Environmental Bucket** – These are specially constructed dredging buckets designed to reduce the resuspension and loss of sediments to the water column. It should be noted that these buckets often have severe limitations in terms of the types of material they can effectively dredge. They can even be more detrimental to water quality if they are deployed with inappropriate material types or situations.
- **Large Capacity Dredges** – Larger than normal dredges are designed to carry larger loads. This allows fewer dredge cycles and less movement to and from the barge, thereby causing less disturbance and resuspension of sediments.

3.2.4 Piling Related Controls

Standard controls for piling removal will include pulling pilings, if at all possible. Digging for piling stubs will be avoided, if possible. Any woody debris that is lost to the water will be captured and removed from the water. If water quality exceedances are observed, additional controls may include deployment of silt curtains around the operational area.

3.3 Barge Loading and Dewatering

As sediments are placed in the barge, water will escape from side ports or the bottom (in the case of split hull barges) of the barge. The following controls are applicable to barge loading and dewatering.

No Barge Overfilling (Standard Control) – In some types of dredging operations, the barge is overfilled with sediment so that additional water (and some associated sediments) are lost. This increases the sediment load in the barge. This practice will not be allowed for this project.

Filter Material Placement at Barge Ports (Standard Control) – Placement of filter material over the barge ports decreases the suspended sediment in water draining from the barge. Filter material may include geotextiles and/or hay bales. Filter material will be changed regularly to ensure efficient filtration of the return water. This control will be employed at all times.

Barge Dewater Within Silt Curtains (Additional Control) – If water quality exceedances are occurring due to barge loading and/or dewatering, the barge may be moved to the inside of the silt curtains around the dredging operation.

Application of Drying Agents (Additional Control) – Where water quality impacts from barge dewatering are observed and other controls are failing to minimize the problem, the addition of drying agents such as fly ash or soil to the barge may be considered. This would reduce the overall loss of water from the material, and may provide advantages for re-handling to upland transport.

3.4 Transferring

Once the barge is loaded, it will be transported to a dock for transfer of the sediment either directly to the upland disposal facility or to upland transport. The following controls can be employed during the unloading of barges, and where applicable, loading of upland transport.

Sediment Spill Protection (Standard Control) – At some facilities the bucket used to transfer material from the barge might normally swing over open water. If so, a protective "capture barge," temporary structure, and/or spill apron will be placed along the swing pathway of the bucket to prevent material from entering the waterway.

Prevent Return Material/Water (Standard Control) – A metal spill apron will be used for off-loading the dredged material from barge to dock. The apron and upland area will include structures (e.g., curbs) necessary to prevent sediment and water from running off the dock and shoreline area and back into the water. In addition, adequate curbing will be installed to contain water and sediments from discharging to the river or any other surface water feature such as drains or ditches.

Upland Transport Liners/Covers (Standard Control) – Railcars, containers, or trucks that are loaded with sediment for transport to upland facilities will be lined with impermeable liners prior to being filled and covered after being filled.

Upland Transport Loading (Standard Control) – Trucks/railcars will not be overfilled to the point that sudden stops may cause "sloshing" or overflow.

Upland Area Sweeping (Standard Control) – The transloading facility will be swept regularly to prevent potential spreading of materials.

Area and Equipment Cleaning (Standard Control) – All contaminated sediment and materials will be removed from the outside of barges, aprons, trucks, bulldozers, and railcars using dry decontamination methods (brushing or sweeping), prior to leaving the project site. Wheels of trucks may be washed as necessary.

Silt Curtains and Booms (Additional Control) – If, despite the use of the standard controls, water quality exceedances occur in the river that appear to be due to material losses, the barge and dock area will be surrounded with a silt curtain and/or sorbent booms.

Limit Operations to Appropriate Weather (Additional Control) – If very high river flows or storm events occur, operations should be limited to the extent necessary to prevent loss of

materials. This may include ceasing operations where rain events might cause overflow of onshore containment devices such as curbs noted above. Limiting operations will be a last resort, as the need to control loss of materials from operations must be balanced with the need to complete the Project within the construction window. Upgrading runoff controls from equipment and transloading facilities will be considered, if appropriate, as an option to limiting operations during rainfall.

3.5 Upland Dewatering

In some cases, it may be necessary to temporarily stockpile and dewater sediments at an upland location prior to transfer to transport to a disposal site. In these cases, the following controls can be used.

Sediment and Water Containment (Standard Control) – Sediment and water placed in an upland dewatering facility will be completely contained within that facility. This may include the use of berms and/or liner materials in the facility to prevent the seepage and loss of water. The facility will also be of sufficient size to contain rain events that might reasonably occur during the operation.

Dewater Handling (***Standard Control)*** – Several potential methods may be used to control and handle dewater. Fly ash, cement, or other drying products may be employed to dry and/or solidify material. In this case, there will be no additional water that will require handling or discharge. In some cases, water may be collected and removed from the dewatering facility. In these cases, the water will be handled in one of the following ways:

- Decanted water will be discharged to sanitary sewer with appropriate approvals and permits.
- Decanted water will be tested, and where it passes Oregon Water Quality Standards, discharged back to the river.
- Decanted water will be tested, and where it fails Oregon Water Quality Standards, treated and subsequently discharged back to the river.

At this time the need for and extent of dewater handling has not been determined. The exact procedure will be determined for final design, and at that time, this standard control will be described in more detail as appropriate to the specific design.

3.6 Cover or Pilot Cap Placement

As described in the RAPP, a cover or pilot cap will be placed over the newly created sediment surface after dredging. The most likely placement method will be via clamshell placement of material from a barge to the bottom. The following controls can be employed during this operation:

Quality of Cover/Cap Material (Standard Control) – Clean materials used for the cover/cap will be suitable for in-water disposal and will meet the criteria of the Dredge Material Evaluation Framework (USACE et al. 1998). They will be essentially free of organic or other types of waste debris.

Placement Methods (Standard Control) – The cover/cap material will be placed on the newly created sediment surface via clamshell bucket. The following operational controls will be used to limit the potential for resuspension and loss of contaminated sediments that may remain in the area:

- The clamshell will be cracked open while swinging over the desired area of placement. This results in "sprinkling" of material over the bottom and avoids impact of a large amount of material with the bottom in one location.
- The entire area will be covered with a 6 inch lift of cover/cap material working from lower to higher elevations. This approach will result in immediate coverage of all potentially contaminated areas and avoids the potential for cross contamination of cover/cap material.
- The entire area will then be covered with additional 6 inch lifts as necessary to achieve the final required cover/cap thickness in the same manner.

Containment Barriers (Standard Control) – A silt curtain will surround the area during cover/cap placement. An oil absorbent boom will also be deployed.

4 OTHER PROTECTIVE MEASURES

4.1 Protection of Land Resources

The land resources within the project boundaries and outside the limits of work shall be preserved in their present condition or be restored to a condition after construction that will appear to be consistent with previous site uses, agreeable, and not detract from the appearance of the area. Areas of bare soil exposed at any time shall be held to a minimum. Surface drainage from cuts and fill, whether or not completed shall be held in sedimentation ponds or the areas shall be graded to control erosion within acceptable limits. Temporary erosion and sediment control measures such as partial backfilling, mulching, ditches, dikes, drains, sedimentation basins, or silt fences or curtains shall be provided as needed, and maintained.

4.2 Disposal

Except as described in this RAEPP, disposal of any wastes, effluents, trash, grease, chemicals, or other contaminants in surface waters will not be allowed. If any waste material is accidentally released in unauthorized areas, the material shall be removed and the area restored to a condition approximating the adjacent undisturbed area.

Petroleum products, chemicals, fresh cement, riprap, grout, or other deleterious waste materials will not be allowed to enter waters of the State. All foreign materials, construction debris, refuse, waste, used absorbent materials, and similar items must be removed from the site and placed in an appropriate upland disposal facility.

4.3 Protection of Fish and Wildlife

All work shall be performed and all steps taken to prevent interference or disturbance to fish and wildlife. All work shall be performed within in-water work periods established for fish by the Oregon Department of Fish and Wildlife, and all work shall comply with a Biological Assessment for the project accepted by National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) or with a Biological Opinion issued by NMFS or USFWS. Water flows or habitat outside the project boundaries that are critical to fish or wildlife shall not be altered or disturbed. Protective measures as noted in Section 3 will be employed if dead or distressed fish are observed. This situation constitutes a water quality exceedance as noted in Section 2, and will result in the appropriate measures and

notifications as described there. A biological assessment has been prepared and submitted to the USFWS and NMFS for review and issuance of a biological opinion, which has not yet been completed by these agencies. It is unclear whether EPA will require implementation of this project if a biological opinion is not available in sufficient time to start construction in the winter work window. Other protective measures may be required by the final biological opinion, and these will be reflected as appropriate in the final design RAEPP.

4.4 Dust Control

Dust control shall be performed as the work proceeds, whenever a dust nuisance or hazard occurs.

5 WATER QUALITY ANALYSIS

The process for determining water quality exceedances, trigger levels, and triggering additional controls as described in this RAEPP is consistent with the substantive requirements of a Section 401 Water Quality Certification in the State of Oregon and Section 404(b)(1) of the Clean Water Act. This RAEPP was developed through review of recent water quality certificates issued for dredging and contaminated sediment remediation projects in the Columbia and Lower Willamette Rivers including the Columbia River Deepening Project (DEQ 2003a) and the McCormick and Baxter Superfund Site Remediation (DEQ 2003b).

The water quality monitoring requirements and exceedance levels are consistent with these recent water quality certifications. The environmental controls (both standard and additional) meet, and in most cases exceed, the requirements of these recent water quality certificates. Because these recent water quality certificates were issued for compliance with Section 401 and 404(b)(1) in these same waters for similar projects, the removal alternative described in the RAPP complies with the substantive requirements of these regulations.

The 404(b)(1) guidelines require consideration of potential impacts on the following:

- Physical and chemical characteristics of aquatic ecosystem
- Biological characteristics of the aquatic ecosystem
- Special aquatic sites
- Human use characteristics

Each of these items and potential alternatives are discussed below. Based on the evaluation below, short-term adverse impacts are being minimized to the extent practicable while still attaining the goal of removing the tar body from the site. Additional mitigation is not needed beyond the standard and potential additional controls proposed here and the placement of a temporary cover or pilot cap until full scale remediation of all contaminated sediments within the Portland Harbor Superfund Site can take place.

5.1 Physical and Chemical Characteristics

The chemical characteristics of the removal action area will be substantially improved due to the removal action. Because the removal action is a time critical action to prevent potential ongoing impacts to aquatic ecosystems, other alternatives to this removal were not

considered. Cover/cap material applied to the area will be cleaner than any sediments currently existing in the area, and will meet open water disposal requirements (USACE et al. 1998).

The physical characteristics of the removal action area will also be improved over existing conditions. Tar body waste material substrate will be replaced with clean sand or similar material that should pose less substrate impact to aquatic ecosystems. The dredge cut will cause a slight depression in the bank of the river. However, the created elevations are similar to the water depths currently present throughout the adjacent river channel as well as the varied shoreline bathymetry throughout this portion of the river.

5.2 Biological Characteristics

There are likely little if any current benthic or similar biological communities in the area due to the presence of tar. Thus, there will be little if any impact to resident communities during the removal. There may be some unavoidable water quality impacts within containment barriers. Proposed standard and additional controls should be sufficient to limit water quality impacts that might impact fish or water column communities outside the containment barriers in the area. Water quality monitoring will provide a means to verify this and upgrade controls as needed. Also, containment barriers will prevent fish from swimming into the removal area. Overall, the short-term adverse biological impacts associated with the removal are likely outweighed by the long-term benefits to area biological communities by removing this material from the river.

5.3 Special Aquatic Sites

No special aquatic sites will be affected by this removal action.

5.4 Human Use Characteristics

Human uses of this industrial shoreline site are limited to dock unloading activities associated with the upland industries. The removal action will have no substantial impact on these activities. In addition, any potential chemical risks to human health posed by the tar body will be reduced by this removal action.

6 REFERENCES

DEQ 2003a. Letter dated June 23, 2003. To: Colonel Richard W. Hobernicht U.S. Army Corps of Engineers. From: Michael T. Llewelyn Administrator Water Quality Division, DEQ. Regarding: U.S. Army Corps of Engineers' (Corps) requests for water quality certification dated September 4, 2002, November 26, 2002 and March 28, 2003 for The Corps Portland District proposal to deepen the Columbia River Navigation Channel between River Mile (RM) 3.0 and RM 106.5, including the area adjacent to Port of Portland Terminal 6 in the Oregon Slough.

DEQ 2003b. Memorandum dated December 9, 2003. To: Susan Gardner, Project Engineer, Ecology & Environment, Inc. From: Kevin Parrett, Project Manager, Oregon Department of Environmental Quality. Subject: Clean Water Act 401 Water Quality Certification and 404 Evaluation McCormick & Baxter Superfund Site.

USACE, USEPA, Washington Department of Ecology, and DEQ. 1998. Dredge Material Evaluation Framework Lower Columbia River Management Area. Public Review Draft. Portland, Oregon.

APPENDIX F

MONITORING AND REPORTING PLAN
(ANNOTATED OUTLINE)

Gasco Removal Action
Monitoring and Reporting Plan – Post Construction

1. Introduction

2. Project and Data Collection Objectives
    - 2.1.1. Removal Action Objectives (RAOs) per SOW
    - 2.1.2. Data Collection Objectives to Meet RAOs

3. Monitoring Approach
    - 3.1.1. Rationale
    - 3.1.2. Monitoring Types
        - Visual/Diver Inspection
        - Bathymetric Survey
        - Seepage Monitoring (Grab Samples/Cores)
    - 3.1.3. Monitoring Area and Locations
    - 3.1.4. Monitoring Frequency
    - 3.1.5. Methods (QAPP as Appendix)

4. Results Reporting
    - 4.1.1. Data Reduction, Analysis, Interpretation, and Summarization
    - 4.1.2. Report Contents
    - 4.1.3. Reporting Schedule

5. Post Construction Project Controls (if needed)
    - 5.1.1. Proposed Controls
    - 5.1.2. Documentation Procedures
    - 5.1.3. Notification Procedures

6. Adaptive Management Process
    - 6.1.1. Tiered Response Approach
    - 6.1.2. Triggers for Response Tiers
        - Controls (if needed)
        - Monitoring

7. Transition to Gasco Site-wide Remedial Action
    - 7.1.1. Integration of Ongoing RI/FS and Source Control Data
    - 7.1.2. Update upon Upland and Harbor-wide Remedial Action
    - 7.1.3. Update upon Sediment Site Specific Remedial Action Long Term Monitoring

8. References

Attachment F-1 – Quality Assurance Project Plan (QAPP)

APPENDIX G

BORING LOGS

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
PROJECT NUMBER: 000029-02
GEOLOGIST/ENGINEER: J. Renda
DRILLING CONTRACTOR: Geotech Explorations, Inc.
DRILLING METHOD: Direct Push/Geoprobe
HOLE DIAMETER: 2-inch

BORING #: RAA-01
DATE BEGAN: 7/21/04
DATE COMPLETED: 7/21/04
TOTAL DEPTH: 20 feet
SHEET: 1 OF 1

Field location of boring
Mudline: 0.5 feet
Staff Gage: 2.5 feet
Latitude: 45.57977374
Longitude: 122.75818444

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
				1.5		1		**SAND (SP)**; black; fine to medium sand, oil saturated, sticky, sheen.
						2		
						3		
						4		
						5		
						6		0.3 feet: **SAND (SP)**; black; fine to medium sand, oil saturated, sticky, sheen.
				3.5		7		0.2 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; no sheen.
						8		0.3 feet: **SAND (SP)**; grayish brown; fine sand. 0.3 feet: **SILT (ML)**; grayish brown; as above.
						9		0.1 feet: **SAND (SP)**; grayish brown; fine to medium sand. 0.6 feet: **SILT (ML)**; grayish brown; as above.
						10		0.1 feet: **SAND (SP)**; grayish brown; fine to medium sand. 1.6 feet: **SILT (ML)**; grayish brown; as above.
						11		
				4.0		12		**SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine sand.
						13		
						14		
						15		0.2 feet: **SAND (SP)**; grayish brown; fine to medium sand. (At base of sample interval)
						16		
				4.5		17		2.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine sand.
						18		
						19		2.0 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 10 to 20 percent nonplastic to low plasticity fines.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-02
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/20/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/20/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring
Mudline: 3.2 feet | Latitude: 45.57982789
Staff Gage: 2.75 feet | Longitude: 122.75792804

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
				0.0		1		No recovery 0-10 feet with Geoprobe. Pushed core liner 4 feet into sediment using PVC rods w/ check valve with 0.5 feet recovery.
						2		0.5 feet: **Sandy Tar**; black; fine to medium sand in tar matrix.
						3		
						4		
						5		
				0.0		6		
						7		
						8		
						9		
						10		
						11		
				3.0		12		**SILT (ML)**; grayish brown; low to medium plasticity fines; light to medium sheen.
						13		@ approximately 1 foot from top of sample interval, 0.2 foot-thick oil/tar layer; firm, sticky.
						14		@ approximately 2.5 feet from top of sample interval, 0.2 foot-thick oil/sand layer with wood fragments.
						15		
				3.5		16		**SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine sand; lenses of color change to black; spotty sheen.
						17		
						18		No sheen in bottom 1 foot of sample.
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-03
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/21/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/21/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 23 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring
Mudline: 27.4 feet | Latitude: 45.58007390
Staff Gage: 5.25 feet | Longitude: 122.75794293

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
					X			No recovery 0-8 feet with Geoprobe; rods sink to 8 feet below mudline. Pushed 3-inch outside-diameter piston core 1.5 feet into sediment on 7/22/04.
				0.0	X	1		
					X			
						2		0.0 to 1.5 feet: **SILT (ML)**: grayish brown; medium plasticity fines; sheen.
						3		@ 0.2 to 0.3 feet: Oil/tar layer; black; firm
						4		@ 0.6 to 0.9 feet: Oil/tar layer; black; firm
						5		@ 1.2 to 1.4 feet: Oil/tar layer; black; firm; droplets of free product.
						6		
						7		
						8		
					X	9		Stratified layers of **Sand (SP), SILT (ML)**, and **SILTY SAND (SM)** in layers of 0.2 to 0.3 feet thick. Trace wood chips; trace oil specks.
					X	10		
				3.0	X	11		
					X	12		
					X	13		
					X	14		**SAND (SP)**; grayish brown; fine to medium sand; loose; no sheen or specks.
					X	15		
				2.0	X	16		
					X	17		
					X	18		
					X	19		0.5 feet: **SAND (SP)**; grayish brown; fine to medium sand. 0.8 feet: **SILT (ML)**; grayish brown; low to medium plasticity.
					X	20		0.3 feet: **SAND (SP)**; grayish brown; fine to medium sand. 0.6 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines.
				3.0	X	21		0.5 feet: **SAND (SP)**; grayish brown; fine sand. 0.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
					X	22		
					X	23		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
PROJECT NUMBER: 000029-02
GEOLOGIST/ENGINEER: J. Renda
DRILLING CONTRACTOR: Geotech Explorations, Inc.
DRILLING METHOD: Direct Push/Geoprobe
HOLE DIAMETER: 2-inch

BORING #: RAA-04
DATE BEGAN: 7/21/04
DATE COMPLETED: 7/21/04
TOTAL DEPTH: 20 feet
SHEET: 1 OF 1

Field location of boring
0.5 feet
Mudline: above water
Staff Gage: 3.5 feet
Latitude: 45.57971933
Longitude: 122.75805875

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		1.0 foot: **SANDY TAR with SILT**; black; fine to medium sand in tar matrix; nonplastic to low plasticity fines; trace fine to medium gravel; angular to subrounded.
						2		
				2.5				1.5 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; no sheen.
						3		
						4		
						5		
						6		5.0 to 6.0 feet: **SAND (SP)**; black; fine to medium sand; approximately 30 percent tar; trace fine to medium gravel.
						7		
				5.0				6.0 to 20.0 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; no sheen.
						8		
						9		
						10		
						11		
						12		
				3.0				
						13		
						14		
						15		
						16		
						17		
				4.5				
						18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
PROJECT NUMBER: 000029-02
GEOLOGIST/ENGINEER: J. Renda
DRILLING CONTRACTOR: Geotech Explorations, Inc.
DRILLING METHOD: Direct Push/Geoprobe
HOLE DIAMETER: 2-inch

BORING #: RAA-05
DATE BEGAN: 7/22/04
DATE COMPLETED: 7/22/04
TOTAL DEPTH: 20 feet
SHEET: 1 OF 1

Field location of boring
Mudline: 3.1 feet
Staff Gage: 4.9 feet
Latitude: 45.57985022
Longitude: 122.75809311

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								1.3 feet: **TAR**; black; firm; sticky.
						1		0.3 feet: **SILT (ML)**; black; low plasticity fines; slight sheen.
								0.3 feet: **SAND (SP)**; black; fine sand, trace nonplastic to low plasticity fines.
						2		
				2.3				0.3 feet: **SILTY SAND (SM)**; black; fine to medium sand, 30 to 40 percent nonplastic to low plasticity fines; trace wood fragments.
						3		
								0.1 feet: **SAND (SP)**; dark gray to black; fine to medium sand.
						4		
						5		
								1.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace wood fibers; slight sheen.
						6		0.5 feet: **SANDY SILT (ML)**; dark gray; low to medium plasticity fines; 15 to 20 percent fine sand; medium sheen.
						7		
				3.5				0.2 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; light sheen.
						8		
								0.1 feet: **SILT (ML)**; dark gray; low to medium plasticity fines; medium sheen.
						9		
								1.1 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; light sheen in thin lenses.
						10		
								SILT (ML); grayish brown; low to medium plasticity fines; no sheen.
						11		
						12		
				3.5				Bottom 1 foot of interval contains lenses of fine sand 0.2 to 0.3 feet thick.
						13		
						14		
						15		
						16		
								2.0 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; loose; wet.
						17		
				5.0				
						18		
								2.0 feet: **SANDY SILT (ML)**; grayish brown; nonplastic to low plasticity fines; 30 to 40 percent fine sand.
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-06
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/20/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/20/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring
Mudline: 4.4 feet | Latitude: 45.58001600
Staff Gage: 3.0 feet | Longitude: 122.75808147

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		0.5 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; loose.
						2		0.8 feet: **TAR with SILTY SAND**; black; fine to medium sand with low plasticity fines in tar matrix.
				2.2		3		0.7 feet: **SANDY SILT (ML)**; grayish brown; nonplastic to low plasticity fines; 30-40 percent fine sand.
						4		0.2 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines.
						5		
						6		0.5 feet: fine to medium gravel sized tar chunks; hard; brittle.
						7		2.0 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines.
				5.0		8		1.5 feet: **SANDY SILT (ML)**; grayish brown; nonplastic to low plasticity fines; 30-40 percent fine sand; specks of oil/sheen.
						9		1.0 feet: **SILTY SAND (SM)**; dark grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines; specks of oil/sheen.
						10		
						11		0.8 feet: **SILTY SAND (SM)**; dark grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines; specks of oil/sheen.
						12		0.3 feet: **SANDY SILT (ML)**; grayish brown; medium plasticity fines; 30-40 percent fine sand; specks of oil/sheen.
				1.1		13		
						14		
						15		
						16		3.0 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine sand; lenses of color change to black; spotty sheen.
						17		2.0 feet: **SAND (SP)**; grayish brown; fine to medium sand; no sheen or spotting.
				5.0		18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-07
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/20/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/20/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring
Mudline: 16.7 feet | Latitude: 45.58011224
Staff Gage: 5.75 feet | Longitude: 122.75818444

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		No recovery 0-5 feet with Geoprobe; rods sink to 5 feet below mudline in the soft sediment.
						2		
						3		
						4		
						5		
						6		**SAND (SP)**; black; fine to medium sand; stratified with 0.3 to 0.4 foot-thick layers of TAR; firm and sticky.
						7		
				3.5		8		
						9		
						10		
						11		0.5 feet: **TAR**; black; 20 to 30 percent nonplastic to low plasticity fines; firm.
						12		0.5 feet: **SILT (ML)**; gray; medium plasticity fines.
						13		1 foot: **TAR**; black; 20 to 30 percent fine to medium sand.
				3.5		14		0.5 feet: **SAND (SP)**; grayish brown; fine to medium sand; few tar blebs; spotty sheen.
						15		0.5 feet: **SILT (ML)**; grayish brown; medium plasticity fines; slight sheen.
						16		0.5 feet: **SAND (SP)**; grayish brown; fine to medium sand; no sheen.
						17		0.5 feet: **SILT (ML)**; grayish brown; medium plasticity fines; specks of oil/sheen.
				2.5		18		2.0 feet: **SAND (SP)**; grayish brown; fine to medium sand; no sheen or spotting.
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-08
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/21/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/21/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring
Mudline: 0.5 feet above water
Staff Gage: 3.2 feet
Latitude: 45.57982296
Longitude: 122.75845286

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		1 foot: **SANDY GRAVEL (GW)**; lt brown; fine to coarse; angular to subrounded; 20 to 30 percent fine to coarse sand.
						2		1 foot: **SAND (SP)**; black; fine to medium sand; oil/tar saturated.
				2.0		3		
						4		
						5		
						6		1.5 feet: **SAND (SP)**; black; fine to medium sand; saturated with oil/tar; firm and sticky.
						7		1.5 feet: **SILTY SAND (SM)**; grayish brown; fine sand; 20 to 30 percent nonplastic to low plasticity fines; no sheen.
				3.0		8		
						9		
						10		
						11		Note: no recovery; move over 1.5 feet and core 10 to 15 feet with full recovery.
						12		**SILTY SAND (SM)**; grayish brown; fine sand; 20 to 30 percent low to medium plasticity fines; no sheen.
				5.0		13		
						14		
						15		
						16		**SILT (ML)**: grayish brown; nonplastic to low plasticity fines; 5 to 10 percent fine sand; loose, wet, no sheen or spotting.
						17		
				5.0		18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site | BORING # RAA-09
PROJECT NUMBER 000029-02 | DATE BEGAN 7/19/04
GEOLOGIST/ENGINEER J. Renda | DATE COMPLETED 7/19/04
DRILLING CONTRACTOR Geotech Explorations, Inc. | TOTAL DEPTH 20 feet
DRILLING METHOD Direct Push/Geoprobe | SHEET 1 OF 2
HOLE DIAMETER 2-inch

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						0		Field location of boring Mudline: 0.2 feet Staff Gage: 3.0 feet Latitude: 45.57990589 Longitude: 122.75826530
						1		1.8 feet: **TAR**; black; firm; sticky. 0.2 feet: **SAND (SP)**; dark gray; fine to medium sand; heavy sheen; oil droplets.
				2.0		2		
						3		
						4		
						5		
						6		**SAND (SP)**; dark gray; fine to medium sand; heavy sheen; oil droplets.
						7		
				3.5		8		
						9		
						10		
						11		**SAND (SP)**; dark gray; fine to medium sand; trace tar globs; heavy sheen; trace wood fragments.
						12		@ 12 to 14 feet; same with approximately 30 percent nonplastic fines.
				5.0		13		
						14		
						15		
						16		@ 16 feet: No sheen
						17		
				5.0		18		17.5 to 20 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; no sheen. @ 19 feet: 0.1 foot sand lense; fine to medium sand.
						19		@ 19.5 feet: 0.1 foot sand lense; fine to medium sand.
						20		

Remarks: A boring was advanced from 0 to 4 feet below mudline with 1.5 feet recovery. 1.5 feet of of tar was observed with sand in drive shoe. In the 4 to 8 foot interval, 2 feet of SAND was observed (2 feet recovery). Borehole was decommissioned with bentonite chips and a second boring was advanced as described above.

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-09
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/19/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/19/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 2 OF: 2
HOLE DIAMETER: 2-inch

Field location of boring
Mudline: 0.2 feet | Latitude: 45.57990589
Staff Gage: 3.0 feet | Longitude: 122.75826530

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						21		2.5 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; no sheen.
						22		1.5 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; loose, soupy; trace wood fibers, no sheen.
				4.5		23		0.5 feet: **SAND (SP)**; grayish brown; fine to medium sand.
						24		
						25		
						26		**SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace fine sand; trace wood fragments; no sheen.
						27		
				5.0		28		@ 27 feet: 0.1 foot-thick sand lens.
						29		
						30		@ 29.5 feet: increase in plasticity and firmness.
						31		
						32		**SAND (SP)**; dark gray; fine to medium sand.
				5.0		33		
						34		
						35		@ 34.5 feet: 0.2 foot-thick silt lense; grayish brown; medium plasticity fines.
						36		
						37		**SAND (SP)**; grayish brown; fine to medium sand.
				5.0		38		
						39		
						40		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site | BORING # RAA-10
PROJECT NUMBER 000029-02 | DATE BEGAN 7/19/04
GEOLOGIST/ENGINEER J. Renda | DATE COMPLETED 7/19/04
DRILLING CONTRACTOR Geotech Explorations, Inc. | TOTAL DEPTH 20 feet
DRILLING METHOD Direct Push/Geoprobe | SHEET 1 OF 1
HOLE DIAMETER 2-inch

Field location of boring

Mudline: 2.3 feet | Latitude: 45.580043205
Staff Gage: 2.0 feet | Longitude: 122.75827003

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		**SAND (SP)**; black; fine to medium sand; 20 to 30 percent oil/tar; loose to firm; wet; heavy sheen.
				3.0		2		
						3		
						4		
						5		
						6		**SAND (SP)**; black; fine to medium sand; 20 to 30 percent oil/tar; loose to firm; wet; heavy sheen.
				2.0		7		
						8		
						9		
						10		
						11		**SILT (ML)**; grayish brown; medium plasticity fines; trace wood fragments.
						12		Oily specks to a depth of approximately 12 feet.
				4.0		13		
						14		
						15		
						16		2.5 feet: **SILT (ML)**: grayish brown; medium plasticity fines; trace wood fragments.
						17		1.0 feet: **SAND (SP)**; grayish brown; fine to medium sand.
				5.0		18		0.5 feet: **SANDY SILT (ML)**; grayish brown; low plasticity fines; 30 to 40 percent fine sand.
						19		0.5 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent low plasticity fines.
						20		0.5 feet: **SANDY SILT (ML)**; grayish brown; low plasticity fines; 30 to 40 percent fine sand.

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-11
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/22/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/22/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring

Mudline: 2.9 feet | Latitude: 45.58003730
Staff Gage: 2.9 feet | Longitude: 122.75844474

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								1.1 feet: **TAR;** black; firm; sticky.
						1		2.2 feet: **SAND (SP)**; dark gray grading to grayish brown; fine to medium sand; slight sheen.
						2		
				3.3				@ approximately 2 feet from top of sample interval: 0.1 foot-thick silt lense
						3		@ approximately 3 feet from top of sample interval: 0.1 foot-thick silt lense
						4		
						5		
						6		**SAND (SP)**; grayish brown; fine to medium sand; few oily specks; slight heavy sheen.
						7		@ approximately 1.9 feet from top of sample interval: 0.3 foot-thick silt lense; low to medium plasticity; sheen.
				3.3		8		@ approximately 2.9 feet from top of sample interval: 0.2 foot-thick silt lense; low to medium plasticity; sheen.
						9		
						10		
						11		0.3 feet: **SAND (SP)**; grayish brown; fine to medium sand; sheen.
						12		3.7 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; Oily specks to a depth of approximately 12 feet.
				4.0		13		@ 1 foot from top of sample interval: sand lense; oily, loose, laminated with silt, sand , and wood fibers.
						14		@ 1.5 feet from top of sample interval: tar chunk; hard, brittle, < 0.1 foot.
						15		@ 2.0 feet from top of sample interval: silty sand lense.
						16		2.8 feet: **SILT (ML)**: grayish brown; low to medium plasticity fines; trace wood fragments.
						17		0.2 feet: **SAND (SP)**; grayish brown; fine to medium sand, < 10 percent nonplastic fines.
				5.0		18		0.5 feet: **SILT (ML)**: grayish brown; nonplastic to low plasticity fines.
						19		0.8 feet: **SAND (SP)**; grayish brown; fine to medium sand. 0.7 feet: **SILT (ML)**: grayish brown; nonplastic to low plasticity fines.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
BORING #: RAA-12
PROJECT NUMBER: 000029-02
DATE BEGAN: 7/20/04
GEOLOGIST/ENGINEER: J. Renda
DATE COMPLETED: 7/20/04
DRILLING CONTRACTOR: Geotech Explorations, Inc.
TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe
SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								Field location of boring Mudline: 4.3 feet Latitude: 45.58016669 Staff Gage: 4.5 feet Longitude: 122.75850000
						1		1.0 feet: **SILT (ML);** grayish brown; nonplastic fines; loose; slight sheen. 0.5 feet: **SILT (ML);** dark gray to black; low plasticity fines; heavy sheen.
						2		Note: An additional sample was collected using a Piston Core sampler. Pushed 3-inch outside-diameter piston core 3.0 feet into sediment on 7/22/04.
				1.5		3		
						4		0.0 to 0.2 feet: **SILT (ML)**: grayish brown; nonplastic fines; loose; oily sheen.
						5		0.2 to 3.0 feet: **SILT (ML)**; grayish brown; low plasticity fines; firm; slight sheen. @ 0.4 to 0.5 feet: black oily layer
						6		
						7		
				0.0		8		
						9		
						10		
						11		**SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace oil specks.
						12		@ 12 feet: 0.1 foot-thick oil/tar lense, black; firm. @ 12.1 feet: color change to dark gray/black with oily laminations.
				4.5		13		
						14		
						15		
						16		**SILT (ML)**; grayish brown; nonplastic to low plasticity fines; trace oil specks.
						17		
				5.0		18		@ 17 to 17.5 feet: **SAND (SP)**; grayish brown; fine to medium sand; slight sheen.
						19		@ 18 to 20 feet: no sheen.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-13
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/20/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/20/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 22 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring
Mudline: 19.9 feet | Latitude: 45.58017940
Staff Gage: 4.0 feet | Longitude: 122.75836670

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								No recovery 0-7 feet with Geoprobe. Pushed core liner 4 feet into sediment using PVC rods w/ check valve with no recovery. Outside of core tube was coated with black oil/tar.
				0.0		1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		1.0 foot: **SILT (ML);** grayish brown; nonplastic fines; loose; slight sheen.
						9		2.0 feet: **TAR**; black; silty with silt lenses and fibrous wood layers.
				4.0		10		0.4 feet: **SILT (ML);** black; nonplastic to low plasticity fines.
						11		0.3 feet: **SILT (ML);** grayish brown; nonplastic to low plasticity fines.
						12		0.3 feet: **SAND (SP);** grayish brown; fine to medium sand.
						13		2.0 feet: **SAND (SP)**; grayish brown; fine to medium sand; loose; slight spotty sheen.
						14		
				3.0		15		1.0 feet: **SILTY SAND (SM)**; grayish brown; fine to medium sand; 20 to 30 percent nonplastic to low plasticity fines; no sheen or oil specks.
						16		@ 2.5 feet from top of sample interval: 0.2 foot-thick silt lense.
						17		
						18		3.0 feet: **SAND (SP)**; grayish brown; fine to medium sand; 3 specks of oil noted in top 1.5 feet of sample interval.
						19		1.8 feet: **SILTY SAND (SM)**; grayish brown; fine sand; 20 to 30 percent nonplastic to low plasticity fines; no sheen or oil specks.
				5.0		20		
						21		0.2 feet: **SILT (ML)**; grayish brown; nonplastic to low plasticity fines.
						22		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site | BORING # RAA-14
PROJECT NUMBER 000029-02 | DATE BEGAN 7/20/04
GEOLOGIST/ENGINEER J. Renda | DATE COMPLETED 7/20/04
DRILLING CONTRACTOR Geotech Explorations, Inc. | TOTAL DEPTH 20 feet
DRILLING METHOD Direct Push/Geoprobe | SHEET 1 OF 1
HOLE DIAMETER 2-inch

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								Field location of boring Mudline: 31.1 feet Latitude: 45.58022110 Staff Gage: 3.75 feet Longitude: 122.75825230
								No recovery 0-10 feet with Geoprobe; rods sink to 10 feet below mudline.
				1.1		1		Pushed 3-inch outside-diameter piston core 1.1 feet into sediment on 7/22/04.
						2		**SILT (ML)**; grayish brown; low to medium plasticity fines; trace wood fibers;
						3		approximately 6, 0.1 foot-thick lenses of black tar; firm and sticky.
						4		
						5		
						6		
						7		
				0.0		8		
						9		
						10		
						11		10.0 to 11.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; loose; blebs of tar/oil.
						12		11.5 to 13.5 feet: **SILT (ML)**: grayish brown to black; low to medium plasticity fines; black dense tar laminations; trace wood fibers and wood chunks.
				5.0		13		@13.5 feet: Fine Gravel.
						14		13.5 to 14.0 feet: **SANDY SILT (ML)**; grayish brown; low to medium plasticity fines; 30 to 40 percent fine sand; no sheen or spotting.
						15		14.0 to 20.0 feet: **SAND (SP)**; grayish brown; fine sand; trace fines; no sheen or spotting.
						16		@ 14.3 to 14.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						17		
				4.0		18		@ 18.0 to 18.4 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						19		@ 19.0 to 19.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-15
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/21/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/21/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring

Mudline: 3 feet above water
Staff Gage: 4.0 feet
Latitude: 45.57996370
Longitude: 122.75874391

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		0.7 feet: **GRAVELLY SAND (SW)**; rust brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines; moist.
				1.0		2		0.3 feet: **GRAVELLY SAND (SW)**; grayish brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines; wet.
						3		@2.5 feet: standing water in borehole.
						4		
						5		
						6		1.0 feet: **SILT WITH SAND (ML)**; grayish brown; nonplastic fines; 20 to 30 percent fine sand; loose; spotty sheen; sluff?
						7		3.0 feet: **SILT WITH SAND (ML)**; grayish brown; nonplastic fines; 20 to 30 percent fine sand; firm; no sheen.
				4.0		8		@ 3 feet from top of sample interval: 0.1 foot-thick woody layer.
						9		
						10		
						11		**SILT WITH SAND (ML)**; grayish brown; nonplastic fines; 20 to 30 percent fine sand; firm; no sheen.
						12		
				3.0		13		
						14		
						15		
						16		No recovery
						17		
				0.0		18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site
BORING #: RAA-16
PROJECT NUMBER: 000029-02
DATE BEGAN: 7/22/04
GEOLOGIST/ENGINEER: J. Renda
DATE COMPLETED: 7/22/04
DRILLING CONTRACTOR: Geotech Explorations, Inc.
TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe
SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring

Mudline: 2.4 feet
Staff Gage: 3.0 feet
Latitude: 45.58024746
Longitude: 122.75866807

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						0		0.4 feet: **SILT (ML)**; dark gray to black; low plasticity fines; loose; medium to heavy sheen; 5 to 10 percent wood chips.
						1		0.8 feet: **SAND (SP)**; dark gray to black; fine to medium sand; trace fines; spotty sheen.
						2		1.2 feet: **SILT (ML)**; black; nonplastic to low plasticity fines; spotty sheen.
				2.8		3		@ 1.8 feet from top of sample interval: 0.1 foot-thick heavy sheen layer.
						4		0.4 feet: **SAND (SP)**; dark gray to black; fine to medium sand; trace fines; spotty sheen.
						5		1.4 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; loose, light sheen.
						6		@ 0.2 feet from top of sample interval: 0.1 foot-thick black oily layer.
						7		0.8 feet: **SAND (SP)**; grayish brown; fine to medium sand; trace fines; light sheen.
				3.2		8		1.0 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; dark gray to black banding; light sheen.
						9		
						10		
						11		0.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace fine to medium sand, no sheen or spotting.
						12		0.3 feet: **SAND (SP)**; grayish brown; fine to medium sand; trace fines; no sheen.
				3.7		13		0.7 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; no sheen.
						14		0.6 feet: **SAND (SP)**; grayish brown; fine sand; trace fines; no sheen.
						15		1.8 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; black laminations; no sheen.
						16		**SILT (ML)**; grayish brown; low to medium plasticity fines; < 5 percent fine sand, trace root hairs; no sheen or spotting.
						17		
				5.0		18		
						19		@ 18.5 to 19.2 feet: loose, soupy.
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site | BORING # RAA-17
PROJECT NUMBER 000029-02 | DATE BEGAN 7/22/04
GEOLOGIST/ENGINEER J. Renda | DATE COMPLETED 7/22/04
DRILLING CONTRACTOR Geotech Explorations, Inc. | TOTAL DEPTH 21 feet
DRILLING METHOD Direct Push/Geoprobe | SHEET 1 OF 1
HOLE DIAMETER 2-inch

LOG OF EXPLORATORY BORING

Field location of boring

Mudline: 2.7 feet | Latitude: 45.58014987
Staff Gage: 3.0 feet | Longitude: 122.75872767

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								No recovery 0-1 feet with Geoprobe; rods sink to 1 feet below mudline.
						1		
								0.5 feet: **SILT (ML)**; dark gray to black; nonplastic to low plasticity fines; loose, trace wood chucks; heavy sheen.
						2		1.0 feet: **SAND (SP)**; dark gray; fine to medium sand; trace fines; light sheen.
						3		
				2.5				0.5 feet: **SILT (ML)**; dark gray; nonplastic to low plasticity fines; loose, trace wood chucks; light sheen.
						4		0.5 feet: **SAND (SP)**; dark gray; fine to medium sand; trace fines; light sheen.
						5		
						6		
								SILT (ML); grayish brown; low to medium plasticity fines; trace woody layers; light sheen lenses.
						7		
						8		@ 1.5 feet from top of sample interval: 0.1 foot-thick woody layer with heavy sheen.
				3.2				
						9		
						10		
						11		
								0.4 feet: **SAND (SP)**; grayish brown; fine sand; trace fines; no sheen.
						12		0.8 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; trace root hairs; no sheen or spotting.
						13		0.7 feet: **SAND (SP)**; grayish brown; fine sand; trace fines; trace spotty sheen.
				3.5				1.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; no sheen or spotting.
						14		0.1 feet: **SILT (ML)**; black; nonplastic fines; firm; brittle; no sheen or spotting.
						15		
						16		
						17		0.5 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; no sheen.
						18		0.2 feet: **SILTY SAND (SM)**; grayish brown; fine sand; nonplastic fines; loose, soupy.
				3.5				1.8 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						19		0.6 feet: **SAND (SP)**; grayish brown; fine sand; trace fines.
						20		0.4 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines.
						21		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Northwest Natural "Gasco" Site | BORING #: RAA-18
PROJECT NUMBER: 000029-02 | DATE BEGAN: 7/21/04
GEOLOGIST/ENGINEER: J. Renda | DATE COMPLETED: 7/21/04
DRILLING CONTRACTOR: Geotech Explorations, Inc. | TOTAL DEPTH: 20 feet
DRILLING METHOD: Direct Push/Geoprobe | SHEET: 1 OF 1
HOLE DIAMETER: 2-inch

Field location of boring

Mudline: 4 feet above water
Staff Gage: 2.75 feet

Latitude: 45.57968324
Longitude: 122.75810387

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
						1		**GRAVELLY SAND (SW)**; rust brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines; moist.
				1.2		2		
						3		
						4		
						5		
						6		5.0 to 20.0 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; 5 to 10 percent fine sand.
				1.5		7		
						8		
						9		
						10		
						11		
				4.0		12		
						13		
						14		
						15		
						16		
				4.0		17		
						18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site | BORING # RAA-19
PROJECT NUMBER 000029-02 | DATE BEGAN 7/22/04
GEOLOGIST/ENGINEER J. Renda | DATE COMPLETED 7/22/04
DRILLING CONTRACTOR Geotech Explorations, Inc. | TOTAL DEPTH 20 feet
DRILLING METHOD Direct Push/Geoprobe | SHEET 1 OF 1
HOLE DIAMETER 2-inch

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
								Field location of boring Latitude: 45.57985626 Longitude: 122.75846549
						1		1.4 feet: **GRAVELLY SAND (SW)**; rust brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines.
						2		0.2 feet: **GRAVELLY SAND (SW)**; gray; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines.
				2.5		3		0.6 feet: **WOOD CHIPS**; dark brown to black; 3 medium sized gravel-like tar chunks; hard.
						4		0.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; 5 to 10 percent fine sand; spotty sheen.
						5		
						6		0.3 feet: **SILT (ML)**; grayish brown; nonplastic fines. 2.0 feet: **TAR**; black; with oil/tar saturated lenses of sand and silt.
						7		
				2.3		8		
						9		
						10		
						11		10.0 to 20.0 feet: **SILT (ML);** gray; low to medium plastic fines; 10 to 20 percent fine sand; no sheen.
						12		
				4.0		13		
						14		
						15		
						16		
						17		
				4.5		18		
						19		
						20		

Remarks:

ANCHOR ENVIRONMENTAL, L.L.C.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Northwest Natural "Gasco" Site | BORING # RAA-20
PROJECT NUMBER 000029-02 | DATE BEGAN 7/22/04
GEOLOGIST/ENGINEER J. Renda | DATE COMPLETED 7/22/04
DRILLING CONTRACTOR Geotech Explorations, Inc. | TOTAL DEPTH 20 feet
DRILLING METHOD Direct Push/Geoprobe | SHEET 1 OF 1
HOLE DIAMETER 2-inch

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	RECOVERY (feet)	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)
						1	
				2.5		2	
						3	
						4	
						5	
						6	
				5.0		7	
						8	
						9	
						10	
						11	
				4.5		12	
						13	
						14	
						15	
						16	
				5.0		17	
						18	
						19	
						20	

Field location of boring

Latitude: 45.57975098
Longitude: 122.75829940

LITHOLOGIC DESCRIPTION

1.5 feet: **GRAVELLY SAND (SW)**; rust brown; fine to coarse sand; fine to coarse gravel; angular to rounded; nonplastic fines.

0.8 feet: **TAR**; black; with oil/tar saturated lenses of sand and silt.

0.2 feet: **SAND (SP)**; dark gray; fine to medium; spotty sheen.

0.3 feet: **SILT (ML)**; grayish brown; low to medium plasticity fines; 5 to 10 percent fine sand; spotty sheen.

5.0 to 5.5 feet: **GRAVELLY SAND (SW)**; gray; fine to coarse sand; fine to medium gravel; angular to subrounded; fine to coarse sand; spotty sheen.

5.5 to 5.6 feet: **SAND (SP)**; dark gray; fine to medium sand; spotty sheen.

5.6 to 20.0 feet: **SILT (ML);** grayish brown; nonplastic to low plasticity fines; 10 to 20 percent fine sand; trace fine sand lenses; no sheen.

10.0 to 20.0 feet: **SILT (ML);** gray; low to medium plastic fines; 10 to 20 percent fine sand; no sheen.

Remarks:

HAHN & ASSOCIATES, INC.	SOIL BORING NUMBER	AN-2-1		
434 NW Sixth Avenue Portland, Oregon (503) 796-0717	HAI LOGGER:	Kim Magruder/Rob Ede	DRILL START Time:	DRILL FINISH Time:
PROJECT: NW Natural Gasco Facility Portland, Oregon	SAMPLING METHOD:	Stainless Steel Soil Sampler	9:23	9:28
	DRILLING METHOD:	Vibracore		
	EQUIPMENT TYPE	Same as above		
	DRILLER:	Bill Jaworski	Date: 04/11/01	Date: 04/11/01
PROJECT #: 2708	DRILLING CONTRACTOR:	Marine Sampling Systems		

BORING DIAMETER: 3-inch OD
CASING DIAMETER: N/A
SURFACE ELEVATION: Estimated to be: N/A
TOP OF CASING ELEVATION: N/A

ABANDONMENT DETAILS	SAMPLE NUMBER*	TIME	HEADSPACE (ppm)	CORE INTERVAL	RECOVERY INTERVAL	DEPTH (feet)	GROUNDWATER	STRATA (USCS)	SOIL DESCRIPTION
				AN2-1A				ML	**AN2-1A (4' 2" core length)** SILT, brown, wet, soft (soupy), small fraction very fine sand (<5%), organic matter (rootlets, wood fiber), no sheen, slight hydrocarbon odor (0 to 10 cm), slight increase in sand content and slight sheen (10 to 20 cm); increased organic matter, decreased moisture content, no sheen, no hydrocarbon odor (30 to 40 cm). SILT, as above to 3', at 3' have a 2" thick tar layer (black and oily with some elastic tar and associated oily tar), slight sheen, hydrocarbon odor, 3-inch thick sandy silt zone from 3'11" to 4'2. **AN2-1B (3' 11" core length)** SILT, olive grey with black mottling, moist, medium soft, with weathered tar layers to 5' 11" bgs, below weathered tar zone silt is olive grey, no sheen, no hydrocarbon odor. **AN2-1C (3' 3" core length)** SILT, olive grey, moist, medium soft, no sheen, no hydrocarbon odor. Total Core Push = Total Recovered Core Length = 11' 4"
			2.0			1			
						2			
						3			
			1.4			4			
				AN2-1B		**5**			
						6			
						7			
			0.0			8		ML	
				AN2-1C		9			
						10			
						11			
						12			
						13			
						14			
						15			

HAHN & ASSOCIATES, INC.
434 NW Sixth Avenue
Portland, Oregon
(503) 796-0717

PROJECT:
NW Natural
Gasco Facility
Portland, Oregon

PROJECT #: 2708

SOIL BORING NUMBER AN-2-2

		DRILL START	DRILL FINISH
HAI LOGGER:	Kim Magruder/Rob Ede		
SAMPLING METHOD:	Stainless Steel Soil Sampler		
DRILLING METHOD:	Vibracore	Time:	Time:
EQUIPMENT TYPE	Same as above	10:06	10:11
DRILLER:	Bill Jaworski	Date:	Date:
DRILLING CONTRACTOR:	Marine Sampling Systems	04/11/01	04/11/01

BORING DIAMETER: 3-inch OD
CASING DIAMETER: N/A
SURFACE ELEVATION: Estimated to be: N/A
TOP OF CASING ELEVATION: N/A

ABANDONMENT DETAILS	SAMPLE NUMBER*	TIME	HEADSPACE (ppm)	CORE INTERVAL	RECOVERY INTERVAL	DEPTH (feet)	GROUNDWATER	STRATA (USCS)
				AN2-2A		1		ML
						2		
						3		
						4		
				AN2-2B		**5**		
						6		ML
						7		
						8		
						9		
				AN2-2C		10		
						11		
						12		S ML
						13		
						14		
						15		

SOIL DESCRIPTION

AN2-2A (4' 0" core length)
SILT, light brown, wet, medium soft, several hard tar fragments with associated oil blebs (0 to 10 cm).

SILT, as above, increased tar fragment content, decreased moisture (10 to 20 cm).
SILT, as above, slightly moist, no tar or oil, slight sheen (30 to 40 cm).

SILT, as above to 1'8", then encounter a weathered black, stiff tar layer (tar w/out the elasticity), black viscous oil below weathered tarry zone extends to base of core at 4'.

AN2-2B (4' 4" core length)
SILT, olive grey and black, moist, few thin fine grained sand layers, much plant material, black, weathered tar layers with viscous oil to 5' 6" bgs, below which Silt becomes olive grey with no tar or oil to base of core at 8' 4"

AN2-2C (3' 8" Core length)
Sandy SILT, light brown and grey mottled, moist, some fines, plant matter, no sheen, slight odor (organic?), fine grained sand across 10'10" to 11'6" interval (moist, grey), no sheen, no odor to base of core at 12 feet bgs.

Total Core Push =
Total Recovered Core Length = 12' 0"

HAHN & ASSOCIATES, INC. 434 NW Sixth Avenue Portland, Oregon (503) 796-0717	**SOIL BORING NUMBER**								**AN-2-3**		
PROJECT: NW Natural Gasco Facility Portland, Oregon	HAI LOGGER:							Kim Magruder/Rob Ede	DRILL START Time: 10:40	DRILL FINISH Time: 10:45	
	SAMPLING METHOD:							Stainless Steel Soil Sampler			
	DRILLING METHOD:							Vibracore			
	EQUIPMENT TYPE							Same as above			
	DRILLER:							Bill Jaworski	Date: 04/11/01	Date: 04/11/01	
PROJECT #: 2708	DRILLING CONTRACTOR:							Marine Sampling Systems			

ABANDONMENT DETAILS	SAMPLE NUMBER*	TIME	HEADSPACE (ppm)	CORE INTERVAL	RECOVERY INTERVAL	DEPTH (feet)	GROUNDWATER	STRATA (USCS)	BORING DIAMETER: 3-inch CASING DIAMETER: N/A SURFACE ELEVATION: Estimated to be: N/A TOP OF CASING ELEVATION: N/A SOIL DESCRIPTION
				AN2-3A		1		ML	**AN2-3A (4' 0" core length)** SILT, olive grey, wet, soft, slight sheen on outside of core, few wood chips, no sheen, no hydrocarbon odor, no product (0 to 10 cm). SILT, as above, 2 small tar fragments (10 to 20 cm) SILT, as above, slightly moist, firm, plant matter - rootlets present, very slight sheen, no hydrocarbon odor, no tar (30 to 40 cm). SILT, as above to 2'9" where layers of black weathered tar (not elastic) are present, patches of viscous oil below weathered tar zone, magnitude of oil (patchy) decreasing to base of core at 4" 0". **AN2-3B (4' 0" core length)** Sandy SILT, light brown, moist, much plant matter, minor black mottling, no sheen, moderate petroleum odor to 5'10", where 4" thick weathered tar is present, tar layer contains several small leaves, tar layer is underlain by light brown sandy SILT with rootlets, no tar, no oil, no sheen (6'2" to 8'). **AN2-3C (4' 2" core length)** Sandy SILT, as above, light brown, soft to medium-stiff, minor rootlets, no odor, no sheen, no oil, no tar, (8' to 11'10"). SAND, grey, moist, very fine grained, no odor, no sheen 11' 10" to 12' 2"). Total Core Push = Total Recovered Core Length = 12' 2"
						2			
						3			
						4			
				AN2-3B		**5**			
						6			
						7			
						8			
				AN2-3C		9		ML	
						10			
						11			
						12			
			0.0			13		SP	
						14			
						15			

HAHN & ASSOCIATES, INC. 434 NW Sixth Avenue Portland, Oregon (503) 796-0717	**SOIL BORING NUMBER**	**AN-2-4**		
PROJECT: NW Natural Gasco Facility Portland, Oregon	HAI LOGGER:	Kim Magruder/Rob Ede	DRILL START Time: 15:05	DRILL FINISH Time: 15:10
	SAMPLING METHOD:	Stainless Steel Soil Sampler		
	DRILLING METHOD:	Vibracore		
	EQUIPMENT TYPE	Same as above		
	DRILLER:	Bill Jaworski	Date: 04/11/01	Date: 04/11/01
PROJECT #: 2708	DRILLING CONTRACTOR:	Marine Sampling Systems		

BORING DIAMETER: 3-inch
CASING DIAMETER: N/A
SURFACE ELEVATION: Estimated to be: N/A
TOP OF CASING ELEVATION: N/A

ABANDONMENT DETAILS	SAMPLE NUMBER*	TIME	HEADSPACE (ppm)	CORE INTERVAL	RECOVERY INTERVAL	DEPTH (feet)	GROUNDWATER	STRATA (USCS)
				AN2-4A		1		
						2		
						3		ML
						4		
				AN2-4B		**5**		
						6		
						7		
			7.2			8		SP
				AN2-4C		9		
			6.3			10		
						11		
						12		
						13		
						14		
						15		

SOIL DESCRIPTION

AN2-4A (4' 0" core length)
SILT, brown, wet, very soft, brown oily blebs on outside of core, no sheen on interior, moderate petroleum odor (0 to 10 cm).

SILT, as above, moist, soft, piece of wood and several blebs of brown oil product within core (10 to 20 cm).
SILT, olive grey, moist, medium-soft, no visible oil product on interior of core, slight sheen (30 to 40 cm).

SILT, as above to 2'7" where sand content increases and a zone of black, weathered tar (moist, non-elastic, disintegrates with pressure) surrounded by patchy viscous black oil, rootlets, sticks, twigs (2'7" to 4' 0").

AN2-4B (4' 2" core length)
Sandy SILT, brown, moist, much plant material, weathered tar zone at 6'0" to 6'6"

SAND, grey, moist, fine grained, hydrocarbon odor, no sheen, no product (6'6" to 8'2").

AN2-4C (2' 0" core length)
SAND, as above, petroleum odor, no oil, no tar, sheen on outside of core only.

Total Core Push =
Total Recovered Core Length = 10' 2"

Table G-1
Sample Station Geographical Coordinates

Station ID	Geographical Coordinates (NAD 83)	
	Latitiude (DD.mmm)	Longitude (DDD.mmm)
RAA-01	45.57977374	122.75795025
RAA-02	45.57982789	122.75792804
RAA-03	45.58007390	122.75794293
RAA-04	45.57971933	122.75805875
RAA-05	45.57985022	122.75809311
RAA-06	45.58001600	122.75808147
RAA-07	45.58011224	122.75818444
RAA-08	45.57982296	122.75845286
RAA-09	45.57990589	122.75826530
RAA-10	45.580043205	122.75827003
RAA-11	45.58003730	122.75844474
RAA-12	45.58016669	122.7585000
RAA-13	45.5801794	122.7583667
RAA-14	45.58022110	122.7582523
RAA-15	45.57996370	122.75874391
RAA-16	45.58005925	122.75862963
RAA-17	45.58014987	122.75872767
RAA-18	45.57968324	122.75810387
RAA-19	45.57976742	122.75854962
RAA-20	45.57975098	122.75829940