PUBLIC REVIEW DRAFT
ENGINEERING EVALUATION/COST ANALYSIS

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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List of Acronyms and Abbreviations

ARAR	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
BMP	Best Management Practices
BTEX	Benzene, toluene, ethylbenzene, and xylene
CDF	Confined Disposal Facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cy	cubic yards
DRET	Dredging Elutriate Test
EE/CA	Engineering Evaluation/Cost Analysis
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
fps	foot per second
H:V	Horizontal:Vertical
NOAA	National Oceanic and Atmospheric Administration
NTU	nepthalometric turbidity units
ODEQ	Oregon Department of Environmental Quality
OSC/RPS	On Site Coordinator/Removal Project Supervisor
PAH	Polycyclic aromatic hydrocarbons
PEC	Probable Effects Concentrations
PRG	Preliminary Remediation Goal
RAEPP	Removal Action Environmental Protection Plan
RAPP	Removal Action Project Plan
RAWP	Removal Action Work Plan
RI	Remedial Investigation
RI/FS	Feasibility Study
ROD	Record on Decision
SAP	Sampling and Analysis Plan
Sevenson	Sevenson Environmental Services, Inc.
Site	Gasco Site
sf	square feet
SOW	Statement of Work
TCLP	Toxicity Characteristic Leaching Procedure
the Order	Administrative Order on Consent

TPAH	total polycyclic aromatic hydrocarbons
TPH	total petroleum hydrocarbons
USACE	United States Army Corps of Engineers

1 EXECUTIVE SUMMARY

1.1 Background

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) (USEPA 2004a). The Order requires that NW Natural perform a number of activities associated with a removal action for the tar body (as defined in the Order) present on the surface of a portion of the nearshore sediments at the Site.

Consistent with the Order, planning and preliminary design of the removal action started in May 2004 and continued through November 2004, when NW Natural submitted the Draft Final Remedial Action Project Plan (RAPP) to EPA (Anchor 2004c). In December 2004, it became apparent to EPA that the removal planning process would exceed 6 months significantly. Where a 6 month planning period exists, preparation of an Engineering Evaluation/Cost Analysis (EE/CA) is required (40 C.F.R. §300.415(b)(4)), and consequently, NW Natural was directed by EPA in February 2005 to prepare this EE/CA consistent with a Non-Time-Critical Removal Action process and in accordance with EPA's *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA 1993).

The Removal Action is taking place in the context of an ongoing upland remedial investigation and feasibility study for the upland portions of the Gasco Site, directed by Oregon Department of Environmental Quality (ODEQ) and the Portland Harbor Superfund Site Remedial Investigation/Feasibility Study (RI/FS), which includes the sediments at the Gasco Site.

The tar body, which is the subject of this Removal Action, is present in and on the river sediments because of oil-gasification by-product discharges early in the 20th century. These discharges to the river ceased in the 1940s. There are no ongoing surface discharges of tar or oils from the upland portions of the Site to the river, and subsurface seeps of oils or related product-type materials have not been observed along the shoreline of the Site either above or below the water line.

1.2 Design Investigations

Sediment cores in and around the tar body were collected at 20 sampling stations in July 2004 to obtain information on the nature and extent of tar material necessary for the removal design. This information was used to define the lateral and vertical extent of tar body that would be removed. Visually contaminated sediments intermixed with the tar were also proposed for removal so that a stable slope would remain after the removal. This results in a total proposed removal volume of approximately 15,000 cubic yards (cy) of combined materials. Analytical data from the visually contaminated sediments indicate they contain high levels of total polycyclic aromatic hydrocarbon (TPAH) as well as some other chemicals, most notably benzene. Leachate and elutriate testing was conducted on the materials to understand the potential for short-term impacts during removal and disposal. Some chemicals were found in both tests above relevant comparative criteria normally applied to each of these tests.

1.3 Streamlined Risk Evaluation

Existing information was used to conduct a streamlined risk evaluation for the tar body and immediate vicinity using conservative screening guidelines for human health and ecological risks. This risk evaluation indicates the potential for human health and ecological risks both from the tar body as well as from nearby sediments that will not be affected by the removal.

1.4 Scope, Goals, and Objectives

The scope, goals, and objectives of the removal action were determined based on a review of the project Statement of Work (SOW, an attachment to the Order). The Order removal action objectives include: eliminating exposure to the river from tar through physical removal, creating a surface of lesser TPAH concentrations through physical removal, allowing for the potential to conduct a pilot capping test relevant to a long-term remedy for the rest of the site, allowing monitoring for any product seepage (if it occurs), preventing migration of chemical from tar downstream through physical removal, complying with relevant regulations to the extent practicable, and contributing to the performance of a long-term remedial action for the Site, if practicable. NW Natural also developed (consistent with EE/CA guidance) very similar removal action objectives that do not specifically require physical removal of tar. EPA continues to support the use of the Order objectives for this project, so all alternatives evaluated were compared to both sets of objectives.

1.5 Screening of Technologies and Selection Alternatives

Potentially useful technologies that could make up removal action alternatives were reviewed and included: capping, dredging, dry removal, construction containment (both rigid and non-rigid methods), transport methods (e.g., trucks, barges, and/or rail), treatment, and disposal locations. These technologies were screened and combined to yield five reasonable alternatives for further evaluation including:

Alternative A – Capping of the tar body in place without removal.

Alternative B – Dredging removal and post-removal capping with floatables controls (such as oil booms or bubble curtains) and non-rigid containment, and disposal in the Columbia Ridge Subtitle D facility. Columbia Ridge has an offloading (barge to trucks) facility at Port of Morrow near Boardman, Oregon. Dewater additive would be used to eliminate free water, improve material handling characteristics and stabilize benzene leaching in the material to some extent. This alternative includes Option B.1, which involves silt curtains extending to the bottom except along one portion of the channel area where they would extend within 2 feet of the bottom with a bedload baffle extending from the bottom up 6 feet into the water column. Option B.2 includes silt curtains extending to the bottom along the entire perimeter.

Alternative C – Dredging removal and post-removal capping with floatables and non-rigid containment and disposal at the ChemWaste Subtitle C facility. ChemWaste has an offloading (barge to trucks) facility available at the Port of Morrow near Boardman, Oregon. Dewater additive would be used to eliminate free water as required by ChemWaste for this facility. This alternative includes Options C.1 and C.2, which are the same options for the use of silt curtains as described for Alternative B.

Alternative D – Dredging removal and post-removal capping with rigid containment and disposal at the Columbia Ridge Subtitle D facility. Columbia Ridge has an offloading (barge to trucks) facility available at the Port of Morrow near Boardman, Oregon. Dewater additive would be used to eliminate free water, improve material handling characteristics, and stabilize benzene leaching in the material to some extent.

Alternative E – Dredging removal and post-removal capping with rigid containment and disposal at the ChemWaste Subtitle C facility. ChemWaste has an offloading (barge to trucks) facility available at the Port of Morrow near Boardman, Oregon. Dewater additive would be used to eliminate free water as required by ChemWaste for this facility.

The alternatives were evaluated by closely following EE/CA guidance by comparison to three primary criteria of effectiveness, implementability, and cost. Each of these general criteria includes subsets of evaluation factors that were also considered.

1.6 Evaluation of Alternatives

Alternative A (capping) does not meet the Order removal action objectives, because it would not physically remove the tar body. Alternative A does meet the more general objectives developed in this EE/CA following the *Guidance on Conducting Non-Time Critical Removal Actions under CERCLA*. The alternative was found to be effective by some of the effectiveness evaluation factors except that it does not involve any treatment of waste (which is EPA's preference under CERCLA), has a small potential for future loss of material through unlikely high current erosional events, and presents some potential longer term risks from dissolved chemical flux from underlying sediments over a small portion of its area. It would have small short-term impacts and would be completed quickly. Alternative A is readily implementable and has a low cost of $1.6 million.

Alternative B (non-rigid containment and Subtitle D disposal) was found to be effective by most evaluation factors including meeting the primary removal objectives of the Order except it has a minor chance of exceeding water quality criteria during construction and does not fully meet one of EPA's project specific disposal performance standards regarding landfill leak detection (although this is not estimated to present a likely potential impact to the environment). The alternative would have a minor potential for water quality or other short-term environmental impacts and a low potential for additional water quality impact in the event of containment failures. It also involves treatment (via dewatering through the application of quicklime or similar reagents) that would reduce benzene leaching in the material. The technologies used are implementable with the exception of Option B.2, involving silt curtains extending to the bottom in the deep channel area, which would have a high potential to fail if actually constructed. Option B.1 is preferable both from a feasibility and effectiveness perspective. The cost for the alternative is $6.4 million.

Alternative C (non-rigid containment and Subtitle C disposal) is very similar to Alternative B in terms of effectiveness. In addition, it would specifically comply with EPA's project specific disposal performance standard regarding leak detection, although the increased potential effectiveness from this is estimated to be small. The alternative is implementable including meeting all project specific disposal performance standards except that Option C.2 (like Option B.2 above) is infeasible. The cost for this alternative is $7.5 million.

Alternative D (rigid containment and Subtitle D disposal) mostly meets the Order removal action objectives in terms of removal with the exception that 1,300 cy of material would be left in place. It would decrease the potential for water quality impacts during the dredging operation, but not necessarily during sheet pile installation and removal. This alternative has a number of other potential short term and long term impacts caused primarily by the use of sheet pile walls. These impacts include: limiting barge access and preventing ship access to the Gasco dock for a period of 8 months, obstructing ship traffic in the navigation channel, the potential for impacts to endangered species that will not occur with the other alternatives, and the potential to drive contaminated sediments into deeper clean sediments and groundwater. In addition, this alternative has an exacerbated potential for bedload movement due to sloughing that will occur when sheet piles are removed, could cause vibration effects including the potential to impact operations at the nearby Siltronics factory and potential for resident fish kills, and has a higher potential for worker health and safety issues due to the larger scale of materials and equipment deployed and the longer duration of the construction. Alternative D does not comply with EPA's project specific performance standard regarding leak detection, although the reduced effectiveness due to this is estimated to be small. There are substantial implementability issues related to the large sheet pile construction. The cost using aggressive sheet pile design assumptions is $10.9 million. If these design assumptions are in error, there is a much greater potential for greatly increased costs rather than decreased costs given all the uncertainties associated with this estimate.

Alternative E (rigid containment and Subtitle C disposal) has a similar level of effectiveness as Alternative D including all the potential and expected impacts. However, it would specifically comply with EPA's project specific disposal performance standard regarding leak detection, although the increased potential effectiveness from this is estimated to be small. This alternative has the same implementability issues regarding sheet piles as Alternative D. The cost of Alternative E is $11.9 million. If the sheet pile design assumptions are in error, there is a much greater potential for greatly increased costs rather than decreased costs given all the uncertainties associated with this estimate.

1.7 Comparative Analysis of Alternatives

A comparative analysis was conducted following EE/CA guidance, where alternatives were compared with respect to the primary evaluation criteria of effectiveness (consists of compliance with ARARs, long-term effectiveness, short-term effectiveness, and treatment), implementability, and cost. A subjective scoring approach was used for the effectiveness subcriteria that weighted each subcriterion relative to long-term effectiveness, because it was deemed by EPA to represent the highest value for this project. These weighted scores express the net benefit of the alternative for each criterion. The scores for each criterion were added together resulting in a Net Unit Benefit. The Net Unit Benefit for each alternative based on these scores was:

- Alternative C – 19.2
- Alternative E – 19.1
- Alternative B – 14.0
- Alternative D – 13.9
- Alternative A – 3.7

The estimated cost for each alternative was divided by the Net Unit Benefit to evaluate the cost per unit benefit. This ratio provides for a relative ranking of the alternatives. The addition of the cost evaluation to the relative criteria scores resulted in the following cost in $1,000 per Net Unit Benefit:

- Alternative C – $391
- Alternative A – $438
- Alternative B – $457
- Alternative E – $625

- Alternative D – $787

1.8 Recommended Removal Action Alternative

Alternative A does not meet the Order removal action objectives. Alternatives B and C meet Order removal action objectives and Alternatives D and E mostly meet the order removal action objectives. The two primary elements that make up the recommended removal action alternative are the selected disposal option, and the selected containment design for the removal area. Of the two disposal options evaluated, the Subtitle C hazardous waste facility disposal has been selected because it will achieve greater long-term effectiveness through providing greater protection in the form of more substantial containment features and leak detection. Although there is a significant added cost associated with Subtitle C disposal, the comparative analysis in Section 5 indicates an incremental potential benefit. Only Alternatives C and E meet the disposal performance standards. There is difference of 1.6 times the cost between Alternative C (silt curtains) and Alternative E (sheet piles).

Sheet pile alternatives were evaluated to address the concern that silt curtains might not provide adequate protection against short-term water quality impacts during the physical removal of the tar body. This EE/CA analysis indicates, as far as is quantifiable given the information available and uncertainties, that the short-term water quality impacts under any containment alternative are likely to be relatively small, although measurable. There are generally small differences between the types and levels of protection provided by silt curtains versus sheet piles, with silt curtains potentially subject to failures and sheet piles potentially causing water quality impacts during installation and removal. Although the potential impacts may be able to be mitigated with BMPs, the sheet pile design for this Site appears to have some potential for non-water quality short term impacts and a long term impact of leaving a small amount of the material in place not found for the other alternatives.

The comparative analysis in Section 5 indicates that the net benefit for silt curtain and sheet pile alternatives are not significantly different when both effectiveness (long-term, short-term, and treatment), and implementability are considered. Consequently, the balance between the types of potential impacts by both containment options, when combined with the much greater costs associated with use of sheet pile walls, are the critical factors leading to the selection of the silt curtain alternative.

Therefore, Alternative C best meets the removal action objectives of the SOW, as modified by the January 14, 2005 disposal performance standards, and as indicated by the cost per net unit benefit shown in Section 5.

2 SITE CHARACTERIZATION

2.1 Site Description and Background

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) (USEPA 2004a). The location of the Site is shown on Figure 1. The Site is within the Initial Study Area of the Portland Harbor Superfund site. It is adjacent to the Siltronics facility (upstream to the southeast) and the U.S. Army Corps of Engineers (USACE) U.S. Moorings facility (downstream to the northwest). More detailed information on the Site and its history is available in the draft Final Removal Action Project Plan (RAPP) as well as the upland Remedial Investigation (RI; HAI 1998). The Order requires that NW Natural perform a number of activities associated with a removal action for the tar body (as defined in the Order) present on the surface of a portion of the nearshore sediments at the Site.

After several rounds of comments and revisions, NW Natural submitted the Final Removal Action Work Plan (RAWP, Anchor 2004a) including a Design Characterization Sampling and Analysis Plan (SAP) to EPA in August 2004, pursuant to Section VIII.16.a of the Order. NW Natural subsequently submitted a Preliminary RAPP and Design Documents in September 2004 (Anchor 2004b) that included a preliminary presentation of design characterization sampling and analysis results. Following full evaluation of the design characterization sampling and analysis results, NW Natural submitted the Draft Final RAPP to EPA in November 2004 (Anchor 2004c). Both versions of the RAPP addressed the requirement of Section 3.A of the Statement of Work (SOW, Appendix B of the Order).

Discussions of appropriate removal design details continued with EPA through the end of 2004. It became apparent to EPA that the removal planning process would exceed 6 months significantly. Thus, preparation of an Engineering Evaluation/Cost Analysis (EE/CA) is required. 40 C.F.R. §300.415(b)(4).

Consequently, EPA instructed NW Natural to prepare this EE/CA document that will be submitted for public review and comment consistent with a Non-Time-Critical Removal Action process. This EE/CA was prepared in accordance with EPA's *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA 1993). Once public comment is obtained on this EE/CA, a preferred design alternative will be selected by EPA for implementation by NW Natural's contractors, including preparation of a final RAPP and associated design documentation and then construction of the removal action.

2.2 Previous and Ongoing Removal and Remedial Actions

No previous sediment remediation or cleanup removal actions have been completed in the aquatic portions of the Site. The Portland Harbor Superfund Site Remedial Investigation /Feasibility Study (RI/FS), which includes the sediments at the Gasco Site, is currently underway. It will eventually result in a Record of Decision (ROD) for remediation of the Portland Harbor Superfund site, including areas of sediments off of the Gasco Site as determined appropriate through that RI/FS and ROD process. In addition, an RI/FS is underway for the upland portions of the Gasco Site above the ordinary high water line under the Oregon Department of Environmental Quality's (ODEQ) voluntary cleanup program. This upland project is currently in the investigation stage and has included some recovery and off-site disposal of subsurface product in some portions of the Site that are not directly relevant to the in-water removal action described in this document.

2.3 Source, Nature, and Extent of Contamination

The removal action area encompasses the river sediments and the riverbank containing surface tar adjacent to the upland portions of the Site. The Order (references to the Order include associated Appendix A – Action Memorandum and Appendix B – SOW unless otherwise noted) defines the area subject to this removal action as the contiguous mass of surface tar, which is also termed the "tar body" in these documents. The Order requires the removal of the tar body rather than attainment of specific concentrations of detected chemicals, although the tar is known to contain high concentrations of total polycyclic aromatic hydrocarbons (TPAHs). Consequently, investigations of the volume of the removal action have focused on defining, through visual observations, the extent and depth of the tar body in this particular aquatic area of the Site.

The tar body is present in and on the river sediments because of oil-gasification by-product discharges early in the 20th century through a swale and into the river. This swale was subsequently filled, and discharges to the river via this conveyance ceased in the 1940s. There are no ongoing discharges of tar or oils from the upland portions of the Site to the river, and seeps of oils or related product-type materials have not been observed along the shoreline of the Site either above or below the water line. Investigations are currently underway to understand whether there is a physical connection between tar and oil in the upland soils and the tar body and whether dissolved chemicals from upland product deposits may be transported via groundwater to the river (HAI 2005).

Sediment cores in and around the tar body were collected at 20 sampling stations (Figure 2) in July 2004 to obtain information on the nature and extent of tar material that is critical for the removal design. At each station, the cores were logged with particular emphasis on visual identification of the tar body, visibly contaminated, and visibly uncontaminated zones as defined in the RAWP (Anchor 2004a). The results of this data collection are described in the draft Final RAPP (Anchor 2004c) and summarized below.

During evaluation of the cores, Anchor and EPA 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
- Somewhat soft, sticky masses of tar
- Dense brittle fragments of tar containing little or no sediments.

Observations of the visibly contaminated zone included sediments that:

- Are saturated (i.e., visibly detectable) dense sticky non-flowing oil (but composed primarily of sediments)
- Are saturated with tar and tar-like substances (but composed primarily of sediments)
- Have a heavy sheen
- Have blebs of oil and/or tar
- Have a slight sheen

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

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 (Table 1 and Figure 2). The elevations and thicknesses of the surface tar body and visibly contaminated zones are detailed in the draft final RAPP (Anchor 2004c). Based on the extent of the tar body, removal of the tar in such a way as to leave a stable slope would result in a removal of approximately 15,000 cubic yards (cy) of material. Due to slope stability issues, a substantial portion of this volume would not be tar body, but underlying visually contaminated sediments.

Field observations and laboratory results indicate that in 75 percent of the core locations, the tar and related material were relatively stiff, at least within some layers at that location. At 25 percent of the stations, the surficial material was relatively soft and was difficult to recover. Observations of material adhered to sampling devices indicated it was likely deposited alluvial sediment and/or other soft tar-like materials. The physical characteristics of the tar material varied from soft, sticky, plastic, stiff and firm, to brittle. The brittle material was generally weathered tar at the surface that has been exposed to air during low river flow conditions. These surface layers were hard enough to walk and drive the core sampling rig on. Most of the tar present below this weathered layer was of a softer consistency. Although this softer material smears on surfaces it touches, it is too viscous to flow noticeably, and the intermixed sands and non-plastic silt/sands prohibited it from acting viscid when sheared in place. No pockets or deposits of liquid or semi-liquid oil were observed in any of the cores. None of the tar layers identified exhibited a noticeable sheen.

The visually contaminated zone varied in consistency from sediments with a slight hydrocarbon odor, slight sheen, slight oil staining, and minor blebs of oil and/or tar to sediments with more noticeable hydrocarbon odor, heavy sheen, and sediments more heavily saturated in dense sticky oil and/or tar blebs. No free oily product beyond small scattered oily blebs was identified in any of the cores either in tar or in visually contaminated sediments. All oily sediments encountered felt very viscous to the touch, were intermixed in a mostly sand/silt matrix, and did not flow noticeably during the core cutting and sampling procedure.

It should be noted that, although sediments from the visibly contaminated zone contained light to heavy sheen in several cores, only small amounts of sheen were occasionally observed on the water surface due to the physical disturbance caused by the core collection activities (including grounding and spudding barges on the tar body). Therefore, the potential for excessive sheening during the removal action is expected to be low.

2.4 Analytical Data

At each of the 20 coring stations, a subsample was collected from within each identified zone (i.e., tar body, visibly contaminated, and visibly uncontaminated) for potential chemical analysis. The objectives of this characterization were to evaluate the chemical concentrations within and below the visibly contaminated zone, the potential water quality impacts at the point of dredging, and the disposal suitability of any removed materials. Because the focus of the removal is on visual tar (as noted above) the purpose of obtaining chemical concentrations from the sediment zones underneath the tar was to understand the chemical characteristics of the potential new post-removal surface that could be created by removing the overlying tar. The purpose of analytical data was not to identify the vertical extent of the removal (which is based on the visual presence of tar) because chemical concentration-based criteria or goals are not an objective of this removal action.

Among other analytical results discussed below, a representative tar body sample was analyzed for total solids and specific gravity to understand the density of the tar material. The density of this sample was 1.23 g/ml. This is somewhat denser than water (which is 1 g/ml) and indicates that tar particles would sink in water over time.

The results of analyses are described in detail in the draft Final RAPP and summarized below.

2.4.1 Chemistry of Sediments Underlying Tar

Select samples of the visually contaminated and visually uncontaminated sediments underneath the tar body were analyzed for bulk sediment chemistry (Table 2). The visually contaminated sediments under the tar have relatively high organic carbon content (likely associated with the presence of sticky oil and tar blebs) and total petroleum hydrocarbon (TPH) and polycyclic aromatic hydrocarbon (PAH) concentrations, whereas the visually uncontaminated sediments contain relatively normal levels of organic carbon for river sediments and substantially less TPH and PAH. The PAH concentrations in the visually contaminated sediments are also generally less than found in samples of tar analyzed in previous investigations (Anchor 2004c).

Neither the visually contaminated or visually uncontaminated sediment zones had 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) in the remaining four of these samples.

Most volatile chemicals were undetected in both sediment layers, except BTEX (benzene, toluene, ethylbenzene, and xylene) compounds, which were often detected in the visually contaminated sediments. It is notable that BTEX compounds were undetected in the deeper visually uncontaminated sediment layers with only a few low level exceptions.

2.4.2 Elutriate Chemistry of Tar and Visually Contaminated Sediments

To provide information for a removal water quality analysis, 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) (Figure 2) and analyzed using the USACE Dredging Elutriate Test (DRET) method (discussed further in the draft Final RAPP). The DRET method is intended as bench scale simulation of chemicals that might be present in the water column very close to a dredging operation (i.e., within a few feet). This information was used in quantitative evaluations of potential water quality impacts associated with dredging.

The results of the DRET test are summarized in Table 3. In summary, several PAH and BTEX compounds were detected in both the tar body and visually contaminated sediment elutriate waters. It was also noted during elutriate testing of the two tar samples, that a sheen was visible at the surface of the test vessel after the elutriate procedure was conducted. This sheen was light and did not have a measurable thickness of non-aqueous phase liquid. The presence of detected chemicals in the elutriate test water is consistent with the presence of a visible sheen. These laboratory observations are also consistent with field observations of some small scale sheening that occurred during design characterization sampling of the tar. No such sheens were observed in DRET tests of visually contaminated sediments underlying the tar.

2.4.3 Disposal Suitability Testing

As directed by EPA, samples of the tar body and underlying visually contaminated sediments were analyzed following the Toxicity Characteristic Leaching Procedure (TCLP) to profile the material for disposal. The results are presented in the draft final RAPP and summarized below.

TCLP results were compared to hazardous waste criteria promulgated with the TCLP test method (Table 4). The two tar body samples had benzene results greater than the relevant criterion. All other chemicals in all samples were below the TCLP criterion. Based on these results and other information, EPA has prepared a set of disposal performance standards in their January 14, 2005 letter (USEPA 2005) to be met by any disposal alternative for the tar material. These performance standards are used in the effectiveness evaluation presented later in this document.

2.5 Streamlined Risk Evaluation

The EE/CA guidance (USEPA 1993) requires a streamlined risk evaluation that is "…intermediate in scope between the limited risk evaluation undertaken for emergency removal actions and the conventional baseline risk assessment normally conducted for remedial actions." The guidance also indicates the risk evaluation "…should focus on the specific problem that the removal action is intended to address." In summary, EPA's Action Memorandum (Appendix A of the Order) indicates that EPA intends the removal action to address the following problems:

- The threat of release of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances associated with tar to the river and downstream areas
- Potential risks to people (such as trespassers, industrial workers, and recreational boaters) via direct exposure to tar related chemicals

- Potential risks to humans through food chain uptake of chemicals in tar
- Potential risks to aquatic biota and wildlife through direct exposure or food chain uptake of chemicals in tar

Chemicals of interest for the Site have been established in the design characterization SAP based on review of existing chemistry data collected in and around the Site. The chemicals primarily associated with the tar and related by-products are PAHs, BTEX, and cyanide. Of the BTEX compounds, benzene is the one most clearly associated with tar type products throughout the Site (HAI 1998, Anchor 2004c). TPH is also present and has been related to toxicity information for other sites in EPA Region 10. The Portland Harbor RI/FS may evaluate risk associated with TPH; however, due to the streamlined nature of the EE/CA process, this type of analysis was not done for this risk evaluation. It should be noted that other chemicals have been detected in and around the tar body area (Appendix A), but most of these chemicals were observed at lower concentrations as compared to the primary chemicals noted above. Although some of these additional chemicals may pose risks, it is very likely that those risks are less than those of the primary chemicals associated with the tar. Also, the Portland Harbor RI/FS risk assessments, both human health and ecological, are still under development and discussion. Therefore, the statements regarding risk in this EE/CA may not be applicable to the harbor-wide RI/FS.

For this EE/CA, potential risks from direct contact to contaminants in the tar body are evaluated below for humans and ecological receptors using screening criteria. Potential risks from bioaccumulation as a result of food chain uptake were not evaluated given the limited scope of this EE/CA.

2.5.1 Human Health Risk Exposure Pathways and Receptors

A simple method of screening human health risks for direct contact is comparison to EPA Region 9 Preliminary Remediation Goals (PRGs) for human exposure to soils (USEPA 2004b). These soils-based guidelines are not directly applicable to submerged sediments. Exposures by people to the tar body via direct contact or ingestion is very limited to scenarios of trespassers at a highly secure facility and/or occasional unexpected or accidental exposures to industrial workers at the uppermost bounds of the tar that are above the waterline during low water conditions. Consequently, use of

PRGs that assume regular upland soil-based exposure scenarios may overestimate risks to people from the tar body, but they allow an initial, conservative screening of potential (rather than confirmed) human health risks from direct contact.

For direct contact, PRGs are available for residential soils and industrial soils. Of these PRGs, industrial soil PRGs are the most applicable, but still conservative, values for this Site for the following reasons:

- Industrial worker exposures to the tar body would be at a frequency and magnitude much less than general industrial exposure assumptions.
- Recreational and trespasser exposures to the tar body would be infrequent, and use of residential values that assume daily exposure would be inappropriately conservative.

In general, the Region 9 PRGs are chemical concentrations that correspond to fixed levels of risk (i.e., either a one-in-a million [10^{-6}] cancer risk or a non-carcinogenic hazard quotient of 1). Surface sediments at the Site were compared to the Region 9 EPA industrial soils PRGs, and this comparison is detailed in Appendix A, Table A-3. For each of the contaminants listed in Table A-3, the ratio of the contaminant level in the sediment/tar body sample to the Region 9 industrial soil PRG is shown. For PRGs based upon non-cancer endpoints, the values (ratios) show exceedances above a hazard quotient of 1. Exceedances greater than one (i.e., above the hazard index) indicate a potential non-cancer effect for the direct exposure human health pathway. For PRGs based upon cancer risk, the values (ratios) show exceedances above a cancer risk levels of one-in-a -million or 10^{-6} cancer risk.

The ratios for each chemical were then summed separately for the PRGs based upon non-cancer effects and for those based upon cancer. Table 5 shows the summed ratios of the PRGs based upon non-cancer effects and cancer risks for surface sediment stations in and near the tar body, as well as those stations outside the immediate vicinity of the tar body but still within the aquatic portions of the Site. As shown in Table 5, stations in and near the tar body have PRG exceedances above one. The analysis also indicated that the PRG exceedances were greater than one for a number of individual chemicals (Appendix A).

With regards to human health food chain risks (i.e., people eating fish and other biota), as noted in the Action Memorandum, such risks are not being quantified for this EE/CA. Such a detailed risk assessment is unnecessary to establish the need for the removal action. However, these food chain risks will be evaluated as a part of the Portland Harbor RI/FS which encompasses the Gasco site. A detailed risk assessment is underway for the Portland Harbor Superfund Site that will directly address these types of potential food chain risks for PAHs and other chemicals present at Gasco. This risk assessment will help define the risk based criteria and/or clean-up goals (including those based upon food chain risks) that will be established by the USEPA through the harbor-wide RI/FS process for the Portland Harbor Superfund site.

2.5.2 Ecological Risk Exposure and Receptors

A simple method of screening ecological risks for the types of direct toxicity pathways identified in the Action Memorandum (and summarized above), is comparison to freshwater sediment Probable Effect Concentrations (PEC) developed by MacDonald et al. (2000). PECs are not promulgated regulatory values, but provide a reasonable method of quickly screening potential direct toxicity aquatic risks in sediments. These values are based on direct exposure freshwater sediment toxicity tests and are relevant to the direct toxicity pathways discussed above.

Surface sediments at the Site were compared to freshwater PECs, and this comparison is detailed in Appendix A. Table 6 contains a summary of the calculated ecological hazard index for surface sediment stations in and near the tar body as well as those stations outside the immediate vicinity of the tar body but still within the aquatic portions of the Site. The hazard index is calculated as the sum of hazard quotients for each individual chemical of interest for the Site. Individual hazard quotients for each chemical represent the ratio of the chemical concentration in surface sediments divided by the PEC. Hazard quotients or hazard index values greater than one indicate a potential risk for direct toxicity to aquatic organisms. As shown in Table 6, stations in and near the tar body have ecological hazard index values above one. Hazard quotients were also above one for a number of individual chemicals (Appendix A).

With regards to ecological food chain risks (i.e., wildlife eating fish), as noted in the Action Memorandum, such risks have not been quantified for the Site. As noted for human health, PAHs would be potentially relevant to this pathway. A detailed risk assessment is underway for the Portland Harbor Superfund Site that will directly address these types of potential food chain wildlife risks for PAHs, and such a detailed risk assessment for this removal action would be both redundant and likely unnecessary to establish the need for some type of removal action.