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July 6, 2007

Ravi Sanga
Remedial Project Manager
U.S. EPA, Region 10
ECL-111
1200 Sixth Avenue
Seattle, WA 98101

Re: East Waterway SRI/FS Final Workplan

Dear Ravi:

The East Waterway Group (Port of Seattle, City of Seattle, and King County) is pleased to submit the approved East Waterway SRI/FS Workplan to EPA. We have included 3 hard copies (as requested) and are also including 21 CDs with the Workplan in *.pdf format.

Please call if you have any questions or need any additional copies.

Sincerely,

Thomas Wang

Tom Wang, P.E.
Anchor Environmental, L.L.C.

cc: Doug Hotchkiss, Port of Seattle
Tom Meyer, City of Seattle
Jeff Stern, King County
Debra Williston, King County
Kym Takasaki, U.S. Army Corps of Engineers
Peter Leon, Parametrix, Inc.
Susie McGroddy, Windward Environmental, LLC

Port of Seattle

EAST WATERWAY OPERABLE UNIT SUPPLEMENTAL REMEDIAL INVESTIGATION/ FEASIBILITY STUDY FINAL WORKPLAN

For submittal to

The U.S. Environmental Protection Agency
Region 10
Seattle, WA

July 6, 2007

Prepared by

ANCHOR ENVIRONMENTAL, L.L.C.

and

WindWard environmental LLC

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ACGs	analytical concentration goals
API	Asian and Pacific Islander
ARAR	Applicable or Relevant and Appropriate Requirements
ASAOC	Administrative Settlement and Order on Consent
CAD	Confined Aquatic Disposal
CDF	Confined Disposal Facility
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic feet per second
City	City of Seattle
COIs	chemicals of interest
COPC	chemical of potential concern
County	King County
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
CSM	Conceptual Site Model
CSO	combined sewer overflow
cy	cubic yards
DDT	dichloro-diphenyl-trichloroethane
DGPS	differential global positioning system
DMMP	Dredged Material Management Program
DQO	Data Quality Objective
Ecology	Washington State Department of Ecology
EE/CA	Engineering Evaluation/Cost Analysis
EFDC	Environmental Fluid Dynamic Code
EISR	Existing Information Summary Report
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
EW	East Waterway
EWG	East Waterway Group
FY	fiscal year
GIS	geographic information system
HHRA	human health risk assessment
HPAHs	high molecular weight polycyclic aromatic hydrocarbons
LDW	Lower Duwamish Waterway

LDWG	Lower Duwamish Waterway Group
LPAHs	low molecular weight polycyclic aromatic hydrocarbons
MLLW	mean lower low water
MNR	monitored natural recovery
MOA	Memorandum of Agreement
NPDES	National Pollutant Discharge Elimination System
NTCRA	Non-Time Critical Removal Action
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PCB	polychlorinated biphenyl
Port	Port of Seattle
ppt	parts per thousand
PRG	Preliminary Remediation Goal
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
RAL	remedial action level
RAO	Remedial Action Objective
RfDs	reference doses
RM	River Mile
RME	reasonable maximum exposure
ROC	receptor of concern
ROD	Record of Decision
SDOT	Seattle Department of Transportation
SMAs	Sediment Management Areas
SMS	Sediment Management Standards
SOW	Statement of Work
SRI/FS	supplemental remedial investigation/feasibility study
SVOC	semivolatile organic carbon
SWAC	surface weighted average concentration
TBT	tributyltin
TOC	total organic carbon
TSS	total suspended solids

U&A	Usual and Accustomed
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
VOC	volatile organic carbon
WSDOT	Washington State Department of Transportation

1 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has ordered the Port of Seattle (Port) to conduct a supplemental remedial investigation/feasibility study (SRI/FS) for the East Waterway (EW) Operable Unit (OU) of the Harbor Island Superfund Site per the process defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or Superfund. The ordered work is identified as a "supplemental" RI/FS because there previously has been significant investigation work conducted for the EW site, including three previous supplemental RIs. The SRI/FS will ultimately lead to an EPA Record of Decision (ROD) outlining cleanup actions to address threats to human health and the environment in the EW.

The Port is a signatory to a Memorandum of Agreement (MOA 2006) between the Port, City of Seattle (City) and King County (County) that details responsibilities and allocation between the signatory entities with respect to the EW SRI/FS project. The Port, City, and County form the East Waterway Group (EWG) and the Port will coordinate with the City and County to conduct the SRI/FS (MOA 2006). For purposes of the SRI/FS, the EWG will be referenced as the entity managing the project under EPA oversight.

This EW SRI/FS Workplan (Workplan) describes the activities that will be undertaken by the EWG as it develops and implements the SRI/FS. The Workplan complies with the requirements of the Administrative Settlement and Order on Consent (ASAOC) and Statement of Work (SOW) (EPA 2006a) signed by the Port and EPA for conducting the SRI/FS. The SRI/FS will be conducted in a manner that is consistent with the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988a), EPA's Data Quality Objectives planning process (EPA 2000), and other applicable guidance. This Workplan describes the overall tasks to be conducted during the SRI/FS, as defined by EPA in its SOW (2006a), and the general approach and objectives for each task. Because previous and current sediment remedial investigation and feasibility study work conducted by the Lower Duwamish Waterway Group (LDWG) is pertinent to the EW SRI/FS project, work conducted under the EW SRI/FS will be consistent with the approach used by the LDWG where determined to be appropriate by EPA and the EWG.

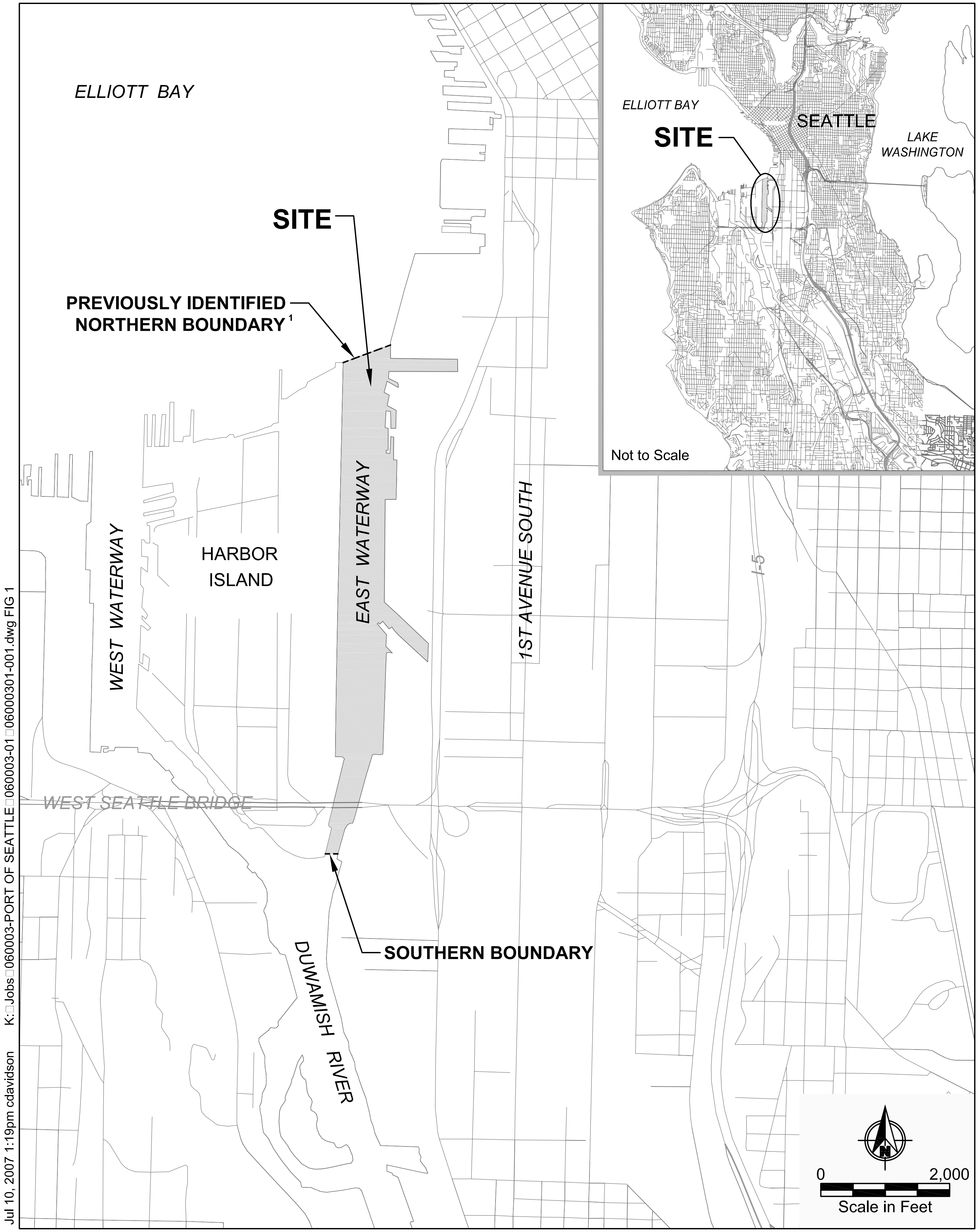
EPA has stated in the SOW that its goal is to issue a ROD in federal fiscal year (FY) 2009. The preliminary Workplan approach was developed to try to meet this goal; however, based on input from EPA during preliminary project discussions, the Workplan schedule currently identifies ROD issuance in May 2010. EWG considers this schedule to be very expedited. Due to the expedited schedule, the SRI and FS will be conducted in an integrated fashion. Data needs for the SRI and FS will be identified collectively, such that the field investigation data, the outcome of the SRI, and the associated risk assessments can support the development and evaluation of remedial alternatives. FS information that may affect the scope of the SRI or risk assessments will also be incorporated into the SRI approach. For example, early FS tasks will be conducted to eliminate remedial process alternatives that are not practical, thus serving to focus the SRI and FS work.

The study boundaries for the purpose of the SRI/FS will be presented in the Existing Information Summary Report (EISR). The southern boundary of the EW is the northern boundary of the Lower Duwamish Waterway (LDW) Superfund site (Windward 2003b) that is adjacent to EW. The northern boundary previously identified for the Engineering Evaluation/Cost Analysis (EE/CA) (Windward 2003c) will be reviewed to determine whether or not it is an appropriate boundary for the SRI/FS study area based on existing sediment chemistry and bathymetric data. The proposed study area boundaries will be presented in the EISR. All existing EW data will be identified in the EISR, including relevant sediment sampling data north of the northern study boundary. The EISR and Conceptual Site Model (CSM) report will discuss the relevance of data outside the Site boundaries to the EW. The Site boundaries will be finalized upon issuance of a ROD.

The area of interest for source control will extend beyond the boundaries of the Site. Review of potential sources will include drainage basins for stormwater and combined sewer overflows (CSOs); nearshore contaminated sites, including sites on Harbor Island and the east shore of the EW; potential upstream influence from the LDW; and sediment north of the mouth of EW.

Detailed methodologies, approaches, and descriptions of the analyses conducted under each of the required reports will be provided in each respective report, as the required analyses will depend and build upon the results of the existing information summary and data gaps analysis. Detailed discussion on sampling (e.g., locations, sampling methods) and the analytical methods will be provided in the quality assurance project plans (QAPPs).

This Workplan presents the SRI/FS approach anticipated for the Site. Because additional data may be generated during the SRI/FS that impacts the current understanding of the Site, the methods and assumptions presented in this Workplan may be refined to incorporate new information. Similarly, it is anticipated that several technical memoranda will be prepared to provide detailed project approaches for various components of the RI, risk assessments, and FS. These memoranda will be submitted to EPA for review and approval.



1 Northern boundary previously identified in the EE/CA (Windward 2003b). The appropriateness of this boundary will be reviewed in the EISR.

Figure 1-1
Vicinity Map and East Waterway SRI/FS Boundary
Supplemental RI/FS Work Plan
East Waterway Operable Unit

1.1 Physical Site Description

This section presents a general overview of the physical characteristics of the site; additional detailed information on the site conditions will be presented in the Existing Information Summary Report (discussed in Section 3.1).

The EW is located about one mile southwest of downtown Seattle, in King County, Washington (Figure 1-1). It is part of the greater Duwamish River estuary, which includes the freshwater/saltwater interface extending as far as 13 miles upstream. The Duwamish River drains approximately 362,000 acres, flowing northward to its terminus in Puget Sound at Elliott Bay. Near the mouth of the Duwamish River at River Mile (RM) 0, the northward flowing river splits into the East and West Waterways, surrounding Harbor Island. The East and West Waterways extend from the southern end of Harbor Island to the island's north end at Elliott Bay. The EW runs along the eastern shore of Harbor Island. The LDW Superfund site is located upstream of the EW (i.e., south of the EW).

The former Duwamish River channel and surrounding floodplains were filled and graded to form the present-day topography. Dredging in 1903 to 1905 created the East and West Waterways, and dredged material from the river was used to create Harbor Island (Weston 1993). Dredge depths varied throughout the EW, with localized areas experiencing dredge depths greater than 60 feet below mean lower low water (MLLW), based upon a cursory review of U.S. Army Corps of Engineers (USACE) bathymetric condition surveys.

The EW is approximately 7,100 feet long and 750 feet wide (for most of its length). It is channelized and has a south-to-north orientation. The southern 1,700-foot section of the waterway varies in width from 250 feet to approximately 150 feet near the West Seattle Bridge (Weston 1993) (see Figure 1-1). The mudline elevation of the EW varies from approximately -40 to -60 feet MLLW in the 750-foot-wide portion of the waterway. Mudline elevations increase to between -13 and -6 feet MLLW in the vicinity of Spokane Street and the West Seattle Bridge (DEA 2003). The shallow water depths at the south end of the EW (i.e., upstream limit of the EW) form a physical constriction that causes the Duwamish River to primarily flow through the West Waterway. The highly developed shoreline within the EW is primarily composed of piers, riprap, constructed seawalls, and bulkheads for industrial and commercial use.

The EW experiences regular vessel traffic of various sizes and types. Container ships call at Terminals 18, 25, and 30. Cruise ships currently call at Terminal 30, and U.S. Coast Guard (USCG) vessels frequent Pier 36. The waterway also has significant tug and barge traffic. The EW is part of the Tribal Usual and Accustomed (U&A) fishing areas for the Muckleshoot and Suquamish Tribes and is extensively utilized for gill net fishing for salmon. There is recreational use of the waterway at the public park adjacent to Slip 36. The public fishing pier at the head of the EW at the Spokane Street Bridge was identified as a popular harvest area within Elliott Bay in a King County 1999 creel survey (King County 1999).

1.1.1 Habitat Features

The aquatic environment of the EW is part of the ecologically important Duwamish River estuary. Dredging and development have substantially altered nearshore environments in Elliott Bay and the Duwamish River estuary since at least 1903. Of the pre-settlement habitat, most (98 percent) of the approximately 2 square miles of tidal marsh and 2.3 square miles of flats and shallows, and all of about 1.9 square miles of tidal wetland, have been either filled or dredged (Blomberg et al. 1988). Currently, there is very little remaining natural shoreline in the EW. The remaining aquatic habitats found in the EW are intertidal and subtidal bottom, and the water column.

1.1.2 Intertidal Habitat

The majority of the EW shoreline is composed of riprap, pier aprons, or sheet piling (Tanner 1991). Shoreline armoring is usually present at the top of the intertidal zone, but areas of sloping mud and sandflats exist below the shoreline armoring in a few isolated locations (Battelle et al. 2001). However, due to the shoreline armoring, these intertidal flats are partially isolated from inputs of sediment, nutrients, and organic matter (i.e., woody debris) from upland riparian vegetation zones; this isolation degrades the habitat quality of these flats (Battelle et al. 2001). In addition, overwater structures, which are common throughout the EW, shade shallow and intertidal habitats, alter microclimates, and inhibit growth of plant communities, thus further degrading nearshore habitats for native fauna (Battelle et al. 2001). The intertidal habitat is regularly disturbed by propwash and vessel wakes, which disrupt colonization and succession of benthic organisms.

1.1.3 Subtidal Habitat

The EW is predominantly a subtidal habitat. Sediment reflects riverine inputs, with a high proportion of fine sediment and organic material. The sediment is composed of organic detritus, flocculants, silts, clays, and river sand. The sediment is dark brown to black in color. The subtidal habitat is occasionally disturbed by propwash and maintenance dredging, which disrupt colonization and succession of benthic organisms.

1.1.4 Hydrology

Recent average discharge (1962-1994) from the Duwamish River was 1,500 to 1,800 cubic feet per second (cfs), measured at the U.S. Geological Survey (USGS) Tukwila gaging station, with flow rates varying from 150 to 11,600 cfs (NOAA 1998). Most (80 percent) of the water flows out of the West Waterway due to the presence of the elevated mudline at the southern end of the EW (Weston 1999). Flow rates from the Duwamish River are highest in the winter due to seasonal precipitation and lowest throughout the late summer dry season. Streamflow includes surface waters from storm drains (approximately 30), three CSOs, and industrial effluents. Numerous drains enter the EW along with the Lander and Hanford CSOs, which will be discussed in greater detail in the EISR.

The Port has collected limited groundwater data in support of previous remedial investigations on both Harbor Island and various terminals on the east shore of the EW. While a detailed hydrologic study has not been performed specific to the entire waterway, separate studies from the area surrounding the EW have been completed. These areas are generally characterized by a relatively shallow groundwater table that may be influenced by the tidal cycle in nearshore areas. While armored slope areas of the shoreline are generally pervious to groundwater flux between the EW and the uplands, the surrounding upland ground surface generally consists of paved areas that limit infiltration and percolation of precipitation through upland site soils. Flux between the EW and surrounding uplands is also likely limited by bulkheads along both the east and west sides of the waterway. All readily available existing groundwater information will be collected and evaluated in the EISR and CSM Report.

1.1.5 Estuarine Features

The Duwamish River flows through the East and West Waterways into the southern part of Elliott Bay, which is located along the eastern shore of central Puget Sound. Elliott Bay experiences mixed semidiurnal tides. The tidal range in Elliott Bay averages 11.4 feet. The maximum recorded tide height is approximately 14.5 feet MLLW and the minimum is approximately -5 feet MLLW (NOAA 2007). Currents in the EW are influenced by Duwamish River freshwater inflow and ebb and flow tides in Elliott Bay (Weston 1993). However, the EW remains primarily saltwater (25 parts per thousand [ppt]) at all flow rates (Weston 1993).

The EW has minimal wind driven wave action because it is oriented south to north, whereas the winds are predominantly from the southwest and the fetch to the north is limited. Wind generated waves are generally less than 2 feet. Waves created by vessel traffic range up to 2 to 3 feet (Weston 1993).

1.1.6 Sediment Dynamics and Load

Sediment characterization for the Harbor Island vicinity showed that the EW generally has finer sediments than observed in the West Waterway. EVS (1995) typified EW surface sediments as ranging from clayey, silty sand to sandy, clayey silt. In that study, the percent distribution of mean grain sizes for surface sediments within the EW was 32 percent sand, 43 percent silt, and 25 percent clay on average, representing a clayey, sandy silt.

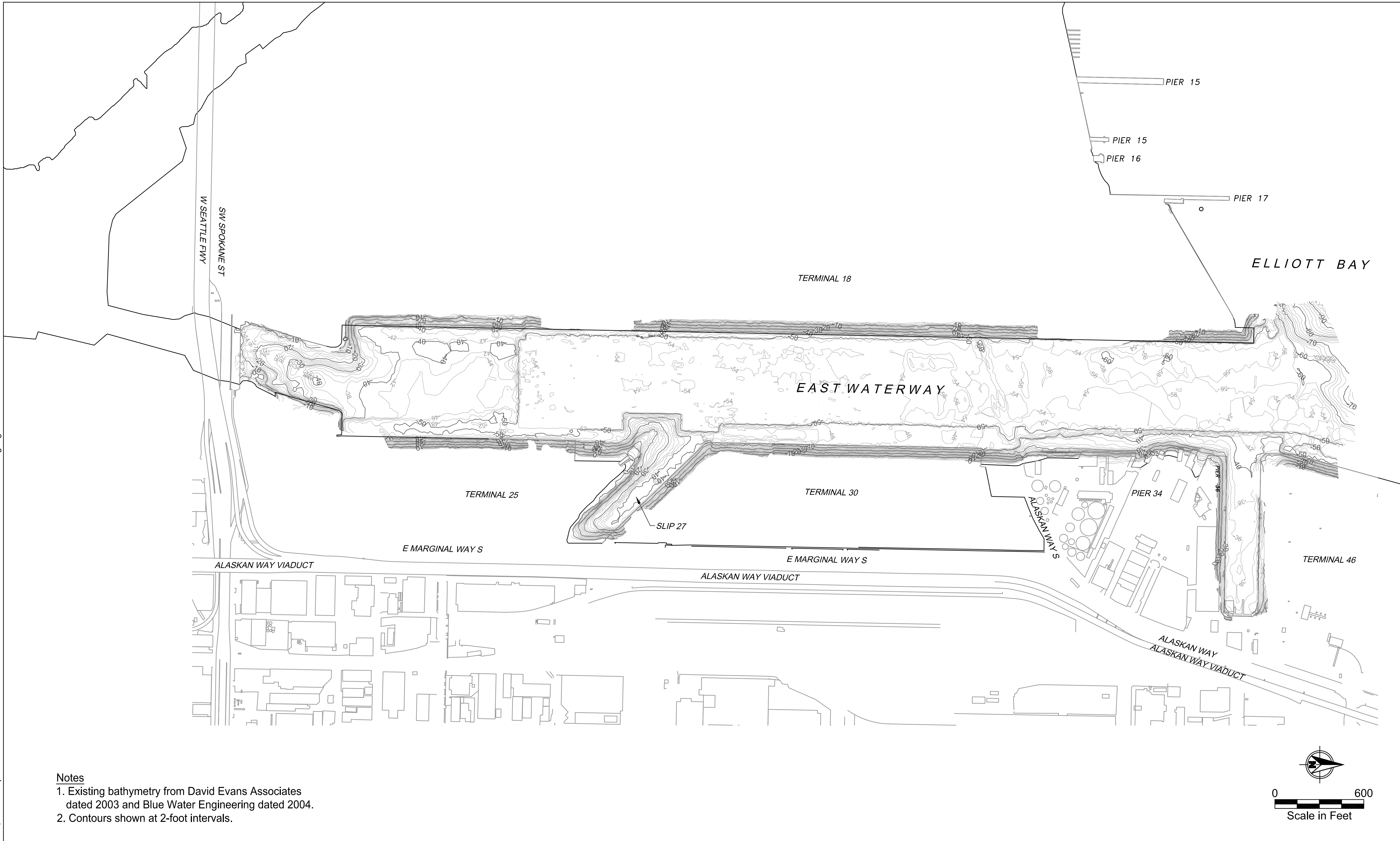
Sediment load in the EW originates primarily from the Green River. USACE dredging records indicate that the total sediment volume transported into the Duwamish River is approximately 150,000 cubic yards (cy)/year (Grette and Salo 1986). McLaren and Ren (1994) have suggested that extreme events (i.e., large storms) acting on the shoreline in Elliott Bay may suspend and transport sediments into the East and West Waterway and up into the LDW. High flow (greater than 5,300 cfs) flushes sediment from the Duwamish River into Elliott Bay (Curl et al. 1987) potentially through both the East and West Waterways. Other sediment sources may be present and will be discussed in the EISR.

After construction of the East and West Waterways in the early 1900s, sedimentation rates within the EW are thought to have been significant until the USACE constructed the upper turning basin in the Duwamish River in the 1920s; this assessment will be verified. The upstream physical constriction at the south end of the EW consists of both a natural sill (i.e., shallow water depth) that has not been previously dredged and constriction at the South Spokane Street crossing, which was initially constructed in the early 1900s. Both features limit the Duwamish River flow into the EW, thus decreasing the sedimentation rate. The waterway depths in the southern EW and north of the Spokane Street Bridge have decreased from the initially constructed water depths that were greater than 60 feet to less than 40 feet. The area in the vicinity of the Spokane Street Bridge and West Seattle Bridge tends to be shallower, ranging from -13 and -6 feet MLLW (DEA 2003). Further evaluation of sediment dynamics and load will be discussed in the Sediment Transport Evaluation.

1.1.7 Recent Dredging and Bathymetry

The Port, USACE, and USCG have conducted dredging events since the early 1990s within the EW to maintain and deepen existing berths and to deepen the federal navigation channel to its authorized depth of -51 feet MLLW. Full berthing widths at Terminals 18 and 30 have been dredged over several dredging events. The federal navigation channel (450 feet wide) has been dredged to -51 feet MLLW from the north end of EW to approximately 4,950 feet south; navigation channel dredging was conducted in 1999-2000. The USCG conducted berth dredging of Pier 36 in 2004-2005. The Port conducted a Non-Time Critical Removal Action (NTCRA) within the EW from 2003 to 2005, dredging approximately 270,000 cy of sediment. A summary of recent dredge footprints, depths, and timing will be provided in the EISR.

A bathymetric survey of most of the EW was conducted in 2003 prior to the Phase 1 removal action (Anchor and Windward 2005). A post-construction survey of the Phase 1 removal action area was completed in 2005. The two data sets have been combined to provide existing bathymetry (Figure 1-2).



Notes
1. Existing bathymetry from David Evans Associates dated 2003 and Blue Water Engineering dated 2004.
2. Contours shown at 2-foot intervals.

Jul 11, 2007 3:10pm dholmer K:\Jobs\060003-PORT OF SEATTLE\060003-01\06000301-002.dwg Fig 1-2

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1-2
Existing Bathymetry
Supplemental RI/FS Work Plan
East Waterway Operable Unit

1.2 Document Organization

The remainder of this document is organized as follows:

- Section 2 presents a summary of previous investigations.
- Section 3 presents our approach to conduct the following SRI tasks: Existing Information Summary Report, Conceptual Site Models (CSMs), Data Gaps Analysis Report, QAPPs, Data Reports, Risk Assessment Tasks, Sediment Transport Evaluation, Source Control Evaluation, and preparation of the SRI report that summarizes the above work.
- Section 4 presents our approach to conduct the Feasibility Study tasks including: Remedial Action Objectives (RAOs), Preliminary Screening of Remedial Alternatives and Disposal Site Alternatives, and preparation of the FS Report.
- Section 5 discusses the project schedule, anticipated sequencing of tasks, and major deliverables.
- Section 6 discusses project management for the SRI/FS.
- Section 7 presents the references cited in this document.

2 SUMMARY OF PREVIOUS INVESTIGATIONS

Previous investigations conducted in EW are summarized in this section. The following data types are summarized in the following subsections, sediment chemistry and bioassay investigations (Section 2.1), tissue chemistry data (Section 2.2), water chemistry investigations (Section 2.3), and biological surveys (Section 2.4). The data discussed here will be presented and evaluated in the Existing Information Summary Report described in Section 3.1. The EISR will provide maps illustrating the available data and sampling locations. The process for evaluating the data and data quality objectives are provided in Section 3.1.1 and 3.1.2. Other appropriate information will be provided in the EISR, including descriptive background information on how the EW OU relates to the Harbor Island Superfund Site. EPA and EWG will discuss the appropriate level of detail for the upland and groundwater data, given that EPA has approved upland cleanups and given that the Harbor Island Soils and Groundwater Operable Unit is in the long-term monitoring phase.

2.1 Sediment Chemistry and Bioassay Investigations

The EW has been the subject of several intensive sediment investigations in recent years (Table 2-1). The studies conducted since 1990 are summarized in the *Data Gaps Analysis Report* completed for EPA in 2001 (Windward 2001a). The majority of samples summarized in the Data Gaps Analysis Report were from the Terminal 18 sediment characterization conducted by EVS (1998) and the EW Stage 1 channel deepening characterization conducted by SAIC (1999a). Both studies were conducted under Dredged Material Management Program (DMMP) oversight and included the collection of surface (0 to 4 feet) and subsurface (greater than 4 feet) sediment samples. A significant portion of this sediment has been removed and will not be included in the RI sediment dataset. Other smaller studies also included sediment cores, but most of these studies focused on the collection of surface sediment samples (0 to 15 centimeters [cm]) using a van Veen grab sampler. Finally, deep sediment cores have been collected to characterize the potential post-dredging sediment surface (SAIC 1999a; Windward 2002b).

Three recent sampling events have involved the collection and analysis of surface sediment samples. Post-dredge monitoring was conducted following the completion of the Phase 1 removal action in 2005 (Anchor and Windward 2005) and the completion of dredging in Slip

36 (Hart Crowser 2005). In addition, recontamination monitoring was conducted in the Phase 1 removal area in 2006 (Windward 2006a).

All analytical results associated with these sampling events will be summarized and provided in detail to EPA in the EISR. Data will be presented relative to Sediment Management Standards (SMS) criteria (and DMMP values where no SMS criteria exists).

The number of bioassay samples collected in the EW is summarized in Table 2-1. The three studies with the largest numbers of bioassays include two characterizations of dredge material (Terminal 18 Dredging and EW Stage 1 channel deepening) and one 2002 study in which 41 surface sediment samples were collected and analyzed for SMS analytes in addition to bioassay testing.

Table 2-1
Previous Investigations (Including Samples that Have Been Dredged)

Event Name	Reference Source	Sampling Dates	Collection Method	Total Samples Analyzed	Analyses	Surface Sediment Samples (0–15 cm)	Surface Sediment Samples (0–4 ft)[a]	Subsurface Sediment Samples (> 4 ft)	Post-Dredging Surface Sediment Samples (>-51 ft MLLW)	Dredged Samples	Bioassay Samples
Pier 27	Smolski et al. 1991	Jun 27-28, 1990	0.1 m^2 van Veen and Vibracorer	39	SMS	15	7	17	0	0	7
Harbor Island RI	Weston 1993	Sep 24-Oct 31, 1991	0.1 m^2 van Veen	30	SMS	24	6	0	0	15	0
Pier 35	Shannon and Wilson 1992	Mar 19-27, 1992	Hollow stem auger drilling	3	SMS	0	1	2	0	0	2
Harbor Island SRI	EVS 1996a,b	Mar 10-23, 1995	0.1 m^2 van Veen and Vibracorer	21	SMS	12	4	5	0	15	3
King County CSO 95	King County 1995	Jun 26-29, 1995	0.1 m^2 van Veen	7[b]	SMS	7	0	0	0	1	0
King County CSO 96	King County 1996	Sep 24-30, 1996	0.1 m^2 van Veen	3[b]	SMS	3	0	0	0	1	6
Pier 36 - underpier	Tetra Tech 1996	Oct 23-24, 1996	Poner grab	3	SMS	3	0	0	0	0	0
Pier 36 - prelim	Berger/Abam 1997	Apr 28-30, 1997	Vibracorer	4	SMS	0	0	4	0	2	0
Pier 36/37 - surface	Tetra Tech 1997	May 19, 1997	0.1 m^2 van Veen	3	SMS	3	0	0	0	3	0
Terminal 18 Dredging - Phase 1	EVS 1998	Mar 11-31, 1996	Vibracorer	86	SMS DMMP	0	67	19	0	77	86
Terminal 18 Dredging - Phase 2	EVS 1998	May 27-Jun 12, 1996	Vibracorer	45	SMS DMMP	0	40	5	0	44	13
EW Stage 1 Channel Deepening	SAIC 1999a	Jul 27-Aug 28, 1998	Vibracorer	99	SMS DMMP	0	63	32	4	44	99
Pier 36 Characterization	SAIC 1999b	Aug 18-26, 1998	Vibracorer	9	SMS DMMP	0	7 (7 TBT porewater)	2 (1 TBT porewater)	0	9	8
Terminal 18 – Post-dredge Monitoring	Windward 2001b	Mar 29, 2000	0.1 m^2 van Veen	13	SMS DMMP	13	0	0	0	0	9

Event Name	Reference Source	Sampling Dates	Collection Method	Total Samples Analyzed	Analyses	Surface Sediment Samples (0–15 cm)	Surface Sediment Samples (0–4 ft)[a]	Subsurface Sediment Samples (> 4 ft)	Post-Dredging Surface Sediment Samples (>-51 ft MLLW)	Dredged Samples	Bioassay Samples
U.S. Coast Guard Pier 36	GeoEngineers 2001	Mar 15-19, 2001	Hollow stem auger	12	SMS DMMP	0	4 (2 TBT porewater)	8	0	12	2
EW/Harbor Island Nature and Extent-Phase 1 & 2	Windward 2002a	Sep 25-28, 2001	0.1 m^2 van Veen	43	SMS DMMP	43	0	0	0	1	41
EW/Harbor Island Nature and Extent-Phase 3a	Windward 2002b	Dec 7-11, 2001	Pneumatic corer	24	SMS DMMP	0	0	0	24	12	0
EW/Harbor Island Nature and Extent-Phase 3b	Windward 2002b	Dec 19-20, 2001	Pneumatic corer	33	SMS DMMP	0	33	0	0	1	0
Pier 36 Dredging Additional Sampling	GeoEngineers 2003	Nov 14, 2002	Vibracorer	3	DMMP	0	3	0	0	3	3
Pier 36 Suitability Confirmation Sampling	GeoEngineers 2004	Nov 17, 2004	Vibracorer	9	DMMP	0	9	0	0	9	0
Phase 1A Removal Post-dredge Monitoring	Anchor and Windward 2005	Jan 25, 2005 and Feb 2, 2005 (PDM) and Feb 25, 2005 and Mar 1, 2005 (PSP)	0.1 m^2 van Veen	89	SMS DMMP	PDM = 52 (21TBTpore water) PSP = 37	0	0	0	0	0
Coast Guard (Pier 36-37 slip and Berth Alpha)	Hart Crowser 2005	May 11, 2005	van Veen	12	SMS	12	0	0	0	0	0
EW Recontamination monitoring	Windward 2006a	Jan 12, 2006 and Jan 23-24, 2006	Vibracorer and 0.1 m^2 van Veen	41	SMS DMMP	20	21	0	0	0	0

Event Name	Reference Source	Sampling Dates	Collection Method	Total Samples Analyzed	Analyses	Surface Sediment Samples (0–15 cm)	Surface Sediment Samples (0–4 ft)[a]	Subsurface Sediment Samples (> 4 ft)	Post-Dredging Surface Sediment Samples (>-51 ft MLLW)	Dredged Samples	Bioassay Samples
Terminal 30 Sediment Characterization Report	Anchor 2006	Oct 2006	4-inch Vibracorer	5	DMMP	0	5	0	5 (archived)	0	1

a Sample count does not include samples from 0–15 cm horizon.

b Sample count does not include samples from the Connecticut CSO

SMS – polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), and metals: arsenic, cadmium, chromium, copper, lead, mercury, silver, zinc, total organic carbon (TOC), and grain size.

DMMP – PCBs, pesticides, SVOCs, tributyltin (TBT), metals (antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), TOC, and grain size.

PDM – post-dredge monitoring

PSP – post sand placement

2.2 Tissue Chemistry Data

Five studies have reported tissue concentrations of fish and shellfish captured throughout the EW (Table 2-2). For each study, Table 2-2 summarizes the tissue type and the analytical results for all analytes that were detected in the tissue samples. Four of the studies had very limited analyte lists. EVS (unpublished) and ESG (1999) presented results for samples analyzed for tributyltin (TBT), polychlorinated biphenyls (PCBs), and mercury; Windward (2002c) and Windward (2005) contained samples analyzed for PCBs and mercury. King County (1999) had an exhaustive analyte list including over 100 different analytes.

Table 2-2
Detected Tissue Chemistry Concentrations

Species	Sample Type	Reference Source	Number of Samples	Detection Frequency (%)	Analyte	Concentration Minimum	Concentration Maximum	Unit (wet weight)
English sole	Skinless fillet	EVS 1999 (unpublished)[a]	3	100	PCBs (total-calc'd)	409	640	µg/kg
			3	100	mercury	0.0259	0.0343	mg/kg
			3	100	methylmercury	23.1	36.8	µg/kg
			3	66.0	tributyltin as ion	0.68 U	1.85	µg TBT/kg
			3	100	dibutyltin as ion	18.5	25.3	µg DBT/kg
			3	100	monobutyltin as ion	2.87	3.17	µg MBT/kg
Mussels	Edible tissue	King County (1999)	6	100	tributyltin as ion	58.7	92.8	µg TBT/kg
			6	50.0	PCBs (total-calc'd)	13 U	32.6	µg/kg
			6	100	arsenic	0.745	1.85	mg/kg
			6	100	cadmium	0.368	0.616	mg/kg
			6	83.3	chromium	0.11 U	0.934	mg/kg
			6	100	copper	1.23	2.18	mg/kg
			6	100	lead	0.426	0.833	mg/kg
			6	100	nickel	0.106	0.23	mg/kg
			6	100	zinc	35.8	49.1	mg/kg
			6	16.7	chrysene	16 U	32.1	µg/kg
			6	66.0	fluoranthene	23 U	45.9	µg/kg
			6	33.0	pyrene	16 U	29.5	µg/kg
			6	50.0	2-methylphenol	44 U	87.9	µg/kg
			6	100	benzoic acid	1050	4720	µg/kg
Red rock crab	Edible tissue	ESG (1999)	3	100	PCBs (total-calc'd)	132.5	204	µg/kg
			3	100	mercury	0.05	0.13	mg/kg
Striped perch	Fillet with skin	ESG (1999)	3	100	PCBs (total-calc'd)	179.3	202.6	µg/kg
			3	33.3	mercury	0.020 UJ	0.70 J	mg/kg
			3	100	tributyltin as ion	5.0 J	31 J	µg TBT/kg
Striped perch	Skinless fillet	ESG (1999)	3	100	PCBs (total-calc'd)	104	135	µg/kg
			3	33.3	mercury	0.020 UJ	0.060 J	mg/kg
			3	100	tributyltin as ion	10 J	21 J	µg TBT/kg
Juvenile chinook salmon (wild)	Whole body [b]	Windward (2002c)	3	100	Mercury	0.024	0.028	mg/kg
			3	100	PCBs (total calc'd)	46.3	72.0	µg/kg
Juvenile chinook salmon (hatchery)	Whole body [b]	Windward (2002c)	3	100	Mercury	0.026	0.028	mg/kg
			3	100	PCBs (total calc'd)	58.9	87.4	µg/kg

Species	Sample Type	Reference Source	Number of Samples	Detection Frequency (%)	Analyte	Concentration Minimum	Concentration Maximum	Unit (wet weight)
English sole	Whole-body (calc'd)[c]	Windward (2006b)	2	100	Mercury	0.02 J	0.03 J	mg/kg
			2	100	PCBs (total calc'd)	3,100	7,800 J	µg/kg
	Fillet	Windward (2006b)	6	100	Mercury	0.03 J	0.04 J	mg/kg
			6	100	PCBs (total calc'd)	1,900	5,700	µg/kg
Sand sole	Whole-body	Windward (2006b)	6	100	Mercury	0.03 J	0.119 J	mg/kg
			6	83.3	PCBs (total calc'd)	20 U	1,310	µg/kg
Shiner surfperch	Whole-body	Windward (2006b)	3	100	Mercury	0.02 J	0.03 J	mg/kg
			3	100	PCBs (total calc'd)	1,380	5,400	µg/kg
Rockfish	Whole-body	Windward (2006b)	2	100	Mercury	0.07 J	0.235	mg/kg
			2	100	PCBs (total calc'd)	2,900	6,200	µg/kg

a Insufficient documentation exists for the validation of these results; unvalidated data will not be used in the risk assessments

b Otoliths and digestive tracts were removed from whole-body samples (Windward 2002c).

c English sole whole-body concentrations were calculated from the analysis of fillet composites and remainder composites

U not detected at given concentration

UJ not detected at given estimated concentration

J estimated concentration

2.3 Water Chemistry Data

The surface water chemistry data for the EW is limited to two investigations (King County 1999, Anchor and Windward 2005). In 1999, King County conducted a Water Quality Assessment of CSOs for the Duwamish River and Elliott Bay (King County 1999). Water samples from three locations along a transect across the waterway off of the Hanford Street CSO, were collected in the EW as part of this sampling event. CSO effluent samples were analyzed for conventionals, metals, organics, and microbiological parameters. CSO effluent was collected during discharge events by ISCO® autosampler. CSO field measurements taken after sample collection included temperature, conductivity/salinity, and pH.

Receiving water samples were collected as discrete grab samples at both 3 feet below the water's surface and 3 feet above the bottom of the waterway. Samples were collected over a 26-week period between October 1996 and June 1997. Field measurements recorded during sampling included dissolved oxygen, temperature, conductivity/salinity, and pH. Samples were collected weekly except during storm conditions when they were collected daily for a period of 3 days following a CSO discharge event. Receiving water was analyzed for total organic carbon (TOC), volatile suspended solids, ammonia nitrogen, nitrate/nitrite nitrogen, total suspended solids (TSS), metals, semivolatile organic compounds (SVOCs), and microbiological parameters.

Water quality monitoring events occurred in conjunction with dredge events in the EW. In 2004 and 2005, water quality monitoring was conducted during the dredging activities for the EW Phase 1A removal action (Anchor and Windward 2005). Chemistry samples were periodically collected as part of the water quality monitoring activities. Thirty-six water samples were taken from locations 1,300 feet upstream of dredging operations to determine ambient conditions. These samples were analyzed for metals (cadmium, copper, lead, mercury, silver, and zinc), TBT ion, PCBs, dieldrin, and dichloro-diphenyl-trichloroethanes (DDTs).

In addition to the surface water data, the EISR will include summaries of the available porewater, groundwater, and seep data. Porewater TBT concentrations have been measured throughout the EW as a requirement of the DMMP characterizations. Groundwater and seep data have been collected as part of the upland remediation work completed on Harbor Island, as well as in the vicinity of Terminal 30, Chevron, and the GATX Corporation terminals.

2.4 Biological Surveys

2.4.1 Benthic Surveys

Taylor et al. (1999) conducted epibenthic invertebrate sampling of Slip 27 in the EW as part of a survey of locations in the lower 2 miles of the Duwamish River estuary. Sampling was conducted at 0.0 and -2.0 feet MLLW using an epibenthic suction pump. Approximately 135 taxa were identified in this survey. The highest epibenthic invertebrate density at all sites was observed at the site near the mouth of Slip 27 in the EW. At all sites, most of the invertebrates collected were potential salmonid prey species. Of the epibenthic invertebrates identified as salmonid prey, harpacticoid copepods were the dominant species at the Slip 27 site.

2.4.2 Fish Surveys

One report was located documenting a fish survey including an EW station. Taylor Associates conducted beach seines at the head and mouth of Slip 27 in 1998, 2000, 2002, 2004, and 2005 (Taylor et al. 1999, Shannon 2006, Taylor Associates 2004, Taylor Associates 2005). Pier 36 was also sampled in 2000. Sampling was conducted April through August 1998, April through October 2000, April through August 2002, and February through March in 2004 and 2005. The top three numerically dominant species at Slip 27 station were chum salmon, chinook salmon, and shiner perch. Together, these species represented 98 percent of the total catch at Slip 27. Additional species captured included coho salmon, sculpin species, Pacific herring, surf smelt, and three-spine stickleback.

Chum salmon, chinook salmon, and coho salmon juveniles have been documented in the EW with juvenile chum and chinook the most abundant salmonid species captured by beach seining in Slip 27 (Taylor et al. 1999, Shannon 2006, Taylor Associates 2004, Taylor Associates 2005). Fish species collected by trawling in the EW include English sole, rockfish, sand sole, and shiner surfperch (Windward 2006b).

3 REMEDIAL INVESTIGATION TASKS

EPA guidance states that, "The RI serves as the mechanism for collecting data to characterize site conditions; determine the nature of the waste; assess risk to human health and the environment…" (EPA 1988a). The following section describes the SRI tasks and the deliverables associated with those tasks. First, the existing site information will be summarized (Section 3.1) and used to develop conceptual site models (CSMs; Section 3.2), which will identify important physical processes within the waterway, as well as likely current and future exposure scenarios for ecological and human receptors. Data gaps will then be identified (Section 3.3) and sampling efforts to remedy the data gaps will be developed (Section 3.4). The results of the sampling efforts will be presented in data reports (Section 3.5). The conceptual site models and the complete SRI dataset will be used to assess risk to both ecological and human receptors in the ecological risk assessment (ERA) and human health risk assessment (HHRA) (Section 3.6). The sediment transport evaluation (Section 3.7) and source control evaluation (Section 3.8) will be submitted as stand-alone reports to help minimize any delay of SRI tasks. Finally, the results of all the SRI tasks will be combined and synthesized in the Supplemental Remedial Investigation report (Section 3.9).

3.1 Existing Information Summary Report

Data necessary for the SRI will be compiled in the Existing Information Summary Report. Data from all of the studies listed in Section 2 have been compiled in a relational database. The Existing Information Summary Report will review the existing data and identify data appropriate for use in the SRI/FS from the existing database. Data not suitable for use in the SRI/FS, such as the data associated with sediment that has been dredged, will be retained in the project database and may be used to identify potential contaminants of interest as well as to inform sampling plans. Relevant existing upland site information relating to transport pathways will be presented in the EISR. This information will include groundwater data, hydrogeologic and geotechnical cross sections, and pertinent historical and ongoing remedial activities. Relevance of data will be further addressed in the Source Control Evaluation Approach Memo. Source control data gaps will be submitted for review and approval to EPA as a separate deliverable.

The Existing Information Summary Report will include, at a minimum, the following elements:

1. Introduction and a statement of the purpose of the report
2. Brief description of the current physical, ecological, and human-use characteristics of the EW OU.
3. Identification of property owners of the EW OU and owners and operators of the uplands.
4. A complete description of what is known about the nature and extent of contamination in all EW environmental media (surface water, groundwater, sediment, tissue), including a summary of existing surface and subsurface sediment data (including sediment bioassay results). Sediment data will be compared to Washington State SMSs (Sediment Quality Standards and Cleanup Screening Levels), or Puget Sound Dredge Disposal Criteria when state SMSs do not exist for particular chemical constituents (e.g., TBT). This comparison will include all the pre- and post-contingency dredge monitoring data that characterize the sediment surface prior to placement of the interim sand layer for the Phase 1 Removal Action. The information summarized also will include all existing information from environmental investigations or cleanups along the EW (e.g., USCG Slip along Pier 36). A brief summary of the nature and extent of contamination that is immediately adjacent to the EW study boundaries (i.e., Lower Duwamish, southern Elliott Bay) will be provided. Upland data adjacent to the EW will not be included unless it is relevent to the EW SRI/FS needs.
5. Identification of all known historical and ongoing sources of contamination to the EW, including an overview of completed or ongoing source control activities, to the extent that this information is available (detailed discussion of source control activities will be presented in a separate source control report).
6. Summary of hydrology and subsurface geology/hydrogeology. Hydrology will include EW flows, tidal information, surface water drainage area to the EW, outfalls, runoff rates and outfall flow rates, and stormwater/CSO discharge data. Geology/hydrogeology will include regional aquifers, flow directions, known/listed contaminated soil/groundwater sites, existing groundwater wells near the EW, and specific local groundwater data.
7. Summary of tissue data taken from the EW (and immediately adjacent locations within the Lower Duwamish River and Elliott Bay).

8. Data Quality Objectives will be developed and used to review the quality of existing data for use in the SRI/FS. A detailed discussion of this process is provided in Section 3.1.2.
9. Other information (including geographic information system [GIS] maps and figures) as necessary to gain a complete understanding of the EW OU. Data management protocols, including geospatial analysis techniques, will be included as an appendix to the existing information summary. All data should be provided to EPA in a Microsoft Office Access database. For each figure, all shapefiles and layers used to create that figure should be identified and submitted to EPA.

3.1.1 Data Categorization

The following two types of data will be assembled from relevant studies and databases and evaluated for possible inclusion in the SRI database. Category 1 data are those data that are sufficiently structured to be incorporated into a formal database. These data include repeated measurements of a consistent list of parameters are made over space and time. Category 1 data have been compiled into a relational database, which is a set of formally structured tables that can be queried many ways without requiring that the database be reorganized. Category 2 data will be used in the risk assessments or in the RI, but not compiled into a relational database at this time because the studies typically do not contain repeated measures of a consistent list of parameters. A memorandum describing the Historical Data Quality Review and a Data Management Memorandum will be submitted to EPA and finalized as attachments to the EISR.

Category 1 Data:

- Sediment chemistry (both bulk and porewater), including sediment grain size
- Sediment bioassay data
- Benthic community analyses
- Tissue chemistry

Category 2 Data:

- Geotechnical data
- Site physical data (e.g., structural data and bathymetry)
- Salmon life history data

- Wildlife lifestage information (e.g., distance to known heron rookeries, feeding areas for nesting Great Blue Heron, seasonal use by bird species, and presence of other wildlife species)
- Abundance and distribution of biological resources
- Important riparian and aquatic habitat areas
- Fish and marine invertebrate home range data/projections
- Fish histopathology and biomarker data
- Site use information (i.e., public access, tribal use, commercial and recreational fish and shellfish consumption, etc.)
- Demographic data including socio-economic and ethnicity information
- Summary of pertinent quality assurance/quality control (QA/QC) information from each study
- Potential contaminant sources, including a summary of individual outfalls, surface water, groundwater, stormwater, CSO discharges, and identification of contaminated shoreline fill

3.1.2 Data Quality Objective Description and Rationale

The Data Quality Objectives (DQOs) were designed to identify data of appropriate quality that may be used in the SRI. DQOs for the EW will be based on those developed for the LDW to the extent possible in order to ensure consistent data evaluation between the two projects. The derivation of DQOs will be consistent with EPA guidance (EPA 2006b).

Preliminary DQOs provided here were developed to evaluate historical data for the LDW. The DQOs are grouped into four categories, are presented in the following sections as bullets in bold font, followed by descriptions of the DQOs. The categories refer to the level at which each DQO would be applied: event, station, sample, or result. For example, a DQO applied at the result level could cause a result record to be qualified for a particular chemical, but not for other chemicals analyzed during a particular study. DQOs applicable only to a particular data type are being identified; otherwise, it can be assumed that each DQO is applicable to all data types.

3.1.2.1 Event Level Data Quality Objectives

- **Hard copy or original electronic copy of data report must be available**
  Data verification of electronic datasets is only possible if the original data report or laboratory data report has been reviewed. Information related to field and laboratory methods must be available. Data will be included in the SRI/FS dataset if it can be documented that they have met minimum QA/QC requirements[1] and are considered valid for use based on a data validation conducted by the authors or an independent party.

- **Field coordinates must be available**
  Accurate coordinates are necessary for constructing a usable GIS. The methods used to generate the field coordinates will be clearly identified in the database. Most sediment investigations conducted in the last 10 years in Puget Sound have utilized differential global positioning system (DGPS) methods. The nominal horizontal accuracy of coordinates obtained using DGPS equipment is 3 to 15 feet. Ideally, sediment data for inclusion in the SRI/FS dataset will be associated with DGPS coordinates. Samples associated with GPS coordinates that have not been differentially corrected (non-DGPS), or with coordinates that were not measured in the field, may be included in the database but will be distinguished from the DGPS coordinates by the positioning method.

  Precise field coordinates for tissue chemistry sampling events may not be readily available given the mobility of the target organisms and collection gear that may be deployed over a wide area. In many cases, the capture location is described as an area rather than as a single position. A sufficient number of coordinates will be added to the database so that the capture location may be accurately described in the GIS. For example, a trawl transect may be described by two points—the beginning and end of the transect line. Other net deployments, such as beach seines, may be described as a single point unless multiple coordinates are available.

[1] Datasets with insufficient documentation for full validation will be assessed in accordance with applicable EPA Functional Guidelines for data review, and the usability of the data will be determined.

All coordinates will be added to the database in the original coordinate system and units used in the electronic file. For location records with a coordinate system that does not match the coordinate system being used for the project GIS (i.e., Washington State Plane North, NAD 83, U.S. survey feet), an additional set of coordinates will be added for each station record to make all data compatible within the GIS.

- **Data review for recency and relevance**
  All data identified in Section 2.1 will be reviewed for recency and relevance. Data associated with sediments that have been dredged will be identified as dredged in the database. The data will be presented in an appendix to the EISR and may be informative in developing sampling efforts in these areas.

- **Data must have been collected using appropriate sampling methods**
  Surface sediment is typically characterized using a surface grab sampler, although the top section of a core sample may also adequately represent surface sediment. The van Veen grab is probably the most commonly used sampler in Puget Sound, but ponar, Ekman, or box corers can also yield acceptable samples. The appropriateness of surface sediment sampling techniques will be evaluated on a case-by-case basis. Data collected using sampling methods that may not provide an undisturbed sample from the sediment surface, such as samples hand-collected by divers, may be added to the database, but will be distinguished from data collected using other methods.

  Chemistry data from sediment porewater will be included in the database. The porewater extraction method can influence the results, so the method will be clearly documented in the database.

  Various types of gear may have been deployed for collection of tissue samples. Each type of gear has a specific bias toward certain types of organisms. This bias is very important to consider when characterizing populations or communities, but may be less important when collecting samples for chemical analysis. The collection gear deployed for each tissue-sampling event will be clearly documented in the database, as will the type of tissue preparation.

Sampler type and sieve size can influence the suite of organisms obtained in a sample of benthic infauna. The database will include all benthic infauna data, but the type of sampling gear deployed may influence the usability of the data. The sampling gear and sieve size for benthic invertebrate sampling events will be clearly documented.

3.1.2.2 Station Level Data Quality Objectives

- **Stations located within dredge prisms or remediated areas have been identified (applicable to sediment chemistry, benthic macroinvertebrate, bioassay data only)**
  Sediment characterization almost always precedes remediation or maintenance dredging projects. For navigational dredging, the material to be dredged is characterized to determine what disposal options are possible. Environmental dredging or capping occurs only after a characterization effort has determined that the sediments represent an unacceptable ecological or human health risk. Sediment data collected prior to a remediation or dredging event may no longer reflect current conditions. Data from locations that have been remediated or dredged may be added to the database, but attributes will be added to these location records so they can be distinguished from locations that have not been dredged or remediated.

  The dredge prisms for dredging events that have occurred within the last 10 years will be incorporated into the project GIS.

- **Co-located samples will be identified**
  A large number of environmental samples have been collected from the EW. Most sampling events involve collection of samples where few samples have been collected before, but there are likely to be surveys where newer samples were collected in locations that have been sampled previously. Using GIS,

stations located within 15 feet of newer sampling locations will be identified. These samples will be evaluated on a case-by-case basis to determine whether newer data better reflect current conditions. If so, older co-located data will be qualified appropriately. All data will be retained in the database; however, the preferred result will be flagged as such. This evaluation will be consistent with the evaluation of co-located samples conducted for the Lower Duwamish Waterway RI.

- **Station type must be clearly identified (applicable to bioassay and benthic macroinvertebrate data only)**
  Data from an appropriately matched reference station are often required to evaluate sediment toxicity[2] and benthic invertebrate[3] data. Reference station samples for a given event will be identified as such in the database. Events lacking reference station samples will be included in the database and evaluated on a case-by-case basis for use in characterizing current conditions.

3.1.2.3 Sample Level Data Quality Objectives

- **Sediment depth should be identified (applicable to sediment chemistry, benthic macroinvertebrate, bioassay data only)**
  Organisms may be exposed to sediment-associated contaminants as a function of the location of the contaminants in the sediment column coupled with their behavior. A depth of approximately 4 to 6 inches (10 to 15 cm) is generally considered to comprise the ecologically available horizon (biologically active zone) in areas without active erosion, although some burrowing invertebrates may be found at greater depths. The collection depths of all sediment samples will be identified in the database. Specific definitions of "surface samples" will be provided in each case where such data are used in the RI.

[2] Appropriate reference samples are matched to site samples on the basis of grain size.

[3] Because physical characteristics of the environment can influence the distribution of benthic organisms, appropriate reference samples are matched to site samples on the basis of grain size, salinity, and water depth.

- **Sample type should be clearly identified**

  Environmental samples may represent various areal extents depending on whether the sample was collected from a single location or was a composite of subsamples collected from different locations. Data from both discrete and composite samples are suitable for the RI, but the sample type may be relevant for evaluating the uncertainty across small spatial scales associated with chemistry data. Sample matrix and preparation method will also be clearly identified in the database.

- **Number of replicates should be identified (applicable to benthic invertebrate and bioassay data only)**

  Replicate samples are typically analyzed for bioassay (laboratory replicates) and benthic invertebrate (field replicates) sampling events. For benthic invertebrate data and bioassay data, the number of replicate samples will be identified. Individual replicate data will be included for both data types in the database.

3.1.2.4 Result Level Data Quality Objectives

- **Reporting limits (applicable to chemistry data only)**

  For historical data reported as non-detected, reporting limits are reported and appropriate qualifiers indicating that the true value is less than the reporting limit will be included. In addition, non-detected results with reporting limits greater than the respective SMS Sediment Quality Standards (Ecology 1995) will be discussed in the EISR. An additional comparison of reporting limits to risk-based analytical concentration goals (ACGs) (based on direct sediment exposure and seafood consumption) will be conducted in the Data Gaps Analysis Report. The usability of the historical data for the risk assessments will be determined in consultation with EPA based on the results of these comparisons. For data collected for the RI/FS, reporting limits will be compared to risk-based analytical concentration goals in the QAPPs in order to ensure sufficient data quality. Both detection limit and reporting limit values will be included in the project database.

- **Calculated values (applicable to chemistry data only)**
  Sums such as high molecular weight polycyclic aromatic hydrocarbons (HPAHs), low molecular weight PAHs (LPAHs), carcinogenic PAHs (cPAHs) and total PCBs are recalculated from the raw data to ensure that consistent rules regarding detection limits and summation are followed. Summation rules specified by the Washington State Department of Ecology (Ecology) in their SMS rule are being applied. Sums not defined by Ecology in their sediment rule (e.g., total PCBs based on congeners) will be calculated following the LDW summation rules and will also be stored in the database. All summation rules will be presented in the EISR.

  Chemistry data may be presented on a normalized basis, either to organic carbon (sediment) or lipid (tissue). Normalized data will not be added to the database because it may not be clear which concentrations were used to normalize. Normalized concentrations will be recalculated from the raw data following the conventions specified by Ecology.

  Data that represent averages of two or more values will not be added to the database because it may not be clear how these averages were derived. If averages are needed for data analysis, they will be recalculated from the raw data using conventions that will be discussed between the EWG and EPA prior to their application to data in the database. Location averaged data will be stored in a separate database table and provided to EPA in conjunction with the raw data tables.

- **Analytical methods**
  Chemistry data may be generated by many different analytical methods. Concentrations reported for a given analyte may or may not be comparable for different methods. Consequently, it is critical that the precise analytical method be documented for all data included in the database. In cases where multiple methods were used for a single analyte in a single sample, the usability of data generated by the different methods will be determined. Analytical selection methodology will be consistent with protocols developed

for the LDW. Any decisions to exclude data based on the analytical method will be thoroughly documented in the deliverable in which these data are used.

In Puget Sound, most bioassays are conducted according to methods specified in the SMS. Any data collected using non-standard methods will be coded as such in the database.

Puget Sound protocols outline the methods and QA/QC requirements for benthic invertebrate organism identification, enumeration, and biomass determination. The methods employed for each sampling event will be reviewed and documented in the database. All appropriate benthic survey results will be included in the database, although results obtained using non-standard protocols will be included in the database with appropriate qualifiers.

- **QA/QC information must be available**
  Only validated data will be used in the risk assessments. Data that cannot be fully validated will be included in the database and can be used for informational purposes in the RI. Validation results are typically in the form of data qualifiers. The data qualifiers given by the data validators will be preserved in the database, but an additional field called "Interpreted Data Qualifier" will be populated for each result record that includes a data qualifier. The intent of this additional field is to provide qualifiers with a consistent definition across all sampling events. The mapping of the original data qualifiers to the interpreted data qualifiers for each sampling event will be provided in the fourth Task 2 deliverable, "Summary of environmental data in the database."

  In cases where data validation was performed by a third party, the qualifiers in the electronic dataset will be compared to qualifiers included in the data validation report. If the data validation qualifiers are not included in the electronic dataset, they will be added.

3.2 Conceptual Site Model

This section presents the approach that will be followed in developing CSMs for physical processes (Section 3.2.1), the ecological receptors (Section 3.2.2), and the HHRA (Section 3.2.3). The CSMs will be presented in the CSM report and will provide an integrated overview of the EW, including identification of the proposed study area boundaries for the purposes of the SRI/FS. They will also be used to form the basis for appropriate data collection and will be refined through the incorporation of new data. The physical processes description will synthesize what is known about important physical processes within EW, focusing specifically on the processes that govern sediment transport within the waterway. The risk assessment CSMs will summarize important physical processes that influence pathways of potential exposure and will select receptors of concern (ROCs) and pathways of exposure for the risk assessments. The risk assessment CSMs will enable the selection of ROCs and exposure pathways for those receptors. This information will then be used to develop exposure scenarios and measurements of exposure. Specific toxicity information will be selected from the literature and combined with exposure information to characterize ecological and human health risks in the ERA and the HHRA. The CSMs will provide a basis for the data gaps analysis.

3.2.1 Physical Processes in East Waterway

This section presents the approach to help define the critical physical processes in the EW that inform the CSM, as well as briefly provide an overview of the anticipated critical processes.

The EW is subject to a range of hydrodynamic forces that potentially affect the movement and stability of sediments. Water circulation within the EW is also affected by the range of hydrodynamic forces. The natural system is complex, with a tidal influence of saltwater from Elliott Bay, and freshwater input from the Duwamish River, along with several outfalls (e.g., storm drains and CSOs) that discharge into the EW. Deep-water currents can flow upstream during flood tides, in the opposite direction of surface currents, depending on the tide stage and Duwamish River discharge rates. During extreme flood tide exchanges, with low river discharge, it may be possible to experience upstream flow throughout the entire water column.

In addition to natural hydrodynamic circulation, the EW is an active shipping channel that supports deep draft container ships, cruise ships, and associated tugboat and smaller boat traffic. The vessels that operate within the EW are large enough that propeller generated currents (propwash) may potentially induce incipient motion in the bottom sediment, causing sediment transport.

Other physical processes may include groundwater from adjacent uplands that discharges through EW sediments under certain conditions. Some upland areas may also contain focused groundwater discharge through backfill for utility corridors. These hydrogeologic processes will be evaluated in the CSM for physical processes.

During storm events, significant discharges may occur from the existing storm drains and CSOs within the EW. These discharges potentially bring additional sediment and contaminant load into the system. The process to evaluate potential sources will be identified in the Source Control Evaluation Approach Memo.

A literature search will be conducted to define the general effects that each of the major hydrodynamic processes could have on sediment stability and recontamination potential. This work will be conducted in conjunction with preliminary evaluation of sediment transport since the two areas are closely related. The existing information and major processes will be summarized in the Sediment Transport Evaluation Report, with an overview presented in the CSM. The existing sample data set will also be used to inform the Sediment Transport Evaluation Report and/or the CSM about recontamination. Extreme events (e.g., tsunamis, seismic events) will also be acknowledged in the CSM and incorporated into the remedial design phase. Other minor processes that have negligible effects on sediment transport will not be evaluated further, including wind transport of particulates, extreme precipitation events, and anchor drag. Some specific information that will be researched on major physical processes includes:

- Current velocities generated by flow events and tidal currents to assess potential for sediment transport
- Circulation patterns within the EW

- Preliminary assessment of range of propwash generated current velocities from existing and anticipated likely future vessels that may use the EW
- Extent of bioturbation throughout the waterway
- Historical sedimentation or erosion rates within the EW to assess natural attenuation options
- Wind-wave and vessel-generated wave impacts on sediment stability on nearshore slopes

The critical physical processes that affect the EW will be visually represented as a figure in the CSM report.

3.2.2 Ecological Conceptual Site Model

This section presents the approach for development the CSM for the EW. The baseline ERA for the LDW Superfund Site is currently undergoing final draft development. The LDW is contiguous with the EW and, in many respects, the ecological receptors and pathways of exposure are similar. Once reviewed and accepted by EPA as applicable for the EW, the LDW ecological CSM can be used as a starting point for the EW ecological CSM. This section presents the approach that will be used to develop the CSM for the EW.

3.2.2.1 Development of Conceptual Site Model

A CSM is a graphical representation of chemical sources, transport mechanisms, exposure pathways, exposure routes, and potentially exposed receptors. The CSM synthesizes pathways of exposure of ROCs to chemical stressors. The CSM will be used with the ERA assessment endpoints to identify measures of exposure. The assessment endpoints determine which endpoints will be examined in detail in the ERA for each ROC/chemical of potential concern (COPC) combination.

For COPCs to pose risk to ROCs, the exposure pathway must be complete. Identifying complete exposure pathways prior to a quantitative evaluation allows the assessment to focus on only those chemicals that can reach ecological receptors (EPA 1997a, 1997b). An exposure pathway is considered complete if a chemical can travel from a source to ecological receptors and the receptor is exposed via one or more exposure routes (EPA 1997a, 1997b). Complete pathways can be of varying importance, so key pathways that reflect maximum exposures to ecological receptors sensitive to that chemical (EPA 1997a, 1997b) are identified as having more importance than pathways likely to provide a very low fraction of the total exposure of an ROC to a chemical.

3.2.2.2 Receptors of Concern

The final ROCs for the ERA will be identified in the CSM. The LDW is contiguous with the EW and shares many similarities with the EW in terms of the ecological populations. The CSM Report will contain an evaluation of the applicability of utilizing the ROCs selected for the LDW.

3.2.2.3 Pathways of Exposure

Final pathways of exposure for the selected ROCs will be identified in the CSM. Pathways for the exposure of ROCs to sediment-associated chemicals in the EW will be designated in one of four ways: complete and significant, complete and significance unknown, complete and insignificant, or incomplete. Each of the four designations is defined below.

- **Complete and significant:** There is a direct link between the receptor and chemical via this pathway, and the specific pathway is considered to be potentially important. Pathways classified as complete and significant will be addressed in greater detail in the ERA.
- **Complete and significance unknown:** There is a direct link between the receptor and the chemical via this pathway; however, there is no accepted toxicological methodology available to quantify the significance of the pathway in the overall assessment of exposure. Pathways classified as complete and significance unknown will be discussed qualitatively in the uncertainty analysis of the ERA.
- **Complete and insignificant:** There is a direct link between the receptor and the chemical via this pathway; however, the significance of this pathway in terms of overall exposure is considered to be negligible. Pathways classified as complete and insignificant will not be evaluated further in the ERA.

- **Incomplete:** There is no direct pathway between the receptor and the chemical. Pathways classified as incomplete will not be evaluated further in the ERA.

3.2.2.4 Assessment Endpoints and Measures of Effect and Exposure

An assessment endpoint is defined as an explicit expression of the ecological value that is to be protected (EPA 1992a). Ecological values include those roles and processes vital to ecosystem function, those providing critical resources such as habitat and fisheries, and the regulatory status of the populations (e.g., threatened or endangered species). An assessment endpoint must define both the valued entity and the characteristic of the entity to be protected. They provide direction for the risk assessment and are the basis for the analyses. Unless an ecological receptor is listed as a threatened or endangered species, assessment endpoints are selected that are relevant to population-level rather than individual effects. For threatened or endangered species, risks to individuals are important to evaluate (EPA 1998a), although specific guidance regarding this approach is not available. The process by which population vs. individual effects will be described and evaluated will be provided in the ERA technical memorandum described in Section 3.6.1.

Selection of assessment endpoints will be based on available information regarding the ecological relevance of the endpoint. In addition, assessment endpoints will be evaluated to ensure that their protection would likely result in protection of other valued entities within the system. Finally, measurement endpoints selected must be amenable to assessment either through previously existing data or data that will be collected for the RI.

3.2.3 Human Health Conceptual Site Model

This section presents the approach for development of the CSM for the EW as well as some discussion of the relevance of specific exposure pathways for quantitative evaluation. The CSM, as presented in the CSM report, will identify and finalize human health receptors and pathways. The details of specific exposure scenarios will be presented subsequently in the HHRA technical memorandum. The development of the

CSM and specific exposure scenarios will occur though discussions with EPA prior to completion of these deliverables.

As noted earlier, the LDW Superfund Site is contiguous with the EW and supports a number of human use activities in common with the EW, and the baseline HHRA for the LDW is currently undergoing final draft development. The exposure scenarios evaluated for the LDW are therefore a starting point for discussions of scenarios to be evaluated for the EW. The relevance of various exposure pathways for EW will be presented in the CSM report.

3.2.3.1 Development of Conceptual Site Model

The CSM is a graphical representation of chemical sources, transport mechanisms, exposure routes, and potentially exposed populations. It provides the basis for developing exposure scenarios to be evaluated in the exposure assessment component of the HHRA.

The CSM Report will include general information about sources leading to chemical contamination of sediment, water, and, ultimately, biota. The model will also include several pathways for human exposure to chemicals through these media. For each pathway-media combination, a determination will be made as to whether the pathway is complete or incomplete. A complete exposure pathway includes an exposure medium and exposure point, a potentially exposed population, and an exposure route. Incomplete pathways do not meet these criteria. Incomplete pathways will be discussed in the pathways evaluation of the risk assessment, but cannot be evaluated quantitatively in the risk assessment since both exposure (a complete pathway) and toxicity are required to quantify risk. A table will be presented in the CSM report as well as the baseline risk assessment that will indicate the characterization of each pathway or potential pathways in the CSM (e.g., complete, incomplete). The identification of complete pathways in the CSM report will be used to inform the data gaps analysis.

Complete pathways expected to represent a potential exposure of health concern will be evaluated in the baseline HHRA. For pathways identified as having low exposure and risk potential relative to other pathways being evaluated, a determination will be made in consultation with EPA about the utility of some type of evaluation of the pathways (e.g., comparisons to other quantified exposure pathways) for risk communication purposes. All other complete pathways will be quantitatively evaluated. The exposure parameters and the likelihood of exposure under both current and future land use at the site will be discussed for all exposure pathways quantified.

3.2.3.2 Specific Exposure Scenarios for Evaluation

Exposure scenarios for the LDW baseline HHRA have been developed and provide a starting place to identify appropriate scenarios for EW. The identification of potentially exposed human populations and the selection of pathways of exposure will occur through discussion with EPA and will be presented in the CSM report. The HHRA Technical Memorandum will provide the details of the parameters to be used in assessing the exposure scenarios.

3.2.3.2.1 Water

The current frequency of swimming in the EW is unknown. King County (1999), in their issue paper on human site use in Elliott Bay and the LDW, indicated that these activities occurred rarely in those water bodies. Recreational opportunities are greater in Elliott Bay and the LDW compared to the EW because of the limited public access and the greater concentration of commercial shipping activity in the EW compared to Elliott Bay and the LDW. Technically, the public may access the EW via boat, but many recreational activities would be unsafe given the abundant shipping traffic. Future remedial and restoration actions that may be conducted within the EW are unlikely to change the frequency of these recreational activities due to the surrounding land use. Commercial shipping traffic is also unlikely to change within the foreseeable future.

Individuals from the Muckleshoot Indian Tribe participate annually in a commercial gillnetting operation in the EW, during which the netfishers have some incidental water exposure. Much of the other occupational work on EW takes place on piers and large ships. Periodically, there may be work on piers, pilings, and boat bottoms, which may result in some exposure to water, although such activities would be relatively infrequent.

King County (1999) concluded that the risk from water recreation activities, including swimming, in both Elliott Bay and the LDW was very low. Excess cancer risks were highest for arsenic and PCBs, ranging from 2E-7 for adults exposed to PCBs to 4E-6 to young children exposed to arsenic.

The specific surface water exposure scenarios, if any, to be evaluated in the risk assessment will be determined through consultation with EPA and presented in the CSM report. Details of parameters for any exposure scenarios to be evaluated in the risk assessment will be described in the HHRA technical memorandum.

3.2.3.2.2 Sediment

The potential for sediment exposure activities, including beach play and clamming, and the utility of evaluating these scenarios will be evaluated in more detail as part of the CSM development.

Individuals from the Muckleshoot Indian Tribe participate annually in a commercial netfishing operation in the EW. The gillnet lead lines come in contact with sediments during normal operations. The fishermen contact this sediment incidentally upon net retrieval. The fishermen may also make incidental contact with surface water and sediment suspended in surface water.

Many of the facilities adjacent to the EW rely on vessel traffic on the waterway, and workers on these vessels could potentially come in contact with sediment and surface water. Potential sediment exposure associated with occupational activities will be evaluated in the CSM report. Appropriate occupational scenarios for the EW will be developed in consultation with EPA and described in detail in the HHRA technical memorandum.

If the need for more information on potential exposures to EW sediments (occupational and/or non-occupational) is identified through the data gaps analysis, approaches to better characterize such activities will be discussed with EPA.

3.2.3.2.3 Seafood Consumption

Several seafood consumption scenarios are relevant for EW, including some that were developed for the LDW HHRA. EPA has provided a draft tribal framework for developing tribal fish and shellfish consumption rates for sites in Puget Sound (EPA 2006c). The tribal framework will be utilized for EW with consideration of specific EW site characteristics as well as the recent application of the tribal framework in the LDW. The tribal framework includes an assessment process for shellfish quality habit to determine if, "the site or its environs have (existing or potential) high quality shellfish physical habitat to support substantial shellfish harvest in the absence of contamination." In consultation with the appropriate tribes, the outcome of this assessment will be used to determine the most appropriate seafood consumption rate to be approved by EPA for the EW. Additional consumption rates may be evaluated in order to provide information for risk communication purposes. EPA will be engaged in a comprehensive discussion of shellfish habitats and populations in the EW, application of the tribal framework, and selection of seafood consumption rates. The details of the selected scenario(s), the rationale, and associated parameters will be presented in the HHRA technical memorandum. King County has a large and diverse Asian and Pacific Islander (API) population (EPA 1999). A creel survey by King County indicated that some API use the EW as a fishing resource (King County 1999). A consumption rate based on fish and other seafood caught in King County (consumers only) reported in the survey of King County API (EPA 1999) was provided in the *Application of Data from an Asian and Pacific Islander (API) Seafood Consumption Study to Derive Fish and Shellfish Consumption Rates .for Risk Assessment* (Kissinger 2005) and is appropriate for application to the EW. The use of this evaluation of the API survey and specific exposure parameter values appropriate for EW will be discussed with EPA. The selected exposure parameters for an API scenario will be described in the HHRA technical memorandum.

3.2.3.3 Reasonable Maximum Exposure Scenarios and Temporal Relevance of Scenarios

EPA (1989) states, "actions at Superfund sites should be based on an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land-use conditions." EPA defines the RME as "the highest exposure that is reasonably expected to occur at a site." The scenarios to be evaluated in the HHRA for EW will be consistent with RME guidelines and appropriate regional guidance (Kissinger 2005; EPA 2006c) and will be described in detail in the HHRA technical memorandum The potential inclusion of alternative scenarios will also be discussed in that memorandum.

Future land use evaluations will be discussed with EPA and presented initially in the CSM report to identify possible exposure pathways. This will include consideration of tribal treaty rights, redevelopment/expansion plans, and expected improvements related to remediation and source control in the LDW. This initial assessment of potential future land use in the CSM will be useful for the data gaps analysis. A more developed discussion will be presented in the HHRA technical memorandum and used to inform selection of exposure parameters.

3.3 Data Gaps Analysis Report

The Data Gaps Analysis Report will include the identification (and initial prioritization) of data gaps for the SRI, ERA, HHRA, and FS. This analysis will include an assessment, related to a preliminary CSM, of data gaps identified from the review of all existing EW data (Section 3.1). The Data Gaps Analysis Report will contain a preliminary contaminants of interest (COI) list for both the ERA and HHRA. The data gaps assessment will include a summary of recommended studies proposed to remedy the identified data gaps. The detailed study designs for these studies will be presented in the QAPPs (Section 3.4).

Resolving the identified data gaps may involve field investigation or modeling, subject to EPA approval. Where existing bioassay, sediment, water and/or tissue data are determined in the data gaps analysis to be of sufficient quantity and quality, and representative of current conditions, they may be proposed for use in lieu of collecting additional data (as approved by EPA). All evaluations of the usability of existing data will be in accordance with EPA's *Guidance for Data Usability in Risk Assessment* (Parts A and B) (EPA 1992b).

In addition, for the historical data, samples for which non-detected results have reporting limits greater than the respective SMS Sediment Quality Standards (Ecology 1995) and risk-based ACGs (based on direct and indirect sediment risks) will be identified. The usability of the historical data for the risk assessments will be determined in consultation with EPA based on the results of these comparisons.

Data gaps analysis will be performed for source control (including groundwater) as part of a separate analysis and will be submitted in a separate Source Control Data Gaps report. This approach is proposed to help expedite completing the data gaps analyses for most of the SRI/FS elements, and handle Source Control elements in a separate process. The Source Control Evaluation Approach Memo will lay out the approach and proposed deliverables for Source Control evaluation.

Data gaps analysis will also be performed for sediment fate and transport analysis as part of a separate analysis (see Sections 3.3.4 and 3.7.3). Existing sediment transport information will be reviewed in the EISR, followed by an assessment of data gaps and need for additional field investigations and modeling as a separate document from the Data Gaps Analysis Report in order to expedite completion of the main data gaps analysis for other RI/FS elements.

3.3.1 Sediment Data

The sufficiency of the existing sediment chemistry and sediment bioassay data for the completion of the SRI/FS will be assessed in order to identify data gaps for the risk assessments, the SRI, and the FS. Historical datasets that are excluded from the SRI/FS dataset will be used to determine appropriate sampling density (i.e., areas where higher concentrations have been reported may require a higher sampling density than areas with no history of contamination). Risk-based analytical concentration goals for sediment will be presented in the Data Gaps Analysis Report.

3.3.2 Tissue Data

The data gaps analysis will be conducted in the context of the CSMs in order to identify relevant species and sample types to propose for analysis. The data gaps with regard to PCBs will explicitly detail the data gaps with regard to PCB congener data as well as total PCB data (measured on an Aroclor basis). Per discussion with EPA, Aroclor sums will be compared with congener sums prior to risk evaluations. The use of congener data in the EW will be consistent with the LDW. The existing tissue dataset is limited (Section 2). Risk-based ACGs for tissue will be presented in the Data Gaps Analysis Report.

3.3.3 Physical Processes

Physical processes identified and discussed in the CSM (Section 3.2.1) will be evaluated in the Data Gaps Analysis Report. Any data gaps identified will also be considered in the Sediment Transport Evaluation Report.

3.3.4 Sediment Transport

The need to conduct additional studies to characterize sediment transport processes is contingent upon results from the data gaps analysis (i.e., sufficiency of existing sediment transport information). The evaluation of sediment transport data gaps may require more time to evaluate and discuss with EPA; therefore the data gaps analysis for sediment transport will be presented in a separate report. This approach allows the completion of the data gaps analysis for other media without potential delay from the sediment transport data gaps analysis. Section 3.7 discusses the approach to evaluate sediment transport, including the data gap analysis.

3.3.5 Geotechnical

The need to conduct additional geotechnical explorations will be evaluated in the data gaps analysis. Existing data sources include existing geotechnical data collected during previous investigations on the adjacent shorelines as well as specific geotechnical explorations (borings) that have been conducted within the waterway. Geotechnical data will be gathered to evaluate the feasibility for dredging and impacts to slope and structural stability for removal alternatives, and to facilitate the evaluation of sediment stability and cap design for confinement alternatives.

Potential critical areas that may require additional geotechnical explorations include slope areas adjacent to existing terminal facilities (including Terminals 18, 25, and 30 and Pier 36), and the mound of sediment located at the north end of Terminal 25 at the mouth of Slip 27.

3.3.6 Structural and Utility

The EW is mostly surrounded by pile-supported pier structures, bulkheads, bridge, and armored slopes. Structural and utility data will be gathered to evaluate the feasibility of conducting remedial actions (such as dredging or capping) adjacent to existing structures or utilities. A structures survey will be conducted to identify existing structures, year constructed, depth of structural supports, design constraints (e.g., maximum depth of dredging permissible), current uses, and users. Existing utilities within the EW will also be identified. One major known utility is located at the approximate mid-point of the EW, and is a buried Qwest telephone cable in an armored trench that crosses the EW.

Sources of data for the structural and utility data gaps analysis will include Port engineering drawings, City and County utility maps, Washington Department of Natural Resources lease/easement/right-of-entry records, and records from the Seattle Department of Transportation (SDOT) and Washington State Department of Transportation (WSDOT). Additional structural information may also be available from the USCG for their facility at Pier 36.

Where detailed information is not available, a facility-specific structural survey may be necessary. The information gathered for this type of survey will include the type of structure, its condition, and pertinent dimensions such as height, width, length, and depth of water adjacent to the structure.

3.3.7 Debris

Existing data will be evaluated to assess the presence or absence of debris in the EW. Information on types and locations of debris will be compiled from historical surveys. Any additional data needs on presence or absence of debris will be identified in the Data Gaps Analysis Report.

3.3.8 Existing and Future Site Uses

As previously discussed, the EW currently experiences regular vessel traffic, including use by cruise ships and container ships. As Port container volume increases, there may be a need to accommodate larger container vessels in the future that may require deeper drafts than the waterway is designed for today. Other uses include recreational and commercial fishing, including an annual commercial netfishing operation by the Muckleshoot Tribe.

The EWG will coordinate with Port Seaport Planning Group, City Department of Planning and Development, the County, USCG, and other stakeholders, including Tribes, to assess potential future uses that may impact the selection of a remedial alternative.

3.4 Quality Assurance Project Plans

All sampling efforts performed as part of the EW SRI/FS will conform to EPA direction, approval, and guidance regarding sampling, QA/QC, data validation, and chain-of-custody procedures. DQOs will be derived in a manner that is consistent with the LDW DQO process and will be consistent with EPA DQO guidance (EPA 2006b). All sampling events will commence with an EPA-approved QAPP, addressing all the QA elements required in the EPA/QA-R5 document (EPA 2001a) and Laboratory standard operating procedures (SOPs) and initial demonstration of capabilities or MDL studies.

QAPPs will be developed for all sampling efforts identified in the Data Gaps Analysis Report (Section 3.3). QAPPs will be based upon the ASAOC, SOW, and EPA guidance. All QAPPs will ensure that sample collection and analytical activities are conducted in accordance with the Puget Sound Estuary Program protocols. Each QAPP will address sampling objectives; sampling procedures; a detailed description of sampling activities; sample locations; sampling equipment and procedures; sample custody; analytical procedures; data reduction, validation, and reporting; and personnel qualifications. To the extent appropriate, QAPPs for the EW also will be consistent with LDW RI/FS sample collection and analytical procedures. Where applicable, the QAPPs will provide risk-based ACGs compared to the target reporting limits provided by the laboratory to evaluate the sensitivity of the proposed analyses relative to ACGs.

Field personnel will be available for EPA QA/QC training and orientation, where applicable. The EWG will demonstrate, in advance, to EPA's satisfaction, that each laboratory it may use is qualified to conduct the proposed work. This includes use of methods and analytical protocols for the chemicals of concern in the media of interest within detection and quantification limits consistent with both QA/QC procedures and DQOs approved in the QAPP for the site by EPA. As noted above, DQOs will consider ACGs established for the LDW RI/FS and will reach agreement with EPA regarding the appropriateness of these ACGs.

Each QAPP will define in detail the sampling and data gathering methods that will be used on the project. It will include sampling objectives, a detailed description of sampling activities, sample locations, sample analysis, sampling equipment and procedures, sampling schedule, station positioning, and sample handling (e.g., sample containers and labels, sample preservation).

Each QAPP will describe the QA/QC protocols necessary to achieve required data quality objectives. The QAPP will be prepared in accordance with *EPA Requirements for Quality Assurance Project Plans* (EPA 2001a) and *Guidance on Quality Assurance Project Plans* (EPA 2002).

Selected analytical laboratories must have and follow an approved quality assurance program, which complies with ANSI/ASQC E-4 1994, *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* (ASQ 1994) and *EPA Requirements for Quality Management Plans* (EPA 2001b) or equivalent documentation as determined by EPA. EWG will provide the QA/QC procedures followed by all sampling teams and laboratories performing data collection or analysis to EPA.

Prior to awarding any work to an analytical laboratory, EWG will provide assurances that EPA will have access to laboratory personnel, equipment, and sample records. EWG will inform the laboratory that an audit may be performed by EPA or its authorized representative, and ensure that the laboratory agrees to coordinate with EPA prior to performing analyses. Upon request by EPA, EWG will allow EPA or its authorized representatives to collect split and/or duplicate samples or have the laboratory analyze samples submitted by EPA for quality assurance monitoring. EWG will notify EPA not less than 14 days in advance of any sample collection activity, unless less advance notice is agreed to by EPA. Furthermore, EPA will have the right to take any additional samples that EPA deems necessary. Upon request, EPA will allow EWG to collect split or duplicate samples of any samples EPA takes as part of its oversight activities.

All analytical data collected shall be provided electronically to EPA in a Microsoft Access compatible format.

Each QAPP will contain a Health and Safety Plan that is designed to ensure protection of the field crew during performance of field sampling efforts. This plan will be prepared in accordance with EPA's *Standard Operating Safety Guide* (EPA 1992c). In addition, the plan will comply with all currently applicable Occupational Safety and Health Administration (OSHA) regulations found at 29 CFR Part 1910.

3.5 Data Reports

Each field study and modeling effort that is conducted (if required) will result in the production of both a draft and final Data Report. Each data report will include all information regarding the field sampling event, including validated analytical results. Final Data Reports will address EPA and other reviewer comments provided on draft documents.

Data Reports shall include, at a minimum, the following information:

1. Introduction and Purpose
2. Summary of the field sampling effort (vessel and equipment used, dates of field effort, recovery information, field observations, sample and station locations)
3. Deviations from the methods and procedures outlined in the QAPP
4. Health and Safety incidents, if any, that occurred during implementation of the QAPP
5. Summary of sample handling and shipment
6. Summary of all data (physical and chemical; field and laboratory measurements, including quality control data)
7. A data validation report
8. Copies of field sampling notes

9. Well/boring/core descriptions and photographs
10. GIS maps of sampling locations
11. Complete electronic raw data output generated during the chemical analysis of samples, including the chain of custody documentation and the worksheet and supporting data for validation (provided to EPA QA officer on CD)

All data (including station locations) will be provided electronically in a Microsoft Office Access compatible format as well as in SEDQUAL format. Information necessary for EPA to perform an independent review of the validated data will also be provided.

Geospatial analysis of the sediment data will be performed using geospatial and interpolation methods consistent with the LDW project, as appropriate for this site. A memo detailing the selected interpolation methods will be submitted to EPA prior to the implementation of any interpolation methods.

3.6 Risk Assessment Tasks

3.6.1 Risk Assessment Technical Memorandum

Following the completion of the ecological and human health CSMs (Section 3.2), draft and final ERA and HHRA Technical Memoranda will be prepared. The Risk Assessment Technical Memoranda will outline the data to be used for each receptor, approach, and methods for use in baseline risk assessments for human and ecological receptors consistent with the methods and procedures outlined in the EPA's HHRA and ERA guidance documents for CERCLA. The Risk Assessment Technical Memoranda will develop the framework for the risk assessments. No field data will be required because risk evaluations will not be conducted in these documents.

To refine the list of chemicals evaluated to those of potential risk concern, the appropriateness of the COI process developed for LDW for the EW will be determined. A process to identify chemical of interest (COIs) will be developed and presented in the risk assessment technical memoranda. A process for identification of COPCs from the list of COIs in various media (e.g., fish tissue and sediment) will also be described, as well as an approach for comparisons of COPCs identified for EW to COPCs identified for the LDW. In addition, each memorandum will present the proposed approach for the risk assessment for COPCs, including the specific methods proposed for the exposure assessment, the effects evaluation, and risk characterization. The Risk Assessment Technical Memoranda will include brief descriptions of key regulatory values, toxicity, and exposure parameter values proposed for use in the baseline risk assessments to ensure agreement on the approach prior to conducting the risk assessment.

3.6.1.1 Ecological Risk Assessment Technical Memorandum

For ecological receptors, the memorandum will provide explicit identification of proposed exposure values that are to be used in the ERA. The memorandum will describe the process by which population vs. individual effects will be described and evaluated. In addition, the process to be used in selecting toxicity values will be presented. The memorandum will also identify any outstanding technical issues that have been identified as being controversial and that will require resolution prior to the completion of the risk evaluation.

3.6.1.2 Human Health Risk Assessment Technical Memorandum

For human health, the Memorandum will provide explicit identification of the specific exposure scenarios and sources for toxicity reference values to be used in the HHRA. The application of the tribal framework and its consistency with the LDW will be discussed further with EPA and the relevant tribes. A detailed discussion of the application of the tribal framework in the EW will be presented in the Human Health Risk Assessment Technical Memorandum during the SRI/FS. Some of the considerations for development of specific exposure scenarios have already been discussed in the human health CSM approach section (3.2.3). Additional issues to be addressed in the Human Health Risk Assessment Technical Memorandum include the definition of exposure units, development of representative datasets, and the handling of non-detected results for exposure-point concentration calculations. In addition, the general approach for bioaccumulation modeling will be discussed, including an assessment of the health protectiveness of modeling total PCBs with respect to TEQ risks. Other issues may be identified in consultation with EPA following the development of the human health CSM. The process for screening COIs to determine COPCs will also be described in this memorandum. This process may include comparison of concentrations of COIs in various media to EPA risk-based concentrations.

Available guidance for some of the seafood consumption scenarios will be discussed with EPA and applied as appropriate for development of seafood consumption exposure scenarios for EW. EPA has provided a framework for developing tribal fish and shellfish consumption rates for sites in Puget Sound (EPA 2006c). In addition, a consumption rate based on fish and seafood caught in King County (consumers only) reported in the survey of King County API (EPA 1999) was provided in the *Application of Data from an Asian and Pacific Islander (API) Seafood Consumption Study to Derive Fish and Shellfish Consumption Rates for Risk Assessment* (Kissinger 2005) and is appropriate for application to the EW. Sediment and water exposure scenarios appropriate for the EW will be developed in consultation with EPA and presented. Consistency between exposure scenarios developed for EW and those used for the LDW will also be considered in the development of exposure scenarios.

An approach for the toxicity assessment will be provided in this memorandum as well. This approach may include review of quantitative estimates of toxicity potential from EPA and other agencies and application of EPA's hierarchical order of toxicity values for use in HHRA (EPA 2003).

3.6.2 Baseline Ecological Risk Assessment

Draft and final ERAs will be prepared following Superfund ERA guidance (EPA/540/R-97/006) and will utilize the EW baseline dataset, which will include all approved historical data (Section 3.1) as well as the data collected for the SRI/FS (Section 3.5) using the methods and procedures outlined in the Ecological Risk Assessment Technical Memorandum. The ERA will include the following components:

1. Data evaluation (data reduction and selection of data sets appropriate for risk assessment)
2. Problem Formulation, including identification of ROCs, the CSM and identification of COPCs (including results of all screening)

3. An effects and exposure assessment for all ROCs[4] (includes all site-specific toxicity studies)
4. Risk characterization and uncertainty assessment (including discussion of all lines of evidence outlined in the Ecological Risk Assessment Technical Memorandum)

For those elements of the EW CSM that are consistent with the LDW CSM (Section 3.2.2), the approach and assumptions used in the ERA for the EW will be consistent as appropriate with that of the LDW.

3.6.3 Baseline Human Health Risk Assessment

The HHRA will evaluate human health risks to adults and children from the EW sediments and fish/shellfish tissue as appropriate. The HHRA will be conducted in accordance with the specific exposure scenario parameters and approach for selection of toxicity metrics outlined in the HHRA technical memorandum. Utilizing approved existing data (Section 3.1) and additional data collected (Section 3.5), a draft and final HHRA will be submitted to EPA for review and approval.

The draft and final HHRA will include, but not be limited to, the following components:

1. Data evaluation (data reduction and selection of data sets appropriate for risk assessment)
2. The CSM including identification of indirect and direct exposure route
3. Identification of COPCs (based on results of screening)
4. Description of exposure scenarios for evaluation
5. Development of exposure point concentrations
6. Toxicity assessment (reference doses [RfDs], Cancer Slope Factors from EPA's Integrated Risk Information System)
7. Risk characterization and uncertainty assessment

[4] Potential exposures to subsurface sediment due to dredging or erosion events will be assessed and risk implications associated with these exposures will also be addressed in a qualitative assessment.

3.7 Sediment Transport Evaluation

Due to the potential complexity of the sediment transport evaluation work, this task will be conducted as a separate stand-alone submittal to help expedite completing the data gaps analysis and start work on QAPPs. To the extent feasible, certain elements of the Sediment Transport data gaps analysis will be integrated into the overall data gaps collection effort. This section will discuss the anticipated approach to be used to evaluate sediment transport in the EW.

The objective of the sediment transport evaluation is to characterize sediment dynamics within the EW. An understanding of the dynamics of sediment transport is necessary to support the formulation of the physical processes CSM, determine the potential mechanisms that redistribute sediments, map areas that may be prone to accumulation or loss of sediment, and identify potential pathways of sediment movement away from potential sources. These types of information contribute to evaluation of FS remedial alternatives such monitored natural recovery (MNR) and mechanical interventions such as capping. One goal of the sediment transport evaluation is to be able to assess the recontamination potential for a given area within EW.

The physical factors that contribute to the supply, erosion, deposition, and movement of sediment strongly influence the distribution and transport of sediment-associated contaminants in a marine system. The basic physical factors are sediment characteristics (e.g., grain size and cohesiveness), current speeds (e.g., natural flows and propwash), mechanical disturbance (e.g., bioturbation and dredging), and mass of sediment input to the system (e.g., river-borne suspended particulate matter and bedload, CSOs, and stormwater). The remainder of this section presents an outline of the approach for conducting the sediment transport evaluation.

3.7.1 Identify Specific Objectives for the Sediment Transport Evaluation

The sediment transport evaluation will follow a systematic approach to meet the stated objectives below:

- Identify and evaluate the primary sources of sediment to EW
- Identify temporal and spatial patterns of sediment erosion and deposition (if applicable)

- Identify the physical processes driving sediment transport
- Identify likely routes or pathways for sediment movement
- Assess how sediment transport pathways may affect the feasibility of remedial alternatives, including MNR, enhanced natural recovery, dredging, and isolation capping
- Assess potential for physical processes to contribute to recontamination

3.7.2 Results of Previous Investigations

A first step in conducting the sediment transport evaluation will be to obtain, review, and summarize results and data from previous investigations of sediment dynamics at the site. We anticipate that data is available for the Duwamish estuary with some studies focusing on the EW. Data may include current speeds, changes in bathymetry over time, flume studies of erosion potential, spatial distribution of particular chemicals of interest near potential sources, changes in surface sediment chemical concentrations in the same area over time, temporal patterns of river flow and suspended particulate load, influences of estuarine-type circulation on sedimentation, and estimates of bedload transport.

Several studies have been published on the LDW, including a Sediment Transport Characterization Report (Windward 2005) that provided a detailed evaluation of deposition and erosion in the LDW. The depositional environment of the LDW was characterized using sediment core radioisotope data in the existing LDW navigation channel and bench-areas, as well other bathymetric analyses. Erosion potential in the LDW was investigated to determine areas of potential sediment bed scour during episodic high-flow events and to quantify the effects of anthropogenic forces (e.g., ship propeller scour and wake) on sediment bed erosion. The quantitative model Sedflume was used for a portion of these analyses.

Another example of a previous sediment transport study was when King County (1999) conducted Environmental Fluid Dynamics Code (EFDC) numerical modeling to investigate hydrodynamics and sediment transport in the Duwamish estuary and Elliott Bay (King County 1999). This model, which extended into outer areas of Elliott Bay, included the EW. We are not aware of any existing studies of propwash impacts to sediment stability within the EW.

A more detailed summary of LDW and EW modeling will be included in the EISR. The available data will then be evaluated to determine any data gaps for which additional studies may be necessary to characterize sediment transport and address the needs for refining the CSM and informing the FS.

3.7.3 Identify Data Gaps and Additional Studies

Data gaps analysis for sediment transport will be discussed in a separate document other than the Data Gaps Analysis Report described in Section 3.3. In the context of the sediment transport evaluation, data gaps may be considered inadequacies in the type and/or quality of information necessary to understand the physical processes within the EW and the role that sediment transport plays in redistributing contaminants within the EW. Data gaps must be identified in terms of specific questions that arise from the CSM and data needs identified for the FS. If data gaps are found to exist, additional studies may be necessary to complement the existing dataset and will be identified in the report.

3.7.4 QAPP for Additional Studies

If one or more additional studies are required, a QAPP specific to each effort will be prepared and submitted to EPA for review. Where studies are related or can efficiently be combined into one effort, one QAPP that addresses multiple studies will be prepared. Provisions for the preparation of QAPPs have been addressed in Section 3.4 and will not be repeated here.

3.7.5 Prepare Sediment Transport Evaluation Report

Sections 3.7.1 through 3.7.5 present the initial sediment transport evaluation work, including the upfront steps to identify data gaps and prepare QAPPs (if needed). This upfront work will be presented in the Sediment Transport Evaluation Approach Memorandum (STEAM) that will be submitted to EPA. All existing data will be presented in the EISR, with data gaps evaluated in the STEAM. Therefore, the STEAM will only include the sections related to the evaluation of existing information and the data gaps analysis. If the STEAM identifies that additional data collection is required, a specific QAPP will be prepared to address those data gaps, as noted in Section 3.7.5. EPA will review this QAPP, and additional collected data will be incorporated into the Sediment Transport Evaluation Report. Data collection and results will be summarized in the Sediment Transport Evaluation Report, rather than in a separate data report.

The Sediment Transport Evaluation Report will be prepared after the sediment transport evaluation is completed, and will include a summary of all evaluation steps, including summary of previous investigations, data gaps analysis, data reports, and results from all required studies and evaluation. This data evaluation report will fully document the additional studies and their results. Both draft and final reports will be submitted to EPA.

3.8 Source Control Evaluation

Source control is a critical part of EPA's Contaminated Sediments Management Strategy (EPA, 1998) and is an important part of the overall effort for the cleanup of the EW sediments. EPA's Contaminated Sediments Management Strategy recognizes that the assessment and control of contaminant sources often involves the work of multiple agencies operating under multiple regulatory programs, with different types of assessment and control activities implemented under various time-frames. The EWG recognizes the need to evaluate all potential sources of sediment recontamination and to coordinate source control activities with the SRI/FS during the course of the project. The EWG is developing a source control team that will function in parallel with the SRI/FS work.

3.8.1 Ongoing Source Evaluation and Control Activities

Source control activities have been ongoing under various regulatory programs, in some cases for decades. Examples of the types of source control activities that are ongoing and that are potentially relevant to the EW include, but are not limited to, the following:

- **Nearshore Site Cleanup:** Cleanup of contaminated upland sites located along the EW shoreline has been conducted under both federal and state cleanup programs. These cleanups include the CERCLA cleanup of the Harbor Island Soil and Groundwater OU by the Harbor Island OU Group, the cleanup of the

Terminal 30/Former Chevron site by the Port, and additional cleanup actions implemented by the Coast Guard, Port tenants, the Port, and private parties.

- **Stormwater and Combined Sewer Management Programs:** Stormwater and CSO control programs within the EW drainage basin are ongoing, including work by the City, County, and the Port. These activities include: ongoing source identification and assessment activities (e.g., over 400 business inspections completed by the City and County; and other Port, City and County source tracing within EW drainage basins); CSO control work led by the County; improvements to municipal stormwater control programs being performed by the Port, City and County consistent with the updated Ecology Phase 1 Municipal Stormwater Permits; and implementation of corrective actions at businesses identified as discharging contaminated stormwater to those drainage basins performed by private parties in coordination with the Port, City, County and Ecology.
- **Spill Control Pollution Prevention and Other Regulatory Programs:** The control of direct spills, waste discharges, wastewater discharges and fugitive emissions to the EW has been the subject of numerous local (e.g., City of Seattle Business Inspection Program), state (e.g., Washington Solid Waste, Dangerous Waste, individual National Pollutant Discharge Elimination System (NPDES) wastewater permitting and oil spill prevention programs) and federal regulatory programs (e.g., spill prevention and control programs regulated by EPA and the Coast Guard).
- **Lower Duwamish Waterway Cleanup:** The EW site is located immediately downstream from the LDW. The Port, City, and County are participating directly in the LDW investigation and cleanup process with Boeing, in coordination with EPA and Ecology. The investigation and cleanup of that site is ongoing and includes evaluations of LDW sediment inputs and transport properties potentially relevant to the EW.
- **Atmospheric Deposition Studies:** As part of the LDW source control work performed in coordination with EPA and Ecology, the County has been assessing pollutant loadings associated with atmospheric contaminant deposition, including data collection within the LDW and EW drainage basins.

- **Elliott Bay Sediment Quality and Sediment Transport Studies:** Numerous studies have been performed documenting sediment quality, water circulation patterns and sediment transport properties within Elliott Bay in the vicinity of the EW including work by municipal and private parties, EPA, Ecology and academic researchers.

3.8.2 Evaluation of Contaminant Sources

As part of the SRI/FS activities, available information will be summarized for all potential sources of sediment recontamination in the EW. This will include a discussion of completed or ongoing source control activities relevant to the EW, such as those activities listed above. This information will be summarized in the Existing Information Summary Report, as described in Section 3.1 of this Workplan.

Following EPA approval of this Workplan, a Source Control Evaluation Approach Memorandum will be developed and provided to EPA for review and approval. That memorandum will discuss how the evaluation of potential sources of sediment recontamination will be performed, and how this evaluation will be coordinated with other SRI/FS activities described in this Workplan. The Source Control Evaluation Approach, as described in the Memorandum, will ultimately result in:

1. Identifying potential sources of contamination to EW sediments
2. Understanding the potential for these sources to recontaminate the EW sediments
3. Assessing the role of ongoing sources on the CSM for the EW
4. Defining a process for identifying source control data gaps relevant to SRI/FS conclusions, identifying a process for collecting relevant field data, if necessary
5. Providing a basis for evaluating recommendations for managing sources through efforts such as inspections, investigation, or other actions and identifying the processes and authorities for source control activities to continue post-ROD in the EW area
6. If applicable, a prediction of potential recontamination and its effect on a cleanup decision

If source control evaluation data gaps relevant to the SRI/FS conclusions are identified, then these data gaps will be presented in a deliverable submitted to EPA for review and approval following the Source Control Evaluation Approach Memorandum, along with an identification of how those data gaps will be filled in parallel with the other SRI/FS activities.

3.8.3 Coordination of the SRI/FS and Source Control Activities

To help coordinate SRI/FS work with source control activities, the source control team will meet periodically and will coordinate with the SRI/FS team to perform the following types of activities:

- Ensure availability of current source control information required for completion of the current SRI/FS as described elsewhere in this Workplan, including potential collection and analysis of new source-related data, and provide other information relevant to the SRI/FS source control evaluation.
- Enhance coordination between the EW SRI/FS and LDW RI/FS efforts, including application of appropriate information and protocols derived for the LDW project to the EW to help expedite the source control evaluation, avoid duplication of effort, and provide consistency between the two proximate waterways.
- Coordinate with EPA and Ecology to enhance or accomplish specific source control efforts under their regulatory authorities (i.e., enforcement actions, if needed), and enhance communication between these agencies and the EWG members.

The roles and activities of the source control team and the methods for coordinating other source control activities and the SRI/FS process will be discussed in the Source Control Evaluation Approach Memorandum.

3.9 Supplemental Remedial Investigation Report

The SRI report will synthesize the results of sediment, surface water, groundwater, seeps and tissue data into a complete evaluation of the nature and extent of contamination in the EW OU. The SRI report will also include discussions of site physical description and site use, historical data, CSM, sediment transport, historical and ongoing sources of contamination, and the results of the baseline ERA and HHRA. The SRI report will include the following information:

- Environmental setting and previous investigations
- Nature and extent of contamination
- Sources, pathways, and source control
  - Potential sources will be described including direct discharges (NPDES outfalls, CSOs, emergency overflows, and storm drains), contaminated properties, spills, leaks, illegal dumping, landfills and land disposal, creeks and surface water run-off, groundwater and seeps, bank erosion, upriver sources, and atmospheric deposition
  - Pathways to the EW will be described
  - Source control efforts to date will be detailed including, area/site investigations and remediation activities, stormwater system inspection, industrial waste inspection programs, hazardous waste inspection programs, industrial and municipal NPDES programs
- Mobility and transport of sediment and sediment-associated chemicals. Mobility of contaminants from physical or chemical means will be discussed in support of remedial alternatives.
  - Physical conditions (sediment transport evaluation)
  - Literature application of contaminant mobility partitioning coefficients
- Summaries of the ERA, HHRA, RAOs, and chemicals of concern

4 FEASIBILITY STUDY ACTIVITIES

The purpose of the FS Report is to develop and evaluate a number of alternative methods for achieving the RAOs and Preliminary Remediation Goals (PRGs) at a contaminated site. This process lays the groundwork for proposing a selected remedy that best eliminates, reduces, or controls risks to human health and the environment. The road map through this process includes several FS steps outlined in CERCLA guidance (EPA 1988a), as well as additional considerations outlined in *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA 2005b). These general steps and considerations include:

- Establishing applicable or relevant and appropriate requirements (ARARs), RAOs, and associated PRGs
- Development of risk-based sediment concentrations and background concentrations for COPCs
- Estimating volumes and areas of sediment with COPC concentrations above remedial action levels (RALs; see Section 4.2.5) that are appropriate for the application of sediment remedial approaches
- Initial screening of remedial and disposal alternatives
- Identifying and screening general response actions, remedial technology types, and specific process options best suited to site conditions
- Assembling the technology types and process options into site-wide remedial alternatives and then completing the screening and final assembly of remedial alternatives
- Completing a detailed evaluation and comparative analysis of retained remedial alternatives, concluding with a recommended preferred remedy

4.1 Development of Preliminary RAOs and Preliminary Screening of Remedial Alternatives and Disposal Site Alternatives

The EWG will develop preliminary site management goals and RAOs early on in the SRI/FS process, and conduct a preliminary screening of remedial alternatives and disposal site alternatives, concurrent with early SRI tasks. RAOs describe what the proposed sediment cleanup is expected to accomplish (EPA 1999). They are narrative statements of the medium-specific or area-specific goals for protecting human health and the environment. RAOs are used to help focus development and evaluation of remedial alternatives. RAOs are derived from the risk assessments and are based on the exposure pathways and receptors. Narrative RAOs form the basis for establishing PRGs.

The purpose for developing preliminary RAOs and screening of remedial alternatives and disposal sites is to quickly eliminate remedial actions that are not practicable to help focus both the SRI and FS work. It is necessary to screen out alternatives that are not practicable early in the process to help meet the schedule constraints identified in the SOW and to avoid unnecessary investigations. Site conditions and existing and future site uses within the EW may limit the remedial alternatives that are feasible and will be factored into the evaluation of both disposal site and remedial alternatives in this preliminary evaluation. The submittals that will be prepared are described in the following sections.

4.1.1 RAO Memorandum

The purpose of this memo will be to identify site-specific RAOs that will impact remedial alternatives evaluation. The memorandum will describe the ARARs that will be used in determining appropriate RAOs and a site remedy. RAOs and PRGs will be consistent with the LDW, where appropriate. Compliance with ARARs is one of the CERCLA "threshold" criteria (the other being overall protection of human health and the environment) for evaluation of alternatives.

The RAO Memorandum will be developed prior to the Risk Assessment Technical Memoranda to define preliminary RAOs and inform the development of potential preliminary remedial alternatives. The preliminary remedial alternatives will be used to help identify data needed for the FS, which will be collected, to the extent possible, as part of field data collection to resolve data needs for the SRI. It is anticipated that the RAOs will be refined throughout the data collection and evaluation phases of the project, including following completion of the HHRA and ERA. RAOs will be finalized in the FS Report.

4.1.2 Disposal Site Alternatives Identification and Screening Memorandum

The purpose of the Disposal Site Alternatives Identification and Screening Memorandum is to identify the range of disposal alternatives for removed contaminated sediment and eliminate disposal site options that are not practicable to implement. The memo will describe particular disposal alternatives including confined aquatic disposal (CAD), nearshore confined disposal facilities (CDFs), local undeveloped upland disposal sites, beneficial reuse of SMS suitable dredged material, and upland commercial landfill options. The following information will be used during the screening process:

- Property ownership where CAD cells and CDFs are considered
- Existing and future site uses where CAD cells and CDFs are considered
- Transportation facilities for offloading, transfer, and shipping of dredged material to upland landfills
- Assessment of the need to treat sediment to utilize any of the disposal options
- Preliminary volume of contaminated sediment targeted for removal from the EW
- COPCs and estimated concentrations in dredged sediment
- Estimated costs for development, operations and maintenance (O&M) of CAD cells, CDFs, local upland disposal site
- Estimated costs for offloading, transportation, and disposal at upland commercial landfills

The screening will be performed using the following anticipated steps:

1. Potential sites for in-water and upland disposal within a reasonable distance from the EW will be identified. Disposal site screening criteria will be developed by the EWG and reviewed and approved by EPA.
2. Candidate sites will be identified for offloading, transfer, and shipping of sediment that would be sent to an upland landfill facility.
3. Implementability issues will be considered for each potential disposal alternative. Such issues will include, but not be limited to property ownership, constructability, long-term and short-term effectiveness, and current and future site use. Sites that are not feasible or effective will be eliminated.
4. For those disposal alternatives that appear to be effective and implementable, sizes and configurations for conceptual CAD cells and CDFs will be estimated based on the potential volume of dredge material requiring disposal. The configurations will consider appropriate locations, dimensions, and physical capacity of candidate sites for use as disposal areas. General assumptions about containment structure design such as excavation side slopes for CAD cells and closure berm dimensions for CDFs will be made using known geotechnical

conditions within the EW, as well as regional geology where detailed data are not available, and best professional judgment.

5. Order of magnitude construction and O&M costs will be developed using current construction and O&M costs for similar projects within Puget Sound that have been completed. Cost accuracy will be -50 to +100 percent in accordance to EPA screening-level cost guidance.
6. All candidate disposal alternatives that pass the EPA approved screening criteria will be carried forward as viable disposal options for the more detailed evaluation in the FS Report.

Potential candidate locations for disposal site options will be within the general bounds of the Duwamish River, East and West Waterways, and Elliott Bay (e.g., within a 5-mile radius). In-water sites beyond these limits will not be considered candidates for disposal areas. The results of the screening process will be described in detail in the Disposal Site Alternatives Identification and Screening Memorandum. Disposal site screening criteria will be reviewed and approved by EPA.

4.1.3 Remedial Alternatives Screening Memorandum

The purpose of the Remedial Alternatives Screening Memorandum is to develop the range of potential remedial alternatives and to narrow the range, consistent with EPA guidance. This process will consist of the following steps:

1. Identify and screen the candidate technologies to eliminate those that cannot be implemented due to technical or other constraints at the site.
2. Assemble the selected technologies into alternatives representing a range of removal, treatment, disposal, natural recovery, and containment technology combinations, as appropriate.
3. Evaluate and eliminate alternatives that are impracticable and cannot be implemented at the site for technical reasons.

Alternatives will include those discussed in the SOW. Conceptual estimates of areas and volumes of contaminated sediment will be used to guide screening of potential remedial alternatives. The screening will broadly consider effectiveness, implementability, and cost, with modifying factors including state and community acceptance. Each alternative carried forward will meet the threshold requirement of protection of human health and the environment, unless these levels are below background. The development and screening of alternatives will provide enough detail to differentiate between the alternatives, while the level of detail for the alternatives will be sufficient to ensure the cost estimates for each will be comparable. The most promising alternatives will be carried forward to the more detailed evaluation in the FS Report, while those that cannot be implemented will be discarded from further evaluation. The following questions will guide the screening process:

- Has the proposed technology been implemented successfully at other sites, with demonstrated long-term effectiveness?
- Can the alternative be conducted without adverse impacts to human health and the environment, both in the short-term and long-term?
- Is the alternative effective at the scale necessary to manage the volume of potentially impacted sediment in the EW?
- Does the alternative reduce toxicity, volume, or mobility of impacted sediments?
- To what extent does the alternative satisfy current and future needs for users of the EW, both during construction and after completion? As previously discussed, the EW currently supports deep draft container ship navigation for Port Terminal 18, Terminal 25, and Terminal 30, as well as numerous smaller shipping and barge activities and Tribal U&A fishing operations. These uses are anticipated to be ongoing both during and after construction of the preferred alternative project elements.
- Are there physical constraints that could limit the use of a technology? For example, complete removal through dredging may not be possible in near shore areas where slope and structural stability would be compromised by the excavation.

4.2 Feasibility Study Report

The FS Report will contain the following content as described in the following sections.

4.2.1 Introduction and Objectives of the FS Report

The first section of the FS Report will include an introduction and describe the objectives of the document. Reference will be made previous work done in the EW, as well as the

SRI document. Additional work done to support the FS Report will also be described in this section.

4.2.2 Remedial Action Objectives

This section will identify final RAOs and how they will be applied to site. Final RAOs will be described based on the RAO memorandum and any subsequent discussion with EPA.

4.2.3 Summary of Preliminary Alternatives Screening

This section will identify and provide an executive summary of the Remedial Alternatives Screening memorandum, and present the shortlisted alternatives carried forward. Further analysis of the alternatives carried forward from this memorandum will occur as part of the detailed evaluation of alternatives in the FS Report.

4.2.4 ARARs

This section will identify all applicable or relevant and appropriate requirements, including chemical-specific, action-specific, and location-specific requirements.

4.2.5 Preliminary Remediation Goals

This section will develop both point- and area-based PRGs using input from EPA on the RAO memorandum. Point-based PRGs must be met at each individual location or group of locations (e.g., chemical criteria under SMS). Area-based PRGs will be met site-wide. An example of an area-based PRG is an area-wide surface weighted average sediment concentration (SWAC) that is protective of seafood consumers. Certain PRGs may only be applicable to specific locations or areas, such as valuable habitats, or important access and other spatial exposure areas deemed important during the risk assessment process. PRGs will be developed after the ERA and HHRA are completed. PRGs will be developed based in part on RALs, which will be derived in the FS report. RALs define the concentrations that require remediation in order to achieve PRGs. The approach for deriving RALs will be conceptually discussed in the RAO Memorandum. RAOs will be narrative in nature, but PRGs will be based on the risk assessments. Site background concentrations as well as risk-based goals will be considered in developing PRGs, which will consider the approach used for the LDW.

PRGs will be used to delineate areas of concern, where existing sediment surface concentrations exceed the PRGs. PRGs and RAOs will be consistent with the LDW where appropriate. Sediment Management Areas (SMAs) will be developed considering the PRGs for each of the areas of concern and other site physical characteristics (e.g., underpier areas). SMAs will represent the boundaries of common remedial actions, and will form the basis for development of the detailed evaluation of alternatives.

4.2.6 Detailed Evaluation of Alternatives

This section in the FS Report will evaluate shortlisted alternatives. The detailed evaluation will further define the alternatives as necessary, analyze the alternatives against CERCLA and other evaluation criteria, and compare the alternatives against one another. The following EPA evaluation criteria as listed in SOW and CERCLA guidance (1988a) will be used:

1. Overall protection of human health and environment. This criterion will draw on the results of the evaluation of criteria 2 through 5 listed below as a final check to ensure that the alternative provides adequate protection of human health and the environment. The evaluation of overall protection will consider how site risks posed through each pathway are reduced, controlled, or eliminated.
2. Compliance with ARARs. This criterion will consider action and location specific ARARs and how the alternative meets the requirements of each ARAR. Where requirements are not met, the basis for justifying a CERCLA waiver will be discussed.
3. Long-term effectiveness and permanence. This criterion will consider both the magnitude of residual risk associated with an alternative, as well as the adequacy and reliability of any controls that would be put in place to manage residual risk. Long-term maintenance and the potential need for replacement of controls will be considered.
4. Reduction in toxicity, mobility, or volume. This criterion will consider the amount (mass and concentration) of contamination that is destroyed, reduced, or immobilized by the alternative. In addition, the extent to which the process

is irreversible, as well as any residuals associated with the alternative will be considered.

5. Short-term effectiveness. This criterion will consider potential short-term impacts to the public and remedial construction workers, as well as to the environment during implementation of the remedy. Controls to mitigate potential impacts will be considered, and the time frame for elimination of these impacts as well as for achieving the response objectives will be considered under short-term effectiveness.
6. Implementability. This criterion will consider the technical challenges associated with construction and the availability of technology and equipment to implement the alternative. Administrative implementability, such as coordination with resource agencies and stakeholder concerns (e.g., Tribal fishing) will also be considered.
7. Cost. Estimated costs will be summarized for each alternative. The basis for preparing these costs will be described in Section 4.2.7 Accuracy of the cost estimates will be -30 to +50 percent in accordance with EPA guidance for FS-level cost estimates (EPA 1988a).
8. State acceptance. The degree to which an alternative will be acceptable to state agencies will be considered based on feedback from state agencies.
9. Community acceptance. Includes existing and future uses in EW. The EW is located adjacent to several concurrent sediment cleanup projects that have involved substantial community review. The degree to which the community and users of the EW are expected to accept an alternative will be considered under this criterion.

4.2.7 Prepare Cost Estimates

Detailed costs will be prepared for each alternative described in Section 4.2.6 considering daily labor and equipment costs, material costs, production rates, transportation costs, and disposal fees. The detailed cost estimates will be prepared as a unit price style cost estimate, and will break down major construction elements into individual unit prices (e.g., mobilization/demobilization, dredging, capping, and disposal) to facilitate comparison between alternatives. Detailed cost tables will be included as an appendix to the FS Report, and summary tables will be included in the body of the text.

4.2.8 Comparative Analysis of Alternatives

The comparative analysis will be prepared to assist EPA in identifying the preferred alternative. The comparative analysis will describe the strengths and weaknesses of each alternative and associated uncertainties. The nine CERCLA criteria presented in Section 4.2.6 will be considered individually, and each alternative will be presented in order from the highest to the lowest ranking alternative for each criterion. The alternatives will be listed in a summary matrix and the costs developed for the alternatives will be included with the matrix. The intent of the matrix is to provide a quick summary of the comparative analysis for the reader.

4.2.9 Prepare Feasibility Study Report

The FS Report will contain detailed discussion of the major elements described above, with supporting appendices to provide more technical detail where appropriate. Potential FS Report appendices may include:

- Geotechnical evaluations (e.g., sediment capping, CDF)
- Sediment Transport (i.e., hydrodynamic and propwash evaluations)
- Monitored natural recovery analysis
- Preliminary fate and transport modeling
- Cap design analyses, including stability modeling evaluations
- CDF studies
- Structural and utility reconnaissance and conditions surveys

5 SCHEDULE

EPA has requested that the EWG develop a project schedule (Figure 5-1) to meet EPA's stated goal in the SOW to issue a ROD by end of federal FY 2009 (i.e., September 2009). The Workplan approach has been developed to try to meet this goal; however, this approach results in expedited task durations that in some cases may be difficult to achieve given the size and complexities of the EW site and project. As a result, the schedule presented in Figure 5-1 provides a more realistic series of deadlines and deliverables, ending with EPA's issuance of a ROD in May 2010. This section will discuss the sequencing of tasks and key assumptions in developing the schedule. It is important to note that due to the expedited schedule, all task durations and review and approval times have little to no slack time, thus it will be critical for all parties to meet each milestone in order to stay on schedule and complete the SRI/FS by May 2010. Where more than moderate revisions are necessary based on substantial comments to deliverables, EWG and EPA will renegotiate the schedule.

Due to the expedited schedule, the EWG will initiate critical FS-related work early in the process, concurrent with SRI tasks. This approach includes preparing the following FS deliverables concurrent with early SRI tasks:

- Memorandum that discusses RAOs
- Disposal site alternatives identification and screening memorandum
- Remedial alternatives screening memorandum

These memoranda will be prepared ahead of field data collection efforts, but are not expected to change substantially with the collection of additional data. The RAO Memorandum, Disposal Site Alternatives Identification and Screening Memorandum, and Remedial Alternatives Screening Memorandum will serve to quickly eliminate remedial actions that are not practicable to help focus the SRI and FS work.

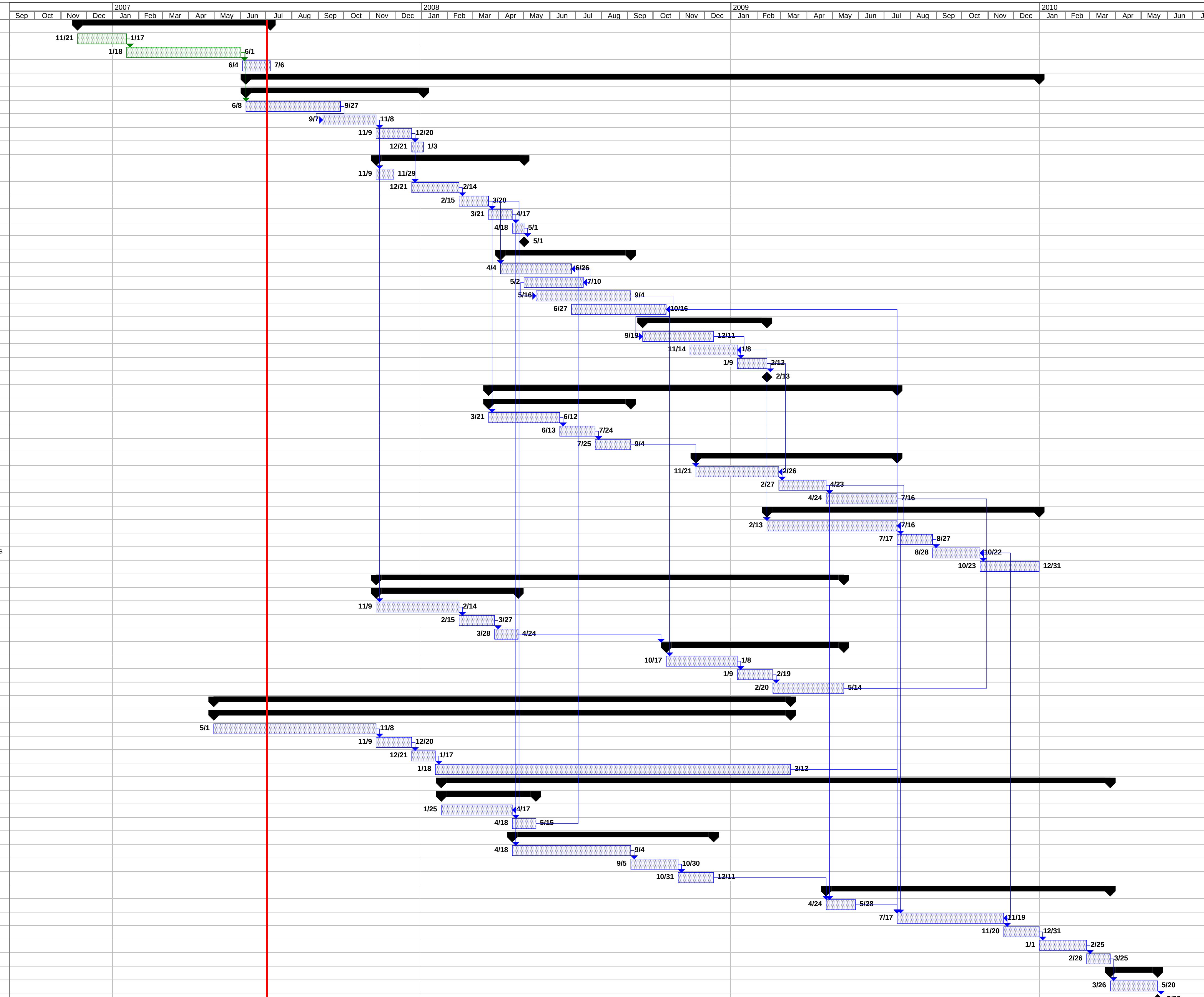
The sediment transport and source control evaluations are also called out separately in the Workplan and schedule to avoid any potential schedule delays. Key assumptions used in developing the preliminary schedule are listed below:

- The overall preliminary schedule assumes a fixed deadline of May 2010. However, the EWG notes that there are many project issues and factors that may result in the need to extend task durations and EPA review and approval time.

- The preliminary schedule has assumed expedited timeframes for EPA reviews based on discussion with EPA. The schedule assumes that comments on all deliverables are minor and easily addressed and that EPA will be responsible for distilling and summarizing any stakeholder comments. Should there be substantial comments, or the comments require significant time to resolve, the overall schedule will likely be delayed.
- In order to conduct field sampling in 2008, which is required in order to meet EPA's ROD issuance in 2010, each QAPP will individually be submitted to EPA as they are completed for review and approval. Individual field sampling events will start after approval of the appropriate QAPP; individual field sampling events may need to start prior to completing and obtaining approval for all QAPPs.
- Field sampling durations, including laboratory analyses, are preliminary estimates, and the schedule will be re-assessed after the data gaps analysis is completed in order to provide a more accurate project schedule for QAPP preparation, field sampling, laboratory analyses, and preparing data reports. The schedule may be significantly affected by the results from the data gaps analysis.
- Final Data Reports will be completed prior to the Draft Ecological and Human Health Risk Assessments, to allow for additional data to be incorporated into the Risk Assessments.
- The EWG will conduct the sediment transport and source control as discrete elements of the SRI/FS that will be conducted on their own timelines in order to avoid potential delay to the overall project schedule. Data needs identified in the overall data gaps analysis task will be developed concurrently with data needs identified in the Sediment Transport Evaluation Approach Memo. Data needs identified from each of these evaluations may fulfill some data gaps identified in the Source Control Evaluation Approach Memo. If necessary, additional activities will be completed to fulfill data gaps identified in the Source Control Evaluation Approach Memo. The project schedule will be reviewed and updated on a routine basis (e.g., monthly) and at key project milestones. Key milestones consist of each draft and final deliverable to EPA as well as EPA approvals. Any necessary changes to the project schedule will be developed by the EWG, in close coordination with EPA.

East Waterway SRI/FS Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	**SRIFS Workplan**	**164 days**	**Tue 11/21/06**	**Fri 7/6/07**	
2	Draft	42 days	Tue 11/21/06	Wed 1/17/07	
3	EPA Review	97 days	Thu 1/18/07	Fri 6/1/07	2
4	Final	25 days	Mon 6/4/07	Fri 7/6/07	3
5	**Supplemental Remedial Investigation**	**670 days?**	**Fri 6/8/07**	**Thu 12/31/09**	
6	**Existing Information Summary Report**	**150 days**	**Fri 6/8/07**	**Thu 1/3/08**	
7	Draft Report to EPA	80 days	Fri 6/8/07	Thu 9/27/07	3
8	EPA Review (Data QA/QC)	45 days	Fri 9/7/07	Thu 11/8/07	7FS-15 days
9	Submit Draft Final to EPA	30 days	Fri 11/9/07	Thu 12/20/07	8
10	EPA Approves Final Report	10 days	Fri 12/21/07	Thu 1/3/08	9
11	**CSM and Data Gaps Analysis Report**	**125 days**	**Fri 11/9/07**	**Thu 5/1/08**	
12	CSM Workgroup meeting	15 days	Fri 11/9/07	Thu 11/29/07	8
13	Draft Reports	40 days	Fri 12/21/07	Thu 2/14/08	9
14	EPA Review	25 days	Fri 2/15/08	Thu 3/20/08	13
15	Submit Draft Final	20 days	Fri 3/21/08	Thu 4/17/08	14
16	Approve Final Report	10 days	Fri 4/18/08	Thu 5/1/08	15
17	**Re-Assess Schedule**	0 days	Thu 5/1/08	Thu 5/1/08	16
18	**Quality Assurance Project Plans**	**110 days**	**Fri 4/4/08**	**Thu 9/4/08**	
19	Draft QAPPs	60 days	Fri 4/4/08	Thu 6/26/08	14FS+10 days,60FF
20	EPA Review	50 days	Fri 5/2/08	Thu 7/10/08	19FF+10 days
21	Final QAPPs	80 days	Fri 5/16/08	Thu 9/4/08	20SS+10 days
22	**Field Data Collection**	80 days	Fri 6/27/08	Thu 10/16/08	21FF+30 days
23	**Data Reports**	**105 days**	**Fri 9/19/08**	**Thu 2/12/09**	
24	Draft Reports	60 days	Fri 9/19/08	Thu 12/11/08	22FS-20 days
25	EPA Review	40 days	Fri 11/14/08	Thu 1/8/09	24FF+20 days
26	Final Reports	25 days	Fri 1/9/09	Thu 2/12/09	25
27	**Re-assess Schedule**	1 day?	Fri 2/13/09	Fri 2/13/09	26
28	**Risk Assessments**	**345 days**	**Fri 3/21/08**	**Thu 7/16/09**	
29	**Risk Assessment Technical Memos**	**120 days**	**Fri 3/21/08**	**Thu 9/4/08**	
30	Draft Memos	60 days	Fri 3/21/08	Thu 6/12/08	14
31	EPA Review	30 days	Fri 6/13/08	Thu 7/24/08	30
32	Discuss Approach and Finalize Memos	30 days	Fri 7/25/08	Thu 9/4/08	31
33	**Baseline Eco & Human Health Risk**	**170 days**	**Fri 11/21/08**	**Thu 7/16/09**	
34	Draft RAs	70 days	Fri 11/21/08	Thu 2/26/09	26FF+10 days,32
35	EPA Review	40 days	Fri 2/27/09	Thu 4/23/09	34
36	Final RAs	60 days	Fri 4/24/09	Thu 7/16/09	35
37	**Supplemental Remedial Investigation Report**	**230 days**	**Fri 2/13/09**	**Thu 12/31/09**	
38	Draft RI Report	110 days	Fri 2/13/09	Thu 7/16/09	25,35FF+60 days
39	EPA Review	30 days	Fri 7/17/09	Thu 8/27/09	38
40	Final RI Report	40 days	Fri 8/28/09	Thu 10/22/09	39,36FF+10 days,50FF+10 days
41	EPA Approves RI	50 days	Fri 10/23/09	Thu 12/31/09	40
42	**Sediment Transport Evaluation**	**395 days**	**Fri 11/9/07**	**Thu 5/14/09**	
43	**Approach Memo**	**120 days**	**Fri 11/9/07**	**Thu 4/24/08**	
44	Draft Approach Memo + Data Gaps	70 days	Fri 11/9/07	Thu 2/14/08	8
45	EPA Review of Draft Approach Memo	30 days	Fri 2/15/08	Thu 3/27/08	44
46	Final Approach Memo	20 days	Fri 3/28/08	Thu 4/24/08	45
47	**Sediment Transport Evaluation Report**	**150 days**	**Fri 10/17/08**	**Thu 5/14/09**	**46**
48	Draft Sediment Transport Evaluation Report	60 days	Fri 10/17/08	Thu 1/8/09	22
49	EPA Review	30 days	Fri 1/9/09	Thu 2/19/09	48
50	Final Report	60 days	Fri 2/20/09	Thu 5/14/09	49
51	**Source Control Evaluation**	**488 days**	**Tue 5/1/07**	**Thu 3/12/09**	
52	**Approach Memo**	**488 days**	**Tue 5/1/07**	**Thu 3/12/09**	
53	Draft Approach Memo	138 days	Tue 5/1/07	Thu 11/8/07	
54	EPA Review	30 days	Fri 11/9/07	Thu 12/20/07	53
55	Final Approach Memo	20 days	Fri 12/21/07	Thu 1/17/08	54
56	Source Control Evaluation Process	300 days	Fri 1/18/08	Thu 3/12/09	55
57	**Feasibility Study**	**565 days**	**Fri 1/25/08**	**Thu 3/25/10**	
58	**Preliminary RAO memos**	**80 days**	**Fri 1/25/08**	**Thu 5/15/08**	
59	Draft Memos	60 days	Fri 1/25/08	Thu 4/17/08	14FF+20 days
60	EPA Review	20 days	Fri 4/18/08	Thu 5/15/08	59
61	**Remedial Alts & Disposal Site Screening Memo**	**170 days**	**Fri 4/18/08**	**Thu 12/11/08**	
62	Draft Memos	100 days	Fri 4/18/08	Thu 9/4/08	15
63	EPA Review	40 days	Fri 9/5/08	Thu 10/30/08	62
64	Final Memos	30 days	Fri 10/31/08	Thu 12/11/08	63
65	**Feasibility Study Report**	**240 days**	**Fri 4/24/09**	**Thu 3/25/10**	
66	Revise Preliminary RAO's and Develop Cleanup I	25 days	Fri 4/24/09	Thu 5/28/09	64,35
67	Draft FS Report	90 days	Fri 7/17/09	Thu 11/19/09	22,66,50,56,38,40FF
68	EPA Review	30 days	Fri 11/20/09	Thu 12/31/09	67
69	Final FS Report	40 days	Fri 1/1/10	Thu 2/25/10	68
70	EPA Approves FS	20 days	Fri 2/26/10	Thu 3/25/10	69
71	**EPA Issues ROD**	**40 days**	**Fri 3/26/10**	**Thu 5/20/10**	
72	**EPA reviews all documentation and prepares ROD**	40 days	Fri 3/26/10	Thu 5/20/10	70
73	**EPA Issues ROD**	0 days	Thu 5/20/10	Thu 5/20/10	72



Project: EWW SRI FS
Date: Mon 7/2/07

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Note: The schedule will be updated regularly in coordination with EPA.

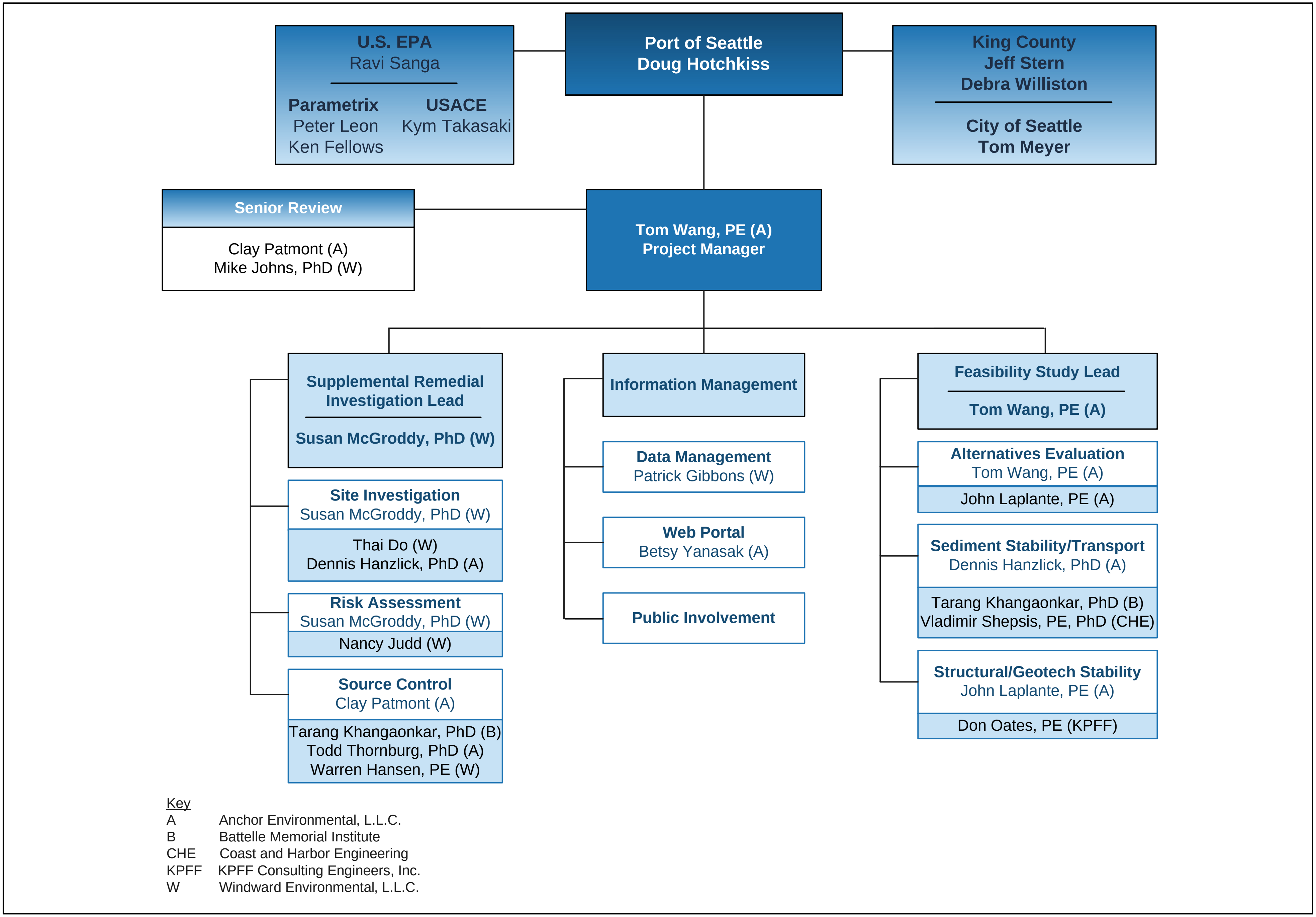
EWW SRIFS 07.02.07.mpp

6 PROJECT MANAGEMENT

This section describes the overall project organizational structure and the general responsibilities of each entity involved in the SRI/FS. The Port has primary responsibility for managing the work completed for the SRI/FS. The Port's project manager is Doug Hotchkiss. The Port has signed a MOA with the City and County that details responsibilities and allocation between the signing parties. This group is referred to as the East Waterway Group (EWG); the EWG will be actively involved in all aspects of the SRI/FS.

Anchor Environmental, L.L.C. (Anchor), is the prime consultant for the EWG and will lead the FS work. Windward Environmental, L.L.C. (Windward), will lead the SRI work. Other team members include: Battelle Memorial Institute, KPFF Consulting Engineers, and Coast and Harbor Engineering.

Tom Wang, P.E., will manage the consultant team and lead the FS activities. The project team organization chart and technical leads are identified on Figure 6-1. Table 6-1 provides key personnel contact information.



ANCHOR ENVIRONMENTAL, L.L.C.

Figure 6-1
Organization Chart
Supplemental RI/FS Work Plan
East Waterway Operable Unit

Table 6-1
Project Team – Primary Points of Contact

Organization	Name	Address	Phone	Email
East Waterway Group				
Port of Seattle	Doug Hotchkiss	PO Box 1209 Seattle, WA 98111	(206) 728-3192	hotchkiss.d@portseattle.org
City of Seattle	Tom Meyer	700 5th Avenue, Suite 3360, PO Box 34023 Seattle, WA 98124	(206) 386-9168	tom.meyer@seattle.gov
King County	Jeff Stern	201 S. Jackson Street, Suite 512 Mail Stop: KSC-NR-0512 Seattle, WA 98104	(206) 263-6447	jeff.stern@metrokc.gov
	Debra Williston	201 S. Jackson Street, Suite 600 Mail Stop: KSC-NR-0600 Seattle, WA 98104	(206) 263-6540	debra.williston@metrokc.gov
SRI/FS Consultants				
Anchor Environmental, L.L.C.	Tom Wang, P.E.	1423 3rd Avenue, Suite 300 Seattle, WA 98101	(206) 287-9130	twang@anchorenv.com
Windward Environmental, L.L.C.	Susie McGroddy, Ph.D.	200 West Mercer Street, Suite 401 Seattle, WA 98119	(206) 577-1292	susanm@windwardenv.com
Battelle Memorial Institute	Tarang Khangaonkar, Ph.D.	4500 Sand Point Way NE, Suite 100 Seattle, WA 98105	(206) 528-3053	khangaonkart@battelle.org
KPFF Consulting Engineers	Don Oates, P.E.	101 Stewart Street, Suite 800 Seattle, WA 98101	(206) 382-0600	doates@kpffspd.com
Coast and Harbor Engineering	Vladimir Shepsis, Ph.D., P.E.	110 Main Street, Suite 103 Edmonds, WA 98020	(425) 778-6733	vladimir@coastharboreng.com
Regulatory Oversight				
EPA Region 10	Ravi Sanga	ECL-111 1200 Sixth Avenue Seattle, WA 98101	(206) 553-4092	Sanga.Ravi@epamail.epa.gov
Parametrix, Inc.	Peter Leon	P.O. Box 460 Sumner, WA 98390	(253) 863-5128	pleon@parametrix.com
	Ken Fellows			kfellows@parametrix.com
U.S. Army Corps of Engineers	Kym Takasaki	P.O. Box 3755 Seattle, WA 98124	(206) 762-3322	Kymberly.C.Takasaki@nws02.usace.army.mil

6.1 File Management

Project files, including GIS files, database files, reports, and reference documents will be maintained either on Anchor's or Windward's servers throughout the duration of the project. Anchor will establish and manage a project website where all official versions of the deliverables will be posted for public access. GIS shapefiles will be shared with EPA.

6.2 Project Meetings and Community Involvement

The EWG and its consultants will meet with EPA on a monthly basis throughout the duration of the SRI/FS process to provide an update on progress and to discuss technical issues as necessary. Additional meetings will be scheduled on an as-needed basis and around key milestones during the project.

EPA is responsible for managing community involvement and distribution of information to stakeholders. EPA will manage communications with the stakeholders and the public. As requested by EPA, the EWG will provide information supporting EPA's community involvement programs related to the work performed pursuant to this Workplan, and will participate in public meetings that may be held or sponsored by EPA. Upon request by EPA, EWG will also participate in other stakeholder/trustee meetings.

6.3 Deliverables

This Workplan specifies and describes agreed-upon tasks to be accomplished for completion of the SRI/FS. Unforeseen changes to the scope and objectives of this Workplan resulting from the collection and analysis of new data, modeling results, and results of the data gap analysis will be discussed with EPA.

Deliverables are described in more detail in the text of this Workplan and are depicted on the project schedule. The following is a summary of the major deliverables for this project, with interim technical memoranda prepared as appropriate during development of the work. In addition to these documents, supporting reports may need to be prepared for technical investigations that will be necessary to complete the FS (e.g., geotechnical evaluations, structural surveys).

- SRI/FS Workplan (this document)
- Existing Information Summary Report
- Conceptual Site Model Report
- Data Gaps Analysis Report
- Quality Assurance Project Plans for field data collection
- Data Reports from field activities
- Risk Assessment Technical Memorandum for Ecological Risk
- Risk Assessment Technical Memorandum for Human Health Risk

- Baseline Ecological Risk Assessment Report
- Baseline Human Health Risk Assessment Report
- Sediment Transport Evaluation Approach Memorandum
- Sediment Transport Evaluation Report
- Source Control Evaluation Approach Memorandum and other to be determined submittals
- Supplemental Remedial Investigation Report
- Site Management Goals and Remedial Action Objectives Memorandum
- Disposal Site Alternatives Identification and Screening Memorandum
- Remedial Alternatives Screening Memorandum
- Feasibility Study Report

EPA will receive a draft and final version of each deliverable unless otherwise specified. Comments from EPA will be addressed in the final documents. All drafts will be submitted electronically in portable document format (PDF) as well as in other software formats (e.g., Microsoft Word and Excel) as appropriate. Electronic files will be loaded to the project website (http://www.eastwaterwaygroup.com or other site name to be determined). Hard copy submittals for draft versions of documents will determined on a case-by-case basis in consultation with EPA. The final version of each document will be delivered in electronic and hard copy format to EPA.

7 REFERENCES

Anchor. 2006. Sediment characterization report Port of Seattle Terminal 30. Prepared for Port of Seattle by Anchor Environmental, L.L.C. October 2006.

Anchor and Windward. 2005. East Waterway Operable Unit, Phase 1 removal action completion report. Appendix C: East Waterway Phase 1 removal post-dredge monitoring data report. Anchor Environmental, L.L.C. and Windward Environmental, L.L.C., Seattle, WA.

ASQ. 1994. ANSI/ASQC E-4 1994, Specifications and guidelines for quality systems for environmental data collection and environmental technology programs. American Society for Quality. Milwaukee, WI.

Battelle, Pentec, Striplin, Shapiro, KCDNR. 2001. Reconnaissance assessment of the state of the nearshore ecosystem: Eastern shore of central Puget Sound, including Vashon and Maury Islands (WRIAs 8 and 9). Prepared for King County Department of Natural Resources, Seattle, WA. Battelle Marine Sciences Laboratory, Pentec Environmental, Striplin Environmental Associates, Shapiro Associates, Inc., King County Department of Natural Resources, Seattle, WA.

Berger/Abam. 1997. Pier 36 preliminary sampling and dredging/disposal analysis. Prepared for U.S. Coast Guard Integrated Support Command, Seattle. Berger/Abam Engineers Inc., Federal Way, WA.

Blomberg G., Simenstad C., Hickey P. 1988. Changes in Duwamish River estuary habitat over the past 125 years. Proceedings of the First Annual Meeting on Puget Sound Research, Seattle, WA.

Curl H.C., Baker E.T., Bates T.S., Cannon G.A., Feely R.A., Geiselman T.L., Murphy P.P., Pashinski D.J., Paulson A.J. 1987. Contaminant transport from Elliott and Commencement Bays. No. 903. Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration, Seattle, WA.

DEA. 2003. Bathymetric survey East Duwamish Waterway. Prepared for Windward Environmental, L.L.C. by David Evans and Associates, Inc. January 8, 2003.

Ecology. 1995. Washington State Department of Ecology sediment quality standards, Chapter 173-204 Washington Administrative Code (WAC). December 1995.

EPA. 1988a. Guidance for conducting remedial investigations and feasibility studies under CERCLA. Interim final. EPA/540-G-89/004. U.S. Environmental Protection Agency, Washington, DC. October 1988.

EPA. 1988b. National contingency plan, pages 51425-26 and 51433. U.S. Environmental Protection Agency, Washington, DC. December 21, 1988.

EPA. 1989. Interim procedures for estimating risks associated with exposures to mixtures of chlorinated dibenzo-p-dioxins and -dibenzofurans (CDDs and CDFs) and 1989 update. EPA/625-3-89/016. U.S. Environmental Protection Agency, Washington, DC.

EPA. 1992a. Framework for ecological risk assessment. EPA/630/R-92/001. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, DC.

EPA. 1992b. Guidance for data usability in risk assessment (Parts A and B), (Publication No. 9285.7-09A, B). U.S. Environmental Protection Agency, Washington, DC.

EPA. 1992c. Standard operating safety guide. Office of Emergency and Remedial Response, Publication No. 9285.1-03, PB 92-963414. U.S. Environmental Protection Agency, Washington, DC. June 1992.

EPA. 1997a. Ecological risk assessment guidance for Superfund: Process for designing and conducting ecological risk assessments. EPA/540/R-97/006. Interim final. Environmental Response Team, U.S. Environmental Protection Agency, Edison, NJ.

EPA. 1997b. EPA Region 10 supplemental ecological risk assessment guidance for Superfund. EPA/910/R-97/005. Region 10 Office of Environmental Assessment Risk Evaluation Unit, U.S. Environmental Protection Agency, Seattle, WA.

EPA. 1998a. Guidelines for ecological risk assessment. EPA/630/R-95/002 F. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, DC.

EPA. 1998b. Guidance for in situ subaqueous capping of contaminated sediments. Assessment and Remediation of Contaminated Sediments (ARCS) Program. U.S. Environmental Protection Agency.

EPA. 1999. Asian and Pacific Islander seafood consumption study in King County, Washington. Exposure information obtained through a community-centered approach. Study results and education outreach. Office of Environmental Assessment, Risk Evaluation Unit, U.S. Environmental Protection Agency, Region 10, Seattle, WA. EPA 910/R-99-003.

EPA. 2000. Guidance for the data quality objectives process, EPA QA/G-4. Office of Environmental Information, U.S. Environmental Protection Agency, Washington, DC. EPA/600/R-96/055.

EPA. 2001a. EPA requirements for quality assurance project plans, EPA QA/R-5. Office of Environmental Information, U.S. Environmental Protection Agency, Washington, DC. EPA/240/B-01/003.

EPA. 2001b. EPA requirements for quality management plans, EPA QA/R-2. Office of Environmental Information, U.S. Environmental Protection Agency, Washington, DC. EPA/240/B-01/002.

EPA. 2002. EPA guidance for quality assurance project plans, EPA QA/G-5. Office of Environmental Information, U.S. Environmental Protection Agency, Washington, DC. EPA/240/R-02/009.

EPA. 2003. Human health toxicity values in Superfund risk assessments. OSWER Directive 9285.7-53. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, DC.

EPA. 2005a. Application of the draft framework for selecting and using tribal fish and shellfish consumption rates for risk-based decision making at CERCLA and RCRA cleanup sites in Puget Sound and the Strait of Georgia to the Lower Duwamish Waterway sediment cleanup action - June 16, 2005. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

EPA. 2005b. Contaminated sediment remediation guidance for hazardous waste sites. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. December 2005.

EPA. 2006a. Administrative settlement agreement and order on consent for the supplemental remedial investigation and feasibility study of the East Waterway Operable Unit of the Harbor Island Superfund site. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

EPA. 2006b. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4. Office of Environmental Information, Washington, DC. EPA/240/B-06/0001.

EPA. 2006c. Draft framework for selecting and using tribal fish and shellfish consumption rates for risk-based decision making at CERCLA and RCRA cleanup sites in Puget Sound and the Strait of Georgia. Revised draft. U.S. Environmental Protection Agency, Region 10, Seattle, WA. May 23, 2006.

ESG. 1999. Waterway sediment operable unit, Harbor Island Superfund site. Assessing human health risks from the consumption of seafood: Human health risk assessment report. Prepared for Port of Seattle, Todd Shipyards, and Lockheed-Martin for submittal to U.S. Environmental Protection Agency, Region 10, Seattle, WA. Environmental Solutions Group, Inc., Seattle, WA.

EVS. 1995. SMS/AET analysis of Harbor Island data. EVS Environment Consultants, Inc., Seattle, WA.

EVS. 1996a. Harbor Island sediment operable unit. Supplemental remedial investigation. Volume 1 of 2. EVS Environment Consultants, Inc., Seattle, WA.

EVS. 1996b. Harbor Island sediment operable unit. Supplementary remedial investigation. Appendices, Volume 2 of 2. EVS Environment Consultants, Inc., Seattle, WA.

EVS. 1998. Port of Seattle Terminal 18 sediment characterization. Sampling and analysis results. Final. EVS Environment Consultants, Inc., Seattle, WA.

EVS. unpublished. Elliott Bay/Duwamish River fish tissue investigation, 1995. Fish collection field log. EVS Environment Consultants, Inc., Seattle, WA.

GeoEngineers. 2001. Dredge material characterization, U.S. Coast Guard rebuild Pier 36 (Berth Alpha), Seattle, Washington. Prepared for U.S. Coast Guard and Berger/Abam Engineers, Inc. GeoEngineers, Seattle, WA.

GeoEngineers. 2003. Dredge material characterization, additional sampling, Pier 36 Slip Dredging, U.S. Coast Guard Support Center, Seattle, Washington. Prepared for U.S. Coast Guard. GeoEngineers, Inc., Seattle, WA.

GeoEngineers. 2004. Pier 36, suitability confirmation sampling results. Memorandum prepared for U.S. Coast Guard. GeoEngineers, Inc., Seattle, WA.

Grette G.B. and E.O. Salo. 1986. The status of anadromous fishes of the Green/Duwamish River system. Prepared for U.S. Army Corps of Engineers, Seattle District. Evans-Hamilton, Inc., Seattle, WA.

Harbo R.M. 2001. Shells & shellfish of the Pacific Northwest. Harbour Publishing, Madeira Park, BC.

Hart Crowser. 2005. Post-dredge sediment characterization, Integrated Support Command, Seattle Pier 36 Facility, U.S. Coast Guard, Facilities Design and Construction Center, Seattle, Washington. Hart Crowser, Inc., Seattle, WA.

King County. 1995. Water quality assessment. Water Pollution Control Division, King County Department of Natural Resources, Seattle, WA.

King County. 1996. Water quality assessment. Water Pollution Control Division, King County Department of Natural Resources, Seattle, WA.

King County. 1999. King County combined sewer overflow water quality assessment for the Duwamish River and Elliott Bay. Volume 1, Appendix B2, B3, and B4: Human health, wildlife, and aquatic life risk assessments. King County Department of Natural Resources, Seattle, WA.

Kissinger L. 2005. Application of data from an Asian and Pacific Islander (API) seafood consumption study to derive fish and shellfish consumption rates for risk assessment. Office of Environmental Assessment, U.S. Environmental Protection Agency Region 10, Seattle, WA.

McLaren P. and P. Ren. 1994. Sediment transport in Elliott Bay and the Duwamish River, Seattle: Implications to estuarine management. Prepared for Washington Department of Ecology. GeoSea Consulting (Canada) Ltd., Salt Spring Island, BC.

MOA. 2006. Memorandum of agreement between the Port of Seattle, the City of Seattle, and King County regarding the East Waterway Operable Unit of the Harbor Island Superfund site supplemental remedial investigation/feasibility study. Effective date March 27, 2006.

NOAA. 1998. Duwamish Waterway sediment characterization study report. Damage Assessment Center, National Oceanic and Atmospheric Administration, Seattle, WA.

NOAA. 2007. Station Information for NOAA ID #9447130 downloaded from http://tidesandcurrents.noaa.gov. January 5, 2007.

SAIC. 1999a. East Waterway channel deepening sediment characterization, Duwamish Waterway, Seattle, Washington. Prepared for U.S. Army Corps of Engineers, Seattle District. Science Applications International Corporation, Bothell, WA.

SAIC. 1999b. Sediment characterization of Slip 36, East Waterway, Coast Guard Station, Seattle, Washington. Prepared for U.S. Army Corps of Engineers, Seattle District. Science Applications International Corporation, Bothell, WA.

Shannon and Wilson Inc. 1992. Hazardous materials survey for Pier 35 replacement, U.S. Coast Guard Support Center, Seattle, Washington. Shannon and Wilson, Inc., Seattle, WA.

Shannon J. 2006. Personal communication (e-mails to Matt Luxon, Windward Environmental, L.L.C. regarding Duwamish-Elliott beach seine data collected by Taylor Associates in 1998, 2000, and 2002-2003. Biologist, Taylor Associates, Seattle, WA. March 30, 2006.

Smolski E.M., Lefkowitz L.F., Thom R.M., Word J.Q. 1991. Port of Seattle Pier 27 report on field sampling, sediment chemistry, and biological analyses. Prepared for Port of Seattle. Battelle Marine Sciences Laboratory, Sequim, WA.

Suquamish Tribe. 2000. Fish consumption survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound region. The Suquamish Tribe, Suquamish, WA.

Tanner C.D. 1991. Potential intertidal habitat restoration sites in the Duwamish River Estuary. EPA 910/9-91-050. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

Taylor Associates. 2004. Memorandum dated June 3, 2004 to S. McGroddy, Windward Environmental, L.L.C., from J. Shannon regarding East Waterway sediment remediation project fish monitoring. Taylor Associates, Seattle, WA.

Taylor Associates. 2005. Memorandum dated May 13, 2005 to M. McLaughlin, Port of Seattle, from J. Shannon regarding East Waterway dredge and cleanup fish monitoring project summary report 2005. Taylor Associates, Seattle, WA.

Taylor W.J., Shreffler D.K., Cordell J.R. 1999. Duwamish East Waterway channel deepening project: alternative dredge disposal sites juvenile salmonid and epibenthic prey assessment. Technical report. Preliminary draft. Prepared for Port of Seattle. Taylor Associates, Seattle, WA.

Tetra Tech. 1996. Preliminary sediment survey for Pier 36 modification, U.S. Coast Guard Support Center, Seattle, Washington. Tetra Tech, Inc., Bellevue, WA.

Tetra Tech. 1997. Surface sediment investigation, Piers 36 and 37, U.S. Coast Guard Integrated Support Center, Seattle, Washington. Tetra Tech, Inc., Bellevue, WA.

Toy K.A., Polissar N.L., Liao S., Mittelstaedt G.D. 1996. A fish consumption survey of the Tulalip and Squaxin Island tribes of Puget Sound region. Department of Environment, Tulalip Tribes, Marysville, WA.

Weston. 1993. Harbor Island remedial investigation report (part 2-sediment). Two volumes. Prepared for U.S. Environmental Protection Agency, Region 10. Roy F. Weston, Inc., Seattle, WA.

Weston. 1999. Site inspection report, Lower Duwamish River (RK 2.5-11.5), Seattle, Washington. Volume 1 - Report and appendices. Prepared for U.S. Environmental Protection Agency, Region 10. Roy F. Weston, Inc., Seattle, WA.

Windward. 2001a. East Waterway, Harbor Island Superfund site: Nature and extent of contamination. Data gaps analysis report. Prepared for Port of Seattle. Windward Environmental, L.L.C., Seattle, WA.

Windward. 2001b. Terminal 18 deepening project. Post-dredge monitoring of Port of Seattle East Waterway deepening, stage 1 dredging area. Data report. Prepared for Port of Seattle. Windward Environmental, L.L.C., Seattle, WA.

Windward. 2002a. East Waterway, Harbor Island Superfund site: Nature and extent of contamination. Surface sediment data report - phases 1 and 2. Prepared for Port of Seattle. Windward Environmental, L.L.C., Seattle, WA.

Windward. 2002b. East Waterway, Harbor Island Superfund site: Nature and extent of contamination. Subsurface sediment data report - phase 3. Prepared for Port of Seattle. Windward Environmental, L.L.C., Seattle, WA.

Windward. 2002c. East Waterway, Harbor Island Superfund site: Technical memorandum: Tissue chemistry results for juvenile chinook salmon collected from Kellogg Island and East Waterway. Prepared for Port of Seattle. Windward Environmental, L.L.C., Seattle, WA.

Windward 2003a. Port of Seattle East Waterway, Harbor Island Superfund site: Nature and extent of sediment contamination data summary report. Windward Environmental, L.L.C. June 19, 2003.

Windward 2003b. Phase 1 Remedial Investigation Report. Windward Environmental, L.L.C. Final. Prepared for Lower Duwamish Waterway Group. July 3, 2003.

Windward 2003c. Engineering Evaluation/Cost Analysis for the East Waterway Operable Unit, Harbor Island Superfund Site. Final. Submitted to US EPA Region 10. July 29, 2003.

Windward. 2005. Lower Duwamish Waterway Remedial Investigation. Data report: Sediment Transport Characterization. Final. Prepared for Lower Duwamish Waterway Group. Windward Environmental, L.L.C., Seattle, WA.

Windward. 2006a. East Waterway Phase 1 removal action. Data report: Recontamination monitoring 2006. Draft. Prepared for Port of Seattle. Windward Environmental, L.L.C., Seattle, WA.

Windward. 2006b. East Waterway, Harbor Island Superfund site. Technical memorandum: Tissue chemistry results for East Waterway fish tissue samples. Windward Environmental, L.L.C., Seattle, WA.