IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF WASHINGTON

| | | |
|---|---|---|
| UNITED STATES OF AMERICA, | ) | |
| | ) | CIVIL ACTION NO. |
| Plaintiff, | ) | 2:14-cv-0588-TSZ |
| | ) | |
| v. | ) | CONSENT DECREE |
| | ) | |
| STATE OF WASHINGTON<br>Through the WASHINGTON<br>DEPARTMENT OF NATURAL<br>RESOURCES | )<br>)<br>)<br>)<br>) | |
| | ) | |
| Defendant. | ) | |
| | ) | |

TABLE OF CONTENTS


I. BACKGROUND ..... 1
II. JURISDICTION ..... 3
III. PARTIES BOUND ..... 3
IV. DEFINITIONS ..... 4
V. GENERAL PROVISIONS ..... 10
VI. PERFORMANCE OF THE WORK BY DNR ..... 13
VII. REMEDY REVIEW ..... 17
VIII. QUALITY ASSURANCE, SAMPLING, AND DATA ANALYSIS ..... 18
IX. ACCESS AND INSTITUTIONAL CONTROLS ..... 20
X. REPORTING REQUIREMENTS ..... 23
XI. EPA APPROVAL OF PLANS, REPORTS, AND OTHER DELIVERABLES ..... 24
XII. PROJECT COORDINATORS ..... 26
XIII. EMERGENCY RESPONSE ..... 27
XIV. PAYMENTS FOR RESPONSE COSTS ..... 28
XV. INDEMNIFICATION AND INSURANCE ..... 31
XVI. FORCE MAJEURE ..... 33
XVII. DISPUTE RESOLUTION ..... 35
XVIII. STIPULATED PENALTIES ..... 39
XIX. COVENANTS BY PLAINTIFF ..... 43
XX. COVENANTS BY DNR ..... 46
XXI. EFFECT OF SETTLEMENT; CONTRIBUTION ..... 48
XXII. ACCESS TO INFORMATION ..... 50
XXIII. RETENTION OF RECORDS ..... 51
XXIV. NOTICES AND SUBMISSIONS ..... 53
XXV. RETENTION OF JURISDICTION ..... 54
XXVI. APPENDICES ..... 54
XXVII. COMMUNITY INVOLVEMENT ..... 55
XXVIII. MODIFICATION ..... 55
XXIX. LODGING AND OPPORTUNITY FOR PUBLIC COMMENT ..... 56
XXX. SIGNATORIES/SERVICE ..... 56
XXXI. FINAL JUDGMENT ..... 57

# I. BACKGROUND

A. The United States of America ("United States"), on behalf of the Administrator of the United States Environmental Protection Agency ("EPA"), filed a complaint in this matter pursuant to Sections 106 and 107 of the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. §§ 9606, 9607 against the State of Washington, through its Department of Natural Resources ("DNR").

B. The United States in its complaint seeks, *inter alia*: (1) reimbursement of costs incurred by EPA and the Department of Justice ("DOJ") for response actions at the Asarco Smelter and the Asarco Sediments/Groundwater sites (collectively referred to herein as the "Site") in Ruston and Tacoma, Washington, which are Operable Units 02 and O6, respectively, of the Commencement Bay Nearshore/Tideflats Superfund Site (the "CB N/T Site") together with accrued interest; and (2) performance of response actions by DNR at the Site.

C. On January 3, 1997, the Court entered a consent decree in this action (the "Asarco Tacoma Smelter Consent Decree") providing for the cleanup by ASARCO Incorporated ("Asarco") of the former Asarco Smelter and Slag Peninsula, or Operable Unit 02 of the CB N/T Site. The Asarco Tacoma Smelter Consent Decree was entered into by the EPA and Asarco pursuant to CERCLA, 42 U.S.C. § 9601 *et seq.*

D. On November 2, 2000, EPA and Asarco amended Section XX, Stipulated Penalties, of the Asarco Tacoma Smelter Consent Decree to add three new subparagraphs. The 2000 amendment (the "First Amendment") to the Asarco Tacoma Smelter Consent Decree added significant stipulated penalties for Asarco's failure to achieve specified milestone dates.

E. On June, 29, 2006, the Court amended the Consent Decree to add Point Ruston LLC ("Point Ruston") to the Asarco Tacoma Smelter Consent Decree in an agreement among

ASARCO LLC, the United States and Point Ruston. In addition to adding Point Ruston, the 2006 amendment (the "Second Amendment") required Point Ruston to perform additional work included in Operable Unit 06, the Asarco Sediments/Groundwater Site, of the CB N/T Site. Operable Unit 06 encompasses the groundwater under the Asarco Smelter, approximately 150 acres of offshore intertidal and subtidal lands, and the Yacht Basin formed by the Slag Peninsula, all located in Ruston and Tacoma, Pierce County, Washington.

F. Point Ruston has entered into a settlement agreement with DNR for obligations relating to the performance of the Remedial Action in Operable Unit 06 and Operable Unit 02. The Remedial Action includes work on aquatic lands owned by the State of Washington, and managed by DNR.

G. The Washington Legislature appropriated funding to DNR to complete sediment capping and shoreline stabilization on the aquatic lands at the Site subject to certain conditions. Accordingly, DNR and Point Ruston have requested that the United States enter into this Consent Decree so that DNR will be able to address its liability to the United States as set forth by the terms of this Consent Decree.

H. The Asarco Smelter Consent Decree as modified by the Second Amendment remains in effect and is binding on the United States and Point Ruston, and nothing in this Decree alters in any way the rights, duties, or obligations of the United States and Point Ruston as set forth in the Asarco Tacoma Smelter Consent Decree and as modified by the Second Amendment.

I. The decision by EPA on the remedial action to be implemented at the Site is embodied in the Asarco/Sediments/Groundwater Operable Unit 06 final Record of Decision ("Sediments ROD"), executed on July 14, 2000, on which the State has given its concurrence;

and the Asarco Tacoma Smelter Operable Unit 02 final Record of Decision ("Asarco Smelter ROD"), executed on March 24, 1995, on which the State has given its concurrence. Both RODs include a responsiveness summary to the public comments. Notice of the final plans were published in accordance with Section 117(b) of CERCLA, 42 U.S.C. § 9617(b).

J. The Parties recognize, and the Court by entering this Consent Decree finds, that this Consent Decree has been negotiated by the Parties in good faith and implementation of this Consent Decree will expedite the cleanup of the Site and will avoid prolonged and complicated litigation between the Parties, and that this Consent Decree is fair, reasonable, and in the public interest.

NOW, THEREFORE, it is hereby Ordered, Adjudged, and Decreed:

## II. JURISDICTION

1. This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. §§ 1331 , 1367, and 1345, and 42 U.S.C. §§ 9606, 9607, and 9613(b). This Court also has personal jurisdiction over DNR. Solely for the purposes of this Consent Decree and the underlying complaint, DNR waives all objections and defenses that it may have to jurisdiction of the Court or to venue in this District. DNR shall not challenge the terms of this Consent Decree or this Court's jurisdiction to enter and enforce this Consent Decree.

## III. PARTIES BOUND

2. This Consent Decree applies to and is binding upon the United States and upon DNR and its successors, and assigns. Any change in ownership or status of DNR including, but not limited to, any transfer of assets or real or personal property, shall in no way alter DNR's responsibilities under this Consent Decree.

3. DNR shall provide a copy of this Consent Decree to each contractor hired to perform the Work required by this Consent Decree and to each person representing DNR with respect to the Site or the Work, and shall condition all contracts entered into hereunder upon performance of the Work in conformity with the terms of this Consent Decree. DNR or its contractors shall provide written notice of the Consent Decree to all subcontractors hired to perform any portion of the Work required by this Consent Decree. DNR shall nonetheless be responsible for ensuring that its contractors and subcontractors perform the Work in accordance with the terms of this Consent Decree. With regard to the activities undertaken pursuant to this Consent Decree, each contractor and subcontractor shall be deemed to be in a contractual relationship with DNR within the meaning of Section 107(b)(3) of CERCLA, 42 U.S.C. § 9607(b)(3).

## IV. DEFINITIONS

4. Unless otherwise expressly provided in this Consent Decree, terms used in this Consent Decree that are defined in CERCLA or in regulations promulgated under CERCLA shall have the meaning assigned to them in CERCLA or in such regulations. Whenever terms listed below are used in this Consent Decree or its appendices, the following definitions shall apply solely for purposes of this Consent Decree:

"Asarco Smelter ROD" shall mean the final Record of Decision for the Asarco Tacoma Smelter Operable Unit 02 of the CB N/T Site, executed on March 24, 1995. The Asarco Smelter ROD is attached as Appendix A.

"CERCLA" shall mean the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601-9675.

"Consent Decree" shall mean this Consent Decree and all appendices attached hereto (listed in Section XXVI). In the event of conflict between this Consent Decree and any appendix, this Consent Decree shall control.

"Day" or "day" shall mean a calendar day unless expressly stated to be a working day. The term "working day" shall mean a day other than a Saturday, Sunday, or federal or state holiday. In computing any period of time under this Consent Decree, where the last day would fall on a Saturday, Sunday, or federal or state holiday, the period shall run until the close of business of the next working day.

"DNR" shall mean the State of Washington as owner of state-owned aquatic lands as defined by RCW 79.90.010 as well as the Commissioner of Public Lands and the Washington Department of Natural Resources (including its predecessors and any successor departments or agencies) as lessor, manager, and/or otherwise exercising the State of Washington's proprietary interest in such public lands for the benefit of the public.

"DOJ" shall mean the United States Department of Justice and its successor departments, agencies, or instrumentalities.

"Effective Date" shall mean the date upon which this Consent Decree is entered by the Court as recorded on the Court docket, or, if the Court instead issues an order approving the Consent Decree, the date such order is recorded on the Court docket.

"EPA" shall mean the United States Environmental Protection Agency and its successor departments, agencies, or instrumentalities.

"EPA Hazardous Substance Superfund" shall mean the Hazardous Substance Superfund established by the Internal Revenue Code, 26 U.S.C. § 9507.

"Future Response Costs" shall mean all costs, including, but not limited to, direct and indirect costs, that the United States incurs for Sediment Cap Response Costs after May 1, 2013, or, in reviewing or developing plans, reports, and other deliverables submitted pursuant to this Consent Decree, in overseeing implementation of the Work, or otherwise implementing, overseeing, or enforcing this Consent Decree, including, but not limited to, payroll costs, contractor costs, travel costs, laboratory costs, the costs incurred pursuant to Paragraph 10 (Notice to Successors-in-Title and Transfers of Real Property), Sections VII (Remedy Review), IX (Access and Institutional Controls) (including, but not limited to, the cost of attorney time and any monies paid to secure access and/or to secure, implement, monitor, maintain, or enforce Institutional Controls including, but not limited to, the amount of just compensation), XIII (Emergency Response), and, Paragraph 76 (Work Takeover).

"Institutional Controls" or "ICs" shall mean Proprietary Controls and state or local laws, regulations, ordinances, zoning restrictions, or other governmental controls or notices that: (a) limit land, water, and/or resource use to minimize the potential for human exposure to Waste Material at or in connection with the Site; (b) limit land, water, and/or resource use to implement, ensure non-interference with, or ensure the protectiveness of the Remedial Action; and/or (c) provide information intended to modify or guide human behavior at or in connection with the Site.

"Institutional Control Implementation and Assurance Plan" or "ICIAP" shall mean the plan for implementing, maintaining, monitoring, and reporting on the Institutional Controls set forth in the RODs, prepared in accordance with the Statement of Work ("SOW").

"Interest" shall mean interest at the rate specified for interest on investments of the EPA Hazardous Substance Superfund established by 26 U.S.C. § 9507, compounded annually on

October 1 of each year, in accordance with 42 U.S.C. § 9607(a). The applicable rate of interest shall be the rate in effect at the time the interest accrues. The rate of interest is subject to change on October 1 of each year.

"National Contingency Plan" or "NCP" shall mean the National Oil and Hazardous Substances Pollution Contingency Plan promulgated pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, codified at 40 C.F.R. Part 300, and any amendments thereto.

"Operation and Maintenance" or "O&M" shall mean all activities required to maintain the effectiveness of any sediment cap placed on State-owned aquatic lands or adjacent shoreline armoring, as required under the Operation and Maintenance Plan approved or developed by EPA pursuant to Section VI (Performance of the Work by DNR) and the SOW, and maintenance, monitoring, and enforcement of Institutional Controls as provided in the ICIAP. O&M also includes sediment monitoring and response actions necessary to insure Owned and Un-capped Property continues to meet Performance Standards. O&M shall include, but is not limited to, all matters identified in Appendix C.

"Owned and Un-Capped Property" shall mean all State-owned aquatic lands that were not covered by the capping work performed by Point Ruston pursuant to the Second Amendment.

"Paragraph" shall mean a portion of this Consent Decree identified by an Arabic numeral or an upper or lower case letter.

"Parties" shall mean the United States and DNR.

"Past Response Costs" shall mean all costs, including, but not limited to, direct and indirect costs, that the United States paid at or in connection with the Site through May 1, 2013, plus Interest on all such costs that has accrued pursuant to 42 U.S.C. § 9607(a) through such date.

"Performance Standards" shall mean the cleanup standards and other measures of achievement of the goals of the Remedial Action, set forth in the RODs and the Statement of Work ("SOW") and any modified standards established pursuant to this Consent Decree.

"Plaintiff" shall mean the United States.

"Sediment Cap Response Costs" shall mean all response costs incurred by the United States: a) performing any oversight of the design and implementation of all work associated with Operable Unit 2 and Operable Unit 6 related to State-owned aquatic lands and adjacent shoreline armoring, and, b) all costs of the United States involved in the negotiations and entry of this Consent Decree.

"Proprietary Controls" shall mean easements or covenants running with the land that (a) limit land, water, or resource use and/or provide access rights and (b) are created pursuant to common law or statutory law by an instrument that is recorded by DNR in the appropriate land records office.

"RCRA" shall mean the Solid Waste Disposal Act, 42 U.S.C. §§ 6901-6992 (also known as the Resource Conservation and Recovery Act).

"Records of Decision" or "RODs" shall mean the Asarco Smelter ROD and the Sediments ROD.

"Remedial Action" shall mean all activities DNR is required to perform under this Consent Decree to implement the RODs associated with the State-owned aquatic lands, in accordance with the SOW and plans submitted under the SOW, any final approved remedial design submission, any approved Remedial Action Work Plan, and other plans approved by EPA, including implementation of Institutional Controls, until the Performance Standards are

met, and excluding performance of the Remedial Design, O&M, and the activities required under Section XXIII (Retention of Records).

"Section" shall mean a portion of this Consent Decree identified by a Roman numeral.

"Second Amendment" shall mean the Second Amended Consent Decree in United States of America v. Asarco Incorporated and Point Ruston, LLC, Civil Action C91-5528 B (D.WA).

"Sediments ROD" shall mean the Asarco/Sediments/Groundwater Operable Unit 06 final Record of Decision, executed on July 14, 2000. The Sediments ROD is attached as Appendix B.

"Site" shall mean the Asarco Smelter and the Asarco Sediments/Groundwater Operable Units of the Commencement Bay Nearshore/Tideflats Superfund Site (collectively referred to herein as the "Site") in Ruston and Tacoma, Pierce County, Washington, and depicted generally on the map attached as Appendix D.

"Statement of Work" or "SOW" shall mean the statement of work for implementation of any response actions required under this Decree, O&M at the Site, and any actions required under the O&M Plan and any plans prepared under the SOW as set forth in Appendix C to this Consent Decree, and any modifications made in accordance with this Consent Decree.

"State-owned aquatic lands" shall mean all state-owned tidelands, shorelands, harbor areas, and the beds of navigable waters managed by DNR pursuant to Chapter 79 Revised Code of Washington.

"Supervising Contractor" shall mean the principal contractor retained by DNR to supervise and direct the implementation of the Work under this Consent Decree.

"Transfer" shall mean to sell, assign, convey, lease, mortgage, or grant a security interest in, or where used as a noun, a sale, assignment, conveyance, or other disposition of any interest by operation of law or otherwise.

"United States" shall mean the United States of America and each department, agency, and instrumentality of the United States, including EPA.

"Waste Material" shall mean (1) any "hazardous substance" under Section 101(14) of CERCLA, 42 U.S.C. § 9601(14); (2) any pollutant or contaminant under Section 101(33) of CERCLA, 42 U.S.C. § 9601(33); (3) any "solid waste" under Section 1004(27) of RCRA, 42 U.S.C.§ 6903(27); and (4) any "Dangerous Waste" under Washington Administrative Code, Chapter 173-303.

"Work" shall mean all activities and obligations DNR is required to perform under this Consent Decree, except the activities required under Section XXIII (Retention of Records).

## V. GENERAL PROVISIONS

5. Objectives of the Parties. The objectives of the Parties in entering into this Consent Decree are to protect public health or welfare or the environment by the DNR's performance of the obligations identified herein, the payment of certain response costs of the Plaintiff, and to resolve the claims of Plaintiff against DNR as provided in this Consent Decree.

6. Commitments by DNR. DNR shall finance and perform the Work in accordance with this Consent Decree, the RODs, the SOW, and all work plans and other plans, standards, specifications, and schedules set forth in this Consent Decree or developed by DNR and approved by EPA pursuant to this Consent Decree. DNR shall pay the United States for Past and Future Response Costs as provided in this Consent Decree.

7. Compliance With Applicable Law. All activities undertaken by DNR pursuant to this Consent Decree shall be performed in accordance with the requirements of all applicable federal and state laws and regulations. DNR must also comply with all applicable or relevant and appropriate requirements of all federal and state environmental laws as set forth in the RODs and

the SOW. The activities conducted pursuant to this Consent Decree, if approved by EPA, shall be deemed to be consistent with the NCP.

8. Permits.

a. As provided in Section 121(e) of CERCLA, 42 U.S.C. § 9621(e), and Section 300.400(e) of the NCP, no permit shall be required for any portion of the Work conducted entirely on-site (i.e., within the areal extent of contamination or in very close proximity to the contamination and necessary for implementation of the Work). Where any portion of the Work that is not on-site requires a federal or state permit or approval, DNR shall submit timely and complete applications and take all other actions necessary to obtain all such permits or approvals.

b. DNR may seek relief under the provisions of Section XVI (Force Majeure) for any delay in the performance of the Work resulting from a failure to obtain, or a delay in obtaining, any permit or approval referenced in Paragraph 8.a and required for the Work, provided that they have submitted timely and complete applications and taken all other actions necessary to obtain all such permits or approvals.

c. This Consent Decree is not, and shall not be construed to be, a permit issued pursuant to any federal or state statute or regulation.

9. Notice of Obligations to Lessees.

a. Within thirty (30) days after the Effective Date of this Consent Decree, DNR shall record a certified copy of this Consent Decree and a notice of obligation to provide access under Section IX (Access From and Institutional Controls by DNR) with the Recorder's Office, Pierce County, State of Washington and DNR's Land Records Office.

b. DNR represents that the obligations it agrees to under this Consent

Decree are consistent with all legal authorities relating to DNR's management of State-owned aquatic lands.

c. For each lease, easement, or other instrument authorizing the use of State-owned aquatic lands within the Site that is negotiated or executed after the Effective Date of this Consent Decree, DNR shall:

(1) Include a notice stating that the property is subject to this Consent Decree and shall reference the recorded location of the Consent Decree.

(2) Include provisions that require lessees to provide access and provide cooperation to EPA for the purposes stated in Paragraph 12 below and to comply with any institutional controls that may be developed pursuant to this Consent Decree (see Section XI below).

d. DNR shall ensure that any and all persons who are authorized by DNR to use aquatic lands within the Site comply with the obligations of DNR with respect to the provision of access and the implementation of institutional controls under Section IX (Access and Institutional Controls by DNR).

10. Notice to Successors-in-Title and Transfers of Real Property.

a. DNR shall, at least 60 days prior to any Transfer of any real property located at the Site, give written notice: (1) to the transferee regarding the Consent Decree and any Institutional Controls regarding the real property; and (2) to EPA regarding the proposed Transfer, including the name and address of the transferee and the date on which the transferee was notified of the Consent Decree and any Institutional Controls.

b. DNR may Transfer any real property located at the Site only if: (1) any Proprietary Controls required by Paragraph 25.c have been recorded with respect to the real

property; or (2) DNR has obtained an agreement from the transferee, enforceable by DNR and the United States, to (i) allow access and restrict land/water use, pursuant to Paragraphs 25.a and 25.b, (ii) record any Proprietary Controls on the real property, pursuant to Paragraph 25.c, and (iii) subordinate its rights to any such Proprietary Controls, and EPA has approved the agreement in writing. If, after a Transfer of the real property, the transferee fails to comply with the agreement provided for in this Paragraph 10.b, DNR shall take all reasonable steps to obtain the transferee's compliance with such agreement. The United States may seek the transferee's compliance with the agreement and/or assist DNR in obtaining compliance with the agreement. DNR shall reimburse the United States under Section XIV (Payments for Response Costs), for all costs incurred, direct or indirect, by the United States regarding obtaining compliance with such agreement, including, but not limited to, the cost of attorney time.

c. In the event of any Transfer of real property located at the Site, unless the United States otherwise consents in writing, DNR shall continue to comply with its obligations under the Consent Decree, including, but not limited to, its obligation to provide and/or secure access, to implement, maintain, monitor, and report on Institutional Controls, and to abide by such Institutional Controls.

## VI. PERFORMANCE OF THE WORK BY DNR

11. In addition to the payments required under Section XIV, DNR shall undertake the following commitments with respect to the Site:

a. DNR shall perform all work under the SOW including O&M;

b. DNR shall undertake any Response Action necessary should future sampling reflect that the sediments in the Owned and Uncapped Property fail to meet applicable Performance Standards.

c. DNR shall perform all other Work and obligations associated with the Site set forth within this Decree.

12. Selection of Supervising Contractor.

a. All aspects of the Work to be performed by, or on behalf of, DNR pursuant to Sections VI (Performance of the Work), VII (Remedy Review), VIII (Quality Assurance, Sampling, and Data Analysis), IX (Access and Institutional Controls), and XIII (Emergency Response) shall be under the direction and supervision of the Supervising Contractor, the selection of which shall be subject to disapproval by EPA. Within sixty days after the lodging of this Consent Decree, DNR shall notify EPA in writing of the name, title, and qualifications of any contractor proposed to be the Supervising Contractor. With respect to any contractor proposed to be Supervising Contractor, DNR shall demonstrate that the proposed contractor has a quality assurance system that complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995), by submitting a copy of the proposed contractor's Quality Management Plan ("QMP"). The QMP should be prepared in accordance with "EPA Requirements for Quality Management Plans (QA/R-2)" (EPA/240/B-01/002, March 2001, reissued May 2006) or equivalent documentation as determined by EPA. EPA will issue a notice of disapproval or an authorization to proceed regarding hiring of the proposed contractor. If at any time thereafter, DNR proposes to change a Supervising Contractor, DNR shall give notice of such to EPA and must obtain an

authorization to proceed from EPA before the new Supervising Contractor performs, directs, or supervises any Work under this Consent Decree. DNR shall demonstrate that the proposed replacement contractor has a quality assurance system that complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995), by submitting a copy of the proposed contractor's Quality Management Plan ("QMP"). The QMP should be prepared in accordance with "EPA Requirements for Quality Management Plans (QA/R-2)" (EPA/240/B-01/002, March 2001, reissued May 2006) or equivalent documentation as determined by EPA).

b. If EPA disapproves a proposed Supervising Contractor, EPA will notify DNR in writing. DNR shall submit to EPA a list of contractors, including the qualifications of each contractor that would be acceptable to them within 30 days after receipt of EPA's disapproval of the contractor previously proposed. EPA will provide written notice of the names of any contractor(s) that it disapproves and an authorization to proceed with respect to any of the other contractors. DNR may select any contractor from that list that is not disapproved and shall notify EPA of the name of the contractor selected within 21 days after EPA's authorization to proceed.

c. If EPA fails to provide written notice of its authorization to proceed or disapproval as provided in this Paragraph and this failure prevents DNR from meeting one or more deadlines in a plan approved by EPA pursuant to this Consent Decree, DNR may seek relief under Section XVI (Force Majeure).

13. DNR shall implement the planning requirements of the SOW and implement O&M for so long thereafter as is required by this Consent Decree.

14. Modification of SOW or Related Work Plans.

a. If EPA determines that it is necessary to modify the work specified in the SOW and/or in work plans developed pursuant to the SOW to achieve and maintain the Performance Standards or to carry out and maintain the effectiveness of the remedy set forth in the RODs, and such modification is consistent with the scope of the remedy set forth in the RODs, then EPA may issue such modification in writing and shall notify DNR of such modification. For the purposes of this Paragraph only, the "scope of the remedy set forth in the RODs" is all work associated with Operable Unit 2 and Operable Unit 6 related to State-owned aquatic lands and adjacent shoreline armoring. If DNR objects to the modification they may, within 30 days after EPA's notification, seek dispute resolution under Paragraph 58 (Record Review).

b. The SOW and/or related work plans shall be modified: (1) in accordance with the modification issued by EPA; or (2) if DNR invokes dispute resolution, in accordance with the final resolution of the dispute. The modification shall be incorporated into and enforceable under this Consent Decree, and DNR shall implement all work required by such modification. DNR shall incorporate the modification into a remedial design or Remedial Action Work Plan, as appropriate.

c. Nothing in this Paragraph shall be construed to limit EPA's authority to require performance of further response actions as otherwise provided in this Consent Decree.

15. Nothing in this Consent Decree, the SOW, or any Work Plan constitutes a warranty or representation of any kind by Plaintiff that compliance with the work requirements set forth in the SOW and the Work Plans will achieve the Performance Standards.

## VII. REMEDY REVIEW

16. Periodic Review. DNR shall conduct any studies and investigations that EPA requests in order to permit EPA to conduct reviews of whether the Remedial Action is protective of human health and the environment at least every five years as required by Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and any applicable regulations.

17. EPA Selection of Further Response Actions. If EPA determines, at any time, that the Remedial Action is not protective of human health and the environment, EPA may select further response actions for the Site in accordance with the requirements of CERCLA and the NCP.

18. Opportunity To Comment. DNR and, if required by Sections 113(k)(2) or 117 of CERCLA, 42 U.S.C. § 9613(k)(2) or 9617, the public, will be provided with an opportunity to comment on any further response actions proposed by EPA as a result of the review conducted pursuant to Section 121(c) of CERCLA and to submit written comments for the record during the comment period.

19. DNR's Obligation To Perform Further Response Actions. If EPA selects further response actions relating to the Site, EPA may require DNR to perform such further response actions, but only to the extent that the reopener conditions in Paragraph 74 (United States' Post-Lodging Reservations) are satisfied. DNR may invoke the procedures set forth in Section XVII (Dispute Resolution) to dispute (a) EPA's determination that the reopener conditions of Paragraph 74 are satisfied, (b) EPA's determination that the Remedial Action is not protective of human health and the environment, or (c) EPA's selection of the further response actions. Disputes pertaining to whether the Remedial Action is protective or to EPA's selection of further response actions shall be resolved pursuant to Paragraph 58 (Record Review).

## VIII. QUALITY ASSURANCE, SAMPLING, AND DATA ANALYSIS

20. Quality Assurance.

a. DNR shall ensure that Work performed by it or on its behalf uses quality assurance, quality control, and chain of custody procedures for all design, compliance, and monitoring samples in accordance with "EPA Requirements for Quality Assurance Project Plans (QA/R5)" (EPA/240/B-01/003, March 2001, reissued May 2006), "Guidance for Quality Assurance Project Plans (QA/G-5)" (EPA/240/R-02/009, December 2002), and subsequent amendments to such guidelines upon notification by EPA to DNR of such amendment. Amended guidelines shall apply only to procedures conducted after such notification.

b. Prior to the commencement of any monitoring project under this Consent Decree, DNR shall submit to EPA for approval, a Quality Assurance Project Plan ("QAPP") that is consistent with the SOW and the applicable guidance documents referenced therein and the NCP. If relevant to the proceeding, the Parties agree that validated sampling data generated in accordance with the QAPP(s) and reviewed and approved by EPA shall be admissible as evidence, without objection, in any proceeding under this Consent Decree. DNR shall ensure that EPA personnel and its authorized representatives are allowed access at reasonable times to all laboratories utilized by or on behalf of DNR in implementing this Consent Decree. In addition, DNR shall ensure that such laboratories shall analyze all samples submitted by EPA pursuant to the QAPP for quality assurance monitoring. DNR shall ensure that the laboratories they utilize for the analysis of samples taken pursuant to this Consent Decree perform all analyses according to accepted EPA methods. Accepted EPA methods consist of those methods that are documented in the "USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis, ILM05.4," and the "USEPA Contract Laboratory Program Statement of

Work for Organic Analysis, SOM01.2," and any amendments made thereto during the course of the implementation of this Consent Decree; however, upon approval by EPA, DNR may use other analytical methods that are as stringent as or more stringent than the CLP-approved methods. DNR shall ensure that all laboratories used for analysis of samples taken pursuant to this Consent Decree participate in an EPA or EPA-equivalent quality assurance/quality control ("QA/QC") program. DNR shall ensure that only laboratories that have a documented Quality System that complies with ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995), and "EPA Requirements for Quality Management Plans (QA/R-2)" (EPA/240/B-01/002, March 2001, reissued May 2006) or equivalent documentation as determined by EPA. EPA may consider laboratories accredited under the National Environmental Laboratory Accreditation Program ("NELAP") as meeting the Quality System requirements. DNR shall ensure that all field methodologies utilized in collecting samples for subsequent analysis pursuant to this Consent Decree are conducted in accordance with the procedures set forth in the QAPP approved by EPA.

21. Upon request, DNR shall allow split or duplicate samples to be taken by EPA or its authorized representatives. DNR shall notify EPA not less than 28 days in advance of any sample collection activity unless shorter notice is agreed to by EPA. In addition, EPA shall have the right to take any additional samples that EPA deems necessary. Upon request, EPA shall allow DNR to take split or duplicate samples of any samples it takes as part of Plaintiff's oversight of DNR's implementation of the Work.

22. DNR shall submit to EPA 4 copies of the results of all sampling and/or tests or other data obtained or generated by or on behalf of DNR with respect to the Site and/or the implementation of this Consent Decree unless EPA agrees otherwise.

23. Notwithstanding any provision of this Consent Decree, the United States retains all of its information gathering and inspection authorities and rights, including enforcement actions related thereto, under CERCLA, RCRA, and any other applicable statutes or regulations.

## IX. ACCESS AND INSTITUTIONAL CONTROLS

24. DNR shall, within 120 days after the Effective Date, submit a proposed ICIAP. The ICIAP shall be a plan to implement the Institutional Controls set forth in the RODs that DNR has the legal authority to implement on state-owned aquatic lands. The ICIAP shall include, but shall not be limited to: (a) a description of the pathways for potential human exposure to Waste Material that may remain during and/or after completion of construction of the Remedial Action; (b) a description of the areas where human activities should be restricted, including legal descriptions for such areas, sample maps, and a plan for preparing final survey maps (e.g., survey of hazardous waste cap); (c) a list of properties where Proprietary Controls are needed; (d) a description of the proposed Institutional Controls and their purpose; (e) a description of the proposed duration of each Institutional Control and an explanation for such duration; (f) a schedule for implementing each Institutional Control; (g) a schedule for completing title work; (h) draft Proprietary Controls enforceable under state law to implement the proposed land/water use restrictions; (i) a description of the authority of each affected property owner to implement each Proprietary Control, including title insurance commitments or other title evidence acceptable to EPA for proposed Proprietary Controls; (j) a description of all prior liens and encumbrances existing on any real property that may affect the Proprietary Controls or the

protectiveness of the remedy, and a plan for the release or subordination of any such liens and encumbrances (unless EPA waives the release or subordination of such liens or encumbrances); (k) a plan for monitoring, maintaining, reporting on, and ensuring the continued efficacy of the Institutional Controls and a contingency plan in the event ICs are ineffective; and (l) a schedule for annual certifications regarding whether the Institutional Controls remain in place, regarding whether the Institutional Controls have been complied with, and regarding enforcement of the Institutional Controls. The ICIAP shall be effective upon EPA's approval, and shall become an enforceable requirement of the Consent Decree.

25. If the Site, or any other real property where access or land/water use restrictions are needed, is owned or controlled by DNR:

a. DNR shall, commencing on the date of lodging of the Consent Decree, provide the United States and its representatives, contractors, and subcontractors, with access at all reasonable times to the Site, or such other real property, to conduct any activity regarding the Consent Decree including, but not limited to, the following activities:

(1) Monitoring the Work;

(2) Verifying any data or information submitted to the United States;

(3) Conducting investigations regarding contamination at or near the Site;

(4) Obtaining samples;

(5) Assessing the need for, planning, or implementing additional response actions at or near the Site;

(6) Assessing implementation of quality assurance and quality control practices as defined in the approved CQAP;

(7) Implementing the Work pursuant to the conditions set forth in Paragraph 76 (Work Takeover);

(8) Inspecting and copying records, operating logs, contracts, or other documents maintained or generated by DNR, Point Ruston or their agents, consistent with Section XXII (Access to Information);

(9) Assessing DNR's compliance with the Consent Decree;

(10) Determining whether the Site or other real property is being used in a manner that is prohibited or restricted, or that may need to be prohibited or restricted under the Consent Decree; and

(11) Implementing, monitoring, maintaining, reporting on, and enforcing any Institutional Controls and the requirements of the ICIAP.

b. Commencing on the date of lodging of the Consent Decree, DNR shall not use the Site, or such other real property, in any manner that EPA determines will pose an unacceptable risk to human health or to the environment due to exposure to Waste Material or interfere with or adversely affect the implementation, integrity, or protectiveness of the Remedial Action or O&M. The restrictions shall include, but not be limited to: those listed in the Land Use Controls Document, attached hereto as Appendix E; and

c. DNR shall execute and record in the appropriate land records office Proprietary Controls that: (i) grant a right of access to conduct any activity regarding the Consent Decree including, but not limited to, those activities listed in Paragraph 25.a; and (ii) grant the right to enforce the land/water use restrictions set forth in Paragraph25.b, including, but not limited to, the specific restrictions listed therein and any land/water use restrictions listed in the ICIAP, as further specified in this Paragraph25.c. The Proprietary

Controls shall be granted to one or more of the following persons, as determined by EPA: (i) the United States, on behalf of EPA, and its representatives; (ii) the State and its representatives; and/or (iii) other appropriate grantees. The Proprietary Controls, other than those granted to the United States, shall include a designation that EPA is a third-party beneficiary, allowing EPA to maintain the right to enforce the Proprietary Controls without acquiring an interest in real property.

26. If EPA determines that Institutional Controls in the form of state or local laws, regulations, ordinances, zoning restrictions, or other governmental controls are needed at or in connection with the Site, DNR shall cooperate with EPA's efforts to secure and ensure compliance with such governmental controls.

27. Notwithstanding any provision of the Consent Decree, the United States retains all of its access authorities and rights, as well as all of its rights to require Institutional Controls, including enforcement authorities related thereto, under CERCLA, RCRA, and any other applicable statute or regulations.

## X. REPORTING REQUIREMENTS

28. In addition to any other requirement of this Consent Decree, DNR shall submit to EPA two copies of written progress reports that are required by the Statement of Work.

29. Upon the occurrence of any event during performance of the Work that DNR is required to report pursuant to Section 103 of CERCLA, 42 U.S.C. § 9603, or Section 304 of the Emergency Planning and Community Right-to-know Act ("EPCRA"), 42 U.S.C. § 11004, DNR shall within 24 hours of the onset of such event orally notify the EPA Project Coordinator or the Alternate EPA Project Coordinator (in the event of the unavailability of the EPA Project Coordinator), or, in the event that neither the EPA Project Coordinator nor Alternate EPA Project

Coordinator is available, the Emergency Response Section, Region X, United States Environmental Protection Agency. These reporting requirements are in addition to the reporting required by CERCLA Section 103 or EPCRA Section 304.

30. Within 20 days after the onset of such an event, DNR shall furnish to EPA a written report, signed by DNR's Project Coordinator, setting forth the events that occurred and the measures taken, and to be taken, in response thereto. Within 30 days after the conclusion of such an event, DNR shall submit a report setting forth all actions taken in response thereto.

31. DNR shall submit four copies of all plans, reports, data, and other deliverables required by the SOW, or any other approved plans to EPA in accordance with the schedules set forth in such plans. Upon request by EPA, DNR shall submit in electronic form all or any portion of any deliverables DNR is required to submit pursuant to the provisions of this Consent Decree.

32. All deliverables submitted by DNR to EPA that purport to document DNR's compliance with the terms of this Consent Decree shall be signed by an authorized representative of DNR.

## XI. EPA APPROVAL OF PLANS, REPORTS, AND OTHER DELIVERABLES

33. Initial Submissions.

a. After review of any plan, report, or other deliverable that is required to be submitted for approval pursuant to this Consent Decree, EPA, shall: (1) approve, in whole or in part, the submission; (2) approve the submission upon specified conditions; (3) disapprove, in whole or in part, the submission; or (4) any combination of the foregoing.

b. EPA also may modify the initial submission to cure deficiencies in the submission if: (1) EPA determines that disapproving the submission and awaiting a

resubmission would cause substantial disruption to the Work; or (2) previous submission(s) have been disapproved due to material defects and the deficiencies in the initial submission under consideration indicate a bad faith lack of effort to submit an acceptable plan, report, or deliverable.

34. Resubmissions. Upon receipt of a notice of disapproval under Paragraph 33.a(3) or (4), or if required by a notice of approval upon specified conditions under Paragraph 33.a(2), DNR shall, within thirty days or such longer time as specified by EPA in such notice, correct the deficiencies and resubmit the plan, report, or other deliverable for approval. After review of the resubmitted plan, report, or other deliverable, EPA may: (a) approve, in whole or in part, the resubmission; (b) approve the resubmission upon specified conditions; (c) modify the resubmission; (d) disapprove, in whole or in part, the resubmission, requiring DNR to correct the deficiencies; or (e) any combination of the foregoing.

35. Material Defects. If an initially submitted or resubmitted plan, report, or other deliverable contains a material defect, and the plan, report, or other deliverable is disapproved or modified by EPA under Paragraph 33.b(2) or 34 due to such material defect, then the material defect shall constitute a lack of compliance for purposes of Paragraph 61. The provisions of Section XVII (Dispute Resolution) and Section XVIII (Stipulated Penalties) shall govern the accrual and payment of any stipulated penalties regarding DNR's submissions under this Section.

36. Implementation. Upon approval, approval upon conditions, or modification by EPA under Paragraph 33 (Initial Submissions) or Paragraph 34 (Resubmissions), of any plan, report, or other deliverable, or any portion thereof: (a) such plan, report, or other deliverable, or portion thereof, shall be incorporated into and enforceable under this Consent Decree; and (b) DNR shall take any action required by such plan, report, or other deliverable, or portion

thereof, subject only to its right to invoke the Dispute Resolution procedures set forth in Section XVII (Dispute Resolution) with respect to the modifications or conditions made by EPA. The implementation of any non-deficient portion of a plan, report, or other deliverable submitted or resubmitted under Paragraph 33 or 34 shall not relieve DNR of any liability for stipulated penalties under Section XVIII (Stipulated Penalties).

## XII. PROJECT COORDINATORS

37. Within 20 days after lodging this Consent Decree, DNR and EPA will notify each other, in writing, of the name, address, telephone number, and email address of its respective designated Project Coordinators and Alternate Project Coordinators. If a Project Coordinator or Alternate Project Coordinator initially designated is changed, the identity of the successor will be given to the other Parties at least five working days before the change occurs, unless impracticable, but in no event later than the actual day the change is made. DNR's Project Coordinator shall be subject to disapproval by EPA and shall have the technical expertise sufficient to adequately oversee all aspects of the Work. DNR's Project Coordinator shall not be an attorney for DNR in this matter. He or she may assign other representatives, including other contractors, to serve as a Site representative for oversight of performance of daily operations during remedial activities.

38. Plaintiff may designate other representatives, including, but not limited to, EPA employees, and federal contractors and consultants, to observe and monitor the progress of any activity undertaken pursuant to this Consent Decree. EPA's Project Coordinator and Alternate Project Coordinator shall have the authority lawfully vested in a Remedial Project Manager ("RPM") and an On-Scene Coordinator ("OSC") by the NCP, 40 C.F.R. Part 300. EPA's Project Coordinator or Alternate Project Coordinator shall have authority, consistent with the NCP, to

halt any Work required by this Consent Decree and to take any necessary response action when he or she determines that conditions at the Site constitute an emergency situation or may present an immediate threat to public health or welfare or the environment due to release or threatened release of Waste Material.

39. EPA's Project Coordinator and DNR's Project Coordinator will meet, as specified in the SOW or as otherwise requested by EPA.

## XIII. EMERGENCY RESPONSE

40. If any action or occurrence during the performance of the Work that causes or threatens a release of Waste Material from the Site that constitutes an emergency situation or may present an immediate threat to public health or welfare or the environment, DNR shall, subject to Paragraph 41, immediately take all appropriate action to prevent, abate, or minimize such release or threat of release, and shall immediately notify the EPA's Project Coordinator, or, if the Project Coordinator is unavailable, EPA's Alternate Project Coordinator. If neither of these persons is available, DNR shall notify the EPA Emergency Response Unit, Region X. DNR shall take such actions in consultation with EPA's Project Coordinator or other available authorized EPA officer and in accordance with all applicable provisions of the Health and Safety Plans, the Contingency Plans, and any other applicable plans or documents developed pursuant to the SOW. In the event that DNR fails to take appropriate response action as required by this Section, and EPA takes such action instead, DNR shall reimburse EPA all costs of the response action under Section XIV (Payments for Response Costs).

41. Subject to Section XIX (Covenants by Plaintiff), nothing in the preceding Paragraph or in this Consent Decree shall be deemed to limit any authority of the United States (a) to take all appropriate action to protect human health and the environment or to prevent,

abate, respond to, or minimize an actual or threatened release of Waste Material on, at, or from the Site, or (b) to direct or order such action, or seek an order from the Court, to protect human health and the environment or to prevent, abate, respond to, or minimize an actual or threatened release of Waste Material on, at, or from the Site.

## XIV. PAYMENTS FOR RESPONSE COSTS

42. Payment by DNR for Past Response Costs.

a. Within 30 days after the Effective Date, DNR shall pay to EPA $93,595.38 in payment for Past Response Costs. Payment shall be made in accordance with Paragraphs 44.a (Instructions for Past Response Cost Payments).

b. The total amount to be paid by DNR pursuant to Paragraph 42.a shall be deposited by EPA in the CB/NT ASARCO Special Account to be retained and used to conduct or finance response actions at or in connection with the Site, or to be transferred by EPA to the EPA Hazardous Substance Superfund.

43. Payments by DNR for Future Response Costs. DNR shall pay to EPA all Future Response Costs not inconsistent with the NCP.

a. Prepayment of Future Response Costs. Within 30 days after the Effective Date, DNR shall pay to EPA $330,000 as a prepayment towards DNR's obligations to pay Future Response Costs. Payment shall be made in accordance with Paragraph 44.a (Instructions for Past Response Cost Payments). The total amount paid shall be deposited by EPA in the CB/NT ASARCO DNR Special Account. These funds shall be retained and used by EPA to conduct or finance future response actions at or in connection with the Site.

b. On a periodic basis, EPA will send DNR a bill requiring payment that includes a SCORPIOS cost summary report, which includes direct and indirect costs incurred

by EPA, its contractors, and DOJ. DNR shall make all payments within 30 days after DNR's receipt of each bill requiring payment, except as otherwise provided in Paragraph 45, in accordance with Paragraphs 44.b (Instructions for Future Response Cost Payments). These payments shall be deposited by EPA in the CB/NT ASARCO Special Account. These funds shall be retained and used by EPA to conduct or finance future response actions at or in connection with the Site or to be transferred by EPA to the EPA Hazardous Substance Superfund. However, DNR shall not be required to remit such payments to EPA until EPA has first drawn on and depleted $330,000 from the CB/NT ASARCO DNR Special Account as payments for Future Response Costs.

44. Payment Instructions.

a. Instructions for Past Response Cost Payments. All payments required, elsewhere in this Consent Decree, to be made in accordance with this Paragraph 44.a shall be made by Fedwire EFT to:

Federal Reserve Bank of New York
ABA = 021030004
Account = 68010727
SWIFT address = FRNYUS33
33 Liberty Street
New York, NY 10045
Field Tag 4200 of the Fedwire message should read "D 68010727 Environmental Protection Agency"

When making payments under this Paragraph 44.a, DNR shall also comply with Paragraph 44.c.

b. Instructions for Future Response Costs Payments and Stipulated Penalties. All payments required, elsewhere in this Consent Decree, to be made in accordance with this Paragraph 44.b shall be made by Fedwire EFT to:

Federal Reserve Bank of New York

ABA = 021030004
Account = 68010727
SWIFT address = FRNYUS33
33 Liberty Street
New York NY 10045
Field Tag 4200 of the Fedwire message should read "D 68010727 Environmental Protection Agency"

When making payments under this Paragraph 44.b, DNR shall also comply with Paragraph 44.c.

c. Instructions for All Payments. The payments made under Paragraph 44.a (Instructions for Past Response Cost Payment) shall reference CDCS Number, Site/Spill ID Number 10EZ in the amount of $29,050.71 and shall reference CDCS Number, Site/Spill ID Number 10LP in the amount of $64,544.67. The payments made under Paragraph 44.b (Instructions for Future Response Cost Payments) shall reference the CDCS Number, Site/Spill ID Number 1 10LP. All payments shall reference DOJ Case Number 90-11-2-698/3. At the time of any payment required to be made in accordance with Paragraphs 44.a or 44.b, DNR shall send notice that payment has been made to the United States, and to EPA, in accordance with Section XXIV (Notices and Submissions), and to the EPA Cincinnati Finance Office by email at acctsreceivable.cinwd@epa.gov, or by mail at 26 Martin Luther King Drive, Cincinnati, Ohio 45268. Such notice shall also reference the CDCS Number, Site/Spill ID Number, and DOJ Case Number.

45. DNR may contest any Future Response Costs billed if they determine that EPA has made a mathematical error or included a cost item that is not within the definition of Future Response Costs, or if they believe EPA incurred excess costs as a direct result of an EPA action that was inconsistent with a specific provision or provisions of the NCP. Such objection shall be made in writing within 30 days after receipt of the bill and must be sent to the United States pursuant to Section XXIV (Notices and Submissions). Any such objection shall specifically

identify the contested Response Costs and the basis for objection. In the event of an objection, DNR shall pay all uncontested Future Response Costs to the United States within 30 days after DNR's receipt of the bill requiring payment. Simultaneously, DNR shall initiate the Dispute Resolution procedures in Section XVII (Dispute Resolution). If the United States prevails in the dispute, DNR shall pay the sums due (with accrued interest) to the United States within five days after the resolution of the dispute. If DNR prevails concerning any aspect of the contested costs, DNR shall pay that portion of the costs (plus associated accrued interest) for which they did not prevail to the United States within five days after the resolution of the dispute. All payments to the United States under this Paragraph shall be made in accordance with Paragraph 44.b (Instructions for Future Response Cost Payments). The dispute resolution procedures set forth in this Paragraph in conjunction with the procedures set forth in Section XVII (Dispute Resolution) shall be the exclusive mechanisms for resolving disputes regarding DNR's obligation to reimburse the United States for its Future Response Costs.

46. Interest. In the event that any payment for Past or Future Response Costs required under this Section is not made by the date required, DNR shall pay Interest on the unpaid balance. The Interest on Past or Future Response Costs shall begin to accrue on the date of the bill. The Interest shall accrue through the date of DNR's payment. Payments of Interest made under this Paragraph shall be in addition to such other remedies or sanctions available to Plaintiff by virtue of DNR's failure to make timely payments under this Section including, but not limited to, payment of stipulated penalties pursuant to Paragraph 62.

## XV. INDEMNIFICATION

47. DNR's Indemnification of the United States.

a. The United States does not assume any liability by entering into this Consent Decree or by virtue of any designation of DNR as EPA's authorized representatives under Section 104(e) of CERCLA, 42 U.S.C. § 9604(e). DNR shall indemnify, save and hold harmless the United States and its officials, agents, employees, contractors, subcontractors, and representatives for or from any and all claims or causes of action arising from, or on account of, negligent or other wrongful acts or omissions of DNR, its officers, directors, employees, agents, contractors, subcontractors, and any persons acting on its behalf or under its control, in carrying out activities pursuant to this Consent Decree, including, but not limited to, any claims arising from any designation of DNR as EPA's authorized representatives under Section 104(e) of CERCLA. Further, DNR agrees to pay the United States all costs it incurs including, but not limited to, attorneys' fees and other expenses of litigation and settlement arising from, or on account of, claims made against the United States based on negligent or other wrongful acts or omissions of DNR, its officers, directors, employees, agents, contractors, subcontractors, and any persons acting on its behalf or under its control, in carrying out activities pursuant to this Consent Decree. The United States shall not be held out as a party to any contract entered into by or on behalf of DNR in carrying out activities pursuant to this Consent Decree. Neither DNR nor any such contractor shall be considered an agent of the United States .

b. The United States shall give DNR notice of any claim for which the United States plans to seek indemnification pursuant to this Paragraph 47, and shall consult with DNR prior to settling such claim.

48. DNR covenants not to sue and agrees not to assert any claims or causes of action against the United States for damages or reimbursement or for set-off of any payments made or

to be made to the United States, arising from or on account of any contract, agreement, or arrangement between any one or more of DNR and any person for performance of Work on or relating to the Site, including, but not limited to, claims on account of construction delays. In addition, DNR shall indemnify and hold harmless the United States with respect to any and all claims for damages or reimbursement arising from or on account of any contract, agreement, or arrangement between any one or more of DNR and any person for performance of Work on or relating to the Site, including, but not limited to, claims on account of construction delays.

49. For the duration of this Consent Decree, DNR shall satisfy, or shall ensure that its contractors or subcontractors satisfy, all applicable laws and regulations regarding the provision of worker's compensation insurance for all persons performing the Work on behalf of DNR in furtherance of this Consent Decree.

## XVI. FORCE MAJEURE

50. "Force majeure," for purposes of this Consent Decree, is defined as any event arising from causes beyond the control of DNR, of any entity controlled by DNR, or of DNR's contractors that delays or prevents the performance of any obligation under this Consent Decree despite DNR' best efforts to fulfill the obligation. The requirement that DNR exercise "best efforts to fulfill the obligation" includes using best efforts to anticipate any potential Force majeure and best efforts to address the effects of any potential Force majeure (a) as it is occurring and (b) following the potential Force majeure such that the delay and any adverse effects of the delay are minimized to the greatest extent possible. "Force majeure" does not include financial inability to complete the Work or a failure to achieve the Performance Standards.

51. If any event occurs or has occurred that may delay the performance of any obligation under this Consent Decree for which DNR intends or may intend to assert a claim of

Force majeure, DNR shall notify EPA's Project Coordinator orally or, in his or her absence, EPA's Alternate Project Coordinator or, in the event both of EPA's designated representatives are unavailable, the Director of the Environmental Cleanup Office, EPA Region 10, within 5 days of when DNR first knew that the event might cause a delay. Within 7 days thereafter, DNR shall provide in writing to EPA an explanation and description of the reasons for the delay; the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to prevent or mitigate the delay or the effect of the delay; DNR's rationale for attributing such delay to a Force majeure; and a statement as to whether, in the opinion of DNR, such event may cause or contribute to an endangerment to public health or welfare, or the environment. DNR shall include with any notice all available documentation supporting its claim that the delay was attributable to a Force majeure. DNR shall be deemed to know of any circumstance of which DNR, any entity controlled by DNR, or DNR's contractors knew or should have known. Failure to comply with the above requirements regarding an event shall preclude DNR from asserting any claim of Force majeure regarding that event, provided, however, that if EPA, despite the late notice, is able to assess to its satisfaction whether the event is a Force majeure under Paragraph 50 and whether DNR has exercised its best efforts under Paragraph 50, EPA may, in its unreviewable discretion, excuse in writing DNR's failure to submit timely notices under this Paragraph.

52. If EPA agrees that the delay or anticipated delay is attributable to a Force majeure, the time for performance of the obligations under this Consent Decree that are affected by the Force majeure will be extended by EPA for such time as is necessary to complete those obligations. An extension of the time for performance of the obligations affected by the Force majeure shall not, of itself, extend the time for performance of any other obligation. If EPA does

not agree that the delay or anticipated delay has been or will be caused by a Force majeure, EPA will notify DNR in writing of its decision. If EPA agrees that the delay is attributable to a Force majeure, EPA will notify DNR in writing of the length of the extension, if any, for performance of the obligations affected by the Force majeure.

53. If DNR elects to invoke the dispute resolution procedures set forth in Section XVII (Dispute Resolution), they shall do so no later than 15 days after receipt of EPA's notice. In any such proceeding, DNR shall have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a Force majeure, that the duration of the delay or the extension sought was or will be warranted under the circumstances, that best efforts were exercised to avoid and mitigate the effects of the delay, and that DNR complied with the requirements of Paragraphs 50 and 51. If DNR carries this burden, the delay at issue shall be deemed not to be a violation by DNR of the affected obligation of this Consent Decree identified to EPA and the Court.

## XVII. DISPUTE RESOLUTION

54. Unless otherwise expressly provided for in this Consent Decree, the dispute resolution procedures of this Section shall be the exclusive mechanism to resolve disputes regarding this Consent Decree. However, the procedures set forth in this Section shall not apply to actions by the United States to enforce obligations of DNR that have not been disputed in accordance with this Section.

55. The parties recognize that some of the Work required under this Consent Decree is also required of Point Ruston pursuant to the Second Amendment. The parties shall make all reasonable efforts to coordinate the work and obligations that are required under both Decrees

and to coordinate the Dispute Resolution processes should they be going forward under both Decrees.

56. Any dispute regarding this Consent Decree shall in the first instance be the subject of informal negotiations between the parties to the dispute. The period for informal negotiations shall not exceed 20 days from the time the dispute arises, unless it is modified by written agreement of the parties to the dispute. The dispute shall be considered to have arisen when one party sends the other parties a written Notice of Dispute.

57. Statements of Position.

a. In the event that the parties cannot resolve a dispute by informal negotiations under the preceding Paragraph, then the position advanced by EPA shall be considered binding unless, within 14 days after the conclusion of the informal negotiation period, DNR invokes the formal dispute resolution procedures of this Section by serving on the United States a written Statement of Position on the matter in dispute, including, but not limited to, any factual data, analysis, or opinion supporting that position and any supporting documentation relied upon by DNR. The Statement of Position shall specify DNR's position as to whether formal dispute resolution should proceed under Paragraph 58 (Record Review) or 59.

b. Within 30 days after receipt of DNR's Statement of Position, EPA will serve on DNR its Statement of Position, including, but not limited to, any factual data, analysis, or opinion supporting that position and all supporting documentation relied upon by EPA. EPA's Statement of Position shall include a statement as to whether formal dispute resolution should proceed under Paragraph 58 (Record Review) or Paragraph 59. Within 14 days after receipt of EPA's Statement of Position, DNR may submit a Reply.

c. If there is disagreement between EPA and DNR as to whether dispute resolution should proceed under Paragraph 58 (Record Review) or 59, the parties to the dispute shall follow the procedures set forth in the paragraph determined by EPA to be applicable. However, if DNR ultimately appeals to the Court to resolve the dispute, the Court shall determine which paragraph is applicable in accordance with the standards of applicability set forth in Paragraphs 58 and 59.

58. Record Review. Formal dispute resolution for disputes pertaining to the selection or adequacy of any response action and all other disputes that are accorded review on the administrative record under applicable principles of administrative law shall be conducted pursuant to the procedures set forth in this Paragraph. For purposes of this Paragraph, the adequacy of any response action includes, without limitation, the adequacy or appropriateness of plans, procedures to implement plans, or any other items requiring approval by EPA under this Consent Decree, and the adequacy of the performance of response actions taken pursuant to this Consent Decree. Nothing in this Consent Decree shall be construed to allow any dispute by DNR regarding the validity of the RODs' provisions.

a. An administrative record of the dispute shall be maintained by EPA and shall contain all statements of position, including supporting documentation, submitted pursuant to this Section. Where appropriate, EPA may allow submission of supplemental statements of position by the parties to the dispute.

b. The Director of the Environmental Cleanup Office , EPA Region 10, will issue a final administrative decision resolving the dispute based on the administrative record described in Paragraph 58.a. This decision shall be binding upon DNR, subject only to the right to seek judicial review pursuant to Paragraphs 58.c and 58.d.

c. Any administrative decision made by EPA pursuant to Paragraph 58.b shall be reviewable by this Court, provided that a motion for judicial review of the decision is filed by DNR with the Court and served on all Parties within ten days after receipt of EPA's decision. The motion shall include a description of the matter in dispute, the efforts made by the parties to resolve it, the relief requested, and the schedule, if any, within which the dispute must be resolved to ensure orderly implementation of this Consent Decree. The United States may file a response to DNR's motion.

d. In proceedings on any dispute governed by this Paragraph, DNR shall have the burden of demonstrating that the decision of the Environmental Cleanup Office Director is arbitrary and capricious or otherwise not in accordance with law. Judicial review of EPA's decision shall be on the administrative record compiled pursuant to Paragraph 58.a.

59. Formal dispute resolution for disputes that neither pertain to the selection or adequacy of any response action nor are otherwise accorded review on the administrative record under applicable principles of administrative law, shall be governed by this Paragraph.

a. Following receipt of DNR's Statement of Position submitted pursuant to Paragraph 57, the Director of the Environmental Cleanup Office, EPA Region 10 will issue a final decision resolving the dispute. The Waste Management Division Director's decision shall be binding on DNR unless, within ten days after receipt of the decision, DNR files with the Court and serves on the parties a motion for judicial review of the decision setting forth the matter in dispute, the efforts made by the parties to resolve it, the relief requested, and the schedule, if any, within which the dispute must be resolved to ensure orderly implementation of the Consent Decree. The United States may file a response to DNR's motion.

b. Judicial review of any dispute governed by this Paragraph shall be governed by applicable principles of law.

60. The invocation of formal dispute resolution procedures under this Section shall not extend, postpone, or affect in any way any obligation of DNR under this Consent Decree, not directly in dispute, unless EPA or the Court agrees otherwise. Stipulated penalties with respect to the disputed matter shall continue to accrue but payment shall be stayed pending resolution of the dispute as provided in Paragraph 68. Notwithstanding the stay of payment, stipulated penalties shall accrue from the first day of noncompliance with any applicable provision of this Consent Decree. In the event that DNR does not prevail on the disputed issue, stipulated penalties shall be assessed and paid as provided in Section XVIII (Stipulated Penalties).

## XVIII. STIPULATED PENALTIES

61. DNR shall be liable for stipulated penalties in the amounts set forth in Paragraphs 62 and 63 to the United States for failure to comply with the requirements of this Consent Decree specified below, unless excused under Section XVI (Force Majeure). "Compliance" by DNR shall include completion of all payments and activities required under this Consent Decree, or any plan, report, or other deliverable approved under this Consent Decree, in accordance with all applicable requirements of law, this Consent Decree, the SOW, and any plans, reports, or other deliverables approved under this Consent Decree and within the specified time schedules established by and approved under this Consent Decree.

62. Stipulated Penalty Amounts – Work, Institutional Controls, Payments and Excluding Plans, Reports, and Other Deliverables). The following stipulated penalties shall accrue per violation

per day for the Work identified in Paragraph 11, including payments as described in Paragraphs 42 and 43, and Institutional Controls as identified in Paragraph 25.

| Penalty Per Violation Per Day | Period of Noncompliance |
|---|---|
| $1,000 | 1st through 14th day |
| $2,500 | 15th through 30th day |
| $5,000 | 31st day and beyond |

63. Stipulated Penalty Amounts - Plans, Reports, and other Deliverables. The following stipulated penalties shall accrue per violation per day for failure to submit timely or adequate reports or other plans or deliverables pursuant to the Consent Decree:

| Penalty Per Violation Per Day | Period of Noncompliance |
|---|---|
| $500 | 1st through 14th day |
| $1,250 | 15th through 30th day |
| $2,500 | 31st day and beyond |

64. In the event that EPA assumes performance of a portion or all of the Work pursuant to Paragraph 76 (Work Takeover), DNR shall be liable for a stipulated penalty in the amount of $50,000. Stipulated penalties under this Paragraph are in addition to the remedies available under Paragraph 76 (Work Takeover).

65. All penalties shall begin to accrue on the day after the complete performance is due or the day a violation occurs and shall continue to accrue through the final day of the correction of the noncompliance or completion of the activity. However, stipulated penalties shall not accrue: (a) with respect to a deficient submission under Section XI (EPA Approval of Plans, Reports, and Other Deliverables), during the period, if any, beginning on the 31st day after

EPA's receipt of such submission until the date that EPA notifies DNR of any deficiency; (b) with respect to a decision by the Director of the Waste Management Division, EPA Region X, under Paragraph 58.b or 59.a of Section XVII (Dispute Resolution), during the period, if any, beginning on the 21st day after the date that DNR's reply to EPA's Statement of Position is received until the date that the Director issues a final decision regarding such dispute; or (c) with respect to judicial review by this Court of any dispute under Section XVII (Dispute Resolution), during the period, if any, beginning on the 31st day after the Court's receipt of the final submission regarding the dispute until the date that the Court issues a final decision regarding such dispute. Nothing in this Consent Decree shall prevent the simultaneous accrual of separate penalties for separate violations of this Consent Decree.

66. Following EPA's determination that DNR has failed to comply with a requirement of this Consent Decree, EPA may give DNR written notification of the same and describe the noncompliance. EPA may send DNR a written demand for the payment of the penalties. However, penalties shall accrue as provided in the preceding Paragraph regardless of whether EPA has notified DNR of a violation.

67. All penalties accruing under this Section shall be due and payable to the United States within 30 days after DNR's receipt from EPA of a demand for payment of the penalties, unless DNR invokes the Dispute Resolution procedures under Section XVII (Dispute Resolution) within the 30-day period. All payments to the United States under this Section shall indicate that the payment is for stipulated penalties and shall be made in accordance with Paragraph 44.b (Instructions for Future Response Cost Payments).

68. Penalties shall continue to accrue as provided in Paragraph 65 during any dispute resolution period, but need not be paid until the following:

a. If the dispute is resolved by agreement of the Parties or by a decision of EPA that is not appealed to this Court, accrued penalties determined to be owed shall be paid to EPA within 15 days after the agreement or the receipt of EPA's decision or order;

b. If the dispute is appealed to this Court and the United States prevails in whole or in part, DNR shall pay all accrued penalties determined by the Court to be owed to EPA, that are not the subject of an appeal by DNR, within 60 days after receipt of the Court's decision or order.

c. Within 30 days after receipt of the final appellate court decision, DNR shall pay the balance of any unpaid stipulated penalties determined to be due, plus Interest, to EPA.

69. If DNR fails to pay stipulated penalties when due, DNR shall pay Interest on the unpaid stipulated penalties as follows: (a) if DNR has timely invoked dispute resolution such that the obligation to pay stipulated penalties has been stayed pending the outcome of dispute resolution, Interest shall accrue from the date stipulated penalties are due pursuant to Paragraph 68 until the date of payment; and (b) if DNR fails to timely invoke dispute resolution, Interest shall accrue from the date of demand under Paragraph 67 until the date of payment. If DNR fails to pay stipulated penalties and Interest when due, the United States may institute proceedings to collect the penalties and Interest.

70. The payment of penalties and Interest, if any, shall not alter in any way DNR's obligation to complete the performance of the Work required under this Consent Decree.

71. Nothing in this Consent Decree shall be construed as prohibiting, altering, or in any way limiting the ability of the United States to seek any other remedies or sanctions available by virtue of DNR's violation of this Consent Decree or of the statutes and regulations upon

which it is based, including, but not limited to, penalties pursuant to Section 122(l) of CERCLA, 42 U.S.C. § 9622(*l*), provided, however, that the United States shall not seek civil penalties pursuant to Section 122(*l*) of CERCLA for any violation for which a stipulated penalty is provided in this Consent Decree, except in the case of a willful violation of this Consent Decree.

72. Notwithstanding any other provision of this Section, the United States may, in its unreviewable discretion, waive any portion of stipulated penalties that have accrued pursuant to this Consent Decree.

## XIX. COVENANTS BY PLAINTIFF

73. Covenants for DNR by United States. In consideration of the actions that will be performed and the payments that will be made by DNR under this Consent Decree, and except as specifically provided in Paragraph 74 (United States' Post-Lodging Reservations), and 75 (General Reservations of Rights), the United States covenants not to sue or to take administrative action against DNR pursuant to Sections 106 and 107(a) of CERCLA relating to the Site. These covenants shall take effect upon the receipt by EPA of the payment required by Paragraph 42.a (Payments for Past Response Costs) and any Interest or stipulated penalties due thereon under Paragraph 46 (Interest) or Section XVIII (Stipulated Penalties). These covenants are conditioned upon the satisfactory performance by DNR of its obligations under this Consent Decree. These covenants extend only to DNR and do not extend to any other person.

74. United States' Post-Lodging Reservations. Notwithstanding any other provision of this Consent Decree, the United States reserves, and this Consent Decree is without prejudice to, the right to institute proceedings in this action or in a new action, and/or to issue an administrative order, seeking to compel DNR to perform further response actions relating to the State-owned aquatic lands and/or to pay the United States for additional costs of response if,

(a) subsequent to the lodging of this decree with the Court, (1) conditions at the State-owned aquatic lands, previously unknown to EPA, are discovered, or (2) information, previously unknown to EPA, is received, in whole or in part, and (b) EPA determines that these previously unknown conditions or this information together with other relevant information indicate that the Remedial Action is not protective of human health or the environment.

75. General Reservations of Rights. The United States reserves, and this Consent Decree is without prejudice to, all rights against DNR with respect to all matters not expressly included within Plaintiff's covenants. Notwithstanding any other provision of this Consent Decree, the United States reserves all rights against DNR with respect to:

a. liability for failure by DNR to meet a requirement of this Consent Decree;

b. liability arising from the past, present, or future disposal, release, or threat of release of Waste Material outside of the Site;

c. liability based on the ownership of the Site by the State when such ownership commences after signature of this Consent Decree by the State;

d. liability based on the operation of the Site by DNR when such operation commences after signature of this Consent Decree by DNR and does not arise solely from DNR's performance of the Work;

e. liability based on DNR's transportation, treatment, storage, or disposal, or arrangement for transportation, treatment, storage, or disposal of Waste Material at or in connection with the Site, other than as provided in the RODs, the Work, or otherwise ordered by EPA, after signature of this Consent Decree by DNR;

f. liability for damages for injury to, destruction of, or loss of natural resources, and for the costs of any natural resource damage assessments. However, nothing in

this Decree amends any term or provision affecting claims and defenses relating to natural resource damages established by the 1997 Consent Decree entered in United States et al. v. State of Washington, Civil Action No. 97-5337-RJB (W.D. WA.);

g. criminal liability;

h. liability for violations of federal or state law that occur during or after implementation of the Work; and **;**

i. liability, for additional response actions that EPA determines are necessary to achieve and maintain Performance Standards or to carry out and maintain the effectiveness of the remedy set forth in the RODs, but that cannot be required pursuant to Paragraph 14 (Modification of SOW or Related Work Plans);

76. Work Takeover.

a. In the event EPA determines that DNR has (1) ceased implementation of any portion of the Work, or (2) is seriously or repeatedly deficient or late in its performance of the Work, or (3) is implementing the Work in a manner that may cause an endangerment to human health or the environment, EPA may issue a written notice ("Work Takeover Notice") to DNR. Any Work Takeover Notice issued by EPA will specify the grounds upon which such notice was issued and will provide DNR a period of ten days within which to remedy the circumstances giving rise to EPA's issuance of such notice.

b. If, after expiration of the ten-day notice period specified in Paragraph 76.a, DNR has not remedied to EPA's satisfaction the circumstances giving rise to EPA's issuance of the relevant Work Takeover Notice, EPA may at any time thereafter assume the performance of all or any portion(s) of the Work as EPA deems necessary ("Work Takeover"). EPA will notify DNR in writing (which writing may be electronic) if EPA determines that implementation of a

Work Takeover is warranted under this Paragraph 76.b. Work Takeover costs are included within the definition of Future Response Costs.

c. DNR may invoke the procedures set forth in Paragraph 58 (Record Review), to dispute EPA's implementation of a Work Takeover under Paragraph 76.b. However, notwithstanding DNR's invocation of such dispute resolution procedures, and during the pendency of any such dispute, EPA may in its sole discretion commence and continue a Work Takeover under Paragraph 76.b until the earlier of (1) the date that DNR remedies to EPA's satisfaction, the circumstances giving rise to EPA's issuance of the relevant Work Takeover Notice, or (2) the date that a final decision is rendered in accordance with Paragraph 58 (Record Review) requiring EPA to terminate such Work Takeover.

77. Notwithstanding any other provision of this Consent Decree, the United States retains all authority and reserves all rights to take any and all response actions authorized by law.

## XX. COVENANTS BY DNR

78. Covenants by DNR. Subject to the reservations in Paragraph 80, DNR covenants not to sue and agrees not to assert any claims or causes of action against the United States with respect to the Site and this Consent Decree, including, but not limited to:

a. any direct or indirect claim for reimbursement from the EPA Hazardous Substance Superfund through CERCLA Sections 106(b)(2), 107, 111, 112 or 113, or any other provision of law;

b. any claims under CERCLA Sections 107 or 113, RCRA Section 7002(a), 42 U.S.C. § 6972(a), or state law regarding the Site and this Consent Decree; or

c. any claims arising out of response actions at or in connection with the Site, including any claim under the United States Constitution, the Tucker Act, 28 U.S.C. §1491, the Equal Access to Justice Act, 28 U.S.C. § 2412, or at common law.

79. Except as provided in Paragraph 86 (Res Judicata and Other Defenses), the covenants in this Section shall not apply if the United States brings a cause of action or issues an order pursuant to any of the reservations in Section XIX (Covenants by Plaintiff), other than in Paragraphs 75.a (claims for failure to meet a requirement of the Consent Decree), 75.g (criminal liability), and 75.h (violations of federal/state law during or after implementation of the Work), but only to the extent that DNR's claims arise from the same response action, response costs, or damages that the United States is seeking pursuant to the applicable reservation.

80. DNR reserves, and this Consent Decree is without prejudice to, claims against the United States, subject to the provisions of Chapter 171 of Title 28 of the United States Code, and brought pursuant to any statute other than CERCLA or RCRA and for which the waiver of sovereign immunity is found in a statute other than CERCLA or RCRA, for money damages for injury or loss of property or personal injury or death caused by the negligent or wrongful act or omission of any employee of the United States, as that term is defined in 28 U.S.C. § 2671, while acting within the scope of his or her office or employment under circumstances where the United States, if a private person, would be liable to the claimant in accordance with the law of the place where the act or omission occurred. However, the foregoing shall not include any claim based on EPA's selection of response actions, or the oversight or approval of DNR's plans, reports, other deliverables or activities.

81. Nothing in this Consent Decree shall be deemed to constitute preauthorization of a claim within the meaning of Section 111 of CERCLA, 42 U.S.C. § 9611, or 40 C.F.R. § 300.700(d).

## XXI. EFFECT OF SETTLEMENT; CONTRIBUTION

82. Nothing in this Consent Decree shall be construed to create any rights in, or grant any cause of action to, any person not a Party to this Consent Decree. Each of the Parties expressly reserves any and all rights (including, but not limited to, pursuant to Section 113 of CERCLA, 42 U.S.C. § 9613), defenses, claims, demands, and causes of action that each Party may have with respect to any matter, transaction, or occurrence relating in any way to the Site against any person not a Party hereto. Nothing in this Consent Decree diminishes the right of the United States, pursuant to Section 113(f)(2) and (3) of CERCLA, 42 U.S.C. § 9613(f)(2)-(3), to pursue any such persons to obtain additional response costs or response action and to enter into settlements that give rise to contribution protection pursuant to Section 113(f)(2).

83. The Parties agree, and by entering this Consent Decree this Court finds, that this Consent Decree constitutes a judicially approved settlement for purposes of Section 113(f)(2) of CERCLA, 42 U.S.C. § 9613(f)(2), and that DNR is entitled, as of the Effective Date, to protection from contribution actions or claims as provided by Section 113(f)(2) of CERCLA, or as may be otherwise provided by law, for "matters addressed" in this Consent Decree. The "matters addressed" in this Consent Decree are all response actions taken or to be taken, including all Work and Remedial Action, and all response costs incurred or to be incurred, at or in connection with the Site, by the United States or any other person, except for the State; provided, however, that if the United States exercises rights under the reservations in Section XIX (Covenants by Plaintiff), other than in Paragraphs 75.a (claims for failure to meet a

requirement of the Consent Decree), 75.g (criminal liability), or 75.h (violations of federal/state law during or after implementation of the Work), the "matters addressed" in this Consent Decree will no longer include those response costs or response actions. However, DNR acknowledges that it has entered into a settlement agreement with Point Ruston LLC and that nothing in this Consent Decree is intended to alter DNR's obligations that are set forth in that agreement.

84. DNR shall, with respect to any suit or claim brought by it for matters related to this Consent Decree, notify the United States in writing no later than 60 days prior to the initiation of such suit or claim.

85. DNR shall, with respect to any suit or claim brought against it for matters related to this Consent Decree, notify in writing the United States within ten days after service of the complaint on such DNR. In addition, DNR shall notify the United States within ten days after service or receipt of any Motion for Summary Judgment and within ten days after receipt of any order from a court setting a case for trial.

86. Res Judicata and Other Defenses. In any subsequent administrative or judicial proceeding initiated by the United States for injunctive relief, recovery of response costs, or other appropriate relief relating to the Site, DNR shall not assert, and may not maintain, any defense or claim based upon the principles of waiver, res judicata, collateral estoppel, issue preclusion, claim-splitting, or other defenses based upon any contention that the claims raised by the United States in the subsequent proceeding were or should have been brought in the instant case; provided, however, that nothing in this Paragraph affects the enforceability of the covenants not to sue set forth in Section XIX (Covenants by Plaintiff).

## XXII. ACCESS TO INFORMATION

87. DNR shall provide to EPA, upon request, copies of all records, reports, documents, and other information (including records, reports, documents, and other information in electronic form) (hereinafter referred to as "Records") within its possession or control or that of its contractors or agents relating to activities at the Site or to the implementation of this Consent Decree, including, but not limited to, sampling, analysis, chain of custody records, manifests, trucking logs, receipts, reports, sample traffic routing, correspondence, or other documents or information regarding the Work. DNR shall also make available to EPA, for purposes of investigation, information gathering, or testimony, its employees, agents, or representatives with knowledge of relevant facts concerning the performance of the Work.

88. Business Confidential and Privileged Documents.

a. DNR may assert business confidentiality claims covering part or all of the Records submitted to Plaintiff under this Consent Decree to the extent permitted by and in accordance with Section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7), and 40 C.F.R. § 2.203(b). Records determined to be confidential by EPA will be afforded the protection specified in 40 C.F.R. Part 2, Subpart B. If no claim of confidentiality accompanies Records when they are submitted to EPA, or if EPA has notified DNR that the Records are not confidential under the standards of Section 104(e)(7) of CERCLA or 40 C.F.R. Part 2, Subpart B, the public may be given access to such Records without further notice to DNR.

b. DNR may assert that certain Records are privileged under the attorney-client privilege or any other privilege recognized by federal law. If DNR asserts such a privilege in lieu of providing Records, they shall provide Plaintiff with the following: (1) the title of the Record; (2) the date of the Record; (3) the name, title, affiliation (e.g., company or

firm), and address of the author of the Record; (4) the name and title of each addressee and recipient; (5) a description of the contents of the Record; and (6) the privilege asserted by DNR. If a claim of privilege applies only to a portion of a Record, the Record shall be provided to the United States in redacted form to mask the privileged portion only. DNR shall retain all Records that they claim to be privileged until the United States has had a reasonable opportunity to dispute the privilege claim and any such dispute has been resolved in the DNR's favor.

c. No Records created or generated pursuant to the requirements of this Consent Decree shall be withheld from the United States on the grounds that they are privileged or confidential.

89. No claim of confidentiality or privilege shall be made with respect to any data, including, but not limited to, all sampling, analytical, monitoring, hydrogeologic, scientific, chemical, or engineering data, or any other documents or information evidencing conditions at or around the Site.

## XXIII. RETENTION OF RECORDS

90. Until ten years after the Effective Date, DNR shall preserve and retain all non-identical copies of Records (including Records in electronic form) now in its possession or control or that come into its possession or control that relate in any manner to its liability under CERCLA with respect to the Site, provided, however, that DNR who is potentially liable as an owner or operator of the Site must retain, in addition, all Records that relate to the liability of any other person under CERCLA with respect to the Site. DNR must also retain, and instruct its contractors and agents to preserve, for the same period of time specified above all non-identical copies of the last draft or final version of any Records (including Records in electronic form)

now in its possession or control or that come into its possession or control that relate in any manner to the performance of the Work, provided, however, that DNR (and its contractors and agents) must retain, in addition, copies of all data generated during the performance of the Work and not contained in the aforementioned Records required to be retained. Each of the above record retention requirements shall apply regardless of any corporate retention policy to the contrary.

91. At the conclusion of this record retention period, DNR shall notify the United States at least 90 days prior to the destruction of any such Records, and, upon request by the United States, DNR shall deliver any such Records to EPA. DNR may assert that certain Records are privileged under the attorney-client privilege or any other privilege recognized by federal law. If DNR asserts such a privilege, it shall provide the United States with the following: (a) the title of the Record; (b) the date of the Record; (c) the name, title, affiliation (e.g., company or firm), and address of the author of the Record; (d) the name and title of each addressee and recipient; (e) a description of the subject of the Record; and (f) the privilege asserted by DNR. If a claim of privilege applies only to a portion of a Record, the Record shall be provided to the United States in redacted form to mask the privileged portion only. DNR shall retain all Records that they claim to be privileged until the United States has had a reasonable opportunity to dispute the privilege claim and any such dispute has been resolved in DNR's favor. However, no Records created or generated pursuant to the requirements of this Consent Decree shall be withheld on the grounds that they are privileged or confidential.

92. DNR certifies individually that, to the best of its knowledge and belief, after thorough inquiry, it has not altered, mutilated, discarded, destroyed, or otherwise disposed of any Records (other than identical copies) relating to its potential liability regarding the Site since the

earlier of notification of potential liability by the United States or the filing of suit against it regarding the Site and that it has fully complied with any and all EPA requests for information regarding the Site pursuant to Sections 104(e) and 122(e) of CERCLA, 42 U.S.C. §§ 9604(e) and 9622(e), and Section 3007 of RCRA, 42 U.S.C. § 6927.

## XXIV. NOTICES AND SUBMISSIONS

93. Whenever, under the terms of this Consent Decree, written notice is required to be given or a report or other document is required to be sent by one Party to another, it shall be directed to the individuals at the addresses specified below, unless those individuals or their successors give notice of a change to the other Parties in writing. All notices and submissions shall be considered effective upon receipt, unless otherwise provided. Written notice as specified in this Section shall constitute complete satisfaction of any written notice requirement of the Consent Decree with respect to the United States, EPA, DNR, respectively. Notices required to be sent to EPA, and not to the United States, under the terms of this Consent Decree should not be sent to the U.S. Department of Justice.

| | |
|---|---|
| As to the United States: | Chief, Environmental Enforcement Section<br>Environment and Natural Resources Division<br>U.S. Department of Justice<br>P.O. Box 7611<br>Washington, D.C. 20044-7611<br>Re: DJ # 90-11-2-698/3 |
| As to EPA: | Richard Albright, Director<br>Office of Environmental Cleanup<br>ECL-117<br>Region X<br>Suite 900<br>1200 6th Avenue, Seattle, WA 98125 |

and:

Kevin Rochlin, Project Manager
Office of Environmental Cleanup
ECL-111
Suite 900
1200 6th Avenue, Seattle, WA 98125

DNR:

Division Manager
Aquatic Resources Division
Department of Natural Resources
1111 Washington Street SE
PO Box 47027
Olympia, WA 98504-7027

and:

Office of the Attorney General
Natural Resources Division
PO Box 40100
Olympia, WA 98504-0100

## XXV. RETENTION OF JURISDICTION

94. This Court retains jurisdiction over both the subject matter of this Consent Decree and DNR for the duration of the performance of the terms and provisions of this Consent Decree for the purpose of enabling any of the Parties to apply to the Court at any time for such further order, direction, and relief as may be necessary or appropriate for the construction or modification of this Consent Decree, or to effectuate or enforce compliance with its terms, or to resolve disputes in accordance with Section XVII (Dispute Resolution).

## XXVI. APPENDICES

95. The following appendices are attached to and incorporated into this Consent Decree:

"Appendix A" is the Asarco Smelter ROD

"Appendix B" is the Sediments ROD.

"Appendix C" is the SOW.

"Appendix D" is the description and/or map of the Site.

"Appendix E" is the Land Use Controls document.

## XXVII. COMMUNITY INVOLVEMENT

96. If requested by EPA, DNR shall participate in community involvement activities pursuant to the community involvement plan to be developed by EPA. EPA will determine the appropriate role for DNR under the Plan. DNR shall also cooperate with EPA in providing information regarding the Work to the public. As requested by EPA, DNR shall participate in the preparation of such information for dissemination to the public and in public meetings that may be held or sponsored by EPA to explain activities at or relating to the Site.

## XXVIII. MODIFICATION

97. Except as provided in Paragraph 14 (Modification of SOW or Related Work Plans), material modifications to this Consent Decree, including the SOW, shall be in writing, signed by the United States and DNR, and shall be effective upon approval by the Court. Except as provided in Paragraph 14, non-material modifications to this Consent Decree, including the SOW, shall be in writing and shall be effective when signed by duly authorized representatives of the United States and DNR. A modification to the SOW shall be considered material if it fundamentally alters the basic features of the selected remedy within the meaning of 40 C.F.R. § 300.435(c)(2)(ii).

98. Nothing in this Consent Decree shall be deemed to alter the Court's power to enforce, supervise, or approve modifications to this Consent Decree.

## XXIX. LODGING AND OPPORTUNITY FOR PUBLIC COMMENT

99. This Consent Decree shall be lodged with the Court for a period of not less than 30 days for public notice and comment in accordance with Section 122(d)(2) of CERCLA, 42 U.S.C. § 9622(d)(2), and 28 C.F.R. § 50.7. The United States reserves the right to withdraw or withhold its consent if the comments regarding the Consent Decree disclose facts or considerations that indicate that the Consent Decree is inappropriate, improper, or inadequate. DNR consent to the entry of this Consent Decree without further notice.

100. If for any reason the Court should decline to approve this Consent Decree in the form presented, this agreement is voidable at the sole discretion of any Party and the terms of the agreement may not be used as evidence in any litigation between the Parties.

## XXX. SIGNATORIES/SERVICE

101. Each undersigned representative of DNR and the Assistant Attorney General for the Environment and Natural Resources Division of the Department of Justice certifies that he or she is fully authorized to enter into the terms and conditions of this Consent Decree and to execute and legally bind such Party to this document.

102. DNR agrees not to oppose entry of this Consent Decree by this Court or to challenge any provision of this Consent Decree unless the United States has notified DNR in writing that it no longer supports entry of the Consent Decree.

103. DNR shall identify, on the attached signature page, the name, address, and telephone number of an agent who is authorized to accept service of process by mail on behalf of that Party with respect to all matters arising under or relating to this Consent Decree. DNR agrees to accept service in that manner and to waive the formal service requirements set forth in Rule 4 of the Federal Rules of Civil Procedure and any applicable local rules of this Court, including,

but not limited to, service of a summons. DNR need not file an answer to the complaint in this action unless or until the Court expressly declines to enter this Consent Decree.

XXXI. FINAL JUDGMENT

104. This Consent Decree and its appendices constitute the final, complete, and exclusive agreement and understanding among the Parties regarding the settlement embodied in the Consent Decree. The Parties acknowledge that there are no representations, agreements, or understandings relating to the settlement other than those expressly contained in this Consent Decree.

105. Upon entry of this Consent Decree by the Court, this Consent Decree shall constitute a final judgment between and among the United States and DNR. The Court finds that there is no just reason for delay and therefore enters this judgment as a final judgment under Fed. R. Civ. P. 54 and 58.

SO ORDERED THIS 24th DAY OF JUNE, 2014.

Thomas S. Zilly
United States District Judge

Signature Page for Consent Decree regarding the Asarco Smelter and the Asarco Sediments/Groundwater Operable Units of the Commencement Bay Nearshore/Tideflats SuperfundSite.

FOR THE UNITED STATES OF AMERICA:

/s/ Robert G. Dreher

ROBERT G. DREHER
Acting Assistant Attorney General
Environment and Natural Resources Division
U.S. Department of Justice
Washington, DC 20530

/s/ David L. Dain

DAVID L. DAIN
Senior Counsel
Environmental Enforcement Section
U.S. Department of Justice
999 18th St.
South Terrace, Room 370
Denver, CO 80202
(303) 844-7371

JENNY A. DURKAN
United States Attorney
Western District of Washington

/s/ Brian Kipnis

BRIAN KIPNIS

AUSA/SLC, Office of the United States Attorney

Western District of Washington

700 Stewart Street, Suite 5220

Seattle, WA 98101-1271

Signature Page for Consent Decree regarding the Asarco Smelter and the Asarco Sediments/Groundwater Operable Units of the Commencement Bay Nearshore/Tideflats Superfund Site.

_/s/ Richard Albright_____
Richard Albright, Director
Office of Environmental Cleanup, Region 10
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101

_/s/ Alex Fidis_____
Alex Fidis, Assistant Regional Counsel
Office of Regional Counsel, Region 10
U.S. Environmental Protection Agency
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101

**FOR DNR**

_4/18/2014__
Date

_/s/ Peter Goldmark_____
Peter Goldmark
Commissioner of Public Lands
State of Washington Department of Natural Resources
1111 Washington Street SE
Olympia, WA 98504

_4/18/2014_
Date

_/s/ Edward D. Callow_____
Edward D. Callow
Assistant Attorney General
Attorney for DNR
1125 Washington Street SE
PO Box 40100
Olympia, WA 98504-0100

Agent Authorized to Accept Service on Behalf of Above-signed Party:

Bob Ferguson
Attorney General
State of Washington
PO Box 40100
Olympia, WA 98504-0100
(360) 753-6200

# Appendix A

# (Asarco Smelter ROD)

**EPA/ROD/R10-95/122**
**1995**

# EPA Superfund
# Record of Decision:

**COMMENCEMENT BAY, NEAR SHORE/TIDE FLATS**
**EPA ID: WAD980726368**
**OU 20**
**PIERCE COUNTY, WA**
**03/24/1995**

# RECORD OF DECISION

COMMENCEMENT BAY NEARSHORE/
TIDEFLATS SUPERFUND SITE

OPERABLE UNIT 02

ASARCO TACOMA SMELTER FACILITY
RUSTON AND TACOMA, WASHINGTON

RECEIVED

MAR 1995

WASTE MANAGEMENT BRANCH

March 1995

U.S. Environmental Protection Agency

Region 10

TABLE OF CONTENTS

1.0 SITE DESCRIPTION ..... 1-1

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES ..... 2-1
2.1 HISTORICAL SITE ACTIVITIES ..... 2-1
2.2 ENFORCEMENT ACTIVITIES ..... 2-1

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION ..... 3-1

4.0 SCOPE AND ROLE OF OPERABLE UNITS ..... 4-1
4.1 SCOPE OF CURRENT WORK ..... 4-1
4.1.1 OU 02 - Asarco Tacoma Smelter ..... 4-1
4.2 OTHER RELATED ACTIVITIES ..... 4-2
4.2.1 OU 04 - Asarco Off-Property (Ruston/North Tacoma Study Area) ..... 4-2
4.2.2 OU 06 - Asarco Sediments ..... 4-2
4.2.3 OU 07 - Demolition and Surface Water Controls ..... 4-2

5.0 SUMMARY OF SITE CHARACTERISTICS ..... 5-1

6.0 DESCRIPTION OF SITE RISKS ..... 6-1
6.1 IDENTIFICATION OF CONTAMINANTS OF CONCERN (SCREENING ANALYSIS) ..... 6-2
6.2 EXPOSURE ASSESSMENT ..... 6-2
6.2.1 Identification of Site Uses, Exposed Populations and Exposure Pathways ..... 6-2
6.2.2 Calculation of Exposure ..... 6-4
6.3 TOXICITY ASSESSMENT..... 6-5
6.4 RISK CHARACTERIZATION ..... 6-7
6.5 UNCERTAINTY ANALYSIS ..... 6-8
6.5.1 Comparison of the Risk Assessment Results to Superfund Regulations and Guidance..... 6-9
6.6 ECOLOGICAL RISK ASSESSMENT ..... 6-10
6.7 EPA'S CLEANUP OBJECTIVES AND TWO-PHASE APPROACH ..... 6-10

7.0 DESCRIPTION OF ALTERNATIVES ..... 7-1
7.1 SUMMARY OF ALTERNATIVES ..... 7-1
7.2 SIGNIFICANT PUBLIC COMMENTS AND ADDITIONAL ANALYSES ..... 7-7
7.2.1 On-Site Containment Facility Comments ..... 7-7
7.2.2 Soil Treatment Comments..... 7-9
7.2.3 Shoreline Armoring Comments ..... 7-10

8.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES ..... 8-1

9.0 THE SELECTED REMEDY ..... 9-1
9.1 PLANT SITE SOILS ..... 9-1
9.1.1 Excavate Soil and Granular Slag From Five Source Areas ..... 9-1
9.1.2 On-Site Disposal ..... 9-2
9.1.3 Capping the Site (PSS and slag and the slag peninsula..... 9-2
9.2 DEMOLISH REMAINING BUILDINGS AND STRUCTURES..... 9-3
9.3 SURFACE WATER ..... 9-4
9.4 SHORELINE ARMORING ..... 9-4
9.5 GROUND WATER AND MARINE SEDIMENT ..... 9-5
9.6 OTHER ELEMENTS OF THE SELECTED REMEDY ..... 9-5
9.6.1 Safety Measures ..... 9-5
9.6.2 Integrating Cleanup With land Use Plans ..... 9-5
9.6.3 Periodic Review ..... 9-6
9.7 CLEANUP SCHEDULE ..... 9-6
9.8 COST OF THE SELECTED REMEDY ..... 9-6
9.9 PERFORMANCE STANDARDS ..... 9-6

10.0 STATUTORY DETERMINATIONS ..... 10-1
10.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT ..... 10-1
10.2 COMPLIANCE WITH ARARs ..... 10-1
10.3 COST-EFFECTIVENESS..... 10-1
10.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE ..... 10-2
10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT ..... 10-3
11.0 DOCUMENTATION OF SIGNIFICANT CHANGES ..... 11-1

LIST OF TABLES

6-1. CONTAMINANTS OF CONCERN FOR SOIL, GROUND WATER AND AIR ..... 6-3
6-2. CLEANUP OBJECTIVES ..... 6-11
7-1. CLEANUP ALTERNATIVES ..... 7-3
8-1. EPA'S NINE EVALUATION CRITERIA ..... 8-2
8-2. COST ..... 8-16
9-1. REMEDIATION GOALS FOR SURFACE WATER IMPACTING PUGET SOUND ..... 9-12
9-2. PRELIMINARY REMEDIATION GOALS FOR CLASS III GROUND WATER IMPACTING SURFACE WATER IN PUGET SOUND ..... 9-13
B-1. INFORMATION REPOSITORIES ..... B-3
B-2. UST OF FACT SHEETS AND BROCHURES FOR THE ASARCO TACOMA SMELTER SITE ..... B-4
B-3. ARSENIC CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS ..... B-7
B-4. COPPER CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS ..... B-9
B-5. REASONABLE MAXIMUM EXPOSURE ASSUMPTIONS FOR RESIDENTIAL USE ..... B-11
B-6. SLOPE FACTORS FOR CANCER-CAUSING CHEMICALS ..... B-12
B-7. REFERENCE DOSES FOR NON-CANCER CAUSING CHEMICALS ..... B-13
B-8. ARARs ANALYSIS ..... B-14

LIST OF FIGURES

1-1. SMELTER SIRE AND SLAG PENINSULA ..... 1-3
6-1. AREAS OF SITE USED FOR THE EXPOSURE ASSESSMENT ..... 6-6
7-1. EXAMPLE OF MULTI-LAYER SOIL CAP ..... 7-4
7-2. HAZARDOUS WASTE OCF ..... 7-5
7-3. EXAMPLE OF SHORELINE ARMORING ..... 7-8
B-1. CANCER RISK BY LAND USE IN THE ARSENIC KITCHEN AREA ..... B-1
B-2. NON-CANCER RISK BY LAND USE IN THE ARSENIC KITCHEN AREA ..... B-2

APPENDICES

APPENDIX A: RESPONSIVENESS SUMMARY
APPENDIX B: FIGURES AND TABLES
APPENDIX C: SUMMARY OF ADDITIONAL SOIL TREATABILITY PILOT-PROJECT FINDINGS
APPENDIX D: ASARCO SMELTER SITE ON-SITE CONTAINMENT FACILITY EVALUATION
APPENDIX E: STATE DEPARTMENT OF ECOLOGY'S CONCURRENCE LETTER
APPENDIX F: ADMINISTRATIVE RECORD INDEX

# DECLARATION FOR THE RECORD OF DECISION

**Site Name and Location**

Commencement Bay Nearshore/Tideflats Superfund Site
Operable Unit 02 - Asarco Tacoma Smelter Facility and Slag Peninsula
Ruston and Tacoma, Washington

**Statement of Basis and Purpose**

This decision document presents the selected remedial action for the former Asarco Tacoma Smelter Facility and adjacent slag peninsula, in Ruston and Tacoma, Washington, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site. The State of Washington concurs with the selected remedy.

This Record of Decision (ROD) describes the final cleanup remedy for soil, slag and surface water and disposal of hazardous soils, demolition debris, and residential soils. This ROD is intended to be an interim action for ground water.

**Assessment of the Site**

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent or substantial endangerment to public health, welfare, or the environment.

**Description of the Selected Remedy**

EPA has divided the Commencement Bay/Nearshore Tideflats Superfund site into seven operable units (OUs) in order to facilitate the investigation, analysis, and cleanup of this very large site. Four of these OUs are associated with the former Asarco smelter:

- OU 02 Asarco Tacoma Smelter and Slag Peninsula
- OU 04 Asarco Off-Property (Ruston/North Tacoma Study Area)
- OU 06 Asarco Sediments
- OU 07 Asarco Demolition

The remedy described in this ROD addresses OU 02 and involves the cleanup of metal (e.g., arsenic, copper, lead) and organic contaminated soil, slag, and surface water and ground water found at the former smelter facility and adjacent slag peninsula. This remedy will address the principal threats posed by conditions at the Site, which are areas that continue to act as the primary known sources (source areas) of contamination to ground water and surface water that are flowing into Commencement Bay. The remedy includes the following elements:

- Excavate source area soils and slag (approximately 160,000 cubic yards).

- Dispose of source area soils and demolition debris designated as hazardous waste (approximately 240,000 cubic yards total) in an on-site containment facility (OCF) that meets or exceeds regulatory standards for hazardous waste landfills.

- Cap the entire Site (plant site soils and slag and the slag peninsula). The low permeability cap will be composed of layers of clean soils, gravel, and clay. The contaminated residential soils excavated from the Ruston/North Tacoma Study Area will be used as a sub-base for the cap.

- Demolish the remaining buildings and structures.

- Replace the entire surface water drainage system.

- Armor portions of the plant site and slag peninsula shoreline.

- Continue to monitor the surface water and ground water.

- Sample marine sediments.

- Develop and implement an enforceable program of restrictions and guidelines to supplement the actual cleanup activities to ensure that the remedial action remains protective and that development activities do not impact the long-term effectiveness of the cleanup.

If it is determined that source control activities do not result in ground water that meets federal and state standards, additional cleanup activities, if practicable, will be identified in a separate ROD.

**Statutory Determinations**

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this Site. However, because treatment of the principal threats of the Site was found not to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element.

At this Site, EPA's determination that soil treatment was not practicable was based on several factors, including the effectiveness of an OCF at isolating contaminated soils and debris from the environment, the community's stated preference during public comment for on-site containment of contaminated waste, and the nearly $30 million difference in cost between treatment and disposal of soil and disposal of soil without treatment in an OCF.

Because the remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted no less often than every five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

<IMG SRC 1095122>
Chuck Clarke Date
Regional Administrator
U.S. EPA Region 10

DECISION SUMMARY

**Commencement Bay Nearshore/Tideflats Superfund Site**
**Asarco Tacoma Smelter Site**
**Operable Unit 02**
**Tacoma/Ruston, Washington**

## 1.0 SITE DESCRIPTION

The Asarco Tacoma Smelter Superfund site ("Asarco Site" or "the Site") is an operable unit (OU) of the larger Commencement Bay Nearshore/Tideflats (CB N/T) Superfund site. The CB N/T Superfund site was listed on the interim priority list by the U.S. Environmental Protection Agency (EPA) in 1981, and included in the first published National Priorities List in September 1983. The Site is located on the western shore of Commencement Bay and consists of 67 acres of property owned by Asarco, Inc. and a 23 acre slag peninsula, home of the Tacoma Yacht Club. The Town of Ruston, the City of Tacoma and the Metropolitan Park District are the three municipalities that have zoning and permitting jurisdiction at this Site. This Record of Decision (ROD) addresses contaminated soils, slag, demolition debris, surface water and ground water on the Site.

The general area of the former Asarco Smelter consists of steep slopes extending down to Commencement Bay producing bluffs along portions of the shoreline. Many of the original smelter buildings and structures were constructed on slag fill, which extended the existing shoreline when molten slag from smelting operations was poured into Commencement Bay. A car tunnel and railroad tunnel are located between the stack hill and the arsenic kitchen area. Some dense vegetation exists on steep slopes (for example, the stack hill) and along the bluffs above Commencement Bay, see Figure 1-1.

The adjacent slag peninsula is composed of different forms of slag (molten or granulated) that were poured or placed on many occasions between 1930 and 1970. Its primary surface features are the Tacoma Yacht Club building, a paved access road, and paved parking areas. An estimated 15 million tons of slag exist at the smelter property and slag peninsula. Surface water features on the smelter property include surface water in the cooling pond and south and east stack hill areas and a number of springs and seeps around the stack hill and arsenic kitchen areas. Surface water drains into one of four drain systems and then into outfalls at the Site called the city (owned by the City of Tacoma), north, middle, and south outfalls. The latter three are owned by Asarco.

A complex pattern of ground water flows through or beneath the smelter property, including through the slag, into Commencement Bay. Three primary groundwater aquifers (water bearing zones) have been identified; two relatively shallow aquifers and one deep aquifer. A thick silt barrier exists between the shallow and deep aquifers throughout much of the Site. Because of the high degree of fractures in and porous nature of the slag, the tides bring seawater inland several hundred feet where it mixes with ground water. The ground water within each of the three aquifers is designated as either potential drinking water (Class IIB) or as non-potable water (Class III). No one is currently drinking the ground water at or near the Site.

Prior to 1890, a number of sawmills were active in the area and deposited wood waste along the shoreline. From 1890 through 1912, the property was used as a lead smelter and refinery. Asarco purchased the property in 1905 and converted it in 1912 into a facility to smelt and refine copper from copper bearing ores and concentrates shipped in from other locations. By-products of the smelting operations were further refined to produce other marketable products, such as arsenic, sulfuric acid, liquid sulfur dioxide, and slag. Asarco ended operation of the smelter in 1985.

Metals were released into the soil, air, and Commencement Bay as a result of the smelting and refining operations. Some examples of the metals present at the Site are arsenic, cadmium, copper, lead, and zinc. Metals in slag or released into soil have migrated to surface and ground water at the Site. Ores that were smelted at the Site have left metals in the buildings and structures on the Site.

There are no listed Resource Conservation and Recovery Act (RCRA) wastes at the Site. In several areas, contaminated soils are RCRA characteristic waste because they fail the Toxicity Characteristic leaching Procedure. Slag is not a RCRA waste under the Bevill exemption (40

There are no known floodplain zones or endangered species at this Site. There are several small areas of the Site, other than the cooling pond, that have been identified as potential wetlands. If these areas are confirmed as wetlands and if remediation occurs in these areas, the extent of mitigation will be determined during remedial design.

<IMG SRC 1095122A>

## 2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

### 2.1 HISTORICAL SITE ACTIVITIES

During the active industrial life of the Asarco Tacoma Smelter, the primary product was refined copper. By-products of the copper smelting process included sulfuric acid, liquid sulfur dioxide, arsenic trioxide, arsenic metal, and copper reverbatory slag. The following is a brief chronological summary of operations at the former Asarco Tacoma smelter.

1890 Began operation as a lead smelter under ownership of the Tacoma Smelter Company.
1902 Copper production was started.
1905 Asarco purchased the smelter.
1917 Plant was rebuilt, stack was constructed, electrostatic precipitators were added.
1930 Blast furnace smelting operations were discontinued and replaced with reverberatories that produced slag as one by-product.
1974 A liquid sulfur dioxide plant began operation, using a dimethylaniline process.
1977 A baghouse was installed to handle dust from the arsenic kitchen and metallic arsenic plant.
1978 Electrolytic refinery ceased operation.
1985 Copper smelting operations were discontinued.
1986 Arsenic production was discontinued, and facility was taken completely out of production.

As described above, much of the present facility is built over fill material, including slag, which was placed by Asarco as part of the smelter operations. Since January 1987, Asarco has completed two phases of demolition activities at the Site. Facilities in the stack area associated with copper smelting and the production of both arsenic trioxide and metallic arsenic were demolished in 1987-1988 during Phase I Site Stabilization. The majority of the remaining building and structures, including the smelter stack, were demolished in 1992-1994 during Phase II Site Stabilization. Much of the Site (where these facilities were located) has been leveled and, to a minor extent, graded.

### 2.2 ENFORCEMENT ACTIVITIES

The history of regulatory activities affecting the former Asarco Tacoma Smelter began in the late 1960s with the passage of air emission standards by the Puget Sound Air Pollution Control Authority (PSAPCA). EPA requirements such as National Pollution Discharge Elimination Systems (NPDES) permits, which regulate point source water discharges, were applied in 1975.

Although PSAPCA began regulating sulfur dioxide and arsenic emissions in 1968, variances to the standards were granted to Asarco until 1975. EPA began enforcement proceedings in the early 1980s to regulate air emissions. Federal and state standards anti variances continued to be issues of contention until the smelter closed in 1985.

In July of 1983 EPA issued proposed standards for arsenic under Section 112 (National Emission Standards for Hazardous Air Pollutants) of the Clean Air Act. Inorganic arsenic had been designated as a hazardous air pollutant in 1980 and the Asarco smelter was a major source of arsenic. The proposed standard for Asarco, requiring hoods on the converters used in the smelting process, was modified after public comment to require, in addition to the hoods, better management practices in handling arsenic contaminated materials. These regulations were never implemented due to a decision by Asarco to cease copper refining in 1985.

In September 1986, Asarco signed an Administrative Order on Consent (AOC) with EPA pursuant to

Section 106(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), in which Asarco agreed to conduct a Remedial Investigation and Feasibility Study (RI/FS) and perform immediate site stabilization activities. Asarco's contractors began the RI/FS in 1987 under EPA oversight. Site stabilization, Phase I and II, were both conducted based on the information collected during the initial investigation of the Site.

In December 1990, EPA issued a ROD for demolition of structures and construction of a surface water diversion system. Asarco agreed to perform this work in a consent decree dated May 18, 1992.

The field investigation and evaluation of remedial alternatives for a final RI/FS was concluded by Asarco in January 1993 and was used to develop a final Site remedy.

In addition to the smelter property itself, Asarco is a responsible party for three closely related OU of the CB N/T Superfund Site, known as Ruston/North Tacoma Study Area, Asarco Sediments and Demolition. These units are reviewed below in the Section 4.0, "Scope and Role of Operable Units."

The following is a brief chronological summary of enforcement activities associated with the former Asarco Tacoma smelter.

| | |
|---|---|
| 1986 | AOC for RI/FS and Phase I site stabilization signed. |
| 1988 | Phase I Site stabilization (demolition) activities completed. |
| 1989 | Draft RI/FS submitted. |
| 1989 | AOC for Expedited Response Action in Ruston/North Tacoma signed. |
| 1990 | Notice of Violation for RI/FS issued. |
| 1990 | Interim ROD for Phase II Site stabilization (demolition) and surface water controls issued. |
| 1991 | Additional investigation of soils and groundwater contamination commences. |
| 1992 | Notice of Violation resolved. |
| 1992 | Consent Decree for demolition entered in federal court. |
| 1992 | Fifth Amendment to the 1986 AOC revising the schedule for the draft and final RI/FS submittals signed.**1** |
| 1993 | Two stipulated Penalties for late draft FS submittals paid by Asarco. |
| 1993 | ROD for Ruston/North Tacoma Study Area issued. |
| 1993 | Unilateral Administrative Order for Ruston/North Tacoma Study Area issued. |
| 1993 | Final RI/FS reports for smelter cleanup submitted and approved. |
| 1994 | AOC for Ground Water, Surface Water, Soil and Marine Sediments monitoring and sampling signed. |

**1** Amendments 1-4 for the AOC also included revised schedules for the performance of RI/FS work.

## 3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Throughout the studies leading up to this ROD, EPA has taken steps to inform and involve the public about activities at the Asarco Smelter site. EPA conducted the activities summarized in this section because the agency believes that community involvement in its decision making process is a key element in developing a successful cleanup plan.

In addition to cleaning up contamination at the Asarco Site, the community is very interested in the future use of the property. Although it is EPA's primary mission to design a cleanup plan that protects public health and the environment, EPA believes this can be done with future development of the Site in mind. Therefore, EPA has considered all comments related to the future of the Asarco Site when selecting cleanup actions.

In order to provide a variety of opportunities for public participation in the cleanup decision making process, EPA developed a communications strategy in 1993 for its activities related to the Asarco Site. This strategy supplemented the existing Community Relations Plan, which included all of the Commencement Bay Nearshore/Tideflats and South Tacoma Channel Operable Units.

This section summarizes the outreach activities that EPA has conducted to date. In addition to

the activities discussed below, EPA has complied with the specific requirements for public participation under CERCLA by publishing a Proposed Plan for public comment on August 12, 1994. The Proposed Plan was mailed to interested individuals and made available at local information repositories (listed in Table B-1 in Appendix B). The original public comment period ran from August 12 through October 11, 1994, and was extended until November 10 at the request of interested citizens. During the comment period EPA held two public meetings. In addition, a summary fact sheet was mailed to EPA's mailing list for the Asarco Site. EPA also published newspaper advertisements in the Morning News Tribune to announce the availability of the Proposed Plan, the comment period and the public meetings. Comments received during the public comment period are summarized along with EPA's responses in the attached Responsiveness Summary.

In addition to the public comment period, the following outreach activities were conducted by EPA:

Small Group Meetings. EPA staff members have attended meetings with groups upon request to share information about the agency's cleanup proposal, and to learn about different groups concerns and needs for information about the Site. These groups include: Black Collective Association; Izaak Walton League; Association of Builders and Contractors; Tacoma Environmental Commission; National Association of Women in Construction; Association of General Contractors; American Institute of Architects Southwest Washington; Environmental Task Force of Tacoma-Pierce County Chamber of Commerce; Kiwanis Club and Rotary Club.

EPA staff will continue to meet with small groups as requested.

Community Interviews. In November 1993 EPA staff met with individual citizens to understand better community concerns regarding cleanup.

Availability Sessions. In October, November and December 1993, EPA and Asarco held sessions where citizens could visit one-on-one with EPA and Asarco staff to discuss cleanup plans.

Community Workgroup Briefing. On May 19, 1994, EPA held a meeting for the Ruston/North Tacoma Community Workgroup. This workgroup was formed in 1989 to provide an avenue for citizens to become involved in residential investigation and cleanup activities. EPA presented a preview of its Preferred Cleanup Alternative at the meeting in order to get feedback and comments from the group.

Public Meeting. EPA held two public meetings during the 90-day public comment period on the Proposed Plan. At the meetings participants learned more about EPA's Proposed Plan and had the opportunity to provide public comments. Transcripts were taken of these two meetings (held August 30 and September 19, 1994) and are available in EPA's Administrative Record for the site.

Periodic Briefings. Briefings have been held for the Town of Ruston, City of Tacoma, Tacoma Environmental Commission, Congressman Dicks' Office and other interested local government officials.

Information Repositories. EPA has established and updates ten repositories where citizens can review detailed information about EPA's Superfund activities. New materials are periodically added to these repositories. Documents subject to public comment can also be found in these locations. The repositories are frequently advertised in fact sheets and in newspaper notices prepared by EPA.

Fact Sheets and Brochures. EPA prepares regular fact sheets for distribution to members of the community to provide current information on the status of site activities. Table B-2 in Appendix B, identifies a list of fact sheets and brochures published about the Asarco Site prior to this ROD.**2**

Coordinating Forum. In July of 1993, the Ruston/North Tacoma Coordinating Forum turned its attention to evaluating cleanup options for the Asarco Tacoma Smelter. The group was originally formed in March 1991 to facilitate discussion and coordination among the various entities involved and/or affected by the Ruston/North Tacoma Residential Study Area project.

**2** Fact sheets devoted exclusively to demolition activities are not included in this list.

In order to address issues associated with cleanup and future redevelopment of the Asarco smelter, the group formed two subcommittees: 1) land use, and 2) technical. The two committees worked for over a year on issues related to developing a cleanup plan for the smelter site. EPA participated directly in the technical subcommittee and received input from the land use committee. Input from both of these committees was instrumental to EPA in developing the Proposed Plan, which was published in August 1994. The following parties participated in the Forum subcommittees:

Land Use Subcommittee*:

Asarco
City of Tacoma
Metropolitan Parks District
Town of Ruston

* All land use subcommittee members were also represented on the technical committee.

Technical Subcommittee:

Agency for Toxic Substances and Disease Registry
Citizens for a Healthy Bay
Community Representative
Environmental Protection Agency
Puget Sound Air Pollution Control Authority
Puyallup Tribe of Indians
Tacoma-Pierce County Health Department
U.S. and State Fish and Wildlife Services

Washington Department of Ecology
Washington Department of Health
Washington Environmental Council

Technical Assistance Grant. In 1991 EPA awarded a Technical Assistance Grant (TAG) to the Citizens For A Healthy Bay. Citizens For A Healthy Bay have used these funds to have technical experts review and comment on cleanup design documents, prepare information for the general public on cleanup work, and prepare information for non-English speaking people who may fish or work on Commencement Bay. They have an office in downtown Tacoma which is open to the public and serves as an information repository for the Commencement Bay and Asarco Superfund sites. They also publish a quarterly newsletter which covers a wide-range on environmental issues associated with Tacoma.

## 4.0 SCOPE AND ROLE OF OPERABLE UNITS

Superfund response activities at the CB N/T Site currently are coordinated under seven separate OUs. Four of the OUs are related to the Asarco Superfund project. They are:

OU 02 - Asarco Tacoma Smelter
OU 04 - Asarco Off-Property (Ruston/North Tacoma)
OU 06 - Asarco Sediments
OU 07 - Asarco Demolition

The remedy described in this ROD addresses cleanup of OU 02, the Asarco Tacoma Smelter. It primarily involves the cleanup of metal-contaminated soils, slag, surface water and ground water. It also addresses the final disposal of demolition debris, the Expedited Response Action (ERA) soils and the Ruston/North Tacoma residential soils.

### 4.1 SCOPE OF CURRENT WORK

#### 4.1.1 OU 02 - Asarco Tacoma Smelter

Based on its evaluation of human health and ecological risks associated with existing conditions

at the Asarco Site, EPA believes that current conditions on the Asarco Site pose unacceptable risks over the long-term to future potential workers, residents and visitors, and to the ground water discharging to Commencement Bay. Therefore, cleanup actions are necessary. EPA's goal is to reduce potential exposures to metal and organic contaminants by removing contaminated soils that act as source areas to the surface water and ground water, by capping the Site (soil and slag) surfaces and by armoring the slag shoreline. Soil removal or capping contaminated soils and slag is expected to reduce the contaminants that are carried into Commencement Bay by surface water and/or ground water and prevent direct contact with the soil and slag by humans and animals.

This ROD describes the final cleanup remedy for soil, Slag and surface water and disposal of hazardous soils, demolition debris and residential soils. This ROD is intended to be an interim action for ground water.

Site Development Planning

Concurrent with EPA's efforts to design a cleanup plan, Asarco, the Town of Ruston, the City of Tacoma, and the Metropolitan Park District formed a "land use committee" and hired consultants to help the group develop a Master Use Plan for future development of the Site after cleanup.

This effort involved significant citizen participation. Asarco and the land use committee held four week-long public forums called "Asarco Weeks" over an eight-month period to solicit ideas regarding the future use of the Asarco property. These efforts resulted in an "Agreement in Principle," negotiated by Asarco, the City of Tacoma, the Town of Ruston, and the Metropolitan Park District of Tacoma, that outlines a proposal for development of the Asarco Site, including responsibilities among the signatories for such development.

The "Agreement in Principle" adopts the "G-2.1" concept, the consensus approach resulting from the Asarco Weeks, and provides general guidelines for open space and development zones, such as commercial, residential, recreational, marine, and mixed uses, and for surface roadways. The G-2.1 concept provides for a park centered on the Site with a setback traffic center and a crescent-shaped development area fronting on grassy areas facing Commencement Bay. The park would tend from Ruston Way to Point Defiance Park.

Although the "Agreement in Principle" and this ROD are separate documents, they contain some common elements. They are separate because they represent different objectives and types of decisions regarding the smelter property. The purpose of the ROD is to document EPA's cleanup decision for the Site. Under the Superfund law, EPA has the authority to select and implement cleanup actions. In contrast, the "Agreement in Principle" outlines a proposal for development of the property after cleanup. The property owners, Asarco and the Park District, and the local governments with jurisdiction over the property, Tacoma and Ruston, have the authority to determine how the property can be used in the future after the cleanup has been completed.

## 4.2 OTHER RELATED ACTIVITIES

### 4.2.1 OU 04 - Asarco Off-Property (Ruston/North Tacoma Study Area)

The initial action for the Ruston/North Tacoma Study Area was an ERA. In March 1989, Asarco and EPA entered into an agreement for Asarco to conduct the ERA in the Ruston/North Tacoma Study Area. The AOC issued under Section 106(a) of CERCLA, required Asarco to clean up and cap 11 publicly accessible properties in Ruston. Contaminated soils excavated from all of the properties are stored temporarily at the Site in a building known as the "fine ore bins building."

In June 1993, EPA issued a ROD requiring that arsenic and lead contaminated soils in residential yards and in public right of ways surrounding the former smelter facility be excavated or capped and disposed off-site. In November 1993, an Explanation of Significant Difference (ESD) was available for public comment and was subsequently signed by EPA, allowing for temporary storage of the Ruston/North Tacoma residential soils on the north end of the former smelter property. The ESD provided for these soils to be left on the former smelter site until either the final Site remedy was selected or until December 31, 1994. EPA issued a Fact Sheet in December 1994 stating that, in general, the community supported disposing these soils on site as a sub-base for a cap and that these soils would remain on site until the final smelter remedy was selected.

By the end of 1994, 79 private properties had been cleaned up and 209 yards had been sampled.

**4.2.2 OU 06 - Asarco Sediments**

EPA issued a Supplemental Feasibility Study for the off-shore sediments in summer 1993. However, EPA, Ecology, Asarco, the Natural Resource Trustees and a community group believed that additional investigations and evaluation of the cleanup actions were necessary. In 1994, Asarco and EPA entered into an AOC requiring Asarco to collect and evaluate additional information regarding the off-shore marine sediments.

**4.2.3 OU 07 - Demolition end Surface Water Controls**

In November 1994, Asarco completed Phase II demolition of remaining Site structures under a federal Consent Decree signed in 1991 with EPA. Also under the Consent Decree, Asarco controls surface water that runs onto the Site to minimize the contact of surface water with contaminated soil in the cooling pond.

The remainder of this ROD discusses only the source control activities for cleanup of OU 02, the former Asarco Smelter, and the final disposal of demolition debris, the ERA soils and the Ruston/North Tacoma residential soils.

**5.0 SUMMARY OF SITE CHARACTERISTICS**

Under EPA's oversight, Asarco collected and analyzed soil, slag, surface and ground water, and sediment samples at the Site.

Soil. The following contaminants were found in soils on the Site at levels that were of potential concern to human health and the environment:

Metals
Antimony, Arsenic, Cadmium, Copper, Lead, Mercury, Silver, Thallium, Zinc

Organic Chemicals
Polyaromatic Hydrocarbons (PAHs) and Polychlorinated Biphenyls (PCBs)

These contaminants in soil are of concern because (1) they are the primary source of contamination to ground water and surface water that is flowing into Commencement Bay; and (2) they are a potential health concern for humans and animal life that be exposed to the contaminants in the soil now or in the future.

Samples show that the principal threats to human health and the environment posed by the Asarco Site are the contaminated materials in the six "source areas" identified on Figure 1-1.

These are areas that have either the highest measured concentrations of contaminants in the soils, appear to act as the primary known sources of contamination to ground water and surface water, and/or have large amounts of contaminated material based upon the historic uses of these areas.**3** These areas are the:

- Stack Hill
- Copper Refinery Area
- Cooling Pond
- Fine Ore Bins Building
- Arsenic Kitchen
- Southeast Area of the Plant

**3** For example, the highest concentration of arsenic found in soil is 403,100 parts per million (ppm) near the arsenic kitchen area. This level is approximately 130 times higher than the highest concentration found in Ruston. The highest concentration of arsenic in ground water is located in monitoring well 111 with 52 ppm (.006 parts per million is EPA's preliminary remedial action objective). This monitoring well is down-gradient from the arsenic kitchen and fine ore bins area. See Table 3 for maximum concentrations of chemicals of concern.

Soil and groundwater concentrations in the source areas are identified for both arsenic and copper in Tables B-3 and B-4, respectively, in Appendix B.

In addition to these six areas, elevated concentrations of metals were detected in soils and slag throughout the entire property. Even though certain areas are not considered principal threats to ground water, the concentrations generally are high enough throughout the Site to pose a threat if they are inhaled, ingested, or touched by people or animals.

Slag contains high concentrations of metals, including arsenic and lead, in a rock-like form. Concentrations of arsenic found in slag ranged from 100 to 24,950 ppm. The slag along the smelter shoreline is a poured matrix. The slag found on the slag peninsula is primarily fine grained, sand-like particles. The slag portions on the Site appear to contribute less contamination to ground water than the source areas described above. Slag poses a threat if ingested by people or animals. In addition, the fine slag particles on the peninsula are blown into Commencement Bay and potentially into the recreational areas of the Yacht Basin and Point Defiance Park.

The face of the slag shoreline appears to be impacted by the tidal activity in Commencement Bay. High energy currents and wave action cause erosion of the slag, which results in slag particles moving from the shoreline and being deposited into the off-shore sediments. Recently, a shoreline monitoring station was washed away.

Surface water samples were collected from seeps (ground water that surfaces from hillsides or in the tunnel), puddles, and at the outfalls that discharge into Commencement Bay. Asarco found that surface water on the Site, including seeps and small stagnant pools below the stack hill and in the arsenic kitchen area, and water in the cooling pond, is contaminated with metals at levels higher than federal or state standards for drinking water and for protection of sea life. The contaminants that exceed regulatory levels include arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel selenium, silver zinc, total petroleum hydrocarbons, and anilines.

The surface water investigation showed that the surface water drainage system on the Site is no longer adequate. The pipes and drains associated with the system may be cracked and/or the pipes filled with contaminated sediments. Surface water can become contaminated by contact with the contaminated sediments in the pipes. The contaminated surface water can then leak out of the system and migrate to ground water or discharge to Commencement Bay.

Ground Water. Three water-bearing zones (groundwater aquifers) were identified at the smelter property. The two shallowest aquifers, the slag and marine sands aquifers, show elevated levels of arsenic, copper, zinc, and other metals. A thick silt barrier between the shallow and deeper aquifers seems to have protected the deeper aquifer, the Pre-Vashon aquifer, from contamination. Only a few water samples from the deeper aquifer have elevated metal concentrations. The few exceptions may result from contamination migrating through a production well, which was drilled into the deeper aquifer during the smelter's operation. This well has now been plugged so that contamination is unlikely to continue migrating from this well into the deeper aquifer.

The three primary ways for metals to move into ground water are: (1) clean or contaminated surface water moving through contaminated soil into ground water; (2) contact between ground water and soil or slag that releases metals into ground water; and (3) leakage and spills, for example, from former process operations such as ore handling, storage, or refining, and from the existing sewer and drainage system.

Organic contamination caused by dimethylaniline (DMA) that was used in the production of sulfuric acid has been identified in the southeast comer of the smelter property. Wood debris and sawdust, left over from sawmill operations and now buried beneath the slag, are decomposing thus contributing to the release of metals, particularly arsenic, from the slag into ground water and Commencement Bay.

The metal levels in ground water decrease as ground water moves through the smelter property towards Commencement Bay. This decrease in contamination may be due to: (1) seawater or groundwater dilution; (2) metals adhering to the slag as ground water moves towards the bay; (3) metals being removed from the ground water through chemical reactions; or (4) the contaminant plume moving slowly through the smelter property.

The contaminants that exceed regulatory levels for ground water entering the bay are: arsenic, beryllium, cadmium, copper, lead, mercury, nickel, selenium, silver, zinc, total petroleum hydrocarbons, and anilines.

Air. Samples of dust were collected at 22 smelter property locations. A model was used to predict how much dust would move into the communities of Ruston and Tacoma if there were no cleanup. The results showed that the highest emissions would be on the smelter property and that emission levels decrease rapidly with distance from the smelter property.

## 6.0 DESCRIPTION OF SITE RISKS

This section of the ROD provides a brief summary of the "On-Property Human Health Risk Assessment" (`Risk Assessment') for the Asarco Tacoma Plant (Kleinfelder 1993). The document was prepared by Asarco, with EPA oversight, to assess the potential human heath risks from Site contamination and was completed according to national and regional EPA risk assessment guidelines. It evaluates potential risk from exposure to contamination in soil, slag, surface water, ground water and air if no remedial action is taken on the site. The results of this assessment were used to decide whether remedial action is appropriate and which exposure pathways and contaminants require remediation.

OVERALL SUMMARY OF RISK ASSESSMENT

Potential health impacts were estimated using the risk assessment and assuming five possible land-use scenarios for the Site: residential, industrial, commercial, recreational and the existing non-use. The result showed that the estimated cancer risks and non-cancer health effects from the Site are the highest for possible future residents who may inadvertently ingest soils or drink ground water at the site. For example, it was estimated that the lifetime chance of developing cancer from ingesting soil in the arsenic kitchen area, assuming residential use (e.g., daily ingestion of soil, a 70 kilogram adult, living on the Site for 30 years), may be as high as two in ten. Repeatedly ingesting soil in the stack hill area may pose a chance of four in a hundred of getting cancer. An unacceptable excess lifetime cancer risk for Superfund cleanups is in a range of approximately one in ten thousand to one in a million. Non-cancer impacts from the Site are likely to present appreciable risk of significant adverse effects to people over lifetime exposures (generally referred to as a hazard index (HI) greater than one).

Residential land use poses the highest potential for health impacts because it assumes that people will spend the most time at the property and therefore potentially be more exposed to contaminants. Other land use possibilities, such as recreational, industrial, commercial, and non-use, assume people will spend less time at the Site and have lower exposures to Site contaminants. Therefore, these other scenarios are estimated to have less potential for health impacts.

Arsenic exposure is responsible for most of the estimated cancer risk from contaminants in soil, slag, ground water and surface water at the Site. Arsenic levels in the surface water and ground water that is discharged to the Bay substantially exceed EPA's water quality criteria for fish ingestion by people, and stat standards that protect marine life. Antimony, arsenic, chromium, copper, lead, manganese, and mercury are some of the chemicals of most concern for non-cancer effects such as organ damage, learning disabilities, and birth defects. A detailed discussion of all of the assumptions and the estimated numerical health impacts associated with each pathway can be found in the Risk Assessment report.

Risk assessments are performed using information on the toxicity of contaminants and assumptions regarding the extent to which people may be exposed to them. This summary of the Asarco Risk Assessment is divided into five sections: (6.1) identification of contaminants of concern (COCs), (6.2) exposure assessment, (6.3) toxicity assessment, (6.4) risk characterization, which is an integration and summary of the information gathered and analyzed in the preceding sections, and (6.5) analysis of the uncertainty involved in developing a risk assessment. In addition, Section 6.6 is a summary of the qualitative ecological risk assessment (EPA 1993).

### 6.1 IDENTIFICATION OF CONTAMINANTS OF CONCERN (SCREENING ANALYSIS)

The selection of chemicals that potentially contribute to risks to human health at the Site, known as the COCs, was a two-step process. First a screening evaluation was done comparing the

maximum chemical concentrations in soil, ground water, and air with conservative health-based concentrations and/or with appropriate criteria and standards. The chemicals selected in this first step were then evaluated, taking into account each chemical's frequency of detection, toxicity, persistence and mobility, in order to select the final COCs in each media. These are shown in Table 6-1.

Chemicals selected for soils, Class IIB ground water (potential drinking water) and air shown in Table 6-1 were selected using exposure parameters based on residential use of the Site.

Water from Class III wells is not suitable for drinking, it contains contaminants and can migrate into the bay. The COCs for Class III ground water were selected base upon the potential for humans to be exposed to these contaminants through consumption of seafood from the bay. Five metals were selected: arsenic, beryllium, lead, manganese and mercury.

All of the metals selected as COCs in ground water and soil were selected as COCs in surface water. Arsenic and lead were selected as COCs of concern in slag based upon information from the Ruston/North Tacoma Risk assessment.

## 6.2 EXPOSURE ASSESSMENT

The exposure assessment estimates the type and magnitude of exposures to the COCs at the Site. It considers the current and potential future uses of the site, characterizes the potentially exposed populations, identifies the important exposure pathways and quantifies the intake of each COC from each medium for each population at risk. The result of the assessment is a calculated daily dose of each COC per body weight for each exposure medium.

### 6.2.1 Identification of Site Uses, Exposed Populations and Exposure Pathways

Site Use Scenarios. The exposure assessment for the Asarco Site considers five land-use scenarios involving different groups of potentially exposed populations. Of the five land-use scenarios considered, one represents the current use or "non-use," and four represent projected future uses: residential, commercial, heavy industrial, and recreational.

Potentially Exposed Populations. Each scenario described above has an associated population that may be exposed to COCs at the site. The populations assumed for each of the site uses are described below.

(1) Non-Use. Currently, the Site is not being used for any purpose other than for site investigation, monitoring and demolition. For this existing use scenario, potentially exposed populations are maintenance workers, guards, trespassers and nearby residents who may be exposed to dust from the Site.

(2) Residential. The Site would be developed for residential use. People would spend 30 years of their lifetime on the Site.

(3) Heavy Industrial. The Site would be developed for industrial purposes. Workers would spend 25 years of continuous employment at the Site.

(4) Recreational or Park. All or part of the Site would be developed as a park. Visiting children and adults would be exposed to Site contaminants.

(5) Commercial. Part or all of the Site would be redeveloped for commercial uses including office buildings and shops. Office workers and merchants would be the primary exposed populations.

**TABLE 6-1. CONTAMINANTS OF CONCERN FOR SOIL, GROUND WATER AND AIR**

| Chemical | Soil | Drinking Water | Ground water Impacting the Bay | Air |
|---|---|---|---|---|
| Antimony | N | N | | |
| Arsenic | C/N | C/N | C/N | C/N |
| Beryllium | | C/N | C/N | |
| Cadmium | C/N | C/N | | C/N |
| Chromium | | C/N | | C/N |
| Copper | N | N | | |
| Lead | C/N | C/N | C/N | C/N |
| Manganese | | N | N | |
| Mercury | N | | N | N |
| Nickel | | C/N | | C/N |
| Selenium | | | | |
| Silver | N | N | | |
| Thallium | N | | | |
| Zinc | N | | | |
| Polycyclic Aromatic Hydrocarbons | C | | | |
| Polychlorinated Biphenyls | C | | | |

C Cancer Causing Chemical
N Chemical Causing Non-Cancer Health Effects
C/N Chemical Causing Both Cancer and Non-Cancer Effect

Exposure Pathways. An exposure pathway is the mechanism by which chemicals migrate from their source or point of release to the population at risk. Four elements comprise a complete exposure pathway: (1) a source of a chemical release (e.g., contaminated soils); (2) movement of contaminants through environmental media (e.g., rain moving through contaminated soil into ground water); (3) a point of potential human contact with a contaminated medium (e.g., use of contaminated ground water for drinking water); and (4) entry into the body or exposure route (e.g., ingestion of drinking water).

The exposure pathways considered for the Risk Assessment varied depending on the land use being considered and on the population potentially exposed. For example, in assuming future residential land use of the Site, the following exposures were evaluated for adults and children: (1) ingestion of slag, soil, and dust; (2) dermal exposure to soil and dust; (3) ingestion of vegetables potentially contaminated by soil contaminants; (4) inhalation of contaminants in the air as a result of dust resuspension from the site; (5) ingestion of potable ground water on the Site; and (6) ingestion of contaminated surface water in pools and seeps on the Site.

In contrast, the potential exposures considered for a site maintenance worker under the current non-use scenario were: (1) ingestion of soil, dust, and slag; (2) dermal exposure to soil and dust; and (3) inhalation of contaminants in dust.

### 6.2.2 Calculation of Exposure

EPA's Superfund guidance requires that the reasonable maximum exposure (RME) be used to calculate potential health impacts at Superfund sites. The RME is the highest exposure that is reasonably expected to occur at the site. It is calculated using conservative assumptions in order to represent exposures that are both reasonable and protective. in the Risk Assessment, RMEs were estimated for the land-use scenarios and exposure pathways described above (see Table B-5 in Appendix B for the RME exposure assumptions for potential residential use). For the residential scenario, average exposures were calculated in addition to the RMEs to represent exposures of a more typical person.

To estimate exposure, data on the concentrations of COCs in the media of concern at Site (the exposure point concentrations) are combined with information about the projected behaviors and characteristics of the people who may potentially be exposed to these media (exposure parameters). These elements of the Asarco Site are described below.

Exposure Point Concentrations: The Site was divided into six areas to calculate the contaminant levels for estimating exposure because the Site is large, the types and concentrations of contaminants vary by area, and there are several possible future land-use scenarios, see Figure 6-1. The areas are (1) the administrative area; (2)arsenic kitchen area; (3) cooling pond area; (4) stack hill area; (5) off-plant area; and (6) general plant slag area. Section 3.0 of the Risk Assessment presents details on the calculations and use of these exposure point concentrations.

Parameters: The parameters used to calculate the RME include body weight, age, contact rate, frequency of exposure and exposure duration. Exposure parameters provided in EPA Superfund guidance were used when available (i.e., for the residential and heavy industrial land uses). Parameters for the other land uses were developed for the Asarco Site using best professional judgement.

For all of the media, except surface water, exposures were estimated assuming long-term exposures to site contaminants (e.g., 30 years of daily use for residential use, 350 days/year, and 25 years, 8 hours/day for 5 days/week, for heavy industrial use). Potential risk from surface water was calculated assuming that a child accidently consumes water that has puddled on the Site. Since there were no data on contaminant levels in Commencement Bay for fish, potential risks from the consumption of fish and shellfish were estimated by comparing the levels of contaminants in selected shoreline wells with EPA's WQC for protection of human health from fish consumption.

## 6.3 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to provide, where possible, an estimate of the

relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. This is done by weighing available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals.

EPA has conducted toxicity assessments for many chemicals and publishes the resulting values, slope factors (Sfs) and reference doses (RfDs), on the Integrated Risk Information System (IRIS) or in the Health Effects Assessment Summary Tables (HEAST). With the exception of lead, which is assessed using the integrated uptake/biokinetic model (IUBK) developed by EPA, IRIS and HEAST were used as a source for Sfs and RfDs.

Sfs have been developed for estimating upper-bound excess lifetime cancer risks associated with exposure to potential cancer-causing chemicals. They are expressed in units of the inverse of milligrams per kilogram of body weight per day (mg/kg-day)-1. S/S are derived from the results of human epidemiological studies or chronic animal bioassays to which mathematical extrapolations from high to low dose and from animal to human have been applied, see Table B-6 in Appendix B.

<IMG SRC 1095122B>

RfDs have been developed to indicate the potential for adverse health effects from ingestion of COCs that exhibit non-cancer effects, such as damage to organ systems (e.g., the nervous system, blood forming system, etc.) and learning disabilities. They are expressed in units of mg/kg-per day. RfDs are estimates within an order of magnitude, of lifetime dally exposure levels for people, including sensitive individuals, that are likely to be without risk of adverse effect. Estimated contact with contaminant(s) of concern from environmental media can be compared to the RfD (e.g., the amount of a contaminant(s) of concern ingested from drinking water or soil in mg/kg/day). Reference concentrations (RfCs) are used to indicate potential non-cancer health impacts from inhalation (usually expressed in milligram per cubic meter), see Table B-7 in Appendix B.

The standard non-cancer risk assessment method described above was not used for the assessment of lead in soil. For the residential scenario, EPA guidelines specify the use of the IUBK model for estimating acceptable lead levels in soil. EPA guidance recommends that soil lead concentrations should be low enough to ensure that blood lead levels do not exceed 10 micrograms per deciliter in 95% of the potentially exposed children. The IUBK model predicts a value of 500 ppm of lead in soil to meet this goal. The exposure point concentrations calculated for lead in soil at the Site were compared to this value of 500 ppm to assess its potential non-cancer impacts.**4**

**4** Since the Risk Assessment was completed, the IUBK model has been revised. The most recent version of the IUBK model results in lead levels of 400 ppm. EPA does not believe that this significantly alters any of the conclusions in the Risk Assessment and does not have an impact upon any Site cleanup decisions.

## 6.4 RISK CHARACTERIZATION

Risk characterization is an integration and summary of the information gathered and analyzed in the preceding sections. Site-specific exposure estimates were combined with cancer Sfs and RfDs to assess potential health impacts.

To estimate cancer risk, the Sf is multiplied by the exposure expected for that chemical to provide an upper-bound estimate of the excess lifetime cancer risk. This estimate is the incremental probability of an individual developing cancer over a lifetime as a result of exposure to cancer-causing chemicals at a site.

The potential for non-cancer health impacts is evaluated by dividing the exposures calculated for each COC at the site by its RfD or RfC. The result is the Hazard Quotient (HQ). By adding the HQs for all contaminants via one exposure pathway, the HI is calculated.

The results of the Risk Assessment show that the estimated cancer and non-cancer impacts from exposure to Site contaminants in soil vary with the Site areas and with the projected future land-use. The estimated lifetime cancer risk from ingesting soil in the arsenic kitchen area, assuming residential land use, may be up to two chances in ten (2 in 10). Cancer risks in the

other five areas of the Site, assuming residential land use, range from about 45 chances in 100 to 2 chances in a 1,000. These risks are lower primarily because contaminant levels are high in the arsenic kitchen area than in the rest of the Site.

Residential exposure to soils in the arsenic kitchen area is estimated to result in an excess cancer risk of 2 chances in 10, but the risks for the other possible site-uses (industrial, commercial, recreational and non-use) in the arsenic kitchen area range from 5 chances in 100 to 2 chances in 1,000. Residential use assumptions result in the highest risks because exposures occur more often and over longer periods of time, more exposure routes are possible and children have higher exposures than adults.

Cancer risks vary by route of exposure. For example, for residential exposures in the arsenic kitchen area, ingestion of soil contaminants results in the highest cancer risk (2 chances in 10) followed by exposure to contaminants in drinking water (about 4 chances in 100), eating vegetables (3 chances in 1,000), inhaling contaminants in dust (5 chances in 10,000) and dermal exposure to soils (5 chances in 100,000), see Figure B-1 in Appendix B.

According to the National Contingency Plan, which governs Superfund cleanup, if the cumulative cancer risk on a site is greater than approximately 1 in 10,000, a cleanup action is generally taken.

The estimated HI, which is used to evaluate non-cancer impacts, is 806 in the arsenic kitchen area assuming soil ingestion and residential land-use. HIs in this area for other land uses range from 7 to 205, see Figure B-2 in Appendix B. The HI for ground water ingestion in the arsenic kitchen area assuming residential land use is 219. HIs above 1 are used in the Superfund program to indicate that site remediation may be necessary.

Arsenic is responsible for the majority of the cancer risk at the Site. Several metals, including arsenic, lead, and copper are responsible for the non-cancer impacts at the Site.

Exposures to arsenic, copper and lead in site surface water may result in acute hazard to children who swallow this surface water. The concentrations of four metals, arsenic, mercury, manganese and beryllium, in Class III ground water near the bay are in excess (above a 1 in 10,000 cancer risk or above RfDs) of EPA's water quality criteria for protection of human health from fish consumption. Aniline is in Class III ground water at concentrations that exceed a risk of 1 in 10,000 assuming fish consumption.

Although the Risk Assessment did not include an evaluation on the adjacent slag peninsula, potential health impacts in this area are expected to be similar to those in Area 6, the general plant slag area. Area 6 was evaluated in the Risk Assessment for arsenic exposure. Assuming residential exposures, cancer risk in Area 6 may be as high as 2 in 1,000 and the HI is above 1. Therefore, both the slag peninsula and the general plant slag area contain arsenic at levels that may result in cancer and non-cancer risks above Superfund levels of concern.

## 6.5 UNCERTAINTY ANALYSIS

The numerical results of a risk assessment (HQs and cancer risk values) are uncertain because of limitations in knowledge regarding exposure and toxicity. Where information is incomplete, assumptions must be made: the greater the uncertainty, the more conservative the assumptions to be protective of public health. Even when actual characteristics of a population are known, selected exposure parameters are biased toward over-estimating rather than under-estimating risk for the majority of the population. A discussion is presented below on how uncertainties in the risk assessment process might overestimate or underestimate risk.

Some of the factors that may lead to a possible overestimation of risk are as follows:

(1) The majority of the soil samples were collected in areas of the Site thought to be contaminated based on past smelter operations, so the whole Site might not be as contaminated as these samples indicate;

(2) Because of a lack of information, the exposure parameters (e.g., exposure frequency and duration) used in the risk assessment are derived in a conservative manner;

(3) EPA assumes that there is a cancer risk associated with all exposures to cancer-causing chemicals and that this risk increases as exposure increases. This assumption may not be true for all carcinogens;

(4) RfDs are developed from animal data using uncertainty factors to take into account the differences between animals and people and the differences in experimental versus environmental exposures. For some chemicals, these uncertainty factors may be overly conservative.

Conversely, there are factors that may lead to a possible underestimation of risk. Some of these factors are as follows:

(1) Some of the unsampled areas of the site may have higher concentrations than those areas sampled;

(2) Soil exposure assumptions were made using surface soil concentrations; some subsurface soils on the Site have contaminant levels that are higher;

(3) The lack of data available for the derivation of exposure factors and toxicity factors (Sfs and RfDs) could result in factors that are too low, although the use of uncertainty factors makes this unlikely;

(4) Estimated cancer risks for arsenic, which is the contaminant of greatest concern at the Site, may be too low. They were evaluated using the Sf in the IRIS data base, which takes into account only arsenic's ability to cause skin cancer although more recent analyses have shown that arsenic ingestion can also elevate risks of internal organ cancers; and

(5) Contribution of site contaminants to fish ingestion exposure by surface water run-off, outfalls, sediments or existing contaminants in the Bay from past Site discharges were not evaluated.

For more detail regarding uncertainty, see Section 6.0 of the Risk Assessment.

### 6.5.1 Comparison of the Risk Assessment Results to Superfund Regulations and Guidance

The results of the Risk Assessment are evaluated to determine if the Site needs to be cleaned up and what cleanup actions are warranted. This evaluation is made by determining whether the cancer risks and the non-cancer health impacts exceed those considered to be of concern to EPA's Superfund program as defined in EPA's National Contingency Plan (NCP) and "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," April 22, 1991, OSWER Directive No.9355.0-30.

Where the cumulative carcinogenic site risk to an individual based on RME for both current and future land use is less than approximately one in ten-thousand, and the non-cancer causing HQ is less than 1, cleanup on a site is generally not warranted unless there are adverse environmental impacts. As described above in the risk characterization section, the cancer risks and HIs calculated were in excess of these two criteria. Based on the results of the Risk Assessment, EPA has determined that cleanup is necessary at the Site.

## 6.6 ECOLOGICAL RISK ASSESSMENT

EPA developed an Ecological Risk Assessment to assess the impacts of contamination on sea life, plants and pets. EPA based its assessment on available literature and Site-related data. The assessment suggests that the metals in soils may have an impact Site vegetation. Based on exceedances of federal and state water quality criteria in ground water and surface water and exceedances of state sediment quality criteria in off-shore sediments, sea life in the off-shore sediments have been adversely affected by releases from the Site.

## 6.7 EPA'S CLEANUP OBJECTIVES AND TWO-PHASE APPROACH

Cleanup actions are necessary because current conditions at the smelter property and on the slag peninsula pose unacceptable long-term risks for current workers, possible future visitors or residents, and sea life and animals. EPA is recommending a comprehensive cleanup strategy in order to address the multiple sources of contamination at the smelter property and slag peninsula. EPA's objectives for the cleanup are identified in Table 6-2. The performance standards for the selected remedy are found in Section 9.

EPA will accomplish its cleanup objectives at the smelter property and slag peninsula in two phases. The first phase, which is described in this ROD, includes activities to control continuing sources of contamination at the smelter property and slag peninsula. These "source control" activities will remove or control portions of the property that are known to be contributing to the contamination of surface water and ground water. Such activities will also minimize possible exposure to contamination via direct contact, and therefore further reduce Site risks.

The second phase could include additional active clean up measures, if necessary, to restore surface water or groundwater quality and will be described in a subsequent ROD. An example of an active measure would be installing a groundwater pump and treat system at the Site. Further active measures would not be necessary if ground water or surface water clean up levels are achieved as a result of the source control measures. In this case, a "no-action" ROD would be issued.

Although sampling of ground water has been conducted since 1987, EPA believes that the following significant uncertainties remain regarding how contaminants move into and through the ground water at the smelter property.

- Impacts of clean up actions on groundwater quality.
- Extent to which concentrations of contaminants in the ground water are naturally being lowered through chemical reactions currently taking place in the groundwater.
- Extent to which dilution by seawater or ground water may also be reducing concentrations of contaminants.
- Loadings of contaminants (for example, kilograms per day) discharged to Commencement Bay via groundwater pathways.

EPA will continue to require monitoring of ground water to provide a better assessment of ground water conditions, an evaluation of the effectiveness of soil and surface water clean up actions on groundwater quality and an evaluation of the practicability of groundwater remedial measures.

**TABLE 6-2: CLEANUP OBJECTIVES**

CONTAMINATED SOIL, DUST AND SLAG

(a) Prevent ingestion and inhalation of contaminated soils slag and dust containing contaminants in concentrations above applicable or relevant and appropriate requirements (ARARs) or above risk-based goals when ARARs are not available or protective;

(b) Reduce releases of contaminants from soil to ground water by:

) Removing the source areas where contaminants leach from soil to ground water

) Limiting the surface water that runs into soil and slag;

(c) Limit the erosion of slag to the off-shore sediments.

ON-SITE GROUND WATER AND SURFACE WATER

(a) Prevent ingestion of potable (Class IIB) ground water and On-site surface water (e.g., seeps, puddles) containing contaminants above ARARs or above risk-based levels when ARARs are not available;

(b) Reduce contact between contaminated soil, slag or fill and surface water and ground water.

GROUND WATER, SURFACE WATER, AND TREATED WATER DISCHARGED TO COMMENCEMENT BAY

(a) Reduce discharge to Commencement Bay of contaminated waters containing contaminants in concentrations above ARARs or risk-based goals when ARARs are not protective or not available;

(b) Reduce leaks and spills of contaminated surface water from drainage and sewage systems.

## 7.0 DESCRIPTION OF ALTERNATIVES

Asarco's Feasibility Study (FS) identified a range of alternatives to achieve the clean up objectives and remediation goals for the smelter property and slag peninsula (Table 7-1). The alternatives represent significantly different approaches to cleanup the Site and protect human health and the environment. The alternatives are different, for example, in terms of their effect on the contamination, what is necessary to maintain their effectiveness, and their cost.

The range of alternatives presents several choices for cleaning up contamination at the Site. EPA decided among the choices in order to select the cleanup remedy for the Site.

In addition to the various cleanup alternatives identified below, demolition of the remaining buildings and structures on the Site and use of the Ruston/North Tacoma residential soils as a sub-base for the Site wide cap were evaluated. In addition to the cleanup alternatives selected, long-term operation and maintenance of the cleanup activities and coordination with Site redevelopment is necessary.

The following section summarizes the cleanup activities under each of the FS alternatives and their estimated costs.

### 7.1 SUMMARY OF ALTERNATIVES

Plant Site-Soils (and Slag Peninsula)

Several cleanup alternatives were evaluated in the FS for plant site soils (PSS), slag at the plant site, and the slag peninsula.

PSS-1 is "no action." This alternative means that no further cleanup actions would be performed. This alternative is included to serve as a baseline for the evaluation of other alternatives.

PSS-2 is "limited action" and would focus on restricting access to the Site by fences with warning signs and deed restrictions to prohibit wells from being drilled into contaminated ground water and future use or development on the Site. The estimated cost of this alternative (capital plus operation and maintenance) for both PSS and the slag peninsula is $1.5 million and the estimated time to install fencing and warning signs is one month ($1.5 million and one month).

PSS-3 includes two types of caps for the plant site and slag peninsula and three different possibilities for excavation and disposal of soil. In general, the purposes of a cap are to prevent the direct contact of people, animals, and surface water with contaminated soils and slag, to prevent contaminated soil from being wind-blown, and to reduce movement of soil contaminants through surface water into ground water. A cap can also be used to make drainage/grade improvements and to prevent contaminated surface water from pooling on the Site.

Caps:

PSS-3A A low permeability (10-7 seconds/centimeter) asphalt cap on areas of the plant site and the slag peninsula that are not currently paved ($6.3 million and three months).

PSS-3B Soil cap over entire plant site and the slag peninsula that includes a Ruston/North Tacoma residential soils sub-base, low-permeability clay layer, gravel drainage layer, and clean topsoil, see Figure 7-1 ($7.6 million and five to seven years).

Excavation/Disposal:

PSS-3C Excavate soil and granular slag from the source areas (see Figure 1-1); dispose of materials, together with demolition debris and Study Area soils, in an OCF, a hazardous waste landfill with a low permeability liner and cap, leak detection, collection and removal system, leachate collection and removal system and surface run-on and run-off control systems, located in the current parking lot, see Figure 7-2. ($23.5 million and seven years).

PSS-3D Same as PSS-3C but dispose excavated materials in an OCF located in the plant slag area ($23.7 million and seven years).

PSS-3E Excavate, treat, and dispose source area soils and demolition debris in an off-site hazardous waste landfill ($75 million and six months).

Estimates of Materials To Be Excavated (in cubic yards)*

- Arsenic Kitchen . . . . 62,000.00
- Cooling Pond . . . . . 18,100.00
- Stack Hill. . . . . 54,000.00**
- Copper Refinery . . . . 14,050.00
- Fine Ore Bin. . . . . 9,850.00
- Demolition Debris . . . 82,000.00

SUBTOTAL . . . . . 240,000.00

- Residential Soils . . . 187,000.00

TOTAL . . . . . 427,000.00

* The Southeast Area of the Plant is not included because it is not practicable to excavate the wood debris buried in slag that is contaminating the ground water, see Section 8 - Implementability.

** This estimate includes 39,700 cubic yards from and around the car and railroad tunnels.

**TABLE 7-1. CLEANUP ALTERNATIVES**

Plant Site Soils (PPS)

PSS-1 No Action (used for comparison).
PSS-2 Limited Action (fences and warning signs).
PSS-3 Capping and/or Soil Excavation

PSS-3A Asphalt cap over unpaved areas on Site and slag peninsula.

PSS-3B Soil cap over entire Site and slag peninsula.

PSS-3C Excavate soil from some areas and dispose in OCF in parking lot.

PSS-3D Excavate Soil from source areas and dispose in OCF in plant slag area.

- Bermed structure in parking lot.
- Three linear concrete cells with vertical walls in NE arsenic kitchen area.
- Circular concrete tank, 525 feet in diameter in arsenic kitchen area.
- Circular bermed structure, 600 feet in diameter, in NE arsenic kitchen area.

PSS-3E Excavate soil from source areas, treat and dispose in offsite landfill.

PSS-4 Treating Soil from Source Areas:

PSS-4A Treat soil, put back treated soil in excavated areas, dispose demolition debris in OCF.

PSS-4B Treat soil, dispose treated soil in offsite landfill, dispose demolition debris in OCF.

Surface Water (SW)

SW-1 No Action (used for comparison).
SW-2 Monitoring Program
SW-3 Cleanup Existing Surface Water Drainage System:

SW-3A Repair leaks and abandon unused portions.

SW-3B Abandon entire system. Construct new drainage system.

SW-3C Slip line existing pipes.

SW-3D Re-route surface water to alternate outfalls.

SW-4 Collect and Treat Surface Water.

Shoreline Armoring

- Riprap (place rocks on shoreline).
- Artificial beach nourishment (sand and gravel).

Ground Water and Marine Sediments

- Additional monitoring and sampling.

<IMG SRC 1095122C>
<IMG SRC 1095122D>

Additional On-Site Disposal Alternatives:

After completion of the FS, Asarco submitted further alternatives for constructing an OCF with a capacity of 240,000 cubic yards as follows:

- Bermed structure in the parking lot built into the hillside and bermed on three sides (estimated cost is $18 million), or
- Three concrete cells in a row with vertical walls located northeast of the arsenic kitchen area. The approximate size of each cell is 200 by 1200 by 45 feet high ($32 million), or
- Circular concrete tank, about 525 feet in diameter, located northeast of the arsenic kitchen area ($22 million), or
- Circular bermed structure, about 600 feet in diameter, located northeast of the arsenic kitchen area ($22 million).

Soil Treatment:

The two PSS-4 alternatives involve treatment of contaminated soils at the plant site using chemical fixation and disposing of them in different locations. Chemical fixation means mixing excavated contaminated materials with cement and lime in order to reduce the mobility of the contaminants.

PSS-4A Put back treated soils in excavated areas on-site and cover the area with a cap. Demolition debris would be disposed in an OCF ($48.2 million and six months).

PSS-4B Dispose of treated soils in an off-site landfill and demolition debris in an OCF ($86.4 million and six months).

Surface Water

Several cleanup alternatives were evaluated to address contaminated surface water at the Site.

SW-1 is no action.

SW-2 relies on soil removal and groundwater remediation to reduce the release of contaminants (for example, arsenic) to surface water. A surface water monitoring program would evaluate the effectiveness of this approach. The estimated cost of the monitoring program is $943,000 and the estimated duration is ongoing.

SW-3 consists of four different measures with respect to the existing surface water drainage system:

SW-3A Repair leaks in the existing system; ongoing maintenance to prevent leaks in the future; plug and abandon portions of the existing system not used ($737,000 and three months).

SW-3B Plug and abandon the entire existing system. Construct new drainage system, including pipes, inlets, and manholes, that prevents leaks and resists corrosion ($1.6 million and 3 months).

SW-3C Insert smaller PVC pipe (or slip lines) into existing pipelines; seal existing drains and sumps and manholes; replace open ditches with new pipes ($969,000 and three months).

SW-3D Re-route surface water that runs onto the Site to alternate drain outfalls ($439,000 and two months).

SW-4 would collect and treat contaminated surface water in a water treatment plant located on the plant site ($23.6 million and ongoing).

Shoreline Armoring

The most effective measure to prevent erosion of the slag shoreline into Commencement Bay is called shoreline armoring.

There are two main types of armoring:

- Line the shore along the smelter property and the slag Peninsula with riprap (large rocks) underlain with 2 feet of smaller rock, see Figure 7-3. Riprap would not be installed on the interior portion of the slag peninsula because of the minimal slag erosion which occurs there ($6.2 million and from six to twelve months).

- Use artificial beach nourishment, which consists of depositing sand and gravel to form a pebble beach. Sand and gravel that erodes would need to be replaced on an annual basis ($1.4 million and two months for beach nourishment).

Mitigation for damage caused to natural resources (e.g., intertidal habitat) would be required for either of these options. The full extent and design of armoring is presently unknown, so the cost to complete mitigation (e.g., replacement of damaged resources) is not estimated. The time to complete mitigation could be up to 2 years, which could be done concurrently with or immediately after shoreline armoring.

## 7.2 SIGNIFICANT PUBLIC COMMENTS AND ADDITIONAL ANALYSES

EPA received many comments on its Proposed Plan for cleaning up the site. These comments are responded to in the Responsiveness Summary (Appendix A). In this section, EPA summarizes some of the most significant technical comments and describes the additional analyses that EPA conducted in response to such comments.

### 7.2.1 On-Site Containment Facility Comments

Several commenters recommended that if the OCF were selected, it should be comprised of multiple cells holding different concentrations of contaminated soil. The reasons given for an OCF with multiple cells were that it would provide one more level of protection against leaking, provide more precise monitoring capabilities, and be easier to remove soil in the future should an innovative treatment technology become available.

<IMG SRC 1095122E>

Although there may be situations where multiple cells are appropriate for hazardous waste landfills, EPA does not agree that multiple cells are warranted for the OCF for this Site for several reasons.**5** First, the contaminated soil and debris that will be disposed is contaminated only with metals rather than a mixture of metals and organic contaminants. Therefore, even though a wide range of metal concentrations found is in soil, adverse reactions caused by different types of contaminants mixing together within the OCF are not likely to occur. Another reason adverse reactions are not expected is that contaminants leaching out of the soil are expected to decrease once the OCF is closed (i.e., when the contaminated soil and debris is isolated from surface and ground water).

**5** The reasons that landfills are normally separated into multiple cells is to (1) separate incompatible wastes and the leachate from those wastes and (2) to limit the open portion of a large landfill that will operate over many years so as to limit the area available for collection of precipitation. Under this scenario, each cell would be constructed and covered prior to constructing another cell. Neither of these reasons are relevant to the Asarco OCF as the waste to be placed is not incompatible and the time the OCF will be open is short.

EPA does not agree that multiple cells would allow for more precise monitoring of down-gradient ground water. The reason is that wastes with the same contaminants would be disposed in each of the cells so in the event that leachate move through the OCF liners and reaches the ground

water it would be difficult to identify from which cell it came.

Operation and maintenance of several leachate collection and removal systems due to multiple cells would be more difficult than operating a single cell leachate collection and removal system. EPA does not believe that operating multiple leachate systems would significantly increase the effectiveness of the OCF. Finally, there do not appear to be any new promising treatment technologies on the horizon that would justify disposing soils with different levels of contamination in separate cells.

**7.2.2 Soil Treatment Comments**

Other commenters recommended that contaminated soil should be treated prior to disposing it in the OCF. The basis for this recommendation was to provide more protection should part of the OCF fail in the future and to be consistent with land disposal restrictions (LDR), which require treatment prior to disposal.

In response, EPA performed an analysis to determine whether treating soils prior to disposal in an OCF is necessary. EPA compared the potential for contaminants leaching from an OCF into underlying ground water if soils were not treated versus if some (15 percent) of the soils were treated. EPA used 15 percent to represent the percentage of soils that are most highly contaminated.

First, EPA assumed that the OCF had a "good" liner and a "good" cap, meaning that the liner and cap conformed to landfill performance requirements. EPA compared estimated leachate rates from this OCF if soils were not treated versus if 15 percent of soils were treated. In both cases, the predicted contaminant loading to ground water was minimal. Treatment did not provide a significant advantage in effectiveness.

Second, EPA assumed that the OCF had a "poor" cap and no liner. Again, EPA compared estimated leachate rates for no treatment versus 15 percent treatment. The predicted rate for no treatment was 106 grams of arsenic per day and the predicted rate for 15 percent treatment was 93 grams of arsenic per day. EPA concluded that this difference is not significant and that treatment did not provide an advantage in effectiveness (but the analysis does show that maintenance of the OCF's cap and liners is important). See Appendix D.

Based on this analysis, EPA believes that treating soils prior to disposal in a properly maintained OCF is not necessary.

In response to the LDR comment, EPA's policy is that waste that is consolidated within an area of contamination is not "placement" and therefore does not require compliance with LDRs (i.e., treatment prior to disposal).

After the Proposed Plan was issued, Asarco submitted its final treatability analysis. One conclusion was that treating soils results in a 30 to 60 percent increase in the volume of soil. The analysis also reported results of additional TCLP and water leaching tests conducted on the treated soil. The TCLP data taken 28 days after treatment, although well below regulatory levels, is slightly higher than data taken immediately after treatment. It is not certain whether this indicates that treatment would be less effective over time in immobilizing contaminants. However, favorable results were obtained from water leaching tests, another measure of the effectiveness of stabilization/solidification. Asarco's analysis is in the administrative record.

**7.2.3 Shoreline Armoring Comments**

Several commenters questioned whether the slag shoreline was eroding, whether the eroded slag particles caused an adverse impact on the adjacent marine environment, and why the shoreline needed to be armored as it is already providing a suitable habitat for marine biota. If shoreline armoring was determined to be necessary, commenters also questioned how it would be anchored to the existing slag face and why riprap (large rocks) was selected instead of artificial beach nourishment (small rocks and sand) to armor the slag.

The need for shoreline armoring is based on the visual observation that slag is eroding in several locations along shoreline and on a report published by Battelle (Crecelius 1986) that

showed that metals released from freshly exposed slag are toxic to marine organisms for up to three to four months. After evaluating the comments received, EPA still believes that some amount of shoreline armoring will be necessary. However, EPA has determined that before the design of the shoreline armoring begins additional data should be collected to determine (1) the extent of shoreline erosion; (2) how and where armoring should be placed; and (3) the impact of armoring to the existing marine biota versus the impact of not armoring slag to the marine biota over time.

After reviewing the most recent literature and discussing riprap versus artificial beach nourishment with the Corps of Engineers, EPA believes that the marine environment off-shore of the Asarco Site would not support artificial beach nourishment due to the high wave energy and fast currents in the area (See memo by ROY F. WESTON, Inc. in the Administrative Record, Section 2.4.1).

## 8.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

EPA uses nine criteria to identify its preferred alternative for a given site or contaminant. With the exception of the no action alternative, all alternatives must meet the first two "threshold" criteria. EPA uses the next five criteria as "balancing" criteria for comparing alternatives and selecting a preferred alternative. After public comment, EPA may alter its preference on the basis of the last two `modifying' criteria.

This section evaluates both the alternatives developed by Asarco (described in Section 7.0) and the remedy selected by EPA (described in Section 9.0) based on the nine criteria described in Table 8-1. The purpose of this evaluation is to highlight the most significant advantages and disadvantages of the alternatives in relation to each of the nine criteria (a more detailed evaluation is provided in Table 5-4-1 of Asarco's FS).

All nine criteria are important; but they are weighed differently in the decision-making process depending on whether they describe a required level of performance (threshold criteria), provide for consideration of technical or socioeconomic merits (balancing criteria), or involve the evaluation of non-EPA reviewers that may influence an EPA decision (modifying criteria). The modifying criteria are generally considered in altering an otherwise viable alternative.

The no-action and limited action alternatives, discussed in Section 7.0, are not protective of human health and the environment and thus are not further evaluated under the nine criteria. Neither alternative effectively addresses contaminants moving into the ground water even though human health may be somewhat protected through administrative or legal measures identified under "limited actions."

### (1) Overall Protection of Human Health And The Environment

The key factor in evaluating the overall protection provided by each of the alternatives is the extent to which an individual's exposure to contaminated soil, slag or surface water is reduced or eliminated and the extent to which the contaminants moving into surface water and ground water are reduced or eliminated.

Plant Site Soils. Asphalt and multi-layer soil caps are protective because they reduce direct contact with contaminated soils and prevent wind-borne releases. Caps also reduce the migration of contaminants from soil to surface water or ground water by reducing surface water flowing through the soil. The more impermeable a cap is, the less surface water will penetrate the cap.

**TABLE 8-1. EPA'S NINE EVALUATION CRITERIA**

THRESHOLD CRITERIA

1. Overall protection of human health and the environment - How well does the alternative protect human health and the environment, both during and after construction?

2. Compliance with federal and state environmental standards - Does the alternative meet all ARARs and state and federal laws?

Alternatives that are not protective or do not attain ARARs are not evaluated further under the remaining criteria.

BALANCING CRITERIA

3. Long-term effectiveness and permanence - How well does the alternative protect human health and the environment after completion of cleanup? What, if any, risks will remain at the site?

4. Reduction toxicity, mobility, or volume through treatment - Does the alternative effectively treat the contamination to significantly reduce the toxicity, mobility, and volume of the hazardous substance?

5. Short-term effectiveness - Are there potential adverse effects to either human health or the environment during construction or implementation of the alternative? How fast does the alternative reach the cleanup goals?

6. Implementability - Is the alternative both technically and administratively feasible? Has the technology been used successfully on other similar sites?

7. Cost - What are the estimated costs of the alive?

MODIFYING CRITERIA

8. State acceptance - What are the state's comments or concerns about the alternatives considered and about EPA's preferred alterative? Does the state support or oppose the preferred alternative?

9. Community acceptance - What are the community's comments or concerns about the preferred alternative? Does the community generally support or oppose the preferred alternative?

Soil excavation in source areas would significantly reduce migration of contaminants to ground water and would, therefore, be protective of off-shore sediments and sea life. Disposal of soils in an appropriate disposal facility, either on site or off site, would prevent direct contact to humans or animals and prevent releases to the environment in the future. Off-site disposal would be protective of ground water and nearby populations because it would permanently remove contaminated source area soils off the Site. An on-site disposal facility (OCF) in the parking lot area, on the plant slag, or in the arsenic kitchen area can be designed with the appropriate engineering measures and institutional controls to minimize or eliminate direct contact with the contaminated soils disposed in it. These measures will also reduce the potential for releases to the environment from the OCF. The OCF is a permanent disposal facility for soils and debris. Treatment of soils would also significantly reduce the potential for the release of chemicals into the environment.

Using the residential soils as a sub-base for a cap is protective because the soils would be placed under a low permeability clay layer and soil cap. The appropriate institutional controls would prevent disturbances of the cap. These soils have not been found to leach above regulatory levels.

In addition, these soils will be disposed on top of the non-source area soils and slag that are not located near ground water. Residential soils contain significantly lower concentrations of contaminants than the material they will be placed on. Therefore, disposing residential soils on site will not add to existing groundwater contamination.

Demolition. The conventional demolition techniques for dismantling buildings, the only alternative evaluated, will be performed in a manner that is protective by first cleaning the buildings and then using dust suppression measures during the demolition activities. Any water generated during the dust suppression activities will be collected to the maximum extent practicable to prevent release into the environment. The effectiveness of dust suppression activities will be evaluated with ambient air monitoring.

Surface Water. For surface water, the replacement of the existing drainage system is protective of the environment because contact between surface water and contaminated sediments in the pipes would be eliminated. Releases of contaminated surface water to ground water through leaks in the pipes would also be eliminated. Slip-lining or repairing the existing drainage system may achieve these benefits, however, the location of all of the existing pipes is not known and many of the existing pipes may not be large enough to be slip-lined. These reductions would result in lower discharges of contaminants to Commencement Bay. The diversion of surface water run-on away from contaminated soil would also control contact between surface water and contaminated soil.

Implementation of erosion controls and other best management practices during the cleanup would control contact between surface water and newly exposed contaminated soil and reduce the transport of contaminants to Commencement Bay. Treatment of surface water would permanently reduce contaminants currently discharged through outfalls to Commencement Bay, but unless the source(s) of contamination is removed, treatment time would be indefinite.

Ground Water. Although specific active groundwater cleanup activities (e.g., pump and treat) will not be conducted during this phase of cleanup, the contaminant loading to the ground water, and to Commencement Bay is expected to decrease significantly based on soil removal, capping of the soil and slag and replacing the surface water drainage system. The potential for exposure to humans will be significantly decreased by placing deed restrictions on the property to prevent the use of ground water.

Shoreline Armoring. Both shoreline armoring and artificial beach nourishment are protective because they control the erosion of the slag shoreline into Commencement Bay and will reduce contaminant leaching from fleshly exposed slag faces.

All actions are protective except the no-action, monitoring, or limited action alternatives.

**(2) Compliance With Federal And State Environmental Standards**

ARARs for all of the alternatives are identified in Table B-8 in Appendix B of this ROD. The following discussion highlights the more important ARARs for this cleanup.

All alternatives will comply with ARARs except the monitoring or limited-action alternatives.

Plant Site Soils And Debris. For soil, an important requirement is attaining the soil cleanup levels and complying with the requirements for selecting cleanup actions under the state's Model Toxics Control Act (MTCA).

Residential standards for soil cleanup will be attained through removal of soil from the source areas and capping the Site (see Figure 7-1 for diagram of soil cap). Institutional controls would ensure that the integrity of the cap is maintained. Construction and maintenance of a cap would allow for a variety of potential uses, including residential, recreational, and commercial uses. MTCA's requirement for selection of cleanup actions is discussed in Section 10.4 ("Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable").

Requirements for design, construction, and operation and maintenance of an OCF are set forth in federal and state law (see Section 9.9, performance standards for the OCF). Federal and state laws for hazardous/dangerous waste landfills include requirements for groundwater monitoring, closure and post-closure, and landfill design and construction.

Both EPA and the State of Washington have "Area of Contamination" policies that provide flexibility when consolidating hazardous or dangerous waste within the portion(s) of the Site that contain already-existing continuous contamination. For example, consolidation of soil and debris on site will not trigger requirements for treatment in order to comply with LDR.**7**

Under the Clean Water Act, mitigation measures must be conducted if capping or other cleanup measures will result in adverse impacts to wetlands or other natural resources.

**6** A cap may not be necessary in some areas of the site if the contaminant levels remaining in the soil after excavation are below the action levels for the Ruston/North Tacoma residential cleanup (230 ppm arsenic, 500 ppm lead) or comparable levels for other contaminants as determined by EPA and Ecology. In such event, soil removal would be combined with adoption of appropriate components of the community protection measures program being used in Ruston/North Tacoma.

**7** The Proposed Plan referenced the Corrective Action Management Unit (CAMU) rule. Because treatment has not been selected for the cleanup, the CAMU rule is not an ARAR.

Demolition. The buildings remaining on site will be demolished as part of this cleanup. Requirements that were used during the previous demolition phase will be applicable to the remaining demolition (see EPA's ROD dated December 31, 1990). These requirements include testing of debris to determine whether it is a hazardous or dangerous waste and, if so, handling,
storage, and disposal of such waste in accordance with federal and state standards. Temporary on-site storage of hazardous waste (e.g., materials removed from the fine ore bins building or source area soils that are excavated while the OCF is under construction) will comply with requirements for waste piles.

Surface Water. Best management practices (BMP) will be used during soil excavation to reduce contact between surface water and newly exposed contaminated soils. Examples of BMPs include sediment ponds, silt fences, diversion ditches, and cut and fill slopes.

The objective of surface water cleanup is to attain requirements for stormwater discharges and surface water cleanup standards under MTCA (see Section 9.9 for surface water performance standards). It may be necessary to establish a mixing zone to attain the discharge limitations for surface water from the point source discharges at the Site (the three surface water outfalls). A mixing zone measures compliance at a location in the surface water near, rather than at, the point of discharge and is authorized under WAC 173-201A-100. Whether a mixing zone is appropriate and, if so, the parameters of a mixing zone, will be determined during remedial design.

Ground Water. EPA will implement a two-step approach with respect to restoring ground water. The first step is removing the contaminated soils that are the sources of contamination in ground water and continued monitoring to determine the impacts of source control on groundwater

quality. The second step would include further active measures to cleanup ground water, if necessary and as feasible, to attain the required groundwater cleanup levels under MTCA.

The source control measures in the first step are in effect an interim action with respect to ground water. Because it is not certain that source control measures alone will restore groundwater quality to required levels under MTCA, EPA is using the interim measures waiver for groundwater ARARs. This means that attainment of the ground-water cleanup levels is deferred until the effectiveness of source control can be evaluated. EPA's preliminary remediation goals for ground water (see Section 9.9) will be used as benchmarks for this evaluation.

In the interim, EPA will require Asarco to implement institutional controls (deed restrictions) to ensure that ground water at the Site is not used for drinking water.

Shoreline Armoring. Under the Clean Water Act, mitigation measures must be conducted if armoring will result in adverse impacts to intertidal habitat.

**(3) Long-Term Effectiveness And Permanence**

Plant Site Soils. The alternatives that excavate contaminated soils in source areas would be more effective over the long-term in restoring ground water and surface water quality and preventing direct contact and ingestion than alternatives that leave such soils in place, even if capped. Permanently removing the primary sources of contamination is a key factor in cleaning up ground water and surface water.

The most widely discussed issue for this cleanup has been how to dispose the contaminated soil that is excavated from the source areas. The alternatives range from disposing the soils in an OCF, treating the soils by solidifying them using a cement and lime matrix and using the treated soil as sub-base for a site cap, treating such soils and disposing them in an on-site solid waste landfill, or transporting the soils to be disposed in an off-site hazardous waste landfill.

The following paragraphs discuss the effectiveness of each of these alternatives over time.

Plant Site Soils - Treatment. An effective treatment method for the metal-contaminated soils at the Asarco smelter is solidification/stabilization. This method does not destroy or detoxify the contaminants in the soil but rather binds the contaminated soil with lime and cement to create a concrete matrix. The contaminants are less able to migrate through the soils into other media, for example, ground water, surface water, or air.

Asarco has performed pilot tests on nearly 500 cubic yards of contaminated soil from source areas at the smelter. The results, some of which were received after the Proposed Plan was issued (see Appendix C for a summary of the report), generally show that treatment will effectively bind the contaminants for a long time. The potential for contaminants to migrate into the ground water or surface water if the treated soil comes into contact with water is expected to be minimal, if the concrete matrix remains stable.

This method of treatment, however, has been used on contaminated soils at other Sites only in the last several years. Therefore, it has not yet been proven that actual results of solidification over many years will match the predicted results from pilot tests. Also, TCLP leaching results taken 28 days alter soil treatment show a slight increase compared to TCLP results taken immediately after treatment. Although both sets of results are below hazardous waste levels, it is not certain whether this is indicative of a long-term trend towards increased leaching.

In addition, there are other long-term concerns with selecting treatment at this Site. Many of these concerns relate to the compatibility of cleanup with future uses of the Site. It should be noted that Asarco's land use plans were based on an OCF. Disposing treated soil on site is not necessarily compatible with these plans for the reasons noted below. These "disadvantages" compared to disposal in an OCF arise because land use plans based on treatment were not developed. Current land use proposals do not discuss whether the development "disadvantages" of disposing treated soils on site can be made compatible with land use plans.

The primary concern is that mixing in the treatment additives increases the volume of the

contaminated soil approximately 30 to 60 percent. It is not certain that treated soil can be compacted to significantly reduce the increased volume. Because it is important that the concrete matrix remain relatively undisturbed and because the treated soil may not be stable enough to support buildings above it, disposing of an increased volume of material on site may impact plans for future construction on the property. Treated soil would have to be disposed only in areas where no construction is likely to occur.

It would also be necessary to monitor the Site to verify the continued effectiveness of treatment, Because sampling treated soil through a site cap is not recommended (punching holes through a low permeability cap is not a good practice), EPA most likely would require continued monitoring of ground water to detect whether concentrations of contaminants in ground water are increasing as a result of metals leaching out of the treated soil. If treated soil is widely dispersed on-site and problems in ground water are detected, it may be difficult to determine which specific areas of treated soil are responsible, thus making it harder to correct the problem. Disposal of treated soil in a solid waste landfill would eliminate many of the problems associated with future Site development and monitoring of the treated soils beneath a site cap.

Another concern is that the effectiveness of treatment was not demonstrated on oversize material (greater than 2 inches in diameter) such as gravel, cobbles, bricks, wood, concrete and other masonry and building debris. Whether a modified process, which could include crushing the oversize material into smaller pieces, would be effective is not known. Accordingly, it is possible that even if treatment was selected, there may still be a significant volume of oversize materials from the Asarco Site that would need to be disposed in another manner.

The last concern is that because concentrations of contaminants are not reduced, it would still be necessary to cover the treated soil with a cap. The cap would need to be inspected and maintained on a regular basis in order to ensure that people do not come into contact with the treated soil in the future. Earthquakes or landslides that affect the cap would need to be responded to in order to prevent contact with the treated soil. It should be noted, however, that because contaminated soil and slag outside the source areas will remain at the Site, a cap over the entire Site will be necessary, and will require inspections, regardless of whether treatment is used.

Plant Site Soils - Disposal in an OCF. This option calls for disposal of contaminated soil and debris in a landfill that would be constructed on site known as the OCF. The design, construction and operation of the OCF would conform to requirements for hazardous waste landfills. Three important issues are discussed in this section regarding an OCF: what type of structure will be built, how that structure will be maintained, and where it will be located on the Site.

The purpose of the OCF is to isolate the contaminated source area soils and debris in a confined area so that contaminants do not migrate into the environment. The OCF will be composed of multiple layers of clean soil and clay that are several feet thick with synthetic liners above, below and around the contaminated soil. These multiple layers serve two primary purposes: to prevent rainwater and ground water from moving into the OCF (water coming into contact with contaminated soil and debris increases the movement of contaminants) and to collect, remove and dispose of any liquids from inside the OCF. As long as these multiple layers are designed, constructed and maintained properly, the OCF will be effective over the long-term in isolating the contaminated materials. Proper design and construction of the OCF will include safeguards to prevent or minimize damages resulting from earthquakes or landslides to the maximum extent practicable.

In addition to the multiple layers of the OCF acting as a barrier to groundwater infiltration, a groundwater diversion system will be constructed in order to re-route ground water away from the OCF.

The primary disadvantage of the OCF option is that the soil and debris will not be treated and will continue to contain high concentrations of contaminants. If there is a breach of the OCF structure, the soil and debris could pose a threat to human health and the environment. Two examples of structural concerns are the finite life of the synthetic liners that will be part of the OCF structure and the potential for the cover to fail. See Section 7.2 above for discussion of EPA's analysis of whether to treat soils prior to disposal in an OCF.

In order to address these concerns, a consistent and reliable operation and maintenance (O&M) program is necessary to ensure the continued effectiveness of an OCF. Important components of the O&M program would include a leak detection system and collection and removal of leachate. The clay portion of the liner should have an indefinite life. One objective in designing the OCF will be to provide as much access as practicable to the wells and cover of the OCF for maintenance and repair.

Maintaining the effectiveness of the cover is also important. Water and wind erosion, lack of vegetation, excessive sunlight, and disturbance by animals or people are all potential problems for landfill covers. Methods to address these potential problems include burying the cover below many feet of soil, ensuring that surface water drains properly over the top of the structure, diverting ground water away from the structure, and maintaining healthy vegetation over the cap to minimize soil erosion.

A program to monitor ground water downgradient from an OCF would be required to ensure that contaminants are not moving out of the structure and into the environment. One potential advantage of the OCF over treatment is that, because the wastes will be confined to a specific area of the Site, it would be easier to monitor downgradient ground water and perhaps to identify and correct problems.

Different kinds of designs for an OCF or landfill were evaluated in the FS, such as linear/concrete cells, circular tanks, and circular bermed structures. The circular earth berm is most like a conventional landfill and it can more readily comply with the requirements for hazardous or solid waste landfills than the linear or concrete tank alternatives.

The vertical walls that are part of the linear, concrete cells would be more difficult to design and construct to meet containment requirements. Another disadvantage is that it would be more difficult to divert ground water below and around a linear system than it would be for the circular systems.

Another important issue with respect to long-term effectiveness for an OCF is its location at the Site. All of the proposed locations for an OCF would be protective of the local community and the surrounding environment. The parking lot is the closest location at the Site to existing residences. The arsenic kitchen and plant slag areas are considerably further removed from residential areas. The depth to ground water in the parking lot ranges from 40 to 90 feet, compared to approximately 6 feet in the arsenic kitchen and approximately 10 feet in the slag fill.

The arsenic kitchen area was selected as the location of the OCF because that location is most compatible with future land use plans. Because ground water is relatively shallow in the arsenic kitchen area, however, an OCF in this location would have to be well-engineered and maintained in order to be protective of ground water. "Well-engineered and maintained" refers to the liners, leachate collection and removal systems, cover, diversion system, and other components described above. For example, well-maintained impermeable and drainage layers would need to be part of the bottom liner in order to be protective of ground water.**8**

**8** The bottom liner will be a double liner system. The first liner collects leachate (water that passes through the waste and is contaminated). The leachate is pumped from a trench and treated and/or removed. The second liner is below the first and collects any leachate that may have passed through the first liner.

Plant Site Soils - Off-Site Disposal Options. Another disposal alternative is transport and disposal of soil and debris in an off-site hazardous waste landfill. This would eliminate the problems described above associated with managing such waste on site. It should be recognized that slag and contaminated soil in non-source areas would remain on-site and still would have to be addressed by capping.

Plant Site Soils - Capping. The above paragraphs discussed management of soils that are significant sources of contamination to ground water. Soil and slag in other areas are believed to have a lower potential for contaminants to migrate into ground water, however, these areas still have elevated levels of chemicals for which a cleanup action is necessary. Leaving such soils in place and placing a multi-layer soil cap on top of them to reduce surface water infiltration will be the most effective in protecting surface water and ground water over the

long-term. Further, the soil cap will reduce leaching in the Southeast Plant area which is impracticable to excavate (see Section 8.6 below).

Either a soil or asphalt cap would be effective in: eliminating the risk of direct contact with or ingestion of contaminated soils and slag; preventing erosion of contaminated soil or fine grain particles of slag into Commencement Bay; reducing the extent to which surface water comes into contact with contaminants in soil and transports them directly or via ground water to Commencement Bay; and preventing the pooling of contaminated water on site. In order for either type of cap to be effective over the long-term, inspections, maintenance, and restrictions on digging below the cap would be necessary. An asphalt cap will require more inspections and maintenance than a soil cap to prevent, detect, and repair cracks and other defects.

An effective long-term solution for disposal of soil from the Ruston/North Tacoma residential cleanup is to use such soil as sub-base for the smelter site cap on top of slag. The site cap would prevent direct contact with the residential soil and reduce surface water coming into contact with the soil. A soil sub-base still would be required on the Site even if Ruston/North Tacoma residential soils were not used.

Demolition. Several buildings remain on site, such as the fine ore bins building, which is used for storage of contaminated materials, the administration building, the surface water evaporation system, and the transformer buildings. The demolition of remaining structures and disposal of the debris will remove the potential for contact with contamination in the buildings and structures. Disposal of materials stored in the fine ore bins building in the OCF (hazardous waste demolition debris, contaminated ERA soils, and calcine deposits) will eliminate the threat that contamination from the demolition debris and the calcine deposits will migrate into the environment. Materials in the fine ore bins building are suspected of contributing to groundwater contamination.

Surface Water. For cleanup of surface water, plugging and abandoning the existing drainage system and replacing it with a new surface water drainage system is the most effective approach over the long term. This alternative will eliminate releases of soil and water from the existing system into ground water and eliminate contact between surface water and contaminated sediments in the pipes.

It would be less effective to attempt to repair leaks and to clean out contaminated sediments because the location of all existing pipes is not certain. Inserting slip lines into pipes with cracks would also be somewhat effective but could not be done in all pipes due to the small diameter and deteriorating condition of some of the existing pipes. Some pipes may need to be replaced even if sliplining were selected as the remedy.

Rerouting surface water that runs onto the Site, from Ruston for example, would reduce contact with contaminated Site soil but would not affect surface water on the Site itself, i.e., rainfall. A new or repaired on-site drainage system would still be necessary.

EPA evaluated treating surface water before it discharges into Commencement Bay even before contaminated soil from the source areas is excavated. Removing the source areas is a necessary first step in any cleanup scenario. Unless the source areas are removed, treatment of surface water could be required indefinitely. Although treatment of contaminated surface water is potentially effective, it may be difficult to consistently achieve cleanup levels given the volumes of water requiring treatment, estimated to be up to 900 gallons per minute. Also, treatment of all surface water may not be possible during significant rainfalls. Bypass flow could be necessary, during such events.

Because the cleanup includes source removal, a new drainage system, and a site cap, it is likely that remaining contaminated surface water, if any, would be from off-site areas. One objective of the new drainage system would be to avoid recontamination of the site cap by surface water run-on. Also, if surface water run-on from off-site areas is contaminated, this problem may need to be addressed in the future.

Ground Water. It is anticipated that groundwater contamination will decrease over the long term because the most significant sources of the contamination will be removed and the entire site will be capped. One purpose of the site cap is to reduce surface water flow into the remaining

on-site contamination soils, which should further reduce the movement of contaminants from soil into ground water.

Shoreline Armoring. The use of large rocks or boulders to armor the shoreline has a better potential to withstand current and wave action and remain in place compared to using the smaller pebbles described in the artificial beach nourishment alternative. If artificial beach nourishment were used, it would be necessary to include measures such as stone face dikes or breakwaters to decrees the effects of the currents and wave energy to prevent extensive erosion of small rocks and sand. If small rocks and sand had to be replaced frequently, recolonization of marine life would be difficult.

In addition, neither riprap nor beach nourishment are typically placed on slopes as steep as those found at this Site; a cutback would be required for either alternative. Areas that are steeper than 1 (horizontal) to 1.5 (vertical) will need a cut back. The toe of the riprap would need to be constructed 1.5 to 2 times the wave height below the water line. Established construction techniques would be used to anchor the toe and face of the armoring. Although stone faced dikes, breakwaters and revetments are commonly constructed, it is uncertain whether it will be possible to place these types of structures at the Asarco Site.

**(4) Reduction of Toxicity, Mobility, Or Volume Through Treatment**

Plant Site Soils and Surface Water. Soil treatment by solidification/stabilization of source area soils ranks the highest for this criterion. The mobility of contaminants in the soil would be significantly decreased by binding them up in a cement matrix. However, the toxicity of the contaminants would not be decreased and the volume of soil would increase by approximately 30-60 percent. Soil excavation and disposal in an OCF does not satisfy this requirement.

Treatment of surface water is the only surface water alterative that would reduce the mobility, toxicity, and volume of contaminants. Disposal of contaminated sludges from the surface water treatment process would be necessary.

**(5) Short-Term Effectiveness**

Plant Site Soils. All alternatives involving soil excavation would result in dust emissions, surface soil erosion, noise and truck traffic. Air monitoring, dust control measures (for example, wetting the soil prior to excavation) and using established transportation routes would be required to mitigate these affects. Also best management practices would be used to control surface water coming into contact with newly exposed contaminated soil. Other traffic control measures could be implemented, such as cleaning truck wheels and lining and covering truck beds when transporting contaminated materials on public roads.

Health and safety procedures would be required under all of the alternatives for workers involved with the handling of contaminated soil.

The construction of any of the alternatives for landfills would result in the short-term release of dust, increased impact of trucks and excavation equipment on site and on public roadways surrounding the site. Safety and dust controls measures would be implemented.

The primary potential short-term risk of off-site disposal is from the large number of trucks hauling material off the site. All transportation and safety requirements would be required.

Capping the soil in place with an asphalt or soil cap would pose limited short-term risks from heavy equipment movement and dust generated from grading the Site. Asphalt capping would take approximately 3 months if Ruston/North Tacoma residential soils are not used as sub-base. if all of the Ruston/North Tacoma residential soils are used as a sub-base, soil capping would take approximately 7 to 8 years. If all residential soils are not disposed ,on the site, soil capping and regrading could be completed within 12 months. Residential soil that is excavated after the cap is in place would be disposed in an appropriate off-site facility pursuant to EPA's ROD and Ecology's Dangerous Waste exemption for Ruston/North Tacoma.

The stabilization treatment system would be fully enclosed thus preventing releases of contaminants into the air and would, therefore, cause the least short-term risk. The system used during the pilot-scale study effectively controlled releases and similar measures are

feasible for a full-scale project.

Demolition. The alternatives for demolishing and dismantling buildings will be effective in safely removing the existing structures. However, short-term releases of dust and particulates will result from these activities and will need to be effectively controlled. Demolition will include dust suppression measures to minimize dust emissions to ambient air and to protect workers. Air monitoring devices will also be used to determine whether air emissions exceed the standards used during previous demolition activities; if so, demolition activities will be temporarily discontinued or additional measures to reduce emissions will be undertaken as appropriate. Demolition of all remaining buildings would take 6 months, but are not likely no begin until 1996.

Surface Water. With respect to altering the existing drainage system, maintenance of the existing system would cause the least short-term risk since little, if any, soil would be disturbed. Slip lining the existing pipes would present some risks to the workers associated with routine plant site action but no adverse effects are expected in the general community. This alternative may present the most risk to the environment if sediments within the drainage pipes were pushed out of the pipes while inserting the liners. Diversion of off-site surface water run-on would present additional short-term construction risks and risks to the community since implementation of this activity would take place off of the smelter property. Plans to prevent traffic and road construction hazards would be necessary.

Completely replacing the drainage system could cause dust to be temporarily generated since some soil excavation and construction will be necessary. This would present short-term risks to site workers and the near-by residents. If the new drainage system were completely constructed within the clean soil of the cap, some of this risk (i.e., posed by contaminated soil) would be eliminated. Many of the original drainage pipes can be sealed and grouted, although, removal of some of these pipes may be necessary. In this case, some soil and/or slag excavation may be necessary. A new surface water drainage system would be installed at the same time the soil cap is being put in place, so sequencing these activities with respect to trucks and workers would be important.

All of these drainage system cleanup approaches would take 2-3 months to implement. the entire system would need to coincide with placing the cap; the other surface water alternatives would occur before the cap placement.

Surface water treatment also poses short-term risk because it would include the construction of a new surface water treatment facility and installation of a new drainage system. Even though transportation routes and operating hours can be established, more noise and truck traffic would be expected. Constructing a surface water treatment plant would take 9 months from ground breaking; it would likely be operated forever if source control measures are not also taken.

Ground Water. In the short-term, metal concentrations in ground water are expected to increase due to the dust-suppression measures (water to control dust enters the soil and moves into underlying ground water) and to the disturbance of contaminated soil within the aquifer. Generally, these higher levels are expected to decrease within a year. Regular long-term monitoring began in the spring 1994, so baseline groundwater data can be used as a reference to determine if elevated levels are temporary or if additional cleanup measures are necessary. Due to groundwater diversion measures, the volume of ground water moving through the Site may be significantly decreased; thereby temporarily increasing the concentration of contaminants because less dilution would occur.

Shoreline Armoring. Placing larger rocks (riprap) as armoring along the shoreline may result in the temporary suspension of finer-grained sediments. Temporary release of metals from newly fractured slag particles in Commencement Bay also may occur if it is necessary to cut back the angle of the shoreline in order to place the riprap. In addition, armoring with riprap would significantly impair or destroy much of the intertidal marine biota that currently exists on or along the shoreline. But riprap can be designed and constructed so that intertidal biota would recolonize this area. Placing riprap would take approximately 12 months.

Mitigation measures, such as replacing valuable habitat, will be required to replace or augment any damage incurred with armoring. The extent of replacement or augmentation is not currently known; it is estimated that this could take up to two years. In order to mitigate damage caused

by armoring, the creation of pocket beaches, mudflats and vegetated shallows will be evaluated. Sloping and/or cutbacks may be used and shoreline irregularity can be designed to support future mitigation of the marine biota. Mitigation may occur at the Asarco Site or another location off the Asarco property.

**(6) Implementability**

Treatment of source area soils using a solidification/stabilization method is implementable. With the exception of the following practical limitations, excavation of source area soils is implementable. Some of the practical limitations on excavating soil from the source areas include:

(a) Natural features. In the arsenic kitchen area soil excavation will be limited due to the presence of a silt aquitard that is beneath the soils. The aquitard acts as a natural protective barrier preventing metals from moving into the deepest groundwater aquifer on the site. EPA believes that it would be detrimental to the lower aquifer to excavate some or all of this protective silt barrier even though the upper portions of it may contain metals with elevated concentrations of contaminants.

(b) Man-made features. It is estimated that 15 million tons, or approximately 40 acres, of slag make up the plant area and the slag peninsula. Previous plant site investigations show that slag contains up to 25,000 parts per million arsenic, copper and lead. Excavation of all of this slag is not practicable, however, because of its large volume, the potential for fractured slag to reach the bay during excavation, and the cost to dispose this volume of material.

The copper refinery and the fine ore bins areas include both contaminated soil and slag. If, after soil removal, these areas continue to act as significant sources of groundwater contamination, EPA will evaluate whether further excavation of slag is necessary.

In the southeast plant area, the combination of organic constituents such as DMA and buried sawdust appear to enhance the mobility of metals in slag, resulting in high concentrations of metals in ground water. The sawdust, however, is buried 25 to 30 feet in slag and under saturated, highly permeable conditions adjacent to the shoreline. Excavation through the slag to remove the sawdust at these depths is not technically practicable.

Otherwise, soils in the arsenic kitchen, stack hill, cooling pond, copper refinery and fine ore bins area can be removed with conventional excavation techniques. Diversion trenches and other techniques to dewater source area soils prior to excavation would need to be used and are implementable when carefully designed and constructed. Treatment or disposal of contaminated water resulting from dewatering is implementable.

OCF

An OCF can be built in either the parking lot or arsenic kitchen areas of the Site. One concern regarding implementability is whether the OCF will have sufficient capacity for on-site soils and debris. Adding some capacity to the bermed structure in the parking lot and to the circular earth berm in the arsenic kitchen area prior to completion of the structure may be possible by increasing its height. However, the ability to "add" height is limited by the need for structural stability and by future uses of the Site. Capacity could also be added to the linear design. Capacity could not be added once the circular concrete tank is constructed.

Off-site disposal would probably require the construction of a staging area. Currently there is no railroad access to the site and trucks would have to be used to transport excavated soils and demolition debris to the staging area.

Capping the Site

Capping with either low permeability asphalt or soil is possible. For either type of cap it would be necessary to regrade the site and assure that several drainage and ponding areas on the site are eliminated. In general, capping would use common conventional construction techniques that have been proven reliable. Maintenance would be required for both types of caps but would be more intensive for the asphalt cap and would require annual crack sealing and seal coats.

Both caps would require guidelines to minimize overall disturbances after they are installed.

Portions of either type of cap would need to be removed if future cleanup activities are necessary (e.g., installing a ground-water pump and treat system).

Surface Water. Repair or replacement of the existing surface water drainage system is feasible but must be coordinated with soil excavation and capping activities. Conducting repair/ replacement activities prior to placing the cap would not be difficult to implement. Once a cap is in place, maintenance, repair or replacement of the existing drainage system or the slip-lined system would be the most difficult since it would require breaking through the cap.

Sliplining most pipes in the current drainage system is technically feasible for most, but not all, of the drain pipes. Also, in order to find and access some of the drainage pipes for slip-lining, it may be necessary to excavate some of the slag. In general, slag excavation is more difficult than removing soil and newly fractured pieces of slag tend to be more leachable in surface and ground water. Over the long-term, it would be most practicable to build a new drainage system for several reasons: (1) blueprints of the new system would be available to future workers, owners, etc.; (2) a new drainage system can be constructed within the cap thus workers would not be exposed to contaminated soils beneath the cap when making repairs; and (3) the protective clay layer of the cap would probably not need to be breached if repairs or replacement of new drainage pipes are necessary. Property access from adjacent land owners for installation of some parts of a new system would be necessary.

Diversion of surface water run-on is also technically feasible. Property access for installation of the surface water diversion system from adjacent land-owners, the Town of Ruston and the City of Tacoma would be necessary and is believed possible. In addition, the City would have to verify that there was sufficient capacity at the City and/or Edwards Street outfalls to accept the diverted surface water.

Demolition. Building demolition and dust suppression are technically and administratively implementable because they employ conventional trade methods.

Ground Water. Groundwater monitoring is possible and has been conducted on this Site for many years. Bi-annual monitoring is currently being performed. Quarterly monitoring would begin as soon as soil excavation is complete and before a cap is installed.

Shoreline Armoring. See discussion above under "long-term effectiveness and permanence."

**(7) Cost**

EPA has grouped Asarco's cost estimates into two major categories. The first group contains these elements of the cleanup that EPA believes are essential under any acceptable cleanup alternative. The total cost of these "essential elements" is $22.5 million. The estimated costs of essential elements and the disposal alternatives are shown in Table 8-2.

**(8) State Acceptance**

The State of Washington concurs with the selected remedy and phased approach described in this ROD for the former Asarco Tacoma Smelter Facility. The combination of measures to excavate and consolidate the more highly contaminated soils and debris in a containment facility with a design equivalent to federal hazardous waste disposal standards, to cap the entire Site, and to provide certain Site restrictions is appropriate and protective against exposure to such soils. This current ROD provides for measures to divert surface waters from contact with contaminants, however, the, ROD also provides that additional remedial measures may be taken on surface water should such further measures be necessary. Ground water will be addressed in a separate, second phase ROD which will be prepared after the impacts of the soils actions and water diversion measures under this ROD have been evaluated. This approach and selected remedy are deemed to be in compliance with the environmental laws and regulations of the State.

**(9) Community Acceptance**

EPA held a 90-day public comment period on the cleanup activities for the Site. It received approximately 900 comments either directly, or through Asarco or the Tacoma City Club. In

addition, EPA has considered public comments in developing its selected remedy by tracking the land use planning strategy and through contacts with and input from the public. Much of the public interest appears to be focused on what to do with the Asarco Site after the cleanup, however, there were many specific comments on the elements of EPA's Preferred Alternative.

EPA believes that its selected remedy will be acceptable to the community based on the public comment received and their continued involvement in implementation of this cleanup.

To date, the most debated public issue regarding the cleanup itself has been whether to dispose contaminated soil and other materials in an OCF. Many members of the community, including the elected leaders and local business leaders, expressed support for an OCF. It appears that most of the support for on-site disposal was a result of Asarco's promise, in the "Agreement in Principle," with Ruston, Tacoma, and the Park District, to fund an estimated $15-20 million of future development activities on the Site.

Although the OCF provision in the Agreement in Principle is not binding on EPA, the overwhelming community support for an OCF is a significant factor in EPA's final remedy selection. Several commenters who generally supported an OCF suggested design modifications for the disposal facility such as treating soil before disposal, constructing separate cells within the unit for more precise monitoring and segregated disposal of soil (see Section 7.2 for EPA's responses to these comments). In addition, several commenters encouraged EPA to select the remedy that would be the most protective of human health and the environment over the long-term and not be influenced by Asarco's promise of future development. Based on EPA's belief that an OCF can be designed to be protective over the long-term and the overwhelming community support, EPA has significantly modified this component of its Preferred Alternative and selected disposal in an OCF rather than treatment.

EPA has received other significant comments on its proposed approach to cleanup the Site. Several natural resource trustee agencies and environmental groups have actively participated in EPA's technical meetings on cleanup and have submitted written comments. They have stated that EPA needs to develop an environmentally sound cleanup for the Site that ends current chemical contamination and that is not compromised or undermined by potential future land uses. EPA believes that its cleanup meets those objectives and that it will be important for these groups and local citizens to continue be involved with the review of the remedial design plans for this Site.

In addition, the Department of Natural Resources, the U.S. Fish and Wildlife Department, Citizens for a Healthy Bay and Asarco raised questions regarding the need for armoring the slag based on the amount of slag erosion and the design of shoreline armoring. Although it is visually apparent that slag is eroding, EPA agrees with the commenters that the extent and location of erosion should be determined first (e.g., using durability tests). After this step, EPA has determined that additional design studies will be conducted to determine the location and extent of armoring, including cutbacks or excavation in order to anchor the base of the armoring.

EPA also received many comments that encouraged site cleanup to progress as quickly as possible. Therefore, EPA has decided that if the Site is ready to be capped, but all of the Ruston/North Tacoma residential soils have not been removed from the Study Area, the Site will be capped and an appropriate off-site disposal facility will be selected for these soils as per Ecology's dangerous waste exemption.

**TABLE 8 2. COST**

Essential Elements:

| Activity | Capital Cost | Operation & Maintenance (annual) | Present Worth |
|---|---|---|---|
| **Plant Site Soils:** | | | |
| Capping the Site | | | |
| Smelter | $6.4 m | $6,000 | $6.5 m |
| Slag | | | |
| Peninsula | $923,000 | $5,800 | $1 m |
| Demolish fine ore bins building | $1.4 m | $0 | $1.4 m |
| Interception trenches (for dewatering and diverting ground water) | $710,000 | $0 | $710,000 |
| **Surface Water:** | | | |
| Replace drainage system with new drainage system | $1.4 m | $7,200 | $1.5 m |
| **Shoreline Armoring:** | | | |
| Shoreline armoring (riprap) | | | |
| Smelter | $3.4 m | $12,000 | $3.6 m |
| Slag | | | |
| Peninsula | $2.5 m | $11,000 | $2.6 m |
| **Ground Water and Marine Sediments:** | | | |
| Abandon production well | $9,750 | $0 | $9,790 |
| Monitoring of ground water and sediments | $650,000 | $263,000 | $4.7 m |

Plant Site Soils
(Excavation/Treatment/Disposal

| Activity | Capital Cost | Operation & Maintenance (annual) | Present Worth |
|---|---|---|---|
| (a) Excavation and treatment of soil and materials from source areas; treated soil put back below Site cap | $38.2 m | $0 | $38.2 m* |
| And | | | |
| (b) Off site disposal of debris | $12.7 m* | $0 | $12.7 |
| SUBTOTAL | | | $50.9 |

* Please note that Asarco recently revised its estimated cost of on site treatment ($38.2 million) from the estimate that was used for Alternative PSS 4A in Section (F) above ($48.2 million).

| | | | |
|---|---|---|---|
| Or | | | |
| (c) Excavation and disposal of soil and debris in RCRA OCF (no treatment) | $22.6 m | $12,000 | $22.8 m |
| Or | | | |
| (d) Excavation and treatment of soil and disposal of treated soil and debris in on site hazardous waste landfill | $65.3 m | $12,000 | $65.5 m |
| Or | | | |

Other Elements:

Institutional controls
$500,000 ..... $0 ..... $500,000

Essential Elements Total ..... $22.5 m

(e) Excavation and treatment of soil and disposal of treated soil in on site solid waste landfill, debris in off site hazardous waste landfill
$70 m ..... $12,000 ..... $70.2 m

Or

(f) Excavation, and off site treatment and disposal of soil and debris
$75.1 m..... $0 ..... $75.1 m

| Essential Elements | | Excavation/Treatment/Disposal | | TOTAL Cleanup Costs |
|---|---|---|---|---|
| $22.5 million | | (a) plus (b) $50.9 million | | $73.4 million |
| $22.5 million | | (c) $22.8 million | | $45.3 million |
| $22.5 million | + | (d) $65.5 million | = | $88 million |
| $22.5 million | | (e) $70.2 million | | $92.7 million |
| $22.5 million | | (f) $75.1 million | | $97.6 million |

*This amount includes an estimated cost of $200,000 to fill the tunnel. Removing the tunnel is estimated to cost $2.2 million. The decision whether to remove or fill will be made during remedial design.

## 9.0 THE SELECTED REMEDY

EPA's selected remedy combines elements from several of the media-specific alternatives described above. The selected remedy meets the requirements of the two mandatory threshold criteria, protection of human health and the environment and compliance with ARARs, and provides the best balance of benefits and trade-offs for the former Asarco Tacoma Smelter site.

Several proposed actions described in EPA's Preferred Alternative have either been initiated or completed since the public comment period. Ground water and sediments monitoring is underway (October 1994). In addition, EPA has allowed Asarco to abandon the production well (December 1994).

The following are the individual components of EPA's Selected Remedy.

### 9.1 PLANT SITE SOILS

#### 9.1.1 Excavate Soil and Granular Slag From Five Source Areas 9

Contaminated soil that fails the TCLP test in the stack hill, cooling pond and arsenic kitchen areas and contaminated soil and granular slag from the copper refinery and fine ore bins building areas will be excavated to the extent feasible. The party (EPA or Asarco) conducting the cleanup will perform the following activities during soil excavation:

(a) Asarco will submit the additional soil borings data required under the AOC (October 1994) to EPA during remedial design.

(b) Use interception trenches, or other applicable technology, to divert ground water where necessary to allow for easier excavation of soils.

(c) Control soil erosion and contaminated stormwater runoff by using best management practices (for example, sediment ponds, silt fences, diversion ditches, cut and fill slopes).

(d) Confirm that all necessary excavation has been performed.

(e) Remove or fill the car tunnel to allow for future land use plans. Whether the railroad tunnel will remain will be determined after discussions with Burlington Northern railroad.

(f) Conduct a wetlands assessment at the Site.

(g) Use capping material (see Section 9.1.3) to fill and regrade the excavated areas.

**9** Excavation of the sixth source area, the southeast plant area, is impracticable (see "Implementability" in Section 8.0 above.)

#### 9.1.2 On-Site Disposal

(a) Construct an OCF northeast of the arsenic kitchen area. The OCF will be an approximately 600-foot diameter circular earth berm with an estimated capacity of 240,000 cubic yards. The liner, cap, leak detection, collection and removal system, leachate collection and removal system and surface run-on and run-off system will meet federal and state standards for a hazardous waste landfill, see performance standards in Section 9.9.

(b) Construct surface water and groundwater diversion controls (for example, interception trenches and grout wall) around the OCF to prevent surface water and ground water from coming into contact with the OCF.

(c) Dispose the soils excavated from the source areas, the bricks temporarily stored on the stack hill, and the hazardous waste materials temporarily stored in the fine ore bins building in the OCF. Materials that are not on-site as of the date of this ROD will not be disposed in the OCF.

(d) Crush or shred over-sized debris prior to disposal.

(e) Conduct the appropriate seismic studies in order to construct the OCF to withstand earthquakes and landslides to the extent practicable.

(f) Monitor air quality to ensure that dust is not generated when soil and debris are excavated and disposed in the OCF (see other "safety measures" below).

(g) Do not dispose wet materials, including marine sediments, in the OCF.

(h) In the design plans for the OCF, allow for a limited amount of additional capacity in the event more than the estimated 160,000 cubic yards of soil or 80,000 cubic yards of demolition debris require disposal. In the event the amount of waste to be disposed is greater than the maximum capacity of the OCF, this material will be disposed off-site in an appropriate facility.

(i) Develop a plan for the closure of Ruston Way adjacent to the Site when construction of the OCF occurs.

(j) Maintain the OCF in perpetuity.

**9.1.3 Capping the Site (PSS and slag and the slag peninsula)**

After excavation of materials from the source areas, cap the entire Site (with the exception of the OCF and the possible exception of the Stack Hill area, see performance standards below) with, from bottom to top, soil excavated during the residential Study Area cleanup, a low permeability clay liner, a gravel drainage layer, at least 12 inches of clean topsoil (i.e., below MTCA residential cleanup levels), and sod, see Figure 7-1. The cap will meet the performance standards identified in Section 9.9. Capping of the Site includes the following elements:

(a) Grade and prepare the Site for capping, including grading the ramp constructed from Thorne Road slag. Use contaminated residential soils as a sub-base for the cap only in areas of the Site where they will not come into contact with ground water, for example, the slag portions of the Site. Stockpile contaminated residential soils on-site until they are ready to be used for capping.

(b) If the Site is ready to be capped, but not all of the residential soils have been excavated from the Ruston/North Tacoma Study Area, an appropriate off-site disposal facility (see Ecology's dangerous waste exemption dated December 20, 1993) will be selected. Whether a temporary staging area, on- or off-site, will be necessary will be determined during remedial design.

(c) Assure that existing asphalt and building pads on the site will not cause pooling and standing water beneath the cap. Eliminate pooling of surface water on the surface of the cap.

(d) Incorporate planning for future development, such as site grading, utilities, surface water drainage systems, landscaping and terracing, into design and construction of the cap to the extent possible.

(e) Fence and plant low lying shrubs in areas determined to be too steep to cap (e.g., the east and west gully slopes of the stack hill). Apply a geotextile material to the soil to provide erosion protection, as well as a means for supporting vegetative development.

(f) Perform mitigation activities if wetlands or aquatic ecosystems are adversely impacted by soil removal or capping. Evaluate the feasibility of setting aside areas on the slag peninsula to allow marine birds to feed and roost.

(g) Maintain the cap.

**9.2 DEMOLISH REMAINING BUILDINGS AND STRUCTURES**

Demolish all of the remaining buildings and structures on the smelter site. The sequence of building demolition and construction of the OCF will be determined during remedial design.

(a) Prior to demolition, inspect all remaining buildings and structures to locate and identify all asbestos-containing material (ACM). Remove ACM from the on-site buildings and dispose of it off-site in accordance with applicable federal and state requirements.

(b) Vacuum and wash buildings and structures at the Site before beginning demolition activities. Wash areas of structures containing dust that are inaccessible for vacuuming to curtail dust emissions. Collect wastewaters generated from the dust suppression system at each demolition site and route to a wastewater evaporation system, or dispose in an appropriate manner.

(c) Reactivate the air monitoring stations which were used during previous demolition activities (e.g., Site Stabilization-Phase 2).

(d) Use conventional trade demolition techniques for the demolition of, or dismantling of the remaining on-site structures. Use conventional equipment, such as shears, grapples, loaders, and cranes, where necessary to safely and efficiently dismantle the structures.

(e) Sample all debris from demolition of remaining buildings before disposal. Dispose any material other than wood waste that is determined to be hazardous waste using the TCLP test (e.g., steel, concrete, metal) in the OCF. Dispose debris that is not hazardous waste, but fails the wipe test, either off-site pursuant to a dangerous waste exemption issued by Ecology dated May 23, 1994, or in the OCF. Where appropriate, pressure wash debris. Recycle metal materials that pass both TCLP and the wipe test. Dispose all wood debris in an appropriate off-site disposal facility.

**9.3 SURFACE WATER**

(a) Plug and abandon or remove the entire existing surface water drainage system and install a new drainage system, including outfalls, in the smelter site cap to collect or divert water that runs onto the Site from the off-site drainage basins and from precipitation that originates on the site. In addition, ensure that seeps on the stack hill and other areas of the Site do not run on the Site.

(b) Monitor surface water quality during and after implementation of repair and replacement of the drainage system, soil removal, and capping. If surface water quality continues to exceed federal and state standards, treatment of surface water will be evaluated.

(c) Maintain the surface water drainage system.

**9.4 SHORELINE ARMORING**

Shoreline armoring of the plant site and slag peninsula, see Figure 7-3.

(a) Determine the extent of shoreline erosion by performing durability tests on the slag (e.g., specific gravity, absorption, accelerated expansion, abrasion tests, freeze/thaw test) and visual observation.

(b) Determine where shoreline armoring should be placed based on erosion tests.

(c) Anchor armoring on the slag face on the bayward side of the slag face along the plant site and slag peninsula, as appropriate, to prevent erosion of the slag due to currents, waves and tidal action. The interior portion of the Yacht Club basin will not require armoring.

(d) Remove abandoned structures, debris and waste (treated pilings, cables) near the shoreline along the slag peninsula as necessary.

(e) Mitigate or compensate for shoreline armoring activities that may result in adverse impacts to intertidal habitat. Identify and analyze potential mitigation measures following the guidelines under the Clean Water Act and the state's hydraulic code rules. EPA will work during the design phase of the cleanup with the federal and state trustees of natural resources to develop a mitigation plan.

Required mitigation measures to remedy the impact to the marine environment from shoreline armoring may include shoreline pull back and sloping, development of pocket beaches, mudflats, vegetated shallows, and shoreline irregularity, and may occur on-site or off the Asarco property.

(f) Maintain the shoreline armoring.

## 9.5 GROUND WATER AND MARINE SEDIMENTS

(a) Continue monitoring surface water and ground water and sampling marine sediments. Future sampling programs may include further monitoring of marine sediments to evaluate whether discharges from the Site after this cleanup are continuing to contaminate the sediments. Remedial measures to address offshore sediments will be included in a separate ROD.

(b) To control contaminants from entering the deeper ground water, EPA directed Asarco in December 1994 to "abandon" the production well, a deep well in the central area of the site that supplied water for smelter activities. Abandoning the well involved making small holes in and filling the well casing (the walls of the well) with grout, a concrete-like material.

## 9.6 OTHER ELEMENTS OF THE SELECTED REMEDY

### 9.6.1 Safety Measures

During cleanup, safety measures include, at a minimum, air monitoring with Hi-vol and PM10 air particulate monitors, using dust suppression techniques during excavation and disposal activities, lining and covering truck beds when transporting contaminated materials on public roads, removing soils from truck wheels before they travel on public roads (for example, from the stack hill area to the lower Site), developing a transportation plan to establish local truck routes to minimize disruption to the community, and temporarily storing hazardous waste on-site in compliance with waste pile requirements.

### 9.6.2 Integrating Cleanup With Land Use Plans

Develop an enforceable program of restrictions and guidelines to supplement the actual cleanup activities. Such measures are necessary to ensure that development activities do not affect the long-term effectiveness of the cleanup and will include, but are not limited to the following:

(a) Establish a maintenance and monitoring program to ensure the continued integrity of the low-permeability soil cap, the OCF and shoreline armoring.

(b) Establish guidelines to ensure that future cleanup measures (including, if necessary, remediation of ground water and/or surface water) will not be prevented or hindered by development activities.

(c) Establish guidelines for conducting construction and maintenance activities to ensure that little or no remaining contamination is exposed or released during future (post-cleanup) excavation. Develop additional guidelines to identify the appropriate actions if contaminant exposure or release occurs (e.g., Asarco's responsibility for disposal of contaminated soil). Activities addressed by these procedures will include installation of underground utilities, basements or elevator shafts and roadways.

(d) Use deed restrictions to prohibit the use of ground water at the Site and to ensure compliance with the program and guidelines described in (a), (b), and (c) above.

(e) Develop public educational materials and markers or signs for future users and occupiers of the Site. The materials and markers or signs will describe the cleanup and explain what the users and occupiers should and should not to maintain the effectiveness of the cleanup.

**9.6.3 Periodic Review**

The protectiveness of the cleanup will be reviewed at least every five years.

**9.7 CLEANUP SCHEDULE**

EPA estimates that the selected remedy will take five years to complete. It is possible that soil removal and/or capping in one area of the Site (for example, the stack hill or parking lot) can be completed so that development activities can start prior to completion of the cleanup of the entire Site.

EPA will not allow development to begin in any area, however, until it determines that cleanup in that area is complete, that development is safe given cleanup activities taking place elsewhere on-site, and that development would not interfere with potential cleanup measures in the future.

**9.8 COST OF THE SELECTED REMEDY**

EPA estimates that the cost to perform the Selected Remedy will be $45.3 million. These costs are estimated and are considered to be accurate to within -30% to +50%. Costs are described using the present worth methodology with a discount rate equal to five percent. The cost estimate includes direct and indirect capital costs, as well as annual operations and maintenance costs. Operation and maintenance (O & M) costs have been estimated for 30 years but O & M activities will be required in perpetuity. See Section 8(7) and Table 8-2 for a more complete breakdown of costs.

**9.9 PERFORMANCE STANDARDS**

The final Site cleanup levels will be adjusted so that the overall cancer risk from all of the media and the exposure pathways will be equal to or less than 1 x 10-5 and the non-cancer effects will be equal to or less than 1.0

PLANT SITE SOILS

In order to obtain the Cleanup Objectives described in Section 6.7, performance standards and/or remediation goals have been established for each medium that will be cleaned up.

Source Areas. The boundaries of the source areas that require excavation generally will be defined by soils that exceed hazardous waste levels as determined by the TCLP test, see below, and by practical limits on excavation, see Section 8 - Implementability. If soils outside the source areas exceed hazardous waste levels, EPA will evaluate whether further excavation is warranted. These numbers do not represent remediation goals but rather serve as markers for areas to be excavated. Because all areas of the Site will be addressed by soil/slag removal, the OCF, or the Site cap, specific remediation goals for PSS have not been selected.

| Chemical | mg/L |
|---|---|
| Arsenic | 5.0 |
| Cadmium | 1.0 |
| Chromium | 5.0 |
| Lead | 5.0 |
| Mercury | 0.2 |
| Selenium | 1.0 |
| Silver | 5.0 |

The entire site, excavated source and non source areas, will be capped. The cap will meet the requirements described herein. If, however, after excavation, soil in the. stack hill area is below levels comparable to the action levels set for the Ruston/North Tacoma cleanup, a less stringent cap using only soil and a vegetative cover will be required. "Comparable" levels will be determined by EPA and Ecology.

Cover System

A low hydraulic conductivity layer including a minimum of one (1) feet of compacted soil over the soil and slag with a maximum hydraulic conductivity of 1 X 10-7 cm/sec, which is to be designed, constructed, operated and maintained to maximize removal of water by the overlying drainage layer and to minimize infiltration of water into the contaminated soil, and slag.

A drainage layer of at least .5 feet or greater granular drainage materials with a hydraulic conductivity of 1 X 10-2 cm/sec or equivalent. The drainage layer, which is placed above the low hydraulic conductivity layer, must be designed to minimize the amount and residence time of water coming into contact with the low hydraulic conductivity layer, thereby decreasing the potential for leachate generation.

A top cover comprised of two (2) layers. The top component is vegetation designed to impede erosion while still allowing surface runoff from major storm events. The lower component is a minimum of one (1) foot of soil capable of sustaining plant species that will minimize erosion.

The cover system must be designed and constructed to meet the following performance standards:

(a) Prevent direct contact of people, animals, and surface water with contaminated soils and slag.

(b) Prevent contaminated soil from being wind-blown.

(c) Provide long-term minimization of migration of liquids through the Asarco Smelter site.

(d) Function with minimum maintenance.

(e) Promote drainage and minimize erosion or abrasion of the cover.

(f) Accommodate settling and subsidence so that the cover's integrity is maintained.

(g) A construction quality assurance (CQA) program shall be established for the cover system to ensure that the constructed cover meets or exceeds all design criteria and specifications.

Modifications of the cover system in areas where development will occur will need to be approved by EPA on a case-by-case basis.

Post Closure Care

Maintain the integrity and effectiveness of the final cover, including periodic inspections and making repairs to the soil cap as necessary to correct the effects of settling, subsidence, erosion, or other events.

Prevent run-on and run-off from eroding or otherwise damaging the final cover.

CONTAINMENT FACILITY

The following performance standards are based on requirements in 40 C.F.R. Part 264 for hazardous waste landfills.**10**

**10** Specific references to federal regulations only are set forth in this section. The requirements of this section are intended to also comply with state requirements for landfills set forth in WAC 173-303-665.

Bottom Liner System (40 CFR Sections 264.301(c)(1), 264.301(a)(1)(i), (ii), and (iii))

A composite top liner including a minimum of one (1) foot of compacted soil with a maximum hydraulic conductivity of 1 X 10-7 cm/sec overlain by a flexible membrane liner.

A composite bottom liner including a minimum of three (3) feet of compacted soil with a maximum hydraulic conductivity of 1 X 10-7 cm/sec overlain by a flexible membrane liner designed to prevent the migration of hazardous constituents into the upper components.

The upper component of the top and bottom composite liner will be designed and constructed to prevent migration of hazardous constituents into this component during the active life and post-closure period. The lower component of the top and bottom composite liner will be designed and constructed to minimize the migration of hazardous contents if a breach in the upper component were to occur.

The liner system shall be designed and constructed to comply with 40 CFR Sections 264.301 (a)(1)(i), (ii), and (iii) to assure that it is engineered to withstand the chemical and physical stresses it will be subjected to while containing the waste. The liner system shall be located, designed, constructed, and operated to be completely above the seasonal high water table.

Leachate Collection and Removal System (40 CFR Sections 264.301(c)(2)) and

264.301(c)(3) and (iv))

The leachate collection and removal system immediately above the top liner must be designed, constructed, operated, and maintained to collect and remove leachate from the landfill during the active life and post-closure care period. It shall be designed and operated to ensure. that leachate depth over the liner does not exceed one (1) foot.

The leachate collection and removal system immediately above the top liner shall be designed and constructed to comply with 40 CFR Sections 264.301 (c)(3) (iii) and (iv) to assure that it is engineered to withstand the chemical and physical stresses it will be subjected to and to minimize clogging.

Whether leachate will be treated and discharged on-site or disposed off-site will be determined during remedial design.

Leak Detection Collection and Removal System (40 CFR Sections 264.301(c)(3)(i-v), 264.301 (0)(4), 264.302, and 264.304).

The leak detection, collection and removal system in between the liners shall be constructed with a bottom slope of one percent or more of granular drainage materials with a hydraulic conductivity of 1 X 10-2 cm/sec and a thickness of 12 inches or more, or with synthetic or geonet drainage materials with a transmissivity of 3 X 10-5 m2/sec or more and it shall be constructed with sumps and liquid removal methods that shall be operated to minimize the head on the bottom liner system in accordance with 40 CFR Sections 264.301 (c)(3)(v) and 264.301 (c)(4). An action leakage rate and response action plan will be established for the. OCF in accordance with 40 CFR Sections 264.302 and 264.304 to address design flow rates in the leak detection system which will result in a head greater than a foot on the bottom liner system.

The leak detection, collection and removal system in between the liners shall be designed and constructed to comply with 40 CFR Sections 264.301 (c)(3)(iii) and (iv) to assure that it is engineered to withstand the chemical and physical stresses it will be subjected to and to minimize clogging.

Surface Run-on Control System (40 CFR Sections 264.301 (g) and (i))

Design, construct, operate and maintain a run-on control system capable of preventing flow onto the active portion of the landfill during peak discharge from at least a 25-year storm. Collection and holding facilities which are associated with this system must be emptied expeditiously after storms to maintain design capacity of the system.

Surface Run-off Control System (40 CFR Sections 264.301 (h) and (i))

Design, construct, operate, and maintain a run-off management system to collect and control at least the water volume resulting from a 24 hour, 25-year storm. Collection and holding facilities which are associated with this system must be emptied expeditiously after storms to maintain design capacity of the system. Discharges to Commencement Bay shall comply with surface water performance standards.

Control of Particulate (40 CFR Section 264.301 (j))

The OCF shall be operated to control wind dispersal of contaminated soil, slag and debris placed in it.

Monitoring, Inspection, and Construction Quality Control (4O CFR Sections 264.303, and 264.19)

A CQA program shall be established for the OCF to ensure that the constructed unit meets or exceeds all design criteria and specifications in accordance with 40 CFR Sections 264.19 and 264.303. The landfill systems must be inspected during operation and the leak detection system after closure. Inspection of the landfill during operations will be in accordance with 40 CFR Section 264.303.

Cover System (40 CFR Sections 264.310 and 264.19)

A composite low hydraulic conductivity layer including a minimum of two (2) feet of compacted soil over the waste with a maximum hydraulic conductivity of 1 X 10-7 cm/sec overlain by a flexible membrane liner designed, constructed, operated and maintained to maximize removal of water by the overlying drainage layer and to minimize infiltration of water into the contaminated soil, slag and debris in the OCF.

A drainage layer of one (1) foot or greater granular drainage materials with a hydraulic conductivity of 1 X 10-2 cm/sec and a thickness of 12 inches or more, or with synthetic geonet drainage materials with a transmissivity of 3 X 10-5 m2/sec or more overlain by filter layer to prevent clogging of the drainage layer. The drainage layer, which is placed above the composite low hydraulic conductivity layer, must be designed to minimize the amount and residence time of water coming into contact with the composite low hydraulic conductivity layer, thereby decreasing the potential for leachate generation.

A top cover layer comprised of two (2) layers. The top component is vegetation designed to impede erosion, but allowing the surface runoff from major storm events. The lower component is a minimum of two (2) feet of soil capable of sustaining plant species that will minimize erosion.

The cover system must be designed and constructed to meet the following performance standards specified under 40 CFR Sections 264.111 and 264.310:

(a) Minimize the need for further maintenance.

(b) Control, minimize or eliminate, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.

(c) Provide long-term minimization of migration of liquids through the closed OCF.

(d) Function with minimum maintenance.

(e) Promote drainage and minimize erosion or abrasion of the cover.

(f) Accommodate settling and subsidence so that the cover's integrity is maintained.

(g) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

(h) A QA program shall be established for the OCF cover system to ensure that the constructed cover meets or exceeds all design criteria and specifications in accordance with 40 CFR Section 264.19.

Closure Certification and Post Closure Care of the OCF (40 CFR Sections 264.310, 264.115, 264.116, 264.117, 264.118, 264.119, and 264.120)

The closure certification, monitoring, operation, maintenance and record keeping requirements of 40 CFR Sections 264.310, 264.115, 264.116, 264.117, and 264.118 must be adhered to after closure of the OCF. The post-closure period for the OCF shall be indefinite.

DEMOLITION/EXCAVATION/DISPOSAL

(a) Air. Hi-vol and PM10 air particulate monitors will be used to confirm that the following levels are not exceeded.

| Chemical | mg/L**11** |
|---|---|
| Arsenic | 02 |
| Lead | 0.75 |
| PM10 | 75 |

(b) Dust Control. A "no-visible dust" standard will be in effect.

**11** The arsenic levee is based on 5 x 10-5 risk-based levels over a 10 year period The lead level is based on ½ the allowable PSAPCA level. PM10 levels are based on half of the quarterly allowable 24-hour allowance.

SURFACE WATER

The remedial goals identified for surface water in EPA's September 1993 document entitled, "EPA's Preliminary Remedial Action Objectives," (Table 9-1) are the performance standards that surface water discharging into Commencement Bay must meet. Whether a mixing zone for point source discharges is necessary will be determined during remedial design.

Shoreline Armoring

Minimize the release of slag particles into the bay.

Ground Water

The preliminary remediation goals for Class III ground water impacting surface water (water that is not suitable for drinking) (Table 9-2) will be used as a benchmark to determine the effectiveness of source control activities. Final groundwater remediation goals will be selected in a final ROD for ground water.

**TABLE 9-1. REMEDIATION GOALS FOR SURFACE WATER IMPACTING PUGET SOUND**

| CONTAMINANT | REMEDIATION GOAL (µ/L) | REFERENCE |
|---|---|---|
| Arsenic | 2.0 | MTCA B, PQLa based on the CRDLb |
| Beryllium | 1.0 | MTCA B, CRDL |
| Cadmium | 8.0 | MTCA B, WQS for aquatic life |
| Chromium VI | 50 | MTCA B, WQC/WQS for aquatic life |
| Copper | 10.0 | MTCA B, PQL based on EPA Method 1220.2 which has an IDL of 1.0 to 2.0 |
| Lead | 5.8 | MTCA B, WQS |
| Mercury | 0.2 | MTCA B, PQL based on CRDL |
| Nickel | 7.9 | MTCA B, WQS |
| Selenium | 71 | MTCA B, WQC/WQS for aquatic life |
| Silver | 1.2 | MTCA B, WQS |
| Zinc | 76.6 | MTCA B, WQS |
| Total Petroleum Hydrocarbons | 10,000.0 | MTCA B, Ecology's Guideline for Discharges Containing Oil and Grease of Mineral Origin |
| Aniline | 1.3-37 | Preliminary criteria for the protection of aquatic life |
| 4-Chloroaniline | 29-61 | Preliminary criteria for the protection of aquatic life |
| N-Methylaniline | 160 | MTCA B, risk-based |
| N-Nitrosodi-phenylamine | 10 | MTCA B, PQL based on CRDL |

a Practical Quantitation Limit
b Contract Required Detection Level

NOTE: If use of a mixing zone is appropriate, the compliance point for the surface water discharge would be at the edge of the designated mixing zone in Puget Sound. These values have not been adjusted to take into account the background levels of these contaminants in uncontaminated surface water on land or in surface water in Puget Sound.

**TABLE 9-2. PRELIMINARY REMEDIATION GOALS FOR CLASS III GROUND WATER IMPACTING SURFACE WATER IN PUGET SOUND**

| CONTAMINANT | EPA REMEDIATION GOAL (µ/L) | REFERENCE |
|---|---|---|
| Arsenic | 6 | MTCA B, background [MTCA B number (106 risk) for fish consumption is 0.14 |
| Beryllium | 1.0 | MTCA B, PQL based on CRDL [MTCA B number (10-6 risk) for fish consumption is 0.08 |
| Cadmium | 8.0 | MTCA B, Water Quality Standards (WQS) for aquatic life |
| Chromium VI | 50 | MTCA B, Water Quality Criteria (WQC)/WQS for aquatic life |
| Copper | 40 | MTCA B, background (WQS is 2.5) |
| Lead | 12 | MTCA B, background (WQS is 5.8) |
| Mercury | 0.2 | MTCA B, PQL based on CRDL (WQS/WQC are 0.025) |
| Nickel | 0.2 | MTCA B, background (WQS is 7.9) |
| Selenium | 71 | MTCA B, WQC/WQS for aquatic life |
| Silver | 1.2 | MTCA B, WQS for aquatic life |
| Zinc | 98 | MTCA B, background (WQS is 76.6) |
| Total Petroleum Hydrocarbons | 10,000.0 | MTCA B ARAR, Ecology Guideline for Discharges Containing Oil and Grease of Mineral Origin (using TPH analysis) |
| Aniline | 1.3-37 | Preliminary criteria for the protection of aquatic life |
| 4-Chloroaniline | 29-61 | Preliminary criteria for the protection of aquatic life |
| N-Methylaniline | 160 | MTCA B, risk-based (10-6) |
| N-Nitroso-diphenylamine | 10 | MTCA B, PQL based on CRDL [MTCA B number (10-6 risk) for fish consumption is 6.1 |

## 10.0 STATUTORY DETERMINATIONS

### 10.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will eliminate, reduce, or control exposure to contaminants on the Site at the former Asarco Smelter facility. Risks from exposure to soil, slag, and surface water will be eliminated by removing and isolating source area soils, capping contaminated soil and slag, demolishing the remaining buildings, replacing the existing drainage system with a new drainage system and armoring portions of the shoreline.

An enforceable program consisting of legal, engineering and administrative restrictions and guidelines will also be developed to supplement the actual cleanup activities. This program is required in order to assure that the cleanup activities remain protective (e.g., cap, armoring and OCF maintenance), to prohibit certain activities (e.g., drinking ground water), and to address the residual risk of the contaminants left on site.

Accordingly, the selected remedy is protective of human health and the environment.

### 10.2 COMPLIANCE WITH ARARs

The selected remedy will attain ARARs under federal and state law (see Table B-8 in Appendix B). Compliance with requirements for selection of cleanup actions under MTCA are discussed in Section 10.4 below. The interim measures waiver will be used for the state ARAR for restoring ground water. EPA will select a final remedial action for ground water that will attain the ARAR or provide a justification for its waiver.

### 10.3 COST-EFFECTIVENESS

The cost of the selected remedy is proportional to its overall effectiveness and it represents a reasonable value for the money to be spent. EPA made this determination by Comparing the cost and effectiveness of treating soil versus disposing untreated soil and debris in an OCF based on the significant community support for on-site disposal.

EPA believes that excavating soil from the source areas is the key step to reducing contaminant concentrations in ground water and surface water. How to dispose of the contaminated soil has been the most significant issue in this cleanup. Treating contaminated soil with a solidification/stabilization process will bind contaminants in a cement-like mixture (but will not detoxify or reduce concentrations). Contaminants in treated soil are unlikely to move out of the soil into other media. The treated soil can be used as sub-base for a site cap. The estimated cost of treating soil is $38.2 million. If soil treatment were selected, the estimated cost for off-site disposal of contaminated debris (which cannot be treated) is $12.7 million, for a cost of $50.9 million. **12**

**12** The $50.9 million is in addition to the estimated cost of $22.5 million for the "essential elements" of the remedy (see Section 8.7 above).

Both soil and debris can be disposed in an OCF. The OCF option will attain a similar objective to treatment, which is minimizing the movement of contaminants into other media, by containing the contaminated soil in a large on-site landfill. The most significant technical difference between treatment and the OCF is that active measures, other than monitoring, would not have been necessary for the treated soil but a permanent operation and maintenance (O&M) program is required to maintain the integrity of the OCF. The O&M program will be a legally enforceable component of the cleanup. The estimated coat for disposal in an OCF is $22.8 million.

The difference in estimated costs between the treatment and OCF options is $28 million. EPA concludes that because the ability of the OCF to isolate contaminants from the environment is as effective as treating contaminated soil, and because of the strong community support/or on-site disposal, the OCF is a cost-effective solution.

It should be noted that the estimated cost to transport and dispose soil and debris in an off-site landfill is $75.1 million, over $50 million higher than the OCF option. Although off-site disposal would permanently avoid all potential problems associated with leaving contamination on-site, EPA believes that, in comparison, the OCF still represents the best value

for the money. This determination is also based on the fact that significant contamination, e.g., 15 million tons of slag would remain at the Site even if contaminated soils from the source areas were disposed off-site. Off-site disposal does not mean that problems at the Site are eliminated.

EPA has determined that the other components of the selected remedy are also cost-effective because they represent a reasonable cleanup value for the money.

**10.4 UTILIZATION OF PERMANENT SOLUTIONS, AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE**

The NCP states that this requirement is fulfilled by selecting the alterative that is protective, complies with ARARs, and provides the best balance of trade-offs in terms of the five balancing criteria (numbers 3 through 7 in Section 8.0). The modifying criteria (numbers 8 and 9) shall also be considered. Under MTCA Section 173-340-360(5), very similar criteria are used to select permanent solutions to the maximum extent practicable and to select from among the hierarchy of cleanup technologies in 173-340-360(4).

Again, the crucial decision at this Site is how to manage soil excavated from the source areas and demolition debris. The alternatives range from treating soil to disposing soil and debris, without treatment, in an OCF, to disposing soil and debris off-site. EPA believes that each of these alternatives is protective and complies with ARARs. For the following reasons, EPA has determined that disposing soil and debris, without treatment, in an OCF provides the best balance of trade-offs considering the balancing and modifying criteria, (e.g., community acceptance).

The most important differences in the alternatives are with respect to long-term effectiveness, cost, and community acceptance. Treating soils with a solidification/stabilization technology appears to be effective in preventing the movement of contaminants out of soils into other media. Treatment will not destroy or reduce the toxicity of contaminants, thus requiring long-term monitoring to ensure that treatment remains effective. Treated soils might have been put back on the Site as sub-base for a cap but not in areas where construction is likely to occur, making it less accommodating of future uses than an OCF. The estimated cost of treatment is $38.2 million, plus $12.7 million for disposing debris that cannot be treated, for a total of 50.9 million. In addition, during the 90-day public comment period, approximately 830 out of 900 local residents, businesses and local officials supported an OCF and future development of the Site.

Disposing soil and debris in an off-site landfill would be the most effective solution for the Site over the long-term because the problems associated with on-site management of this soil and debris would be eliminated. It is, however, important to remember that regardless of which alternative is selected, an estimated 15 million tons of slag, which contains hazardous substances, and contaminated soil not within the source areas will remain at the Site because it is impracticable to remove and dispose it elsewhere. Although slag and non-source area soil currently contribute less than the source areas to groundwater contamination, these are still contaminated areas that cannot be left alone. Their contribution to groundwater contamination can further be reduced by capping these areas. Thus, even if EPA selected off-site disposal of soil and debris, long-term management of the contamination that remains on-site would still be an important component of EPA's cleanup. Off-site disposal, excluding management of remaining slag and soil on-site, is estimated to cost $75.1 million. In addition, 830 out of 900 commenters supported an OCF and future development of the Site.

The OCF option, which consolidates the most contaminated soil and debris in a landfill on-site, is an effective solution over the long-term if it is designed and constructed properly and continuous attention is paid to its operation and maintenance.**13** Its estimated cost of $22.8 million is significantly less than the $50.9 million for treatment and the $75.1 million for off-site disposal. Further, Asarco has demonstrated that the OCF can be constructed on-site so as not to interfere with plans for future development of the property. Comments from individuals and groups in the community overwhelmingly endorsed this approach because of their desire to see such development at the Site. Accordingly, because it is an effective method to isolate contaminants from the environment, costs significantly less than other options, and is most accommodating of future uses desired by the community, EPA has determined that the OCF option provides the best balance of tradeoffs and, therefore, is the permanent solution to the

maximum extent practicable for cleanup of the Asarco Site. For the same reasons, under MTCA, selecting disposal in an engineered facility is appropriate even though immobilization of hazardous substances is more preferred in the regulations.

EPA has determined that other components of the selected remedy are also permanent to the maximum extent practicable.

**13** EPA's analysis shows that treating soil before it is placed in an OCF does not provide significant benefits in terms of reducing contaminants moving into the environment should there be a structural failure of the OCF in the future. Therefore, this option has not been selected. See Section 7.2 and Appendix D.

## 10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT.

As explained in Section 10.4 above, none of the components of the selected remedy will satisfy the preference for treatment. If treatment of surface water is necessary in the future, the preference for treatment would be satisfied.

## 11.0 DOCUMENTATION OF SIGNIFICANT CHANGES

In the Proposed Plan, EPA recommended treatment of contaminated source area soils because treated soils did not significantly leach above regulatory levels and EPA believed that the community and the elected officials were strongly opposed to an OCF based on meetings held in the community over the past several years. During the public comment period on the Proposed Plan, EPA received comments from the majority of the public and their elected representatives strongly encouraging the selection of an OCF in lieu of soil treatment (solidification/stabilization) and disposal.

The two approaches for these soils are comparable in terms of their overall protectiveness but differ primarily with respect to their cost and compatibility with future land use and community acceptance. For the reasons stated above, EPA's selected remedy provides for the on-site containment of excavated source area soils. Soils will not require treatment before disposal in the OCF.

In the Proposed Plan, EPA recommended that the slag shoreline along the Asarco Site and the slag peninsula be armored with riprap. During the public comment period, several commenters wondered whether the shoreline was eroding, whether the erosion was causing an adverse impact on the adjacent marine sediment and if more harm than good would be caused if by adversely impacting existing habitat which lived on the current slag face.

Several commenters questioned whether the slag shoreline was eroding, whether the eroded slag particles caused an adverse impact on the adjacent marine environment, and why the shoreline needed to be armored since it is already providing a suitable habitat for marine biota. If shoreline armoring was determined to be necessary, commenters also questioned how it would be anchored to the existing slag face and why riprap (large rocks) was selected instead of artificial beach nourishment (small rocks and sand) to armor the slag.

After evaluating the comments received and finding out that a shoreline monitoring station, consisting of large rocks piled against the shoreline was destroyed by tidal action and strong shoreline currents, EPA still believes that some amount of shoreline armoring will be necessary to prevent erosion of slag particles, which cause adverse effects to marine organisms in the Bay. However, EPA has determined that before the design of the shoreline armoring begins, additional data should be collected to determine (1) the extent of shoreline erosion; (2) how and where armoring should be placed; and (3) the impact of armoring to the existing marine biota versus the impact of not armoring slag to the marine biota over time. EPA will encourage other state and federal resource agencies and community groups to participate in the development of the shoreline armoring.

**APPENDIX A**

**ASARCO**

**RECORD OF DECISION**

**RESPONSIVENESS SUMMARY**

March 1995

U.S. Environmental Protection Agency
Region 10

TABLE OF CONTENTS


1.0 OVERVIEW ..... 1-1
- 1.1 SITE BACKGROUND ..... 1-1
- 1.2 PROPOSED PLAN FOR CLEANUP ..... 1-2
- 1.3 SELECTED REMEDY ..... 1-3
- 1.4 SUMMARY OF COMMUNITY INVOLVEMENT AND CONCERNS ..... 1-3

2.0 PUBLIC COMMENTS AND EPA RESPONSES ..... 2-1
- 2.1 SOIL TREATMENT ..... 2-1
- 2.2 ON-SITE CONTAINMENT FACILITY (OCF) ..... 2-5
- 2.3 CAPPING ..... 2-11
- 2.4 SHORELINE ..... 2-13
- 2.5 SURFACE WATER ..... 2-16
- 2.6 GROUNDWATER ..... 2-18
- 2.7 OFF-SITE DISPOSAL ..... 2-19
- 2.8 MONITORING/LONG-TERM CONTROLS ..... 2-19
- 2.9 HEALTH ..... 2-20
- 2.10 DEVELOPMENT/LAND USE ..... 2-22
- 2.11 COSTS ..... 2-24
- 2.12 PUBLIC INVOLVEMENT ..... 2-25
- 2.13 MISCELLANEOUS ..... 2-27

3.0 ASARCO'S COMMENTS AND EPA RESPONSES ..... 3-1

LIST OF ACRONYMS USED IN THIS DOCUMENT

| | |
|---|---|
| AIP | Agreement in Principle |
| ANS | American Nuclear Society |
| ARARs | Applicable or Relevant and Appropriate Requirements |
| Asarco Site | The Former Asarco Smelter Site |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 |
| CHB | Citizens for a Healthy Bay |
| DNR | Washington State Department of Natural Resources |
| EPA | U.S. Environmental Protection Agency |
| MWEP | Municipal Waste Extraction Procedure |
| NPL | National Priorities List |
| OCF | On-Site Containment Facility |
| Park District | The Metropolitan Park District |
| ppm | parts per million |
| PRP | Potentially Responsible Party |
| Puyallup Tribe | The Puyallup Tribe of Indians |
| RCRA | Resource Conservation and Recovery Act |
| ROD | Record of Decision |
| Ruston | Town of Ruston |
| SARA | Superfund Amendments and Reauthorization Act of 1986 |
| Tacoma | City of Tacoma |
| TCLP | Toxicity Characteristic Leaching Procedure |
| WDFW | Washington Department of Fish and Wildlife |

## 1.0 OVERVIEW

The U.S. Environmental Protection Agency (EPA) has written this Responsiveness Summary to respond to public comments received regarding the Proposed Plan for cleanup of the former Asarco Smelter Site. EPA initially held a public comment period from August 12 through October 11, 1994. At the request of members of the community, the comment period was extended to November 10, 1994. This document reflects all of the comments that were either voiced at one of the two public meetings held during the comment period, or submitted in writing. Questions that were asked and answered at the public meetings, held on August 30 and September 19, 1994, are recorded in the meeting transcripts, and are not included in this document. The transcripts are available in the Administrative Record for the Site is located at EPA Region 10, the Main Branch of the Tacoma Public Library and all of the Information Repositories listed in Table B-1 in Appendix B.

In addition to EPA's efforts, Asarco solicited public comments on EPA's Proposed Cleanup Plan as well as on an "Agreement in Principle" between the company and local governments for future development of the site. Comments received by Asarco in response to its request have been summarized and are included with Asarco's comments on the Proposed Plan, Section 3.0 of this document. The Responsiveness Summary meets the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

## 1.1 SITE BACKGROUND

The former Asarco Smelter project is part of the Commencement Bay Nearshore/Tideflats Superfund Site in Tacoma, Washington. The Commencement Bay Site was placed on the National Priorities List (NPL) in September 1983. The Asarco Smelter Facility and the adjacent Tacoma Yacht Club breakwater (slag peninsula) are located along the shoreline in Tacoma and Ruston, Washington.

The former Asarco Smelter Site (the Asarco Site) consists of the 67-acre smelter property and the 23-acre adjacent peninsula. Many of the facility buildings and structures were erected on slag fill (a black, rock-like byproduct from the smelting process), which extended the existing shoreline when molten slag material was poured into Commencement Bay during smelting operations. An estimated 15 million tons of slag exist on the smelter property and along the slag peninsula.

Metal smelting and refining operations were active at the Asarco Site from the late 1800s until 1985 when the smelter facility was closed. During that time, lead and copper were refined from metal-bearing ores and by-products of the smelting operations were further refined to produce other marketable products such as arsenic, sulfuric acid and sulfur dioxide. Metals and organic compounds were released into the air, soil, and Commencement Bay as a result of these operations. Metals in the slag, or that were released into the soil have migrated into the Bay and into groundwater underneath the Asarco Site.

Over the past several years, samples of soil, slag, surface, and groundwater have been taken at the Asarco Site. Elevated concentrations of heavy metals and some organic compounds were detected in soil and slag throughout the property as well as in the Bay, groundwater and off-shore sediments. The contaminants of most concern for possible effects to public health and the environment include: arsenic, cadmium, chromium, copper, lead, nickel, silver, zinc, and dimethylaniline.

Samples show that the principal threat to human health and the environment is the contaminated material in the "source areas." EPA and Asarco have identified the following six source areas: the Stack Hill, Copper Refinery Area, Cooling Pond, Arsenic Kitchen, Fine Ore Bins Building, and the Southeast Area of the Plant. These are areas that have the highest known concentrations of metals and/or organic compounds and continue to act as the primary known sources of contamination to the Bay and groundwater. Elevated arsenic concentrations ranging up to 403,100 parts per million (ppm) were detected in soil samples at one source area at the Asarco Site. Highly mobile organic compounds are also considered a principal threat because they are leaching out into surface and groundwater that is flowing into Commencement Bay.

Cleanup actions are necessary at the Asarco Site because it currently poses long-term cancer risks for workers, possible future visitors or residents, sealife, and animals. EPA has

selected a comprehensive cleanup strategy in order to address the multiple sources of contamination at the smelter property and along the slag peninsular EPA identified a range of alternatives (series of choices) to achieve cleanup objectives and goals for the Asarco Site. These alternatives are summarized in Table 7-1 of the Record of Decision. EPA has evaluated the choices and public comments on the Propose Plan, and has selected the Phase I (source control) cleanup remedy for the Asarco Site. In addition to evaluating cleanup options, representatives of Asarco, the City of Tacoma (Tacoma), the Town of Ruston (Ruston), and the Metropolitan Park District (the Park District) have formed a "land use committee" which has negotiated an "Agreement in Principle" that calls for preparation of a consensual Master Use Plan for future development of the Asarco Site after cleanup.

**1.2 PROPOSED PLAN FOR CLEANUP**

One of EPA's objectives in issuing the Proposed Plan is to enable the public to participate in the process for selection of a cleanup approach for the Asarco Site. Public comments are solicited to determine whether the range of approaches is adequate, whether the discussion of differences between approaches is reasonable and comprehensive, whether EPA has made good choices in developing a preferred alternative, and whether the choices made will meet community objectives for the Asarco Site.

In developing the Proposed Plan, EPA considered the following nine legally mandated Superfund evaluation criteria:

(1) Overall protection of human health and the environment;
(2) Compliance with federal and state environmental standards;
(3) Long-term effectiveness and permanence;
(4) Reduction of toxicity mobility, or volume through treatment;
(5) Short-term effectiveness;
(6) implementability;
(7) Cost;
(8) State acceptance; and
(9) Community acceptance.

The Preferred Alternative, outlined in EPA's Proposed Plan, addressed contamination of plant site soils, the slag peninsula, groundwater, and surface water. It was based on the alternatives summarized in Table 7-1 in the Record of Decision, plus additional elements that EPA believes were necessary for a comprehensive cleanup. The individual components of the Preferred Alternative included excavation and treatment of soils from the source areas; disposal of soil and other materials; capping the entire Asarco Site; demolition of the remaining buildings; replacement of the entire surface water drainage system; shoreline armoring of the plant site and slag peninsula; abandonment of the production well; monitoring of surface and groundwater and sampling of marine sediments; safety measures; integration of cleanup with land use plans; cleanup schedule; and costs.

**1.3 SELECTED REMEDY**

EPA has carefully evaluated all of the cleanup alternatives and public comments received on the Proposed Plan, and has selected a cleanup remedy to control the source of contamination at the Asarco Site. This selected remedy is Phase I of the comprehensive cleanup plan, and is described in detail in Section 9.0 of the Record of Decision. In general, the selected remedy for source control of the contamination at the Asarco Site includes excavation of source area soils, demolition of the remaining buildings and structures, disposal of the source area soils and demolition debris in an on-site containment facility (OCF) which meets or exceeds regulatory standards for hazardous waste landfills, cap the entire Site except for the OCF which has its own cover, replace the entire surface water drainage system, armor portions of the plant site and slag peninsula shoreline, continue to monitor the surface water and groundwater, sample marine sediments and develop and implement an enforceable program of restrictions and guidelines to supplement the actual cleanup activities to ensure that the remedial action remains protective.

**1.4 SUMMARY OF COMMUNITY INVOLVEMENT AND CONCERNS**

EPA has placed a high priority on community involvement because many Ruston and North Tacoma

property owners and residents may be affected by EPA's chosen cleanup approach. EPA recognizes that, in addition to cleaning up contamination at the Asarco Site, the community is very interested in the future use of this property. Although the primary mission of the EPA is to design a cleanup that protects human health and the environment, EPA believes that this can be accomplished with future development of the Asarco Site in mind. To achieve this goal, significant citizen participation has been important to EPA's process for selecting a remedy. The following activities were undertaken by EPA to seek public input:

- Availability Sessions where citizens could visit one-on-one with EPA and Asarco to discuss cleanup plans,
- Meetings with interested small groups to discuss investigation findings and cleanup alternatives;
- Interviews with individual citizens to improve understanding of community concerns;
- A 90-day public comment period to provide citizens with an opportunity to review the Proposed Plan and other documents related to the cleanup and submit comments to EPA;
- Two public meetings, held on August 30 and September 19, 1994, to answer questions and obtain citizen input on EPA's Proposed Plan; and
- Meetings with the Ruston/North Tacoma Coordinating Forum which is comprised of representatives from local, state and federal municipalities or agencies.

Transcripts of the August 30 and September 19 public meetings and the public comment letters and cards received by EPA are part of the Asarco Smelter Administrative Record, which is available for viewing at EPA Region 10, the Main Branch of the Tacoma Public Library and all of the information repositories listed in Table B-1 in Appendix B. In general, the commenters expressed concerns about the soil, groundwater, and surface water contamination, and its health effects; the longevity and stability of on-site containment/disposal; the effects on future land use; and issues involving the cleanup plan design, costs, and benefits to the community from future development.

The next six paragraphs provide a summary of comments received and are followed by a detailed response section to specific comments. During the comment period, numerous commenters expressed preferences regarding the cleanup of the contaminated soils. Some commented specifically in relation to the future development of the Asarco Site. Many commenters stated a preference for on-site containment of the contaminated soils, reasoning that only by approving the less expensive OCF alternative would there be money left over to develop the Asarco Site. Many stated a preference for on-site containment, reasoning that an OCF is safe, environmentally effective, and the most economical alternative. Other commentors opposed on-site containment because of concerns regarding the stability, longevity, and safety of an OCF, and stated that development should not be an issue in choosing the best cleanup decision. Several commenters felt that the development money Asarco has offered may have already tainted the cleanup decisions of EPA and the local communities. Other commenters suggested that a combination of on-site containment, treatment, and/or off-site disposal would be the most effective remedy for the contaminated soils and other materials.

Contamination in the groundwater, surface waters, and sediments was a concern of some of the commentors; they felt that EPA did not adequately address this issue in the Proposed Plan and offered opinions and suggestions regarding the remediation of these areas.

Many commenters voiced their opinions or suggestions regarding the proposed treatment of soils at the Asarco Site. Some commenters expressed a preference for on-site treatment prior to disposal; others opposed on-site treatment because of issues regarding stability, post-cleanup monitoring, and cost of treatment. Several commenters made suggestions of alternative treatment methods for the contaminated soils.

Many commenters also voiced their opinions and offered suggestions regarding the nature of future development at the Asarco Site. Some commenters expressed appreciation for the efforts of Ruston, Tacoma, the Park District and Asarco in negotiating a Master Development Plan and

were eager to see development of the site. Other commenters disagreed, referring to the plan as a "bribe" to the nearby residents of Ruston and Tacoma to influence their acceptance of a less expensive OCF without treatment.

Some commenters expressed appreciation for past and current efforts on the part of EPA and Asarco; others expressed criticism of one or both organizations. Several commenters indicated disapproval of Asarco and what they viewed as action motivated only by organizational self-interest, which was seen as running counter to public interest. Some commenters expressed the opinion that Asarco had excessively endangered public health in its pursuit of profits Asarco provided comments to EPA' that are included in Section 3 of this Responsiveness Summary. Additional public comments received by Asarco are also included in this section. The next section (Section 2) provides detailed responses to public comments communicated verbally during the public meetings, and written communications received by EPA during the 90-day public comment period.

## 2.0 PUBLIC COMMENTS AND EPA RESPONSES

### 2.1 SOIL TREATMENT

1. COMMENT: Several commentors recommended against treatment of contaminated soil. Several commentors questioned the long-term effectiveness of the proposed soil treatment. Some commentors stated that encapsulation/stabilization is an unproven technology, is difficult to monitor over the long-term, does not reduce the volume of the contaminants, and/or is not cost effective. Some commentors expressed the opinion that there may be serious risks if the resulting mixture were spread over the Site, because the small concrete particles may break down with an end result that is worse than the current situation. Several commentors added that this would have a devastating impact on future Site development. One commentor also stated that, due to the unknown long-term effectiveness of stabilization, this option does not meet the nine evaluation criteria.

RESPONSE: Although EPA is not selecting soil stabilization/solidification for the Asarco cleanup, it has been used at a number of Superfund sites around the country. These technologies are relatively new, such that no data exists that would show how the stabilized material would hold up 50 or 100 years from now. However, tests have been developed to simulate conditions in the future.

EPA believes that many commentors expressed a valid concern about the future monitoring of the treated soils if the soils were placed in various areas beneath a site cap. Although EPA believes that an effective monitoring system could be designed to detect if treated soils were contributing to groundwater contamination, it believes that the leak detection and collection system for the OCF is better with respect to identifying any future problems. Monitoring any Superfund remedy over the long-term always presents site specific challenges and EPA believes that a successful monitoring program can be developed for the Asarco cleanup.

2. COMMENT: A few commentors, including the City of Tacoma Environmental Commission and Citizens for a Healthy Bay (CHB), expressed the opinion that long-term monitoring of the Asarco Site after the cleanup activities were completed would be more difficult and costly if the soil were treated because the treated material would be placed throughout the Site. CHB also expressed the concern that deed restrictions would be necessary.

RESPONSE: In EPA's original proposal, treated soils would have been consolidated in the excavated or other areas on the Site not impacted by groundwater, not spread around. The groundwater monitoring program that EPA would have required for treated soils would have been equivalent to that selected for the OCF.

Deed restrictions and institutional controls will be necessary regardless of the remedy selected because some hazardous contaminants will remain on site under all of the alternatives.

3. COMMENT: Several commentors stated a preference for on-site treatment of metals and other contaminants of concern prior to disposal. One commentor cited off-site health risks, Potentially Responsible Party (PRP) liability, and cost benefits as reasons for on-site treatment.

RESPONSE: EPA has selected disposal of excavated source area soils in an on-site containment facility (OCF) without requiring soil treatment prior to disposal. As discussed in section 7.2. in the Record of Decision (ROD), EPA compared the potential movement of contaminants out of the OCF of treated and untreated soil. EPA found that the potential difference in leachate between treated and untreated soil disposed in an OCF was minimal if the good quality of the cap and bottom liner was maintained.

EPA believes that disposing the source area soil in an OCF and capping the rest of the Site will alleviate any potential health risks to adjacent neighborhoods. Asarco will be responsible for the cleanup regardless of the remedy selected. Most of the public comments received supported an OCF more than soil treatment because an OCF cost less and would allow future development to occur. EPA believes that the additional cost for soil treatment would not result in a more effective remedy over the long-term.

4. COMMENT: One commentor suggested that EPA perform a series of small pilot tests to determine the effectiveness of the proposed treatment on the contaminated soil prior to engaging in final cleanup activities.

RESPONSE: In May 1994, EPA, Asarco and Asarco's contractor ITEX, conducted a pilot-scale treatment project that solidified approximately 500 cubic yards of soil at the former Asarco Smelter Site. The results are described in Appendix C of the ROD. Additional information can be found in section 2.5 of the Administrative Record.

5. COMMENT: One commentor expressed concern that treating the soil with lime may create a different mixture of contaminated elements, and wondered if the EPA has conducted tests to ensure that this does not occur.

RESPONSE: The pilot-treatability study used lime, or calcium oxide, as one of the primary additives. EPA found that "a different mixture of contaminated elements" was not created, rather the metals were simply bound up within the cement. The results of this study can be found in the Asarco Smelter Administrative Record and are described in Appendix C of the Record of Decision (ROD).

6. COMMENT: Citizens for a Healthy Bay (CHB) does not support soil stabilization and commented that there are no assurances that the treated soil will remain stable and will not leach 10, 50, or 100 years from now. They stated that the long-term leachability of the stabilized material is difficult to determine because the method used to evaluate the long-term mobility, the Municipal Waste Extraction Procedure (MWEP), utilizes a 30-day test, and the results of some of the leachability tests were not made available to the public.

RESPONSE: MWEP and the Toxicity Characteristic Leaching Procedure (TCLP) are reasonably good predictors of future leaching, but the treatment technology is so new that actual results of how well treatment works over a long period of time are not available. EPA believes that the MWEP and ANS 16.1 water leaching tests, which are frequently used today at municipal waste facilities, are good predictors of the future impacts of rainwater and surface water coming into contact with treated soils. A summary of the results of both of these tests are attached in Appendix C and the complete document is located in the Administrative Record for this Site.

7. COMMENT: The Tacoma-Pierce County Health Department stated that it would only support treatment if EPA could assure that treatment would be a "permanent fix that would never leach."

RESPONSE: EPA cannot make this guarantee for either disposal option for contaminated soils at the Site. The only alternative that may be able to meet this criterion is "off-site disposal." However, off-site disposal is much more expensive than other available options. Further, even with off-site disposal, it is not possible to remove all contaminated material so some contaminated soil and slag would still remain on Site and need to be capped. For more information on the reasons for this decision to select an OCF, see Section 8.0 in the ROD.

Alternative Treatment Methods

8. COMMENT: Several commentors indicated that additional treatment technologies exist to remove and/or destroy metals in the soil and that these technologies should be considered in the cleanup plan. Citizens for a Healthy Bay (CHB) requested that the time to consider

different cleanup options at the Site be extended to assess the results of alternative treatment studies and allow for public review. CHB also requested that copies of all information received by EPA regarding treatment technologies be sent to their office for review and publication. Two commentors stated that the public comment period should be reopened when the results of any treatment technology are received by EPA.

RESPONSE: Under an EPA Administrative Order on Consent, Asarco conducted a literature search for treatment technologies which would eliminate metal contamination from soils at the former smelter site (see the "Treatability Literature Study Report," May 12, 1992 in Section 2.5.5 of the Administrative Record). Through this literature search it appeared that soil stabilization/solidification was the most appropriate treatment technology for the contamination at this Site. During the public comment period, another treatment vendor claimed that his company's soil-washing technology could remove the metals from the soils for approximately the same cost as on-site containment. EPA has been working with this vendor since the first public meeting, but as yet, has not received additional information which indicates that this treatment process is effective. EPA has informed the vendor of its continued willingness to receive information. The additional soil treatability information on the MWEP test was sent to Citizens for a Healthy Bay. EPA did extend the public comment period for an additional 30 days.

9. COMMENT: Several commentors suggested that chemically extracting the metals from some of the more contaminated soils would be an environmentally and economically sound alternative to stabilization and/or land disposal.

RESPONSE: To date EPA has not identified a chemical-extraction process which is effective for the metals which are found on Site.

10. COMMENT: Several commentors suggested a variety of additional treatment technologies for contaminated soils and/or groundwater. Some of the soil technologies recommended are: (1) bioremediation, (2) combining the metal-contaminated soil with excavated clay and melting the mixture in an on-site kiln, (3) "closed incineration" which is used by oil companies, and (4) the use of any in-situ technologies where possible. In addition, a commentor suggested using wet oxidation of organics, electro-filtration of heavy metals and ozone treatment for groundwater.

RESPONSE: EPA required Asarco to conduct a treatability literature search report, see reference in Response No. 8. In this report all of the applicable technologies for treatment of metals contamination in soils were evaluated.

(1) Bioremediation. EPA believes that the commentor is referring to the bioremediation of metals in an artificial wetland environment. If this is the case, there are microbes that can be used to alter the oxidation state of metals, which in some cases may result in the metals becoming less mobile, but this process would not remove the metals from the environment. Biological treatment of leachate that is generated at some sites has also been used, but this type of treatment does not favorably impact the source of the contamination. Conceptually, Desulfouibrio spp. (a type of microbe) can cause metals to be precipitated in sulfides, but this type of treatment has not been shown to be effective on the type or concentrations of waste at the smelter site.

(2) In-situ vitrification of metals in soil, or combining clay with contaminated soils at high temperatures, was explored, but determined not to be cost-effective. One company, Geosafe, has conducted field demonstrations (small scale) of soil vitrification, which would bake the soil into a slag-like matrix. This has not been proved to be effective at full-scale yet.

(3) Closed Incineration. EPA spoke to the project manager of "Seaview" (Bluebell, Pennsylvania) who developed the technology for "incinerating" hazardous compounds, primarily hydrocarbons, found in off-shore drilling materials. This process involves heating the contaminated materials until the hydrocarbons are burned out of the sediments. EPA does not believe that this treatment process would be effective for treating the contaminated soils found at the Asarco Site.

(4) In-situ technologies, such as soil flushing or vitrification could potentially be used at the Site. However, environmentally dangerous chemicals (e.g., strong acids and chelating agents) would have to be used for soil flushing and it would be necessary to be absolutely sure that all of these chemicals could be captured before they discharged into the bay. Additionally, this could be a lengthy and expensive process due to the high metal concentrations found at this Site.

Following completion of the actions under this ROD, EPA will evaluate the need for remedial measures for surface and groundwater. If surface water treatment is necessary, Asarco will be required to evaluate these approaches, along with others. In-situ treatment technologies will be considered where appropriate.

11. COMMENT: One commentor suggested using sulfur instead of lime in the proposed treatment, because the higher pH of lime would increase the solubility of arsenic.

RESPONSE: EPA recognizes that sulfur chemicals are another set of treatment reagents that could be used to produce insoluble species of arsenic. Like the cement and lime based solidification methods, sulfur reagents have to be tested to make sure they are compatible with the particular waste that is being treated. The concerns that EPA has with sulfur chemicals are (1) the treated soil would be "soil-like" which would mean that surface/groundwater would be more likely to come into contact with the treated soil particles and (2) although sulfides are stable in a low oxidation environment, if they are exposed to air, the sulfides can oxidize and release a more soluble form of arsenic and sulfate.

**2.2 ON-SITE CONTAINMENT FACILITY (OCF)**

12. COMMENT: Numerous commentors expressed their support of the Master Development Plan and stated a preference for on-site containment without treatment. A majority of the commentors reasoned that only by approving the less expensive alternative would there be money available to invest in development of the Asarco Site. In addition, some people expressed the opinion that, besides saving money, on-site containment without treatment would save time. Other commentors reasoned that, as the soil treatment and OCF options are equally protective, the additional dollars that would be required for treatment are better spent on preparing the land for development. One person added that an OCF can always be dug up later if it is determined to be a hazard.

RESPONSE: EPA is required to select a remedy which is protective of human health and the environment. Both soil treatment and on-site containment are protective cleanup options. In this case, EPA further considered the compatibility of protective cleanup plans with future land use plans. EPA believes that the future use of this Site is important and has tried to select cleanup activities that will not prevent reasonable future uses of the Site. EPA has also considered the cost effectiveness of the alternatives. However, it should be noted that EPA's determination that the selected remedy is cost-effective is based on a comparison of the various cleanup approaches described in the Proposed Plan, not on Asarco's ability to afford land development activities.

Contrary to the commentors belief, soil treatment would be completed faster than designing and constructing an OCF. The pilot-treatability test indicated that the soil treatment would take approximately 6 months. However excavating and disposing soils in an OCF could take approximately 2 years.

It is true that an OCF could be "dug up" in the future if it is determined that the OCF is not as effective as once thought and/or if a new treatment technology is discovered. However, EPA believes that the likelihood of this happening is small. EPA is selecting a hazardous waste facility (the OCF) as part of its cleanup option because it believes that this unit can be constructed in a manner which will effectively isolate the waste from the environment and be protective of human health and the environment over the long-term.

13. COMMENT: Several commentors questioned the integrity and effectiveness of on-site disposal, stating that OCF technology is still new and unproven and other waste disposal sites, over time, have all experienced leakage. Two people cited the example of Gas Works Park in Seattle, where the public was assured the soil was safe, but the soil was later discovered to be unsafe and had to be removed at great expense to the taxpayer. Another commentor referred to an

example several years ago when Tacoma encouraged the development of apartments near its refuse site. The contaminants eventually surfaced and the public had to purchase the apartments at a high price following lawsuits. Additionally, several commentors questioned the leachability of contaminants to groundwater and surface waters from an OCF.

RESPONSE: Many of the landfills which have failed in the past have been municipal solid waste landfills that have not been constructed with multiple liners and caps which would be required at the Asarco Site. These landfills have contained a variety of wastes (e.g., solids, liquids, and hazardous constituents). Over time, many of these incompatible wastes have mingled creating either the release of toxic leachate or methane gas. The OCF, which has been selected for this Site, will not contain different types of wastes, rather it will contain "inert wastes" (wastes that are not chemically reactive with each other) such as contaminated soil and demolition debris (excluding wood). Since the metals in the source area soils have been found to become mobile when water passes
through them, it will be important to design a cap which strictly controls surface and groundwater infiltration.

14. COMMENT: Several commentors raised questions regarding the stability of an OCF or landfill in what they considered to be the probable event of a major earthquake. One of these commentors expressed the belief that, due to the geology of the area, an earthquake-triggered (or other naturally-occurring) slide would carry contaminated materials into the bay. One commentor wondered if the Site was fundamentally suited for an OCF.

RESPONSE: Preliminary seismic evaluations of the smelter plant area were conducted during the Feasibility Study. These evaluations indicate that this area is suitable for an OCF (e.g., it is not located on a fault line). However, an additional seismic evaluation of the area where the OCF will be constructed will be a requirement of the Remedial Design/Remedial Action work plans that are developed after the ROD is signed.

15. COMMENT: Several commentors expressed the opinion that if the OCF alternative is chosen a multiple cell approach should be used, with the more contaminated soils stored and/or treated and disposed in a separate cell. They reasoned that this approach would allow for one more level of protection for a leaking OCF and enable removal of the contaminated soils in the future if necessary. Another commentor added that separate cells would offer more precise monitoring capabilities, because the contaminated material ranges over three orders of magnitude in contaminant concentration. Another commentor suggested that, by using separate cells, the more contaminated soils could be treated when new technologies become available.

RESPONSE: Because the type of material to be placed in the OCF is relatively similar (metal contaminated soil and debris) EPA does not believe that there are significant advantages to storing the waste in separate cells. Segregating soils based on the metals concentration may be appropriate if there were a promising soil treatment technology pending and EPA believed that certain soils would be a good candidate for treatment. However, this is currently not the case.

The reasons that landfills are normally separated into multiple cells is to (1) separate incompatible wastes and the leachate from those wastes and (2) to limit the open portion of a large landfill that will operate over many years so as to limit the area available for collection of precipitation. Under this scenario, each cell would be constructed and covered prior to constructing another cell. Neither of these reasons are relevant to the Asarco OCF as the waste to be placed is not incompatible and the duration the OCF will be open is short.

16. COMMENT: One commentor stated that EPA did not present soil treatment before disposal in an OCF as an option in the Proposed Plan, and that treating the most contaminated soils may be a way to mitigate the high costs of remediation and still allow for future development.

RESPONSE: EPA presented this alternative, soil treatment before disposal in an OCF, in Section (H)(7) of the Proposed Plan. The estimated cost of this alternative was $65.5 million. When the Proposed Plan was issued, EPA did not believe that it would be necessary to dispose treated soil in a hazardous waste landfill. Therefore, the costs of disposing treated soils were calculated based on a solid waste landfill. This cost was $70.2 million because hazardous demolition debris would still need to be properly disposed off-site. Disposing treated soil and debris would be more expensive than using an OCF.

17. COMMENT: Two commentors expressed concern that tourists, families, developers, and/or restaurateurs would be hesitant to visit or build on a hazardous waste site that may potentially leak.

RESPONSE: The hazardous waste to be disposed in the OCF would be isolated from potential access by people through a multilayer cover and the legal restrictions requiring that the cover be maintained. Further, as part of the future land use activities sponsored by Asarco, Tacoma, Ruston and the Metropolitan Park District, interviews were conducted with bankers and future developers to determine if there would be a market for development on a remediated Superfund site. The research indicates that constructing an on-site landfill does not appear to pose significant barriers to future uses of and investment in the Site.

18. COMMENT: One commentor stated that the option of including both soil and demolition debris in an OCF should have been presented in EPA's evaluation of cleanup options.

RESPONSE: This option was included in EPA's Preferred Alternative, on page 14 in Section (G)(1)(b) and (c).

19. COMMENT: One commentor suggested that the "ditch" leading up to the railroad tunnel would be an ideal location for the OCF, because it is unattractive and in need of remediation.

RESPONSE: EPA does not believe that this would be an "ideal" location because the gully located on the south side of the stack hill is private property and may potentially be considered a wetland. In addition, there are many areas along the hillsides where groundwater exits and creates small ponds and marshes at the base of the gully. It is important to select an area for disposal of contaminated materials where surface water and groundwater can be controlled.

20. COMMENT: One commentor inferred that, because Hydrometrics (the contractor hired by Asarco to design the OCF in the Feasibility Study) is a subsidiary of Asarco, their assurances regarding the safety and stability of an OCF cannot be taken seriously.

RESPONSE: EPA expects Hydrometrics to perform all of its work in accordance with appropriate professional standards regardless of who owns the company. In addition, EPA and its own Consultant, ICF/Kaiser Engineers, Inc., have carefully reviewed Hydrometrics' work to ensure that Hydrometrics' data-gathering, analyses, findings, and conclusions, including with respect to the construction of an OCF, have been performed in accordance with acceptable methods and legal requirements. Further, EPA's in-house technical personnel have conducted their own independent analysis of an OCF and have concluded that it can be constructed in a manner that is protective of human health and the environment.

21. COMMENT: One commentor requested that EPA provide an example of an OCF that has been around for 50 years in a geographically similar area and exposed to an equivalent amount of water runoff. He also added the question: If the soil is so stable, why then is there contamination in the surface water?

RESPONSE: Because there were no requirements for double-lined landfills with separate leachate detection and collection systems before 1984, specific examples of the performance of double-lined landfills more than 10 years old are not available.

The contamination that is found in the surface water is primarily from soil particles being carried by the water (total metals) and not from metals leaching off soil particles into the water (dissolved metals).

22. COMMENT: One representative from the Washington and North Idaho District Council of Labor expressed opposition to on-site containment because of the poor labor relationship that his union is currently experiencing with Hydrometrics or Asarco.

RESPONSE: EPA has no authority to mediate-labor disputes between Asarco and its contractors. EPA requires, however, that Asarco comply with worker health and safety requirements at all times during performance of cleanup work.

23. COMMENT: One commentor supported the use of pre-stressed concrete in the construction of an OCF.

RESPONSE: Although concrete liners and caps could be constructed to prevent contaminants from migrating out of the OCF or prevent water from migrating into the OCF, concrete has a higher tendency to fracture. If this occurred in the liner, it would be irreparable, whereas clay has the capability to reseal itself if water were to contact it in the future. Experience has demonstrated that concrete, or asphalt caps, generally require more maintenance than clay and synthetic caps.

24. COMMENT: One commentor stated that concentrating contaminated residential soils in an OCF close to the shoreline would further aggravate the local environment.

RESPONSE: Residential soils will not be disposed in an OCF, but will be used as a sub-base to the low permeability cap (see Figure 7-1 in the ROD) that will be placed on the Site.

25. COMMENT: One commentor asked if releases from an OCF could be monitored if the Site is already contaminated and wondered if existing contamination would make it more difficult or unlikely to detect leaks from an OCF.

RESPONSE: EPA has many years of groundwater data from this Site that can serve as a baseline prior to construction of the OCF. EPA plans to continue groundwater monitoring before, during and after cleanup. Therefore, we will be able to evaluate the groundwater contamination trends before and after construction, of the OCF. In the event that contaminants begin to leach out of the OCF, they will be detected as increases above then existing conditions via the groundwater monitoring program.

26. COMMENT: One commentor stated that a hazardous waste facility, under Resource Conservation and Recovery Act (RCRA) siting requirements, would not typically be in a wet climate with full public access and immediately adjacent to an exceptional water body, such as Commencement Bay. For these reasons, if soil treatment is ineffective, the proposed OCF should be modified to use additional clean soil as a cover to diminish future exposure, with the contaminated soils segregated by level of contamination into separate cells. This commentor added that the OCF should be built like any other RCRA facility, with the soils receiving the same amount of treatment as would be required if they were to go to the RCRA facility in Arlington, Oregon.

RESPONSE: EPA agrees that a new hazardous waste landfill typically would not be sited in this type of location, assuming that the area was relatively clean. EPA and the State try to avoid introducing contaminants to pristine or clean areas. But the smelter site is not such an area and it is generally recognized that a significant amount of contamination, such as 15 million tons of slag, cannot be removed from this location. Accordingly, EPA believes that construction of a landfill in accordance with federal and state requirements at this location, given existing contaminated conditions, is an acceptable part of the overall cleanup. EPA is not requiring treatment of soil prior to disposal in the OCF because the OCF can effectively isolate the soil from the environment, see Section 9.9 of the ROD. See Response to Comment No. 15 regarding construction of separate cells.

27. COMMENT: One commentor stated that the siting decision for the OCF needs to carefully consider the hydrogeology of the Asarco Site. An impermeable structure, such as an OCF, is likely to alter the current groundwater system and raise the water table around the OCF. He expressed the opinion that the OCF should not be constructed atop a shallow aquifer if other more protective locations exist. Other commentors wondered if there would be any way to pump out water that may seep into the OCF before it moves from the OCF into Commencement Bay.

RESPONSE: All groundwater and surface water which currently flows across or through the central area of the Site, where the OCF will be located, will be rerouted through new drainage systems or diversion trenches. It is not likely that the groundwater table will rise as a result of these activities.

In addition, a thick silt aquitard lies beneath the shallow aquifer in this location and will prevent rerouted or displaced groundwater from migrating to the deeper aquifer.

The OCF will be designed so that groundwater is unlikely to come into contact with the OCF and so that surface water (rain water) will be diverted. In addition, EPA believes that the minimal amount of leachate which may be generated inside the OCF will be handled by the leachate

collection and removal system before it is released into the groundwater or the bay.

28. COMMENT: A few commentors believe that EPA should consider the potential for including contaminated sediments in the OCF. In contrast, the Town of Ruston commented that it is opposed to using the OCF for the disposal of dredged, dewatered marine sediments, due to the necessity of reopening a closed OCF, the potential for adverse chemical reaction with materials in the OCF, and its adverse impact on future development. Tacoma, the Metropolitan Park District and Asarco also opposed disposing sediments in the OCF.

RESPONSE: At this time, it has not been determined that off-shore sediments need to be dredged and disposed. However, Ruston, Tacoma, the Metropolitan Park District and have presented several reasons why this material should not be disposed in the OCF should dredging and disposal be required in the future: (1) the sediments will be very wet and may introduce water into the OCF that could mobilize the metals on the soils, and (2) there may not be enough room remaining in the OCF after the soils and demolition debris are disposed. Although sediments could be dried before they are disposed, it is unlikely that sufficient capacity could be added for the sediments without interfering with land use plans. For these reasons, EPA agrees with the commentors opposed to disposing sediment in the OCF. Other alternatives for disposing dredged sediments will be evaluated by Asarco and EPA.

29. COMMENT: One commentor stated that because the Tacoma Asarco Smelter processed ores that other smelters did not want, all of the contaminated soils should be consolidated on the site.

RESPONSE: EPA agrees that consolidation of soils on site makes sense but not necessarily for the reason provided by the commentor.

30. COMMENT: The Puyallup Tribe of Indians (the Puyallup Tribe) is concerned that the construction of an OCF before implementation of a source control strategy may preempt the future remediation of groundwater, therefore they request the construction of the OCF not occur until after the groundwater studies are completed. The Tribe stated that a source control strategy must develop specific plans for control of permitted and unpermitted point source and non-point source discharges and that "No remediation should begin unless source control can be implemented and enforced." The Tribe added that the cleanup of this Site must ensure that there will be no further pollutants entering the environment from any source.

RESPONSE: The Tribe appears to be stating that EPA should directly reduce levels of contaminants in surface water and groundwater prior to removing contaminated soil and constructing an OCF for disposal of such soil. The Tribe's concept of "source control" appears to be to treat contaminated surface water and groundwater prior to discharge.

EPA agrees with the Tribe's proposed result but not with its recommended sequence of cleanup activities. Because contaminated soils existing at the Site are the primary source of contaminants found in surface water and groundwater, EPA believes it is important to first remove the most contaminated soils from the primary source areas and isolate them from surface water and groundwater so the connection between the sources of contamination and the discharges to Commencement Bay is severed.

After the sources are removed and isolated in the OCF, the entire Site is capped, and a new surface water drainage system is installed, EPA will monitor the levels of containments in discharges from the Site. If these levels continue to exceed acceptable requirements, EPA will determine what further actions, including water treatment, are necessary to reduce the discharge of contaminants into Commencement Bay. EPA notes that the cleanup levels for surface water are consistent with the Tribe's water quality standards. By promulgating its water quality standards, the Tribe appears to recognize that there are acceptable levels for pollutant discharges other than "no further pollutants."

**2.3 CAPPING**

31. COMMENT: One commentor preferred that Asarco cap the land "as is" rather than excavating and consolidating the contaminated soils.

RESPONSE: The soils located in areas identified by EPA as "source areas" have very high concentrations of contaminants which are mobilized by contact with groundwater. In order to address the significant groundwater problem at the Site, EPA believes it is necessary to remove these soils before capping the entire Site.

32. COMMENT: There were several comments regarding the capping materials that were proposed to be used for a Site cap. Two commentors believe that the "clean" soils from Pt. Defiance are probably also contaminated with Asarco emissions; another commentor was concerned about contaminants from the excavated Study Area soils potentially leaching into the Bay and another commentor suggested that contaminated sediments as well as Study Area soils should be included in the cap.

RESPONSE: All soils used for the top layers of the cap will be sampled to verify that they are clean. Although the Ruston/North Tacoma soils do not leach metals into surface water or groundwater, EPA believes that the cap will protect the contaminated soil particles from being washed into the bay by surface water. At this time, EPA is not sure whether sediments will need to be dredged or not.

33. COMMENT: Several commentors expressed the opinion that the capping or OCF soil cover should be greater than 2 feet so more substantial vegetation can be planted on top without breaching the cap. One commentor added the opinion that a 1-2 foot soil cap would not be sufficient to ensure permanent protection of construction, public access, utility work, and other activities that may occur on site.

RESPONSE: The total thickness of a multilayer soil cap is at least two and a half feet; for an OCF the thickness is at least five feet. The 1-2 foot soil cap required for the OCF would be in addition to filter material, one foot of drainage material, a fabric liner and two feet of compacted clay. For the soils cap, the one foot of clean soil would be in addition to 6 inches of gravel and one foot of clay. EPA notes that plans for development of the Site may result in even thicker layers of soil in the cap or above the cover of the OCF.

34. COMMENT: Two commentors stated that clay capping is susceptible to cracking. One of these commentors suggested using a geomembrane liner in combination with the low permeability soils as a substitute for clay capping. A few commentors are concerned about sulfide formation if anything other than a "soil only" cap is used or if waste is buried deeper than four feet (sulfides increase the possibility of a "reducing" environment).

RESPONSE: Although clays that dry out are susceptible to cracking, the advantage of clay is that once surface water does begin to migrate through the cracks it rehydrates the clay and the cracks are resealed. Although synthetic liners are often used in conjunction with clay, it is for this reason that synthetics are rarely used alone. A synthetic liner may be used as part of the cap and liner of the OCF and will not be used as part of the site wide cap.

EPA has not experienced sulfide formation at sites where wastes were buried deeper than four feet. Also, see Response to Comment No. 11.

35. COMMENT: The Tacoma-Pierce County Health Department's comment letter expressed the opinion that the placement of contaminated residential soils under a cap containing one foot of low permeability soils is not appropriate because the soil would be considered dangerous waste if generated elsewhere in the state. It stated that the original plan was for the residential soils to be disposed at an off-site landfill and asks how this fits into the proposal to use soils as fill material on the Asarco Site. The Town of Ruston supported using Ruston/North Tacoma soils as a sub-base for a cap on the Site.

RESPONSE: The Health Department later clarified its comment to EPA's project manager and stated that their primary concern about the Ruston/North Tacoma residential soils was their potential to leach. After EPA explained that the data indicated that these soils do not significantly leach above regulatory standards with acid or water extraction, the health department representative agreed that the proposed method of disposal was sufficient.

The Ruston/North Tacoma Study Area Record of Decision (June, 1993) stated that the residential soils would be dispose off site unless an alternative method of disposal was selected in the ROD for smelter cleanup. To determine whether it would be acceptable to the community, EPA proposed

using these soils as a sub-base for a cap in the Proposed Plan for the Smelter Cleanup.

36. COMMENT: One commentor suggested that the contaminated Ruston/North Tacoma soils should not be placed under future parks, open space, or in areas such as streams crossing the Site.

RESPONSE: Since these soils will be beneath a protective cap, EPA believes that these types of restrictions for the placement of residential soils are not necessary. In the event that trees or vegetation that have deeper roots will be planted in parks or open spaces, the thickness of the soil covering can be modified appropriately. Presently, EPA is not aware of any streams crossing the Site.

37. COMMENT: One person was concerned that capping soils in place may still allow contaminants to leach into groundwater aquifers and the bay. He stated that the soil should be removed if the concentrations are dangerous.

RESPONSE: The most highly contaminated soils will be excavated. The Site soils which will not be excavated do not appear to be primary sources of groundwater contamination. However, because rainwater does contact these soils, soil particles are washed into the bay. EPA believes that a clean soil and clay cap will prevent rainwater from coming into contact with the contaminated soils and will prevent contaminated soil particles from washing into the bay.

38. COMMENT: A commentor stated that the cap should be designed to accommodate underground parking.

RESPONSE: EPA's paramount interest is maintaining the integrity of the cap. If an underground parking lot can be constructed so as not to compromise the integrity of the cap, EPA will consider it along with other land uses that may be proposed.

**2.4 SHORELINE**

39. COMMENT: One person commented that the entire slag face should be securely enclosed so that no leaks are possible.

RESPONSE: If a non-permeable (leak proof) barrier of some type is placed securely against the slag face a "bathtub" effect will be created on the Site. Right now, hundreds of gallons of groundwater move through the Site each day. Placing a barrier at the slag face would cause this water to back up. EPA believes that the shoreline armoring approach will prevent erosion, but still allow groundwater to move into the bay.

40. COMMENT: The Washington Department of Natural Resources (DNR) expressed the opinion that the alteration of the existing shoreline during Site cleanup, as described in the Proposed Plan, may result in the exposure of new slag faces. They believe that this may lead to additional contamination of the bay due to increased toxicity and mobility of contaminants, as well as increase the volume of slag requiring treatment/disposal. DNR cannot support any activities that would create freshly exposed slag and believes that this issue has not been adequately evaluated in the nine criteria analysis. DNR recommended that a quantitative analysis of leaching associated with freshly exposed slag be performed prior to finalizing any plans to cut back the slag.

RESPONSE: EPA anticipates that at least some shoreline armoring will be necessary. EPA shares DNR's concern about exposing too many freshly cut surfaces to bay water since this is the condition when metals in the slag are most leachable. Prior to armoring, EPA will determine if significant erosion is occurring. If it is, and armoring is necessary, DNR, other Natural Resource Trustees, and interested members of the community will be asked to be involved in the development of the remedial design work plans associated with shoreline armoring.

41. COMMENT: DNR stated that armoring and careful design aimed at creating an area which habitat would repopulate is preferred without cutbacks which may lead to further contamination of Commencement Bay.

RESPONSE: EPA agrees with this recommendation.

42. COMMENT: One commentor stated that implementability criteria, overall protection of

human health and the environment criteria, community acceptance criteria, and land use plans have not included the analysis of shoreline armoring design.

RESPONSE: Analysis of this alternative has been included in Section 8.0 in the ROD. However, EPA agrees that additional studies will be necessary to determine the extent and location of armoring and the specific design for anchoring the too (bottom) of the riprap.

43. COMMENT: Citizens for a Healthy Bay and other commentors stated that the Preferred does not give an adequate description of the remediation proposed for the shoreline. They suggested that before the ROD is written, more information regarding the range of alternatives considered, the benefits and drawbacks of each alternative, and site-specific information regarding how this or any other alternative would be implemented needs to be made publicly available. They also questioned whether the riprap will be placed on top of, the existing slag face, or if the slag face will be cut away and then covered with riprap as shown in the feasibility study.

RESPONSE: In the ROD, EPA has modified the Proposed Plan's approach with respect to shoreline armoring based on public comments received. Before developing the design for shoreline armoring, Asarco will be required to conduct additional studies to determine where and to what extent the shoreline is eroding. Sections of the shoreline that are significantly eroding will be armored. At that time, site-specific information will be collected to determine whether cutbacks are necessary and how the riprap will be anchored in order to design the armoring. Citizens for a Healthy Bay, the Natural Resource trustees and other members of the public will be encouraged to participate in this process. Also, see Responses to Comment Nos. 40 and 41.

44. COMMENT: The Puyallup Tribe agreed with the proposal for shoreline armoring. Another commentor requested that the shoreline armoring requirements be flexible enough to accommodate different shoreline needs.

RESPONSE: The shoreline armoring will be designed to accommodate future land uses. Presentation and mitigation of shoreline habitat will also be an objective of shoreline armoring.

45. COMMENT: One commentor stated that a minimum slope of 2.5 (horizontal) to 1 (vertical) needs to be used for any riprap placed on the slag face. It was further added that the explanation was inadequate regarding how this alternative will be implemented without interfering with future sediment remediation. He also stated that it is unclear as to how the armoring will be held in place.

RESPONSE: EPA has been advised by the Corps of Engineers that in most locations, the steepest slope that should be used for riprap armoring is 1 to 1.5, and that areas with slopes greater than this would require cutbacks. Sequencing shoreline armoring and sediment remediation activities will be necessary but at this time the extent of sediment cleanup is not known. By the time work plans will be required for shoreline armoring design, EPA should know what portion of the sediments are contaminated and how these sediments can be cleaned up (e.g., capping, dredging or natural recovery). In many places a "toe" can be excavated out of the slag in order to anchor the armoring. The specific design details of armoring will be determined at a future date. EPA will encourage members of the community to participate in this process.

Natural Resources

46. COMMENT: Several commentors indicated that more emphasis should be placed on developing a range of alternatives for restoration of the natural habitat of the bay, nearshore, and shoreline areas. One commentor suggested that EPA establish an ambitious whole-watershed restoration program as part of the site remediation plan; one commentor stated that shoreline treatment and natural resource restoration options should be explored before a final cleanup design is developed; and one commentor requested that the effects of shoreline armoring on existing habitat be evaluated.

RESPONSE: EPA will work closely with community members and Natural Resource Trustees to develop a comprehensive design plan to try to address all of the commentors concerns. EPA will evaluate whether the mitigation/restoration sites identified by the U.S. Army Corps of Engineers, EPA, U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration (NOAA) in the Commencement Bay Cumulative Impact Study, Volumes I and II (May/June 1993) and the "Vision

Document for Commencement Bay," by the Commencement Bay Cleanup Action Committee (November 19, 1993) are appropriate for the Asarco cleanup.

Although EPA does not believe that "shoreline treatment" is possible, it will identify the effects of armoring on the existing habitat and will explore mitigation opportunities while designing shoreline armoring.

47. COMMENT: Several commentors suggested that the area be returned to a pre-industrial wilderness.

RESPONSE: Although this is a nice idea, it does not appear to be practicable, particularly given the 15 million tons of slag at the Site. EPA's objective is to cleanup the Site so that it will not pose a threat to human health and the environment in the future.

48. COMMENT: Two commentors suggested that the EPA should coordinate its design/cleanup efforts with resource agencies such as National Oceanic & Atmospheric Administration and the Natural Resource Damage Assessment Trustees.

RESPONSE: EPA has been working with these agencies during the RI/FS and decision-making phases and will continue to do so during remedial design and remedial action activities.

49. COMMENT: One commentor expressed the opinion that the alternatives presented (OCF or soil stabilization) are not adequate to accomplish the cleanup correctly. He believes the cleanup should integrate public health issues with the restoration of both aquatic and terrestrial habitats, and the economic thresholds necessary to facilitate quality development.

RESPONSE: The cleanup activities which have been selected are intended to prevent or minimize the contaminant exposure to humans, animals and sealife. Preservation of habitat (or mitigation for adverse impacts to habitat) are also an objective of this cleanup. EPA intends to continue working with the local community regarding the future development of the Site so that "quality development" after the cleanup will also be possible.

50. COMMENT: The U.S. Fish and Wildlife Service commented that they were pleased to see that EPA recognizes mitigation for habitat losses associated with remediation activities as a necessary element in the overall success of the preferred alternative.

RESPONSE: EPA hopes that the U.S. and State Fish and Wildlife Services will continue to be involved in this project.

51. COMMENT: One commentor stated that restoration should be considered while a remediation plan is being developed and that EPA should consider restoring the two natural streambeds that were on the Site. Two commentors requested that as the site remediation plan is finalized, the OCF, liners, and other infrastructure should be made consistent with the restoration of natural streambeds and areas near the shoreline. One commentor suggested that water-sensitive site design that allows natural infiltration of stormwater runoff and reestablishment of natural vegetation be adapted in the location of the two former small streams on the Asarco Site.

RESPONSE: EPA recommends that stream bed restoration be considered under the future development process. EPA notes that CERCLA § 107(f)(1) does not allow for recovery where damages to natural resources have occurred wholly before December 11, 1980. "Natural infiltration" of stormwater runoff is not a good idea if it means that stormwater will come in contact with contaminated soils beneath the Site cap.

Sediments

52. COMMENT: One commentor expressed the opinion that guidelines must be developed for further maintenance and repair of the existing pier structures to minimize impact to sediments.

RESPONSE: EPA's selected cleanup remedy does not address the existing piers. If these piers are to be use for future land use activities, the repair and maintenance will need to be addressed by the Public Development Authority established to oversee future development activities.

**2.5 SURFACE WATER**

53. COMMENT: One commentor advised that plugging the present drainage system should be done in such a manner as to prevent all water from leaching into the pipes and potentially draining into the bay, and that care should be taken to avoid incidental flushing of the contaminated drain sediments into the bay. This commentor also stated that if applicable and relevant and appropriate requirements (ARARs) are not reached through these surface water measures, surface water treatment be required regardless of its cost. He also wondered if any drainage system presently exists on the slag peninsula. The Puyallup Tribe noted that treatment of surface water (and groundwater) would be difficult particularly during peak flows. The design of the treatment system must account for the worst case scenario instead of allowing for waivers of water quality standards or by-passes.

RESPONSE: Under EPA's selected remedy, all of the existing surface water drainage system will be plugged. If the surface water that flows through the new drainage system does not meet the remedial action objectives (see Section 9.9), surface water treatment will be required to the maximum extent practicable. There is no drainage system on the slag peninsula.

54. COMMENT: The Town of Reston commented that any surface and stormwater management and drainage systems must be designed in consultation with Ruston, Tacoma, and the Park District and meet or exceed all local, state and, federal standards and regulations. The Town of Ruston stated that the surface water drainage system should not be designed as to make routine maintenance and/or any required repair prohibitive.

RESPONSE: EPA will work with the Town of Ruston to accomplish these objectives by involving the Town in development of the Statement of Work and work plans for the design and implementation of the cleanup.

55. COMMENT: The Puyallup Tribe commented that the existing surface water drainage system needs to be plugged and abandoned and a new system constructed. If surface water quality fails to meet federal and state standards, treatment of surface water must be required regardless of cost. The Tribe also requested the creation of detention facilities, such as small streams and drainages, to provide natural areas for wildlife and help control surface water during peak flows. In addition, it requested that Site cleanup ensure that no additional contaminants be released into the environment (e.g., recontaminate the sediments). The Tribe objected to the use of a mixing zone.

RESPONSE: EPA agrees with the need to plug and abandon the existing surface water system and build a new one (see Section 9.3 of the ROD). If surface water cleanup levels are not attained as a result of the new system and capping the Site, the need for treatment will be evaluated.

Detention facilities, silt fences, diversion ditches, cut and fill slopes, will be used as appropriate when soil is being excavated in order to reduce contaminated runoff from excavated areas. Once a soil cap is placed on the Site, EPA will evaluate whether such measures are needed as part of the new surface water drainage system. See Response to Comment No. 51 regarding streams on the Site. EPA believes that construction of a surface water drainage system will prevent the release of contaminants into the bay from surface water. EPA notes that mixing zones are authorized under both state law and Section 9 of the Tribe's Water Quality Standards. Whether a mixing zone is appropriate for the Asarco Site will be determined during remedial design.

56. COMMENT: One commentor stated that the former cooling pond area should be fully remediated to become part of the overall natural area on the Asarco Site, and added that the contaminated soil in the cooling pond area should not be capped in place but removed.

RESPONSE: Approximately seven feet of contaminated soil will be removed from the cooling pond area. If contaminated soil exists beneath this depth it will be capped. Whether this area becomes a "natural area" or a "development zone" will be determined with community participation during future land use meetings.

**2.6 GROUNDWATER**

57. COMMENT: Several commentors stated that passive treatment of groundwater and surface

water is not adequate and that a source control strategy for point source and non-point source discharges should be implemented prior to commencement of soil remediation. One commentor added that the mass loading of hazardous releases from groundwater and surface water should be fully documented, and a cleanup strategy developed to ensure that contaminants will not continue to enter Commencement Bay. Another commentor requested that the EPA provide more detail on how groundwater will be remediated, and stated that groundwater remediation would result in a significant reduction of ongoing injuries to the bay's natural resources. Two commentors stated that if monitoring reveals that the groundwater fails to meet federal and state standards, the Master Development Plan must allow for the construction and operation of a treatment facility or other contingency plan. The Puyallup Tribe commented that the remediation of soil may interfere with the future remediation of groundwater.

RESPONSE: Efforts to document and evaluate surface water and groundwater contamination are presently underway with the collection of surface water data every month and the collection of groundwater data twice a year. EPA believes that the source control activities will significantly reduce contaminant loading into surface and groundwater. See Response to Comment No. 30 regarding the sequencing of cleanup activities and the basic premise of EPA's source control strategy.

If it is determined that active measures are necessary to clean up surface water and groundwater, a separate analysis and proposal regarding such measures will be issued for public review. EPA does not agree that soil remediation will interfere with the future remediation of groundwater because removal and disposal of soil does not preclude active measures for groundwater.

58. COMMENT: One commentor stated that the preferred alternative will fail to achieve cleanup goals for groundwater because EPA's preferred alternative proposes a waiver of applicable or relevant and appropriate requirements (ARARs) relating to groundwater cleanup and deferral of sediment remediation.

RESPONSE: At this time it is not certain whether source control activities selected by EPA will attain the federal and state groundwater cleanup goals. Accordingly, a temporary waiver of the requirement to meet such goals for this action is appropriate. EPA will continue to monitor the Site and will take the appropriate groundwater cleanup measures if necessary and to the maximum extent practicable.

59. COMMENT: One commentor recommended continual groundwater monitoring at the Site until it is determined that contamination no longer exists.

RESPONSE: EPA and Asarco agreed to a long-term groundwater monitoring plan in October 1994 that requires groundwater monitoring until 1999. EPA anticipates that a cleanup decision for the groundwater will be made by then.

**2.7 OFF-SITE DISPOSAL**

60. COMMENT: Several commentors expressed a preference for the removal of contaminated soil and off-site disposal citing concerns for the longevity, stability, and future exposure risks of on-site disposal. Some commentors suggested that leaving contaminated materials on site would not provide a permanent solution and would only be a toxic legacy for future generations. Another commentor expressed the opinion that any material hauled off site would be a liability for another community.

RESPONSE: EPA agrees with the commentor's description of the advantages of off-site disposal. But a significant disadvantage is the cost of off-site disposal, nearly $50 million more than disposal in an OCF. Together with the fact that not all contamination will be removed from the Site under any alternative (e.g., 15 million tons of slag cannot be removed) EPA has determined that the cost-effective cleanup solution at the Site is disposal of source area soils in an OCF and placement of a soil cap over the entire Site.

If materials were disposed off-site, it would most likely be placed in a permitted and regulated hazardous waste facility which has already been constructed and permitted and should, therefore, not be a liability for another community.

61. COMMENT: One commentor expressed the opinion that development of the Asarco Site should not be allowed unless the soil is removed off site.

RESPONSE: EPA believes that the Site can be safely developed if the contaminated soil that remains on site is either isolated in an OCF or capped in place.

**2.8 MONITORING/LONG-TERM CONTROLS**

62. COMMENT: Several commentors expressed the opinion that any contaminated material remaining on site in an OCF or underneath a cap should be surrounded by monitoring wells and tested regularly. One commentor asked if a program would be established and funded to ensure ongoing monitoring and repairs when necessary. Another commentor wondered who would be responsible for ensuring that the post-cleanup monitoring is performed.

RESPONSE: Fifty-eight monitoring wells are being used for sampling under the long-term monitoring program. EPA and Asarco have agreed to install additional groundwater monitoring wells after source areas soils have been excavated (see the Post-RI Long Term Monitoring Sampling and Analysis Plan," October 1994). All of the wells in the source areas will be sampled quarterly. During the design of the OCF, EPA will ensure that monitoring wells are in appropriate locations to detect problems with the OCF should they occur in the future. Asarco will be responsible for maintaining and repairing all wells as necessary. EPA will ensure that Asarco monitors the Site after all cleanup activities are completed.

63. COMMENT: One commentor suggested that local land trusts, public agencies (Housing Authorities), and environmental groups should be involved in future site monitoring and management responsibilities.

RESPONSE: EPA believes it is most appropriate for Asarco to have responsibility for all future monitoring activities. But, EPA is planning to involve other entities in monitoring and management activities.

64. COMMENT: One commentor suggested that deed restrictions and other legal means for ensuring institutional controls for the Asarco Site need to be strict to ensure a permanent protection for the soil cap placed across the Site and any containment facility built on the site.

RESPONSE: EPA agrees (see Section 9.6.2(a) of the ROD) and will include requirements in the future agreements with Asarco to implement institutional controls including deed restrictions.

65. COMMENT: One citizen commented that the Park District and Tacoma cannot be counted on to keep their promise of post-development monitoring because they have not kept previous promises.

RESPONSE: Asarco will be responsible for conducting all future Site monitoring, including monitoring after the cleanup has been completed.

66. COMMENT: One commentor stated that regardless of whether Asarco treats the soil or disposes it in an OCF; monitoring, cap maintenance, air monitoring, and surface water monitoring must be required.

RESPONSE: EPA agrees that monitoring is necessary; these measures are required in the selected remedy found in Section 9.0 of the ROD.

**2.9 HEALTH**

67. COMMENT: Two commentors were concerned about health effects from contaminants on site and believe that some of their close family members have suffered from chronic health problems and may have died prematurely as a result of working at the Asarco Smelter.

RESPONSE: EPA expresses its regret for this commentors situation. EPA's cleanup decision is based on the health risks posed by current conditions at the Site. EPA cannot evaluate the extent to which workers' health may have been affected while employed at the smelter, but EPA can assure that any future population which comes into contact with the Site will not be

adversely impacted.

68. COMMENT: One representative from the Washington and North Idaho District Council of Labor voiced concerns about the health and safety of site workers participating in the cleanup operation. He expressed the opinion that Hydrometrics has demonstrated continuing disregard for worker safety and health concerns by allowing contaminated vehicle/equipment rinse water to be discharged directly into Commencement Bay via storm sewers.

RESPONSE: EPA requires Asarco to submit health and safety plans for all of the cleanup activities that occur on the Site. During any cleanup activities, EPA has an oversight contractor on site to ensure that the work plans and the health and safety plans are being followed appropriately. Any concerns about worker safety should be forwarded directly to the Washington Department of Labor and Industries. See also Response to Comment No. 22. During soil excavation and disposal activities, EPA will require Asarco to control discharges of contaminated water.

69. COMMENT: The Puyallup Tribe requested that EPA take into consideration their hunting, fishing and other subsistence activities on and near the Puyallup Reservation and added that the living resources in Commencement Bay and human population that depends on these resources must not be subject to the bioaccumulation of hazardous chemicals. The Puyallup Tribe also stated that the protection of anadromous fish (species which live in fresh and salt water), on which much of the tribe relies for spiritual subsistence and economic survival, is of paramount importance. The Tribe requested that EPA conduct a fish consumption study prior to issuing the ROD for the smelter cleanup.

RESPONSE: EPA has not evaluated how much fish from Commencement Bay is consumed by the Puyallup Tribe in making its cleanup decisions in this ROD. EPA has agreed, however, to consider this information when making its cleanup decision regarding groundwater.

EPA is and will continue to take into account the concerns of the Puyallup Tribe, which encompass the existence of contamination in all of Commencement Bay, not just that associated with the Asarco Site. EPA has set its cleanup goals at levels which it believes are protective of human health and the environment. Because `protectiveness' includes minimizing contamination in fish that may be consumed by humans, EPA is particularly focusing on contaminant levels in fish in its continued investigation of marine sediments off-shore of the Site.

70. COMMENT: Two commentors felt that the health risks associated with the contamination of the Asarco Site may be exaggerated because they have not experienced adverse health effects from living near the Site. One commentor suggested that stress from the cleanup process is probably more debilitating than the arsenic contamination, and the other commentor expressed the opinion that EPA should offer a real-life comparisons of the alleged increased health risks from exposure to lead and arsenic.

RESPONSE: The potential health risks that have been identified at the Site in the Risk Assessment are primarily based on predicted adverse effects posed by current Site conditions to potential residents, workers, recreational visitors or trespassers, i.e., people who may spend varying amounts of time at the smelter in the future. Because residents, workers, etc. are not living/working/playing on the Site now, it is not possible to give real-life examples. The evaluation of potential increased health risks from lead and arsenic are summarized in Section 4.2 of the Risk Assessment (Kleinfelder, 1993).

Residential:

71. COMMENT: One person questioned whether or not it is safe to eat home grown produce from the area.

RESPONSE: The Risk Assessment conducted for the Ruston/North Tacoma Study Area indicated that the risk from eating fruits and vegetables that are grown in the area is very small. Precautions which are recommended by the local health department include, thoroughly washing leafy produce such as lettuce, and produce which is grown underground, such as carrots and radishes.

72. COMMENT: One person expressed the opinion that Asarco has been given "special

treatment" because the level of arsenic and lead contamination that it has been ordered to excavate is greater than the Action Levels established by the State.

RESPONSE: EPA believes this commentor is referring to action levels for the residential area EPA disagrees that Asarco has been given "special treatment." EPA has selected safe cleanup levels for the soils. Decisions regarding the cleanups of both the Ruston/North Tacoma Study Area and the Smelter Site, including the specific determinations of action levels, have been made in accordance with federal and state requirements, and with the concurrence of the Washington Department of Ecology.

**2.10 DEVELOPMENT/LAND USE**

73. COMMENT: Numerous commentors expressed specific opinions regarding the development that should occur at the Asarco Site after cleanup. One person commented that, if the Asarco Site is beautified, surrounding property values would be elevated and residents would be angered by the resulting increase in property taxes. One commentor expressed the opinion that Asarco is living up to the public trust by their commitment to invest 15 to 20 million dollars beyond the cleanup cost to encourage future development. Another person commented that redevelopment would not compensate for the legacy of pollution that Asarco will leave behind.

RESPONSE: All of the comments received by EPA regarding future development will be forwarded to the Land Use Group which includes representatives from the City of Tacoma, the Town of Ruston, the Metropolitan Park District and Asarco. EPA believes that the cleanup of the smelter site will reverse the legacy of pollution from the operation of the smelter. EPA is not in the position to evaluate the potential for property taxes to change based on Site development activities.

74. COMMENT: Many commentors were concerned that only financial benefits, and not environmental and/or long-term human health considerations, have been considered in the Master Development Plan. Two of these commentors expressed the opinion that the development plan was designed primarily to enable Asarco to save significant cleanup costs. One person commented that when a company pollutes an area so badly it achieves the distinction of worst Superfund site, a cursory cleanup for the sake of profit and added local taxes does not meet the intent of Superfund legislation.

RESPONSE: EPA has selected cleanup measures that will comprehensively address contamination at the Site and that are fully in accordance with the Superfund law. Further, the primary intent of the Master Development Plan is to provide for future development of the Site once cleanup has been completed. Accordingly, other than the need to maintain the protectiveness of the cleanup measures, it is reasonable that the Master Development Plan not focus on environmental considerations.

75. COMMENT: Several commentors suggested that development would hinder remediation of groundwater and surface water and restoration of natural habitat and that development should not be allowed until that portion of the Site is fully remediated. One commentor suggested that the cleanup be modified to include a provision that development may not hinder remediation or restoration, and another commentor stated that development should not occur until the effectiveness of a permanent remedy is clearly established for surface water, groundwater, and sediments.

RESPONSE: The selected remedy requires that development activities not interfere with potential cleanup activities, including the possibility that surface water and/or groundwater treatment will be necessary in the future (see Sections 9.3 and 9.5 in the ROD).

76. COMMENT: Two commentors requested that Asarco separate the cleanup effort from the commercial development of the Asarco site; one of these commentors requested that Asarco acknowledge this separation publicly.

RESPONSE: These two processes are separate but contain common elements: EPA is determining the environmental cleanup of the Site. The local municipalities and Asarco will be facilitating the development of the Site.

However, EPA and the other parties involved recognize the advantage of combining some of the

planning elements for future development with the design of site cleanup activities. For example, if Asarco and the local governments can identify the type and locations of development (number of people, type of services necessary) then it can design the water, sewer, electricity and phone lines at the same time Asarco and EPA are designing a cap for the Site. This will allow the cap, with the necessary utilities, to be installed at one time rather than installing the cap and digging it up later to install utilities.

77. COMMENT: Two people commented that if Asarco conducted the cleanup and did not have enough money left over for development, the Asarco Site' would be redeveloped anyway because it is prime valuable property. Two people added the comment that a pollution free site and community would be the biggest asset to encourage development in the area, and another commentor suggested that Asarco will redevelop the Site based on economic reasons alone, regardless of any "Principles of Agreement" with the local communities. One commentor expressed the opinion that the property would be more valuable if there was not an OCF on the Site.

RESPONSE: By signing the "Agreement in Principle," Asarco and the local governments committed to using their best efforts to develop the property. EPA hopes that all of these parties will honor their commitments and that the former smelter will be returned to productive uses for the community. EPA has no opinion on whether the Site would be redeveloped if Asarco had insufficient funds.

78. COMMENT: The Town of Ruston commented that an important element necessary for future development is EPA providing an appropriate release indemnification from liability for Ruston, Tacoma, the Park District, the Public Development Authority, and future lessees and lenders.

RESPONSE: At the national level, EPA Headquarters is committed to encouraging development and reuse of Superfund sites. National policies and guidance regarding such matters, including the potential liability associated with Superfund sites, are being revised. EPA Region 10 will work with Headquarters' policies and guidance to provide as much certainty to potential owners, investors and tenants at the Asarco Site as possible.

79. COMMENT: The Town of Ruston commented that the design and implementation of remediation must support the Master Development Plan by allowing appropriate areas of the Asarco Site to be cleaned in a timely manner, thus opening these areas to development prior to completion of the remediation of the entire Site.

RESPONSE: EPA's intent is to allow development of the Site in a timely manner. However, EPA's primary concern is the safety and well-being of the site workers, surrounding residents and any potential future users of the Site. Development activities will be allowed to proceed when it is certain they will not interfere with cleanup of the Site.

**2.11 COSTS**

80. COMMENT: Several commentors expressed the opinion that Asarco has made great financial gains at the expense of the environment and should be held financially accountable for a thorough cleanup. One commentor expressed the opinion that the revenue generated by Asarco during its operation and the revenue that will be generated after development will far exceed the cost of any cleanup.

RESPONSE: Under the Superfund law, Asarco is liable to perform (or pay for) the cleanup selected by EPA. The cleanup must attain specific statutory mandates, including protection of human health and the environment. The amount of money that may have been generated by Asarco while the smelter was operating (or could be generated after cleanup) does not influence the extent of cleanup necessary to be protective and therefore is not considered by EPA when selecting a cleanup.

81. COMMENT: Several commentors indicated that the extra cost for treatment of the contaminated soils should not be a factor in determining the best cleanup alternative.

RESPONSE: One of the requirements for cleanups selected under the Superfund law is that they are cost-effective. EPA uses several factors to determine whether cleanup measures are cost-effective, including comparing the relative costs and effectiveness of various cleanup alternatives. Based on EPA's analysis and review of the comments received, EPA believes that

the additional "effectiveness" provided by treating soils is not worth the increased cost compared to disposing soils in an OCF.

82. COMMENT: One commentor posed two cost-related questions: How much will it cost to treat the soil and store it in an OCF, and how much will it cost to clean the aquifers?

RESPONSE: EPA estimates that it would cost $70 million to treat source area soils, dispose the treated soils in an on-site solid waste landfill, and dispose the demolition debris in an off-site hazardous waste landfill. (This option is approximately $20 million more than soil treatment/disposal beneath the Site cap and $47 million more than soil disposal without treatment and debris disposal in the OCF.)

Asarco has estimated that the cost of pumping and treating groundwater for 2 years and 30 years at $15.6 million and $20.1 million, respectively. Using an in-situ (in place) groundwater treatment method would cost $1.3 million and using in-situ groundwater treatment by seawater injection would cost $1.5 million for 30 years. Given the uncertainty of whether these groundwater measures would be effective in cleaning up the aquifers, EPA has determined that it is appropriate to take the source control measures identified in the selected remedy and then evaluate what, if any, further groundwater cleanup activities are necessary.

83. COMMENT: One citizen expressed the opinion that the billions of dollars spent on the Superfund program in the U.S. is disgraceful and has shown very few results.

RESPONSE: EPA disagrees. Accomplishments under the Superfund program include performing thousands of short-term removal actions (e.g., responding to emergency spills, etc.), completing major cleanup construction activities at over 278 sites, and starting major cleanup activities at more than 430 sites.

84. COMMENT: One commentor expressed the view that millions of dollars have already been wasted trying to determine the best cleanup method for the Asarco Site.

RESPONSE: EPA and Asarco have spent significant time and money to determine the types and locations of contamination on the Site and how the Site can be cleaned up. These evaluations are necessary and worthwhile and will result in an efficient cleanup.

85. COMMENT: One commentor expressed the opinion that Asarco should have been responsibly setting aside money for cleanup every year since the Site was deemed to be part of a Superfund site. Another commentor stated that Asarco had a savings account for contamination cleanup in excess of $150 million dollars.

RESPONSE: Asarco will be required to fund the amount necessary for cleanup of the Site. How Asarco chooses to pay for the cleanup is its own decision.

86. COMMENT: One citizen was dismayed at the amount of money Asarco was spending on its public relations campaign, stating that the money spent sending her leaflets, correspondence, and Christmas cards would be better spent on cleanup of the Asarco Site.

RESPONSE: EPA will not credit or deduct the amounts Asarco has spent on public relations campaigns from the amount it will be required to spend on cleanup.

**2.12 PUBLIC INVOLVEMENT**

87. COMMENT: Many commentors expressed the opinion that Asarco is trying to pressure the public into accepting the provisions of the "Agreement in Principle," including the less expensive on-site containment option, in exchange for development money. Two commentors suggested that Asarco has "bought off" the officials from Ruston, Tacoma, the Park Board, and other community agencies. Another commentor expressed frustration with Asarco's "carrot and stick" tactics to keep contamination on the Site and requested that EPA weigh-in on the side of the public when making decision. One of these commentors suggested that there will be a lot of alienation against the EPA if the OCF is not approved.

RESPONSE: EPA believes that the community participation in planning for the future development of Site was important and beneficial to the community. The local governments and

Asarco succeeded in providing many sessions for community members to express their point of view and then took their comments and used them to develop an overall design strategy for the project.

It appears that one reason Asarco spent a lot of time and money on the development project was in hopes that a less expensive cleanup option would be supported by the community. For the past 4-6 years elected representatives of the community had been strongly opposed to an OCF. During the land development sessions, the facilitators were able to understand what the objections and concerns were about on-site disposal and were able to design a preliminary development plan to address these objections and concerns.

Asarco's efforts were very public, as was the approval of the "Agreement in Principle," by the councils in Ruston and Tacoma, and the Park Districts' board. The local governments recommended to EPA that an OCF be selected. The charge that Asarco has "bought off" public officials is unfounded. During the public comment period, EPA received approximately 830 out of a total of 900 cards and letters of support for an OCF and future development. EPA shares the opinion of these commentors that an on-site containment facility can be constructed to protect human health and the environment.

Independent of the land use community participation sessions, EPA sponsored 2 public meeting and spoke at 10 meetings with local community groups such as the Rotary Club and the Environmental Commission of the Chamber of Commerce. The overwhelming message heard at all of these meetings was support for on-site disposal of soil and debris.

88. COMMENT: Several people commented that the EPA should make the best and safest cleanup decision possible, without public influence, pressure from the land use committee and/or development considerations. Some of these commentors suggested that the propaganda and development money offered by Asarco may be tainting the approach by the federal government to the cleanup and that EPA should keep these considerations separate from the cleanup decision. One commentor was disturbed by Asarco's seemingly "manipulative" pamphlet. Conversely, two commentors expressed the opinion that the EPA use a more democratic process to decide the cleanup method for the Asarco Site and give greater consideration to public opinion.

RESPONSE: Public comment on EPA's cleanup decision is an important part of the remedy selection process. In this case, EPA encouraged the land use process to occur prior to issuance of EPA's Proposed Plan in order for the agency to fully understand the needs of the community and not preclude future development options needlessly. Nonetheless, EPA's paramount concern is protection of human health and the environment, which will be achieved by the cleanup remedy that EPA has selected for the smelter site.

89. COMMENT: Several commentors commended Asarco, the municipalities, and the community for coming together to work on a major urban revitalization plan. Some commentors stated that this project is a demonstration of how EPA can work with the community to promote environmental remediation and economic development.

RESPONSE: Although we are not done yet, EPA is also pleased with the work the Land Use Group has completed and believes that working on Site cleanup together with future development of Superfund sites is an effective approach.

90. COMMENT: One citizen would like to know what she can do to help, and which politicians have expressed concern or provided assistance.

RESPONSE: There will be many opportunities for community involvement during the development of the environmental cleanup design work plans. EPA will send out Fact Sheets that describe ongoing work and also provide notice of opportunities for the public to participate. In addition, EPA anticipates that the Land Use/Development Group will continue to sponsor community sessions in order to refine the uses for the "development zones."

Many of the elected and appointed representatives of Ruston, Tacoma and the Park District have been involved in the land use and cleanup processes, such as:

Phil Parker, Mayor of Ruston
Charlene Hagen, Ruston Town Council
Ray Corpuz, City Manager of Tacoma
Paul Miller, Tacoma City Council
Jim Montgomerie, Metropolitan Park District

91. COMMENT: One person was dismayed by the course of events at the Pierce County Council meeting because she felt that the environmental aspects of the cleanup were not adequately addressed, only development and financial topics were discussed in detail. She also expressed the opinion that most of the people in the community are not adequately informed of EPA's cleanup proposal.

RESPONSE: EPA was not notified of the County Council meeting. EPA uses various ways to keep the public informed, such as Fact Sheets, public meetings, news ads, mailing lists, TAG Grants and information repositories. We are always open for any suggestions, so please let us know of your ideas. EPA believes that by the end of its 90-day public comment session and the Asarco Week #4 meetings that hundreds of local community members were aware of and had participated in the cleanup and planning decisions for this Site.

**2.13 MISCELLANEOUS**

92. COMMENT: One commentor believes that the following statement is not complete and does not address the other characteristics of dangerous wastes as defined in Washington State Dangerous Waste Regulations (WAC 173-303): "Waste that is not a federal hazardous waste but has the potential to migrate into the environment would be disposed in a solid waste landfill that meets state requirements (Page 23, Paragraph 5 of the Proposed Plan)." He asked if the Toxicity Characteristic Leaching Procedure (TCLP) is the only criterion that was used to make the determination.

RESPONSE: The statement in the Proposed Plan was intended to clarify that soils not regulated under federal law (e.g., treated soils that pass the TCLP test) may still need to be disposed in a landfill that met state solid waste landfill requirements. This determination would have been based on the results of water leaching tests showing that disposal of treated soil would not be protective of the environment. The state has specified its requirements for disposal of dangerous waste in WAC 173-303. The state's determination of "dangerous waste" can be based on metal concentration as well as TCLP leachate concentration.

EPA has selected the OCF, the untreated soils that will be disposed on site are a federal hazardous waste. Therefore, the OCF will meet both federal and state hazardous and dangerous waste requirements for landfills.

93. COMMENT: One person suggested that Asarco has profited at the expense of the environment because of the lack of environmental concern on behalf of the local governments. This commentor stated that the "Tacoma Aroma" is symbolic of the way the local governments have been dominated by industry. This commentor added the example of the local water treatment plant that has been in violation of EPA standards for years, however the city has chosen to pay the fine rather than remedy the problem.

RESPONSE: EPA encourages the commentor to express his/her views directly to the appropriate local governments.

94. COMMENT: Several commentors expressed the opinion that the EPA has done a good job in its development and presentation of the preferred alternative and Proposed Plan.

RESPONSE: EPA appreciates the comment.

95. COMMENT: Several public agencies, the Washington Department of Natural Resources, Citizens for a Healthy Bay, and the Puyallup Tribe commented that they would like to have greater involvement and input in the development and planning of the Preferred Alterative/ Proposed Plan. Additionally, the Puyallup Tribe requested that EPA act in concert with Federal Indian Policy and consult with the tribe on whether the Proposed Plan is consistent with Environmental Justice policies.

RESPONSE: All of these organizations participated on the Coordinating Forum (local, state and federal representatives with an interest in the Asarco Smelter project) which was convened in July 1993. Policy makers and staff members from local government, local, state and federal health departments, and environmental representatives participated in all aspects of reviewing and commenting on the cleanup alternatives and future land use concepts. EPA will encourage these same organizations to participate in remedial design.

Consistent with EPA's Indian Polich, EPA's Regional Administrator met with representatives of the Puyallup Tribe on March 16, 1995, to consult on a government-to-government basis on all of the Tribes concerns. EPA believes that the Proposed Plan is consistent with its regional, Environmental Justice principles.

96. COMMENT: The Puyallup Tribe reiterated the Clinton Administration's policy that "people of color and the economically disenfranchised should not be forced to bear unfair environmental burdens" (Executive Order 12898, Federal Register 7629).

RESPONSE: EPA believes that the cleanup it has selected is fully in accordance with the objectives and requirements of Executive Order 12898.

97. COMMENT: Several commentors were troubled by the estimated time for completion of the cleanup. They believe that the cleanup action has taken too long already and/or that the cleanup process and consequent development should be expedited. Other commentors requested EPA to take time to carefully consider public comments and to make scientifically sound decisions.

RESPONSE: EPA has reviewed all of the comments received during the public comment period. It is EPA's intent to work with Asarco and the local municipalities so that cleanup activities can begin as soon as possible. One approach to ensure that Site cleanup will not be delayed is that when the Site is ready to be capped, even if all of the residential soils from the surrounding neighborhoods have not been removed, a cap will be installed and the Ruston/North Tacoma soils will be disposed in an appropriate off-site disposal facility, see Section 9.0 of the ROD.

98. COMMENT: One commentor expressed concern about the noise that the cleanup project would generate.

RESPONSE: Heavy equipment and machinery will be used during the cleanup but EPA will require Asarco to reduce the noise to the extent possible by limiting the work hours and selecting dedicated routes that trucks and traffic can use. Local residents and government will have an opportunity to participate in the development of these plans.

99. COMMENT: One commentor believed that the stack bricks would be removed after demolition, however was surprised to learn that they would only be covered with dirt.

RESPONSE: The stack bricks were covered with dirt after the stack was demolished in January 1993. However, the selected remedy calls for these bricks to be unburied and permanently disposed in the OCF.

100. COMMENT: The Puyallup Tribe commented that the nine criteria used to analyze the alternatives should not all be given equal weight. They stated that the protectiveness of human health and the environment and compliance with ARARs are the most important threshold criteria.

RESPONSE: Section 8.0 of the ROD explains how EPA evaluated the cleanup alternatives using the nine criteria. EPA emphasizes the importance of protectiveness and compliance with ARARs by designating them as "threshold criteria." This means that an alternative was not evaluated further if it did not meet these criteria.

101. COMMENT: One commentor expressed the opinion that, given the hazardous waste sites for which Asarco may also be responsible for in Montana and Colorado, Asarco is the fifth worst polluter in the country and possibly the world. This commentor also expressed the opinion that "Asarco's long-standing policy appears to be coverup and not cleanup."

RESPONSE: Asarco will be held responsible for cleaning up the former Asarco Tacoma smelter as well as other sites.

102. COMMENT: One commentor expressed the opinion that Asarco should have been forced to clean up and redevelop the Site years ago, and that Asarco has needlessly delayed clean up and redevelopment of the Site through endless litigation.

RESPONSE: Actually, to date there has not been litigation associated with the cleanup itself. Since 1986, EPA and Asarco have focused on the investigation of the Site, the analysis of potential cleanup alternatives, and the demolition of smelter buildings and structures.

103. COMMENT: One person commented that the cleanup method and development plan are irrelevant as long as his commute to work is not affected, and the new development is clean, legal, and profitable.

RESPONSE: EPA believes that the cleanup method and development plan are very relevant to the future of the community overall. EPA notes, however, that the community should expect that roads around the smelter may need to be closed during parts of the cleanup.

104. COMMENT: One commentor requested that the public comment period be extended past the October 11, 1994, deadline.

RESPONSE: The public comment period was extended to November 10, 1994, based on citizens' requests.

105. COMMENT: One commentor requested that interested parties be provided with a straightforward comparison between EPA's preferred alternative and the alternative proposed by the land use committee.

RESPONSE: The majority of the cleanup activities identified in EPA's selected cleanup remedy are also identified in Paragraph 7 of the "Agreement in Principle. However, EPA's selected remedy, see Section 9.0 of the ROD, provides more detail than the "Agreement in Principle" as to why many of the cleanup measures are necessary. Both the "Agreement in Principle" and the Selected Remedy require the cleanup to be protective of human health and the environment over the long term.

Common Elements of the "Agreement in Principle" and EPA's Preferred Alternative.

- Utilization of Ruston/North Tacoma residential soils as the sub-base for the plant and breakwater (slag peninsula) cap
- Monitoring and institutional controls
- Abandonment of the production well
- Installation of groundwater/surface water interceptor trenches
- Replacement of the existing drainage system, including outfalls
- Shoreline armoring

Additional Elements of EPA's Proposed Plan.

- Treatment of source area soils by solidification/stabilization and disposal as a sub-base to the site-wide cap
- Demolition of remaining buildings and structures
- Mitigation measures if wetlands or intertidal habitat are adversely impacted by cleanup activities
- Safety measures
- Integration of cleanup with land use plans

It should be noted that EPA's Selected Remedy in the Record of Decision selected disposal of soil without treatment in an OCF rather than soil treatment with solidification/stabilization. The "Agreement in Principle" also identified disposal of soil without treatment in an OCF. Other elements of the Selected Remedy are very similar to the elements in the Preferred Alternative described above.

106. COMMENT: One Metropolitan Park Board member commented that he did not sign the "Agreement in Principle" because he did not have the opportunity to fully analyze the situation and he was pressured, lied to, and threatened. He also stated that the Metropolitan Park Board has not agreed, passed, or discussed the "Agreement in Principle," nor have they authorized any

letters to be directed to EPA.

RESPONSE: EPA's understanding is that the Metropolitan Park Board did pass and sign the "Agreement in Principle" with all but one supporting vote. EPA suggests that this member talk directly with fellow Board members.

107. COMMENT: One commentor expressed the opinion that, based on the information on page 13 of EPA's Proposed Plan, it appears that all of the approaches are protective of public health and the environment and that it is difficult to determine which options are truly protective.

RESPONSE: On page 9 of the Proposed Plan, EPA provided all of the cleanup alternatives that were considered. On page 21, EPA explained that "the no-action alternatives are not protective of human health and the environment and thus were not further evaluated under the nine criteria." Otherwise, EPA believes that any of the remaining alternatives (other than monitoring and limited action) would have been protective of human health and the environment.

108. COMMENT: The Town of Ruston requested that EPA respect the permitting processes of the local governments (Ruston, Tacoma, Park District) and not preclude or usurp their authorities to require Asarco to obtain any and all infrastructure permits, and that these municipalities would like to review remediation plans.

RESPONSE: EPA agrees that it is important to work within the established permit processes of the local governments. EPA's expectation, however, is that these processes will not result in delays to cleanup activities.

## 3.0 ASARCO'S COMMENTS AND EPA RESPONSES

As part of an effort to obtain public comment regarding the Master Development Plan, Asarco distributed self-addressed, postage-paid comment cards to the public at several community meetings. Two different card types were distributed by Asarco during this effort, the first batch of cards were entitled, "Tell EPA what you think of the Asarco Land Use Plan," and included the statement, "I want the Asarco Site redeveloped," the second batch of cards were entitled "Tell EPA You Support the Asarco Master Development Plan," and included two statements to select from: "I support development of the Asarco Site and the on-site containment facility" and "I would like additional information about the plan and community meetings." Additional space was provided on both cards to include comments and the respondent's address/phone number.

A total of 673 comment cards were forwarded to EPA by Asarco during the public comment period. Based upon the type of comment card and the nature of the reply received, EPA has tallied and separated the cards into the five following general categories with regard to cleanup preference:

- 547 comment cards were marked in favor of the development of the Asarco Site including an on-site containment facility.
- 69 of the comment cards, respondents offered specific comments and suggestions for development of the Asarco Site, but not a preferred cleanup method.
- 24 of the comment cards, respondents indicated that they would like additional information and/or expressed specific questions, but did not state a cleanup preference. The questions have been summarized and responded to in Section 2.
- 19 respondents indicated that they were either opposed to the OCF or suggested a combination of on-site containment and treatment.
- 14 of the comment cards, respondents offered miscellaneous suggestions and comments, but did not indicate their cleanup preference.

EPA notes that many individual commentors sent their letters and "reply cards" directly to EPA and that most of these commentors also stated they were in favor of future development and an OCF.

In addition to comments received from citizens, local officials, and Natural Resource Trustees,

EPA received comments from Asarco, Inc., the Potentially Responsible Party for this Site. The comments below summarize Asarco's overall concerns as well as its specific technical concerns with the Proposed Plan. As a member of the Land Use Group, Asarco did not support EPA's Preferred Alternative of soil treatment based on cost, long-term effectiveness and because it believes that treatment would preclude the implementation of future land development plans.

**GENERAL COMMENTS**

1. COMMENT: Asarco believes that although the cleanup decision is separate from the plans for future use of the Site, that the terms of the "Agreement In Principle" should be a significant factor to modify EPA's remedy when using the nine criteria analysis. Asarco believes that even if soil treatment and on-site containment facility (OCF) were "equal" with respect to the threshold and balancing criteria, that the community support for and on-site containment should compel EPA to select and OCF.

RESPONSE: As a modifying criteria, community acceptance, could result in EPA favoring a feasibility study that was otherwise equal with respect to all of the other threshold and balancing criteria. As stated in the Proposed Plan, EPA recognizes that in addition to cleaning up contamination at the Asarco Site, that the community is very interested in Site development as well. As a result, EPA received numerous comments from community members, community leaders and local businesses and groups supporting an OCF and future site development. It was these comments, in addition to the "Agreement in Principle," that convinced EPA that the selection of the OCF would be the best cleanup remedy.

2. COMMENT: Asarco stated that on-site containment meets both of the threshold criteria described in the "nine criteria:" (1) Protection of human health and the environment and (2) all Applicable and Relevant and Appropriate Requirements (ARARs) and on-site containment facilities (OCFs) have shown their effectiveness over the long term at sites throughout the country.

RESPONSE: EPA agrees that either soil treatment or on-site soil containment meet the two threshold criteria and that an OCF can be designed to be protective over the long-term.

3. COMMENT: Asarco stated that EPA's Proposed Plan is not "cost-effective," nor does it "utilize a permanent solution and alternate treatment technologies or resource recovery to the maximum extent practicable" which are two of five balancing criteria described in the "nine criteria." Asarco believes that cost-effectiveness is a "condition (emphasis added) for remedy selection, not merely a consideration during remedial design and implementation," (55 F. Reg. 8726), and that "cost-effectiveness" is based on the selected remedy's overall effectiveness which is described in § 300.430 (f)(1)(i)(B) of the National Contingency Plan (NCP) as long-term-effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, and short-term effectiveness.

RESPONSE: EPA has made a determination in the ROD that disposal in the OCF is the cost-effective remedy (see section 10.3 of the ROD). This determination is based on EPA's finding that disposal in an OCF is an effective approach for isolating soil and debris from the environment and because disposal in an OCF is estimated to cost nearly $30 million less than treatment of soil. In addition, the community clearly stated that it believed that selecting an OCF would allow future development opportunities at the Site.

4. COMMENT: Asarco also stated that increased cost of treatment would not result in a commensurate decrease in risk at the Site.

RESPONSE: EPA believes that the primary issue raised by the choice between treatment and soil was not the reduction in risk, which would be comparable, but the ability to select a remedy that would remain protective over the long-term and be compatible with future plans for the Site.

5.COMMENT: In addition, Asarco identified several additional reasons why soil treatment should not be selected. These reasons are:

- there is no evaluation of the effectiveness of treatment over many years;
- the cost of treatment is prohibitively high ($150/ton);
- the amount of additive required results in a low density product resulting in a significant increase in volume of treated material;
- the physical properties of the treated material raise implementability questions with respect to future plans for Site development; and
- the longer time for remediation would have serious negative effects on future land use plans.

RESPONSE: EPA's response is as follows:

(1) EPA agrees. Although as noted in Response No. 21 in Section A, landfills have also not been around for a significant number of years either. (2) The cost of treatment, re-evaluated in context of the responses received from the community, indicated that a less costly and equally protective cleanup was preferred. (3) Although it is not clear how/if the increased soil volume would have impacted Site development, EPA believes that this could have been factored into Site plans in the future. (4) EPA agrees that the appropriate places on the Site would have had to have been identified to ensure. comparability of soil treatment with Site development. (5) EPA is not sure why Asarco believes that soil treatment would take longer than construction and filling an OCF. The Feasibility Study states that treatment would take 6 months and the OCF alternative could take up to 2 years.

6. COMMENT: The overwhelming community support for the "Agreement in Principle" should result in the selection of a containment alterative as the remedy and the NCP allows EPA to select an alternative favored by the community over an equally protective alterative.

RESPONSE: EPA has selected an OCF as part of its selected remedy, see Section 9.0 in the ROD.

7. COMMENT: The ROD should acknowledge the work currently being conducted under the Administrative Order on Consent which was signed by EPA and Asarco in 1994, and allows maximum future flexibility in any modifications to the current shoreline so that the uplands and marine remedial actions can be integrated in a reasonable and cost-effective manner. In addition, Asarco stated that CERCLA does not authorize EPA acting alone to impose habitat restoration or mitigation as part of a remedial action, but instead, states that restoration measures may be agreed upon by the PRP and the natural resource trustees.

RESPONSE: EPA acknowledges that sampling and analysis activities are being conducted under the 1994 AOC. Integration of the cleanup of sediments and cleanup of uplands portions of the Site is a worthwhile objective but is not a specific provision of the AOC. During the development of the work plans for Site cleanup, EPA will work in conjunction with Asarco, the natural resource trustees and the community to develop the necessary mitigation measures for the Site, see Section 9.0 of the ROD. EPA agrees that restoration measures (i.e., to compensate for past injuries to natural resources) will be determined by Asarco and the natural resource trustees.

8. COMMENT: The ROD should resolve the issue of the Ruston/North Tacoma Study Area residential soils disposal and should set performance standards, rather than numerical remediation goals, for groundwater monitoring.

RESPONSE: The selected remedy for the Ruston/North Tacoma residential soils is to place them beneath a cap (e.g., used as a sub-base) in areas that will not be impacted by groundwater, see Section 9.0 of the ROD. The ROD identifies measures to control the sources to groundwater (e.g., soil excavation, containment and capping and replacing the surface water drainage system) and monitors the effect of these activities. The Class III preliminary remediation goals will be used as bench marks to evaluate the impact of source control activities on groundwater that enters Commencement Bay.

9. COMMENT: There are some fundamental differences between EPA's preferred remedy and the remedial actions proposed as part of the Agreement in Principle. The primary differences involve how soil is handled after excavation from source areas.

RESPONSE: EPA has selected disposal of source area soil in an OCF in the Record of Decision.

10. COMMENT: Treatment of a portion of excavated soils, the arsenic kitchen soils for

example, would be prohibitively costly.

RESPONSE: EPA believes that treatment of any part of the excavated soils before disposal in an OCF would certainly add to the overall cost of the cleanup. Because several commenters recommended that some or all of the soils be treated before placing them in an OCF, EPA evaluated the environmental benefits of treatment. In this analysis, see Appendix D, EPA has determined that treatment of the most contaminated source area soils would not substantially decrease the potential impact on groundwater from leachate. EPA has not selected treatment of soils as part of the ROD.

11. COMMENT: Over 70 physical, chemical, biological and thermal treatment processes were examined for potential application for the smelter site. Among the technologies investigated for site specific applications for the site were soil washing, soil acid leaching, and soil fixation.

The studies showed that soil washing and/or leaching was not applicable for the site because of difficulties with physical and chemical conditions of site soils. Technical problems with soil leaching included incomplete removal of arsenic, failure of leached or washed materials to pass TCLP after treatment, and additional treatment requirements associated with acid fluid treatment and subsequent disposal.

Two commercial vendors were able to demonstrate, in the short term, attainment of treatment objective. However, projected treatment costs are high and considerably more expensive than other soil options including the use of an OCF.

RESPONSE: EPA believes that soil treatment by solidification/stabilization could be effective over the long-term. The additional studies conducted by Asarco indicate that the TCLP test results are slightly less effective after 28-day testing (but are still significantly below hazardous waste regulatory threshold levels for treatment) and that the volume of the treated material increased by approximately 60%. EPA did not select treatment, however, because soil can effectively be isolated in an OCF, the OCF was much less expensive than treatment, and because the majority of commenters supported disposal in an OCF in conjunction with land use plans.

**SPECIFIC COMMENTS**

All of the following comments from Asarco refer to EPA's Proposed Plan, dated August 10, 1994.

12. COMMENT: Page 4, fourth paragraph, first sentence. The sentence should read "surface water features on the smelter property include surface water in the cooling pond...." There is no longer surface water flow into the pond and surface water flow has been diverted around the cooling pond since Spring 1993.

RESPONSE: This comment has been incorporated into the "Background" section of the ROD and it now states that, "Surface water features on the smelter property include surface water in the cooling pond..."

13. COMMENT: Page 5, legend to Figure. "known sources" should be changed to "identified source areas"

RESPONSE: The clarification has been made in revised Figure 1-1.

14. COMMENT: Page 6, first paragraph, last sentence. The remedial investigation identified six areas as source areas of arsenic and metal concentrations to groundwater, based primarily on the association of these areas with elevated concentrations in groundwater. Of these areas, the arsenic kitchen and the southeast plant area have subsurface soil data that support the hypothesis that these areas contribute arsenic and metals to groundwater. The stack hill contributes arsenic and metals to surface water where groundwater "daylights" through soils that contain elevated arsenic and metals. Available soil and water data from the cooling pond suggest there are little impacts to groundwater, from this source; however, the pond is considered a source area because of its total sediment arsenic and metal concentrations and because of its historic use as a process water pond that stored water containing elevated arsenic and metals. The remaining areas (copper refinery area and fine ore bins area) are assumed groundwater

sources primarily because of their association with elevated groundwater concentrations and known history of these facilities. Soils in these areas were assumed to be sources to groundwater for feasibility study purposes; however, insufficient data are available to positively establish soils from these areas as groundwater arsenic and metal sources.

The sentence would be more representative of actual site conditions if it read "These are areas that appear to act as the primary sources".

RESPONSE: The ROD states that, "These are areas that have either the highest measured concentrations of contaminants in the soils, appear to act as the primary known sources of contamination to groundwater and surface water, and/or have large amounts of contaminated material based upon the historic uses of these areas."

15. COMMENT: Page 6, second paragraph, first sentence. The first sentence is not true. First, the areas have not been identified based on the presence of the "highest known concentrations" but, instead, based on their association with highest groundwater concentrations of arsenic and metals. In some cases, such as the arsenic kitchens and stack hill areas, these areas do contain some of the highest total soil metal concentrations, but, more importantly, also the highest leachate soil concentrations. However, some of the identified source areas are not associated with confirmed total soil data. For example, to date the soil quality underneath the fine ore building has not been tested. Second, not all metals and/or organic chemicals are "highly mobile and leaching out of soils or slag." The sentence should be changed from "...which are highly mobile and are leaching out of soils or slag..." to "...which may be leaching out of soils or slag..." Also, the suggestion that high metal values automatically result in principal threats to groundwater is not correct. High metal values in themselves are not an indication of a threat to groundwater, as demonstrated by slag. The threat to groundwater is determined by leachability and subsequent mobility of a chemical.

RESPONSE: See response to Comment No. 14.

16. COMMENT: Page 6, fourth paragraph, last sentence. The statement that, "Most of the slag portions of the Site appear to contribute less contamination... as compared to the source areas..." is incorrect. All slag contributes less than the source areas. However, this effect can be obscured by other sources, such as is the case for the slag located in the plume down-gradient from the arsenic kitchen. It would be representative of actual conditions if this sentence was changed to read: "Slag appears to contribute less metals to groundwater...as compared to the source areas..."

RESPONSE: The ROD states that, "The slag portions of the Site appear to contribute less contamination to groundwater as compared to the source areas described."

17. COMMENT: Page 6, sixth paragraph, second sentence. It is not certain pipes are filled with sediment or that they are cracked. Because of the age of the plant, an assumption was made in the FS that drainage lines were cracked and that sediment in pipes was possible. A suggested change to the sentence is "pipes may be cracked and/or contain contaminated sediment."

RESPONSE: The ROD states that, "The pipes and drains associated with the system may be cracked and/or the pipes filled with contaminated sediments."

18. COMMENT: Page 6, ninth paragraph, last two sentences. Based on site data, it is apparent that smelter site groundwater arsenic and metals are more affected by low redox conditions associated with the presence of organic material than by resultant pH conditions. The presence of seawater apparently buffers groundwater in the southeast plant area and pH concentrations are typically above 8 indicating acidic conditions at this location are not occurring.

RESPONSE: The language in the ROD is revised to read that wood waste buried in the slag is decomposing, thus contributing to the release of metals, particularly arsenic, from the slag.

19. COMMENT: Page 6, last paragraph, first sentence. The metal levels in groundwater do more than just "appear" to decrease as groundwater moves toward the bay; the data indicate that this decrease is a fact. We suggest changing this sentence to read; "The metal levels in groundwater decrease as groundwater moves through smelter property toward Commencement Bay".

Although the cause of the decrease remains a subject of debate, as pointed out by the description of potential causes in the following sentence, the metals levels decrease is documented by validated data.

RESPONSE: The ROD states that, "The metal levels in groundwater decrease as groundwater moves through the smelter property towards Commencement Bay." EPA agrees that the reason(s) why this decrease occurs has not yet been established.

20. COMMENT: Page 7, first paragraph, last sentence. No large cracks as described in the proposed plan have been identified during the RI/FS. The crack hypothesis is entirely of regulatory origin. Although one well had a higher test permeability than surrounding wells, the significance of the well test relative to groundwater metal transport is not clear. All available evidence indicates that dilution and/or adsorption are occurring to the same degree in the central portion of the site. If anything, dilution and/or adsorption are probably most effective in the central portion of the site, as evidenced by the substantial decrease in metals concentrations over relatively short distances.

RESPONSE: This sentence was not included in the ROD.

21. COMMENT: Page 7, EPA's Cleanup Objectives, first sentence, cleanup actions necessary because of "long-term cancer risks for workers". Long-term cancer risks to sealife and animals were not evaluated as the sentence implies.

RESPONSE: Risks to sealife and animals were qualitatively evaluated in EPA's ecological risk assessment. EPA's conclusion was that sealife has been adversely impacted by releases from the Site and that the Site posed risks to terrestrial animals and vegetation.

22. COMMENT: Page 8, Contaminated Soil Dust and Slag, Objective c, "Prevent the erosion of slag to the off-shore sediments". Existing data suggest the significance of slag erosion is highly overestimated in the Proposed Plan. Although slag contains elevated concentrations of total metals, available data show in the marine environment, slag and sediment that contain slag have a very low leachability. In addition, no detrimental effects of slag on sea life have been documented. In fact, the off-shore community at the smelter is viable and healthy. Slag has been used on the plant site and on the Yacht Club breakwater because its physical properties (coarse grain size and massive texture) made the material an ideal medium for shoreline armoring construction. Armoring of the slag would be primarily cosmetic with little, if any, benefit to the marine environment. While slag armoring could provide a habitat niche for marine life, installation of armoring will, at least temporarily, adversely affect presently established communities.

RESPONSE: EPA believes that slag is eroding to some degree, and therefore exposing faces that leach metals more readily than weathered faces. As part of the remedial design, EPA will require that additional studies are conducted to indicate which part of the slag shoreline is eroding and where shoreline armoring should be placed.

23. COMMENT: Page 11, Shoreline Armoring. This section appears to begin with the premise that shoreline erosion is a substantive issue. Although shoreline armoring was among alternatives evaluated in the FS, to date no information has been produced to document that shoreline erosion is a substantial source of slag to the marine sediments of Commencement Bay.

This question is raised for two reasons. Slag was directly placed in Commencement Bay and its sediments by disposal actions over a 75-year period. Visually obvious erosion could only account for a very small fraction of the slag present in Commencement Bay sediments.

Erosion is visually obvious at some locations along the slag peninsula and smelter property. However, many portions of this area show no obvious evidence of erosion. This raises the question of whether rumoring the total shoreline is appropriate, or if armoring is at all appropriate?

It is also reasonable to question whether slag erosion is causing any environmental other than those produced by physical erosion of natural substrates. The study of freshly cut slag by Battelle (Crecelius, 1966) showed that marine larvae settle as rapidly on slag as on basalt rock and concrete. Although this study showed metals are released from freshly cut slag for three to

four months, this brief period would produce very minor contributions of metals to Commencement Bay waters or sediments at the visually apparent erosion rates.

The EPA discussion assumes that a 5 foot thick layer of riprap over a 2 foot layer of small rock is necessary, to prevent erosion. Although total armoring for the shoreline was assumed in alternatives presented in the FS, it will be necessary to conduct an engineering analysis of shore processes along the smelter property and slag peninsula to determine what design is most appropriate, as well as if and where protection might be required.

The existing slope along the north portion of the bayward face of the slag peninsula may be too steep to make armoring practical without major shoreline modification. The steep slope at the north end of the Yacht Club breakwater extends to great depths (at least to 200 feet) indicating that major dredging or cut back at this location may be required to establish a foundation for shoreline monitoring.

Combined plant site and breakwater shoreline armoring costs would be $6.2 million dollars based on assumptions presented in the FS and cost projections presented in the Proposed Plan. This expense would be incurred for primarily cosmetic alterations to the shoreline and provide little environmental benefit. In fact, shoreline armoring will have a significant impact on diverse and apparently healthy communities already established in shoreline slag.

RESPONSE: EPA agrees that additional engineering studies are necessary to determine the extent of shoreline armoring that will be needed in areas that are eroding. EPA does not believe that shoreline armoring will be conducted for cosmetic purposes only, but will be placed in those areas which pose a threat to the offshore environment.

24. COMMENT: Page 14, Plant Site Soils, 1c. It should be noted that, in many cases, sampling results will not determine the feasible extent of excavation, but will provide documentation on post-excavation conditions. Excavation in some areas, particularly in the fine ore bins area and the copper refinery areas, will be limited by equipment capabilities, and by limitations association with high water table and high permeability conditions.

RESPONSE: EPA recognizes that some materials in the source areas will not be able to be excavated, see "implementability" in Section 8.0. In addition, Asarco will be required to confirm that all necessary source area excavation, as practicable, has been performed.

25. COMMENT: Page 14, Plant Site Soils, 1d. In addition to demolition materials, some soil contains coarse grained fractions that are greater than 2 inches in size. During pilot scale testing, these sizes were simply screened out and were not treated. If treatment were to be implemented on a large scale, these fractions would either have to be ground to a finer size for incorporation in the treatment process, or dispose with demolition debris. Either action involves an increase of material handling, processing and costs over those associated with the soil fixation process activities demonstrated during the pilot scale tests.

RESPONSE: EPA understands that there may be some additional costs associated with a full-scale treatment project. However, treatment has not been selected in this ROD for this Site.

26. COMMENT: Page 14, Plant Site Soils, 1e. Removal of the car tunnel was not included in the primary remedial action scenarios evaluated during the FS and this action is not included in the Proposed Plan cost estimates. The FS assumed removal of the car tunnel and railroad tunnels as available options and responsibilities of the owners: Tacoma/Ruston, and Burlington Northern railroad, respectively. Since the tunnel is associated with seeps that have poor water quality, it is possible that concrete from the tunnel, if removed, would require disposal as a hazardous waste. It is estimated that removal of the tunnel, including demolition costs, would increase present cost estimates as high as $2.2 million. Filling the tunnel may be more cost effective than demolition and removal. In addition, the car tunnel is part of a unit construction with the rail tunnel which would be impacted by removal of the car tunnel portion of the structure.

RESPONSE: The determination of whether the tunnel is removed or filled in will be made during the design phase of the project. As noted in Section 9.0 of the ROD, the OCF will be designed to allow for a limited amount of additional capacity in the event there is more than the estimated 160,000 cubic yards of soil and more than the estimated 80,000 cubic yards of

demolition debris that requires disposal, see Section 9.1.2. EPA notes that Paragraph 4 of the Agreement in Principle states that: "Asarco agrees to fill or remove the existing tunnel..."

27. COMMENT: Page 15, 3a, use of fabric as marker. A marker would not be necessary for most of the plant site to identify the base of an imported soil cap. The presence of slag which has a very dark color and coarse grained texture that would be significantly different in color and texture from fill, and topsoil imported to the site would provide easy identification when the base of the cap was penetrated. In addition, remaining man-made features such as concrete slabs, foundation or pavement would also easily be identified at the base of the cap.

Ruston soils would also easily be identified. These soils will be incorporated under a drainage gravel layer which is, in turn, underlain by a clay layer. These distinctly different soil types would be easily identified and would mark the locations of the base of imported topsoil as well as the top of underlying Ruston residential soils.

RESPONSE: EPA agrees that a visual marker will not be necessary since the clay layer will serve this function as clay will be located above the slag, building pads and foundations and the Ruston/North Tacoma residential soils.

Asarco is incorrect in stating that the clay layer will underlie the residential soils. The residential soils will be used as a sub-base below the clay on the Site cap. Residential soils can be placed in areas of the site not likely to be impacted by groundwater.

28. COMMENT: Page 16, Figure 3 (in Proposed Plan), Hazardous Waste On-Site Containment Facility (OCF). The figure is not correct. The part of the cover that includes a 1 foot layer, which underlies the filter material, would not consist of compacted soil as shown in the figure but, instead, would consist of a drainage layer.

RESPONSE: In the cap, beneath the one foot of drainage material, there will be a fabric liner and two feet of compacted soil above the waste material, see Figure 7-2.

29. Page 18, Surface Water, second paragraph, last sentence. As noted several times in the FS, large scale treatment of surface water to consistently meet low standards with arsenic and metal marine criteria may not be technically feasible. This is particularly true for the relatively large flows (200 gpm or greater) associated with surface water discharge from drainage areas above the plant site.

RESPONSE: EPA will evaluate the need for, and the feasibility of, surface water treatment after the source control activities in the ROD are completed.

30. COMMENT: Page 18, Shore Line Armoring of the plant site and slag peninsula. "One goal for the shoreline would be to restore aquatic habitat that would benefit eelgrass salmon and other marine life. Methods may include shoreline pull back and sloping, development of pocket beaches, mudflats, vegetated shallows, and shoreline irregularity. There is no evidence that shoreline armoring would provide any aquatic habitat more suitable for marine biota than the existing slag surfaces. The armoring might provide less suitable habitat because of the loss of physical irregularities that the slag provides. Rock riprap provides a generally even, flat surface inhabited by fewer species and number of organisms than the highly irregular surfaces of slag.

Neither slag nor shoreline armoring provide a suitable habitat for eelgrass. Shallow water wave energies that require hard substrates (armoring) prevent eelgrass growth. Eelgrass also requires slit to sand-gravel substrates, not hard surfaces. Salmon and other sea life are capable of using the existing slag habitat, and are unlikely to benefit from shoreline armoring.

Development of pocket beaches, mudflats, shoreline pullback, etc., goes far beyond shoreline armoring. These actions would require great modification of the existing conditions and would result in environmental and economic costs far greater than traditional shoreline armoring as presented in the Feasibility Study. Existing features that have present or potential future economic or environmental value such as the off-shore piers may not survive modifications associated with modifications of features as discussed in EPA's plan. The additional economic costs are not factored in the costs presented in the FS or in the Proposed Plan. Preliminary estimates to include features described in the Proposed Plan as part of shoreline armoring

indicate costs would be increased $6 million to $9 million above the $6.25 million presented in the, Proposed Plan for plant site and shoreline armoring costs. Since, as noted above, the area is by nature not suited for many of features such as mudflats, eelgrass, and pocket beaches, as well as shoreline cut backs would involve significant alteration to existing conditions. For instance, off-shore features such as breakwaters would probably be necessary to encourage fine-grained environments that maintain features such as mudflats and eelgrass. Presently not possible in the relatively fast moving coarse grained deposition environment typical to not only the Asarco Site but the adjacent gravel beach areas outside the plant site off-shore area. Obviously, implementation of features that require such an alteration of existing conditions would require considerable study as part of preliminary remedial design efforts.

RESPONSE: The riprap itself is not expected to provide a more suitable habitat than the slag; however, the armoring can be designed to have ledges or irregularities that are more supportive of marine biota than the slag. These areas could be constructed with gravel and on a more gentle slope than the slope of the present Site. A habitat conducive to epibenthic species (organisms living on the sea floor) could be created, which would, in turn, be beneficial to salmon.

EPA agrees that low-energy habitats would not likely persist along the Asarco shoreline. However, a moderately active environment, such as a gravelly/sandy area conducive to other types of aquatic species, may be able to be created off the Asarco Site. Although on-site mitigation is a preference, a habitat that is conducive to eelgrass could be created as part of an off-site mitigation effort.

EPA agrees that reducing the effects of the currents on the exposed face of the Asarco Site would require extensive effort, including the use of groins or breakwaters. These costs, which would be weighed against their benefits, are not part of the shoreline armoring costs in the FS, but rather can be part of the mitigation costs since they would benefit the mitigation efforts. These costs could also be weighed against their overall benefit and/or be compared to other mitigation efforts with similar costs.

Shoreline pullback, sloping, and shoreline irregularity are possible at the Site and can be part of the shoreline armoring and/or mitigation efforts. For example, shoreline armoring, which is intended to reduce the erosion of slag, can be accomplished adjacent to an area that is cut back and less shallow, which could be intended as part of a mitigation site. The most appropriate habitats (e.g., those with the greatest chance of persistence) would then be chosen for these various post-remediation environments. The associated costs could be part of the shoreline armoring costs and the mitigation costs.

EPA will consider the existing futures on-site end the planned uses of the site in the remedial design stage so as to ensure compatibility.

EPA acknowledges that much more about the sediments site will be learned from the ongoing and upcoming expanded RI/FS activities, including a better understanding of the amount of erosion at the site and potential disposal and mitigation sites.

31. COMMENT: Page 18, Shoreline armoring of the plant site and slag peninsula. "Further, since armoring would adversely impact intertidal habitat of the shoreline, mitigation and/or restoration measures would be necessary." The admission that adverse impact to intertidal habitat would occur is evidence that the existing habitat has substantial production and ecological value. Mitigation would apparently be required because this production habitat would be degraded by shoreline armoring. Why conduct armoring unless the habitat would be degraded by shoreline armoring. Why conduct armoring unless the habitat is to be improved by this action? If it is improved, why require mitigation; isn't the action mitigation? Off-shore ecological impacts were noted in the FS evaluation as well as in the EPA Proposed Plan. As off-shore studies by Parametrix have shown, the area contains a diverse and productive environment that is essentially the same as other coarse grained bottom areas that are not located near or potentially impacted by existing or past smelter activities.

RESPONSE: EPA disagrees. EPA acknowledges that there is intertidal habitat that currently occupies the slag face at the Site; however, sampling activities on the off-shore sediment site provide evidence of adverse biological effects. The present expanded RI/FS activities at the sediments site will help quantify the harmful effects at the site with respect to the present

communities and allow EPA to balance the benefits of armoring compared to the impacts to existing habitat caused by armoring. EPA agrees that replacing one community with a similar community is not a beneficial use of funds; however, if the present off-shore biological community is shown to be impacted, a replacement community and/or mitigation effort may be warranted.

32. COMMENT: Page 18, Item (9), Safety Measures, lining and covering truck beds. Lining and covering truck beds probably would not be necessary for on-site activities. Excavation in areas such as the arsenic kitchen area, the copper refinery area, or the fine ore bins would not require such precautions. However, it is noted transportation across public roads from areas such as the stack hill or the cooling pond may require some of the safety precautions described in the Proposed Plan.

RESPONSE: If trucks are just moving from one location to another on-site, lining truck beds would probably not be necessary. But lining of truck beds, and other safety measures, will be required for transportation of waste off-site.

33. COMMENT: Page 19, Item 10 (b), guidelines to ensure disposal of dredged sediments would not be preventative or hindered by development activities. Although an OCF could be designed to hold shoreline sediment, additional steps, may have not been completely evaluated, would be necessary to ensure compatibility with incorporation into the OCF. Contrary to the sediment handling procedures anticipated with either use on an OCF or treatment, off shore sediments would have to be dewatered, with subsequent disposal and/or treatment of the decant water. If incorporated into a treatment option for "upland" soils, marine sediments themselves would not require treatment as all testing indicates the leaching potential is very low and most samples had leachable metal concentrations less than analytical limits. However, a key issue would be the increase in size of the OCF "foot print" to hold marine sediments and the resulting loss of available land area available for development. Vertical expansion limited by physical constraints, as well as constraints imposed by proposed road development and aesthetics and an increase of the "foot print" would be necessary. In addition to land needed for a larger foot print, more land area will be needed, at least temporarily, for sediment dewatering during construction, which would also complicate remediation and development logistics.

RESPONSE: EPA has decided not to dispose dredged sediments in the OCF. See the response to Comment No. 28 in Section A above.

34. COMMENT: Page 21, Shoreline Armoring: "Shoreline armoring under the Preferred Alternative is protective because it controls the erosion of the slag shoreline into Commencement Bay". It has not been demonstrated that all or most of the slag shoreline is eroding into the bay or that slag erosion is detrimental to the biological production at the smelter shoreline or slag peninsula.

RESPONSE: See the responses to Comment No. 43 in Section A above and Comment No. 22 in this Section.

35. COMMENT: Page 22, Surface Water "EPA believes that it may be appropriate to establish mixing zone when establishing discharge limitations for surface water". Asarco concurs a mixing zone would be appropriate.

RESPONSE: The language on mixing zone is included in the ROD, see Section 9.9. regarding performance standards for surface water. The determination whether a mixing zone is appropriate and, if so, the parameters of the mixing zone will be made during remedial design.

36. COMMENT: Page 22, Mitigation/Restoration. The Proposed Plan states that mitigation and restoration would be necessary to compensate for "impacts to wetlands" during the cleanup. It is not clear which areas of the site EPA considers to be wetlands. During discussions about remediation of the site, some, parties have taken the position that any alternative which contemplates filling the cooling pond would need to comply with mitigation standards under section 404 of the Clean Water Act. However, the cooling pond is not a wetlands within the definition of "waters of the United States." and section 404 requirements do not apply to its modification during remediation. The Asarco pond was part of a waste treatment system and qualifies for the specific exemption for treatment ponds in 33 CFR §328.3 (a)(7). Consequently, to the extent that there may be other regulated wetlands on the site, the specific areas of the

site involved should be specifically identified and should exclude the cooling pond.

RESPONSE: EPA agrees with Asarco's interpretation regulations that the cooling pond is not a wetland. Other areas of the Site, however, may be wetlands. A wetlands assessment will be required on the Site before remedial activities begin. If any wetlands are identified that will be adversely impacted by remedial activities, the appropriate mitigation measures will be required.

37. COMMENT: Page 24, Surface Water, last sentence referring to surface water treatment relative to long-term effectiveness and permanence. The long-term effectiveness of surface water treatment is questionable if large volumes are necessary to treat and discharge standards are extremely low. Volume control would be key to successful implementation. Treatment would be an on-going operation that would require periodic and relatively consistent maintenance. However, if lines are completely replaced and a design cap is implemented as proposed by EPA, surface water treatment should not be necessary to address sources from the plant site. In effect the treatment plant as proposed by EPA would be addressing off-site sources of arsenic and metals.

RESPONSE: EPA agrees that replacing the surface water drainage system should eliminate the need for surface water treatment. After cleanup activities under the ROD are completed, EPA will determine whether surface water discharging into the bay meets the remediation goals (see Section 9.9 of the ROD).

38. COMMENT: Page 24, Shoreline Armoring, Preferred Alternative, large rock and boulder riprap instead of artificial beach nourishment as riprap has a better potential to withstand current and wave action and remain in place compare to using smaller pebbles under the artificial beach nourishment option." Contrary to EPA's position, coastal engineering and design experts often promote beach nourishment over riprap structures. The Army Corps of Engineers and others prefer, in many cases, to use beach nourishment because it can provide better erosion/deposition control, than riprap design (Mark Lorane, Applied Coastal Science Inc., personal communication). This is particularly true where a potential exists for riprap structures to result in changes in wave and current patterns which result in unexpected and/or uncontrolled erosion or deposition in adjacent unmodified areas.

RESPONSE: EPA recognizes that riprap structures should be constructed only when necessary, and erosion from water flowing around the ends of the slope protection (e.g., breakwater) can cause erosion. The slope protection can be constructed in order to minimize this type of erosion. The design characteristics for the Asarco Site, including the hole of beach nourishment versus riprap structures, can be determined during remedial design, when there is a better understanding of the wave action and current energy at the site.

39. COMMENT: Page 25, Shoreline Armoring, "Slag pieces cause adverse impacts to sea life in offshore sediments." Adverse impacts of slag pieces to sea life have not been demonstrated by EPA's own admission.

RESPONSE: EPA disagrees. A report published by Battelle (Crecelius, 1986) concluded that metals released from freshly exposed slag are toxic to marine organisms for up to three to four months. Also, one of the objectives of the expanded sediments RI/FS is to evaluate whether slag pieces deposited in marine sediments are causing adverse impacts in the marine environment.

40. COMMENT: Page 26, Interception Trench Costs. These costs should be rounded to be consistent with other figures presented in this section.

RESPONSE: These numbers were rounded. See Table 8-2 in Section 8.0 of the ROD.

41. COMMENT: Page 27, Surface Water Costs. On Page 24, EPA states use of surface water treatment if necessary for plant site runoff surface water treatment costs are not presented in the Proposed Plan. The FS presented surface water treatment costs for all anticipated run-on to the site at $23,600,000, present value. EPA's proposal would only address treatment after replacement of the present drainage system and implementation of diversions as necessary. Assuming the majority of runoff is diverted, the EPA proposal could require treatment of some undetermined volume. Even modest volumes of water (50 to 100 gpm) requiring arsenic and metal treatment would result in a significant amount of costs not presented in the plan. Asarco's

experience at the East Helena Superfund site, where a treatment plant was installed to address plant water gains of about 50 gpm, shows costs to treat constituents similar to those at the Tacoma site are about $7,000,000, However, if outfall drainage lines are completely replaced and a design cap is implemented as proposed by EPA, surface water treatment should not be necessary to address sources from the plant site. The treatment plant as proposed by EPA in effect would be addressing off-site sources of arsenic and metals.

RESPONSE: The need for, and feasibility of, surface water treatment will be evaluated should source control activities not attain performance standards for surface water.

42. COMMENT: Page 27, Shoreline Armoring Costs. Assuming riprap shoreline armoring costs as presented in the FS, the costs presented in the Proposed Plan are consistent with the FS. However, the costs do not reflect features discussed in the plan including pocket beaches, mudflats, eel grass, cut backs etc. Preliminary cost projections incorporating features as described in the Proposed Plan indicate shoreline armoring costs could increase $6 million to $9 million over the cost presented in the Proposed Plan. Four scenarios were considered:

1. Armoring as presented in the proposed plan.

2. Armoring assuming no encroachment in the bay and cut backs are necessary prior to riprap installation.

3. Shoreline armoring with advancing slopes and groins, and silt/sand fills needed to create vegetated shallows, pocket beaches and shoreline irregularities for aquatic habitat development.

4. Same as Scenario 3 but all cut backs and no advancing features.

While it is assumed for cost estimation purposes that features described in the four scenarios above could be implemented, it is far from certain incorporation of these features is technically feasible. A summary of preliminary cost estimates for the armoring scenarios is presented below:

| Proposed Plan Costs #1 | Capital | O&M | Present Worth |
|---|---|---|---|
| Plant site and breakwater | 5.9 million | $23,000 | $6.2 million |
| Scenario #2 | Capital | O&M | Present Worth |
| Plant site and breaker | $8-6 million | $24,000 | $9.0 million |
| Scenario #3 | Capital | O&M | Present Worth |
| Plant site and breakwater | $11.9 million | $48,000 | $12.6 million |
| Scenario #4 | Capital | O&M | Present Worth |
| Plant site and breakwater | $14.6 million | $48,000 | $15.4 million |

RESPONSE: The costs associated with mitigation activities will be in addition to the shoreline armoring costs. Mitigation costs can vary significantly, depending on the location of the site, the necessary preparation activities, and size of the site. Because EPA does not yet know the extent to which shoreline armoring will be required, EPA is not estimating the potential cost of mitigation.

43. COMMENT: Page 27, Institutional Controls. The $500,000 under the O & M (annual) column should be moved to the Present Worth column

RESPONSE: This amount has been moved, see Table 8-2 in Section 8.0 of the ROD.

44. COMMENT: Page 27, Plant Site Excavation Costs. The excavation or demolition costs

presented do not include removal or filling of the car tunnel. As explained in the FS, this option was presumed to be the responsibility of the owner. Removal of the tunnel would increase costs an estimated $2.2 million.

RESPONSE: In Paragraph 4 of the Agreement in Principle, Asarco agreed to remove or fill the car tunnel. EPA believes the approach to be used should be decided during remedial design.

45. COMMENT: Page 29, first column - last sentence continuing to the second column. This sentence is not comprehensible and needs revision.

RESPONSE: EPA corrected the error in subsequent editions of the Proposed Plan.

46. COMMENT: Page 30, (1) Statutory Findings, "cost-effectiveness." Asarco does not concur that soil treatment is cost effective compared to other equally protective alternatives such as containment in an OCF. EPA's preferred alternative is almost $30 million higher than that proposed in the Agreement in Principle between Ruston, Tacoma, the Metropolitan Park District and Asarco.

RESPONSE: EPA has determined in the ROD that disposal of soil and debris in an OCF is a cost-effective cleanup action.

**APPENDIX B**

**FIGURES AND TABLES**

<IMG SRC 1095122F>
<IMG SRC 1095122G>

**TABLE B-1. INFORMATION REPOSITORIES**

| | |
|---|---|
| In Ruston: | Ruston Town Hall<br>5117 North Winnifred |
| | Asarco Information Center<br>5311 North Commercial |
| In Tacoma: | Tacoma Public Library Main Branch<br>1102 Tacoma Avenue South, Northwest Room |
| | McCormich Regional Branch Library<br>3722 North 26th |
| | City of Tacoma<br>747 Market Street, Suite 420 |
| | Tacoma Pierce County Health Department<br>3633 Pacific Avenue |
| | Citizens for a Healthy Bay<br>771 Broadway |
| | Pacific Lutheran University Library<br>121st and South Park Avenue |
| In Olympia: | Washington Department of Ecology<br>300 Desmond Drive S.E. |
| In Seattle: | Environmental Protection Agency<br>1200 Sixth Avenue |

**TABLE B-2. LIST OF FACT SHEETS AND BROCHURES FOR THE ASARCO TACOMA SMELTER SITE**

| Date | Topic(s) |
|---|---|
| 9/86 | Fact sheet announcing an AOC between EPA and Asarco for an RI/FS, site stabilization, and an announcement of a public meeting. |
| 10/86 | Fact sheet announced a public meeting on November 6, 1986, for concerned citizens to hear about the results of the exposure pathways study for the Asarco Smelter. |
| 4/87 | Status Report published. |
| 8/87 | Status Report published. |
| 3/88 | Status Report published. |
| 5/88 | Status Report published. |
| 7/88 | Superfund update on the Asarco project. |
| 8/88 | Status Report published. |
| 12/16/88 | Fact sheet announced that EPA was to study arsenic contamination in the Ruston area, evaluate who might be at risk, and decide what actions need to be taken. |
| 4/27/89 | Fact sheet provided a status report of the smelter site RI/FS. |
| 5/11/89 | Fact sheet announced that EPA received the proposed work plan from Asarco for demolition of the structures and of the smelter stack. |
| 7/14/89 | Fact sheet requested Asarco to conduct the investigation to determine the extent of contamination at the smelter. |
| 9/89 | Update of all Superfund projects in Tacoma including information on the Asarco Smelter, and EPA's invitation to residents to join a community workgroup. |
| 2/90 | Update of all Superfund projects in Tacoma including a status report on the Asarco Smelter. |
| 5/8/90 | Fact sheet announced a Notice of Violation issued to Asarco by EPA. |
| 7/16/90 | Fact sheet announced the public meeting and comment period for the proposed plan for the initial site cleanup. |
| 8/90 | Update of all Superfund projects in Tacoma including a status report on Asarco. |
| 1/14/91 | Fact sheet announced the plan for the interim cleanup measures. This was the first ROD for the site. |

**TABLE B-2. LIST OF FACT SHEETS AND BROCHURES FOR THE ASARCO TACOMA SMELTER SITE (Continued)**

| Date | Topic(s) |
|---|---|
| 2/13/91 | Update of all Superfund projects in Tacoma including the Asarco Smelter cleanup measures. This fact sheet also included information on EPA's Community Workgroup and community interviews which were underway. |
| 5/6/1991 | Fact sheet provided an update of all of the Asarco Superfund projects including the status of the smelter investigation. |
| 8/6/91 | Update of all Superfund projects in Tacoma including the Asarco Smelter interim measures (demolition) and the overall site investigation which now includes Asarco sediments. |
| 10/91 | Brochure describing all of the Superfund activities related to the Asarco Smelter including; the Ruston North Tacoma Study Area, the smelter site investigation and demolition, and marine sediments. |
| 1/9/92 | Fact sheet announced the public meeting and comment period on EPA and Asarco's efforts to demolish structures on the site, including the smelter stack. |
| 3/92 | Update of all Superfund projects in Tacoma including the status of the smelter demolition, disposal of the debris, collecting surface water on the site, implementing controls to reduce the amount of surface water entering the site, and an overall site investigation. |
| 7/14/92 | Fact sheet updated all of the Asarco Superfund projects. |
| 11/92 | Update of all Superfund projects in Tacoma including a status report on the Asarco smelter. |
| 1/11/93 | Fact sheet updated all of the Asarco Superfund projects. |
| 6/93 | Update on all Superfund projects in Tacoma including the smelter demolition and the overall site investigation. |
| 9/22/93 | Fact sheet announced the availability of the RI/FS and Risk Assessment reports for the site. |
| 1/24/94 | Update on the hazardous waste cleanup project. EPA integrated the smelter facility and the slag peninsula cleanup activities with the cleanup for the off-shore sediments project. |
| 3/94 | Brochure (revision of 10/91 version) describing all of the Superfund activities related to the Asarco Smelter including; the Ruston North Tacoma Study Area, the smelter site investigation and demolition, and marine sediments. This brochure continues to be available to members of the community upon request, and is provided as a handout at all of EPA's public forums. |

**TABLE B-2. LIST OF FACT SHEETS AND BROCHURES FOR THE ASARCO TACOMA SMELTER SITE (Continued)**

| Date | Topic(s) |
|---|---|
| 4/28/94 | Fact sheet described a field test of a soil treatment technology, which was being considered for the Asarco Site. |
| 8/94 | Update on the hazardous waste cleanup projects in Tacoma, including the Asarco demolition activities and the smelter cleanup. |
| 8/12/94 | Summary of EPA's Proposed Plan, announcement of public comment period and public meetings. |
| 10/5/94 | Fact sheet announced EPA's proposal to allow slag to be moved from Thorne Road to the Asarco Smelter site. Public comments were invited from October 6 to November 4, 1994. |
| 11/21/94 | Fact sheet announced Asarco was moving the slag from Thorne Road in the Tacoma tideflats to the former Asarco Smelter in Ruston. |
| 12/29/94 | Fact sheet announced that all buildings slated for removal have been demolished and hazardous waste is being stored in the Fine Ore Bins building. |

**TABLE B-3. ARSENIC CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS**

ARSENIC KITCHEN

| Surface Soil (ppm) | Subsurface Soil >1.5 ft (ppm) | Class III GW Slag (µg/L) | Class III GW Marine Sands (µg/L) | EPA GW PRG (µg/L) |
|---|---|---|---|---|
| Max: 33,225 | Max: 262,500 | Max: N/A | Max: 117 | 6 |
| Mean: 16,174 | Mean: 7,819 | | | |
| Min: 2,020 | Min: 6.6 | | | |

COPPER REFINERY

| Surface Soil (ppm) | Subsurface Soil >1.5 ft (ppm) | Class III GW Slag (µg/L | Class III GW Marine Sands (µg/L) | EPA GW PRG (µg/L) |
|---|---|---|---|---|
| Max: N/A | Max: 3,250 | Max: 0.271 | Max: 0.277 | 6 |
| Mean: N/A | Mean: 601 | | | |
| Min: N/A | Min: 3.3 | | | |

STACK HILL

| Surface Soil (ppm) | Subsurface Soil >3 in (ppm) | Class III GW Slag (µg/L | Class III GW Marine Sands (µg/L) | EPA GW PRG (µg/L) |
|---|---|---|---|---|
| Max: 3,450 | Max: 3,025 | Max: N/A | Max: 4.542 | 6 |
| Mean: 1,389 | Mean: 402 | | | |
| Min: 112 | Min: 0.18 | | | |

**TABLE B-3. ARSENIC CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS (Continued)**

FINE ORE BIN BUILDING

| Surface Soil (ppm) | | Subsurface Soil >7 ft (ppm) | | Class III GW Slag (µg/L | Class III GW Marine Sands (µg/L) | EPA GW PRG (µg/L) |
|---|---|---|---|---|---|---|
| Max: | N/A | Max: | 1,180 | Max: 31 | Max: 2.8 | 6 |
| Mean: | N/A | Mean: | 643 | | | |
| Min: | N/A | Min: | 8 | | | |

S.E. Plant area

| Surface Soil (ppm) | | Subsurface Soil >5 ft (ppm) | | Class III GW Slag (µg/L | Class III GW Marine Sands (µg/L) | EPA GW PRG (µg/L) |
|---|---|---|---|---|---|---|
| Max: | N/A | Max: | 24,950 | Max: 51.69 | Max: 1.5 | 6 |
| Mean: | N/A | Mean: | 4,084 | | | |
| Min: | N/A | Min: | 10 | | | |

**TABLE B-4. COPPER CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS**

ARSENIC KITCHEN

| Surface Soil (ppm) | Subsurface Soil >1.5 ft (ppm) | Class III GW Slag (µg/L | Class III GW Marine Sands (µg/L) | EPA GW PRG (µg/L) |
|---|---|---|---|---|
| Max: 37,375 | Max: 53,250 | Max: N/A | Max: 0.0051 | 40 |
| Mean: 15,308 | Mean: 2,669 | | | |
| Min: 4,838 | Min: 8 | | | |

COPPER REFINERY

| Surface Soil (ppm) | Subsurface Soil >2.5 ft (ppm) | Class III GW Slag (µg/L | Class III GW Marine Sands (µg/L) | EPA GW PRG (µg/L) |
|---|---|---|---|---|
| Max: N/A | Max: 16,700 | Max: 0.914 | Max: 2.8 | 40 |
| Mean: N/A | Mean: 2,159 | | | |
| Min: N/A | Min: 29 | | | |

STACK HILL

| Surface Soil (ppm) | Subsurface Soil >1.5 ft (ppm) | Class III GW Slag (µg/L | Class III GW Marine Sands (µg/L) | EPA GW PRG (µg/L) |
|---|---|---|---|---|
| Max: 2,600 | Max: 5,750 | Max: N/A | Max: 33 | 40 |
| Mean: 2,309 | Mean: 439 | | | |
| Min: 2,068 | Min: 2 | | | |

COOLING POND

| Surface Soil (ppm) | Subsurface Soil >3 in (ppm) | Class III GW Slag (µg/L | Class III GW Marine Sands (µg/L) | EPA GW PRG (µg/L) |
|---|---|---|---|---|
| Max: 341,250 | Max: 1,250 | Max: N/A | Max: 0.011 | 40 |
| Mean: 59,423 | Mean: 122 | | | |
| Min: 201 | Min: 0 | | | |

**TABLE B-4. COPPER CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS (Continued)**

FINE ORE BIN BUILDING

| Surface Soil (ppm) | | Subsurface Soil >7 ft (ppm) | | Class III GW Slag (µg/L | | Class III GW Marine Sands (µg/L) | | EPA GW PRG (µg/L) |
|---|---|---|---|---|---|---|---|---|
| Max: | N/A | Max: | 1,980 | Max: | 0.14 | Max: | 10.2 | 40 |
| Mean: | N/A | Mean: | 1,230 | | | | | |
| Min: | N/A | Min: | 60 | | | | | |

S.E. PLANT AREA

| Surface Soil (ppm) | | Subsurface Soil > 5 ft (ppm) | | Class III GW Slag (µg/L | | Class III GW Marine Sands (µg/L) | | EPA GW PRG (µg/L) |
|---|---|---|---|---|---|---|---|---|
| Max: | N/A | Max: | 10,975 | Max: | 0.122 | Max: | 0.008 | 40 |
| Mean: | N/A | Mean: | 2,246 | | | | | |
| Min: | N/A | Min: | 0.8 | | | | | |

**TABLE B-5. REASONABLE MAXIMUM EXPOSURE ASSUMPTIONS FOR RESIDENTIAL USE**

| Exposure Group | Exposure Route | Age Group (years) | Body Weight (kg) | Contact Rate | Frequency (days/years) | Duration (years) |
|---|---|---|---|---|---|---|
| Onsite Residents | inhalation | 0-30 | 70 | 20 m3/day | 350 | 30 |
| | soil ingestion | 0-6 | 15 | 200 mg/day | 350 | 6 |
| | | 6-30 | 70 | 100 mg/day | 350 | 24 |
| | slag ingestion | 0-61 | 15 | 110 mg/day | 350 | 6 |
| | | 6-301 | 70 | 55 mg/day | 350 | 24 |
| | | 0-60 | 15 | 22.5 mg/day | 350 | 6 |
| | | 6-300 | 70 | 22.25 mg/day | 350 | 24 |
| | dermala | 0-6 | 15 | 3900 mg/day | 350 | 6 |
| | | 6-30 | 70 | 1900 mg/day | 263 | 24 |
| | | | | 5000 mg/day | 87 | 24 |
| | leafy vegs. | 0-6 | 15 | 0.3 mg/day | 40 | 6 |
| | | 6-30 | 70 | 1.4 mg/day | 40 | 24 |
| | root vegs. | 0-6 | 15 | 1.5 g/day | 69 | 6 |
| | | 6-30 | 70 | 2.5 g/day | 69 | 24 |
| | water | 0-30 | 70 | 2 L/day | 350 | 30 |
| Offsite Residential | inhalation | 0-30 | 70 | 20m3/day | 350 | 30 |
| Recreational Visitor | inhalationb | 0-30 | | | | |
| | soil ingestion | 0-6 | 15 | 90 mg/day | 208, 52, 12 | 6 |
| | | 6-30 | 70 | 45 mg.day | 208, 52, 12 | 24 |
| | slag ingestion | 0-6 | 15 | 90 mg/day | 208 | 6 |
| | | 6-30 | 70 | 45 mg/day | 208 | 24 |
| | dermala | 0-6 | 15 | 12000 mg/day | 208, 52, 12 | 6 |
| | | 6-30 | 70 | | 156, 39, 9 | 24 |
| | | | | 1900 mg/day | 52, 13, 3 | 24 |
| | | | | 5000 mg/day | | |
| | fishc | 0-30 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Trespasser | inhalationb | 6-30 | | | | |
| | soil ingestion | 6-30 | 70 | 45 mg/day | 24 | 24 |
| | slag ingestion | 6-30 | 70 | 45 mg/day | 24 | 24 |
| | dermala | 6-30 | 70 | 1900 mg/day | 18 | 24 |
| | | | | 5000 mg/day | 6 | 24 |

a Skin area available to contact per day in cm2 is multiplied by a soil/skin adherence factor factor of 1.0 mg/mc2, giving units in mg/day.

b Evaluated qualitatively.

c The fish pathway is evaluated by comparison of ground-water concentrations to ambient water quality criteria.

1 Indoor slag ingestion.

2 Outdoor slag ingestion.

**TABLE B-6. SLOPE FACTORS FOR CANCER-CAUSING CHEMICALS**

| CHEMICAL | EXPOSURE ROUTE | CRITERIA VALUEa | WEIGHT OF EVIDENCE CLASSb | TOXIC ENDPOINT | SOURCE |
|---|---|---|---|---|---|
| Arsenic | inhalation | 15c | A | lung cancer | IRIS |
| | Oral | 1.75 | A | skin cancer | IRIS |
| Beryllium | Oral | 4.3 | B2 | unspecified tumor locations by injection | IRIS<br>IRIS |
| Cadmium | inhalation | 6.3 | B1 | lung tumors | IRIS |
| Chromium VI | inhalation | 42 | A | lung tumors | IRIS |
| Lead | | B2 | B2 | renal tumors in rate, no criteria values set | IRIS |
| Nickel | inhalation | B1 | A | lung cancer | IRISd |
| PAHsΘ | oral | A | B2 | stomach tumors | IRIS |
| PCBs | oral | 7.7 | B2 | liver tumors | IRIS |
| | Dermal | 9 | B2 | liver tumors | see text |
| Aniline | Oralf | 0.0056 | B2 | spleen and body cavity tumors in rats | IRIS |

IRIS Integrated Risk Information System, U.S. EPA (1993b).

a Units (mg/kg/day)-1

b Classification definitions:
- A - Human Carcinogen, sufficient evidence in humans.
- B1 - Probable Human Carcinogen, limited human data available.
- B2 - Probable Human Carcinogen, sufficient evidence in animals, inadequate or no evidence in humans.
- C - Possible Human Carcinogen, limited animal evidence.

c The IRIS inhalation slope factor for arsenic is based on an administered dose from occupational exposure, see text.

d IRIS lists a unit risk factor is µg/m3 equivalent to 0.84 (mg/kg/day)-1 for nickel refinery dust.

e The 7 carcinogenic PAHs are: benzo(a)anthracene, benzo(b)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and ideno(1,2,3-cd)pyrene.

f The exposure route for aniline is through ingestion of seafood exposed to aniline in Commencement Bay.

**TABLE B 7. REFERENCE DOSES FOR NON CANCER CAUSING CHEMICALS**

| CHEMICAL | EXPOSURE ROUTE | RFD/RFCa | UNCERTAINTY FACTOR | RFD/RFC CONFIDENCE | TOXIC ENDPOINT | SOURCE |
|---|---|---|---|---|---|---|
| Antimony | Oral | 0.0004 | 1000 | Low | reduced lifespan, altered cholesterol levels | IRIS |
| Arsenic | Oral | 0.0003 0.0008 | 3 | Medium | hyperpigmentation, hyperkeratosis of skin | Glass & SAIC (1992) |
| | | | | | | IRIS |
| Beryllium | Oral | 0.005 | 100 | Low | no adverse effects at this dose | IRIS |
| Cadmium | Oral | 0.0005 (water) | 10 | High | proteins present in urine | IRIS |
| | | 0.001 (food) | 10 | High | | |
| | Dermal | 0.000025 | | Low | proteins present in urine | see text |
| Chromium Vi | Oral | 0.005 | 500 | Low | no adverse effects at this dose | IRIS |
| Copper | Oral | 0.04 | | | gastrointestinal irritation, flu like disease | HEAST |
| Leadd | Oral | 500 mg/day | | | neurological and behavioral effect | U.S. EPA (1990e) |
| Manganese | Oral | 0.005 (water) | 1 | Medium/low | central nervous system effects | IRIS |
| | | 0.14 (food) | 1 | Medium | central nervous system effects | IRIS |
| Mercury | Oral | 0.0003 | 1000 | | kidney effects | HEAST |
| | Inhalation | 0.0003 | 30 | | neurological | HEAST |
| Nickel | Oral | 0.02 | 300 | Medium | neonatal mortality, dermatological effects | IRIS |
| Selenium | Oral | 0.005 | 3 | High | selenium poisoning, biochemical alterations | IRIS |
| Silver | Oral | 0.005 | 3 | Low | skin discoloration | IRIS |
| Thallium | Oral | 0.00007 | 3000 | | hair loss, possible liver effects | HEAST |
| Zinc | Oral | 0.2 | 10 | | ANEMIA | HEAST |

IRIS Integrated Risk Information System, U.S. EPA (1993b).
HEAST Health Effects Assessment Summary Tables, U.S. EPA (1992d).
RfC Reference Concentration.
RfD Reference Dose.
a Unites of Oral RfD are mg/kg/day; Units of Inhalation are mg/m3, unless noted.
b Results of the uptake/biokinetic model (Glass and SAIC, 1992) is used to assess lead in soil for the residential scenario.

**TABLE B-8. ARARs ANALYSIS**

The following requirements are applicable or relevant and appropriate requirements (ARARs) for the cleanup of the Asarco Smelter.

| ARARs | Summary | Comment |
|---|---|---|
| FEDERAL ARARs | | |
| RCRA | | |
| 40 U.S.C. § 6901 et seq. | | RCRA § 3001(b) (a) (A) (11) and 56 FR 27300 exempt primary copper smelter slag from RCRA. Therefore, RCRA 18 not an ARAR for slag. Other wastes on site may be characteristic hazardous waste in which case RCRA regulations are potential ARARs. There are no known listed wastes on site. |
| 40 CFR Part 261 | | |
| Identification and Listing of Hazardous Waste | Standards applicable in identifying solid wastes involved in site remediations that are subject to regulation as hazardous wastes. | |
| 40 CFR Part 262 | | |
| Standards applicable to Generator. of Hazardous Waste | These packaging and administrative requirements apply if hazardous waste is shipped off site. | Pursuant to EPA's AOC policy, these requirements do not apply to on site movement of hazardous waste. (55 Federal Register 8756, March 8, 1990). |
| 40 CFR Part 264 | | |
| Standards for Owners and Operator. of Hazardous Waste Treatment, Storage, and Disposal Facilities | | The substantive standards detailed below are ARARs for the smelter site remediation if on site treatment, disposal, or storage of hazardous remediation waste takes place. |
| 40 CFR § 264.18(b) | | |
| Location standard for floodplain | Standards require that washouts from a 100 year flood be prevented. | These requirements apply only to areas on site deemed within a 100 year floodplain. |
| Subpad F: Release From Solid Waste Management Units | | The requirements of Subpart F are applicable to construction and operation of an OCF. |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| 40 CFR § 264.91 | | |
| Required programs | Substantive monitoring and response requirements may be applicable if hazardous constituents are detected at points of compliance. | |
| 40 CFR § 264.92 | | |
| Groundwater protection standard | Standard requires that the hazardous constituent limits are not exceeded beyond the point of compliance in the uppermost aquifer underlying the waste management area. | |
| 40 CFR § 284.93 | | |
| Hazardous constituents | Standards by which EPA identifies the hazardous constituents to which the above groundwater protection standard applies. | |
| 40 CFR § 264.94 | | |
| Concentration limits | Concentration limits are set forth for the hazardous constituents identified under 40 CFR § 264.93. | |
| 40 CFR § 264.95 § 284.99 | | |
| Monitoring requirements | Monitoring requirements are set forth to ensure compliance and detect contamination. | |
| Subpart G: Closure and Post closure | | Subpart G ARARs are applicable to an OCF. |
| 49 CFR § 264.111 | | |
| Closure performance standard | A TSD facility must be closed in a manner which minimizes the need for further maintenance and protects human health and the environment. | |
| 4.0 CFR § 264.114 | | |
| Disposal or decontamination of equipment, structures and soils | All contaminated soils, equipment and structures must be properly disposed of or decontaminated. | |

**TABLE B-8. ARAR8 ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| 40 CFR § 264.117 | | |
| Post closure care and use of property | Monitoring is required alter closure is completed. | |
| Subpart L: Waste Piles | | |
| 40 CFR § 264.251 | | |
| Design and operating requirements | Requirements include protection from precipitation and surface water run on, control of dispersal of waste by wind, and no generation of leachate. | |
| Subpart N: Landfills | | The requirements of Subpad N are applicable to construction of an OCF. |
| 40 CFR § 264.301 | | |
| Design and operating requirements | Landfill standards require liners and leachate collection systems constructed of materials which provide sufficient protectiveness of human health and the environment. | |
| 40 CFR § 264.303 | | |
| Monitoring and inspection | Monitoring of liner integrity required. | |
| 40 CFR § 264.310 | | |
| Closure and post closure care | Closure of a landfill requires a cover which minimizes migration of liquids, functions with minimum maintenance, and provides long term Integrity. | Monitoring and maintenance is required during the post closure period identified by EPA. |
| 40 CFR § 268 | | |
| Land Disposal Restrictions | | |
| 40 CFR § 268.35 | | |
| Waste specific prohibitions third third wastes | Contaminated soil and debris that are hazardous wastes under RCRA are prohibited from off site land disposal unless treated pursuant to treatment standards. | Under the EPA AOC policy, Land Disposal Restrictions (LDRa) are not applicable to disposal of remediation wastee within an area of contamination. If contaminated soil and debris are disposed of off site, LDRs are applicable requirements. |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| 40 CFR Part 268, Subpart D | | |
| Treatment Standards | Contaminated soil and debris shipped off site for disposal at a RCRA landfill must be treated before disposal. | If soil and debris are shipped off site to s RCRA TSD facility and LDR treatment standards apply, a treatability variance may be necessary. |
| 40 CFR § 257.3 | | |
| Criteria for classification of solid waste disposal facilities and practices. | A solid waste facility which disposes of non hazardous waste must meet the following criteria or it will be considered an open dump and be prohibited under RCRA § 4004. A facility located In a floodplain must not wash out in the event of a flood. A facility must not jeopardize endangered species, violate ground water or surface water quality standards or violate air quality standards. | These requirements apply if non hazardous wastes are disposed of on site. |
| 40.CFR Part 257, Appendix I | The appendix sets forth MCLs for both organic and inorganic chemicals for use in determining compliance with the ground water criteria. | |
| CLEAN WATER ACT | | |
| 33 U.S.C. §§ 1251 st.seq. | | |
| CWA §§ 303 and 304 (Federal Water Quality Criteria) | Pursuant to CERCLA § 121(d)(2)(B)(i), otherwise non enforceable water quality criteria, developed by EPA for surface water, are ARARs. Two kinds of water quality criteria have been developed: one for protection of human health, and another for protection of aquatic life. | |
| 33 U.S.C. § 404 and 40 CFR Part 230 | | |
| Discharge of Dredged or fill material | Mitigation measures required for potential adverse impacts to intertidal habitat or wetlands. | |
| 40 CFR § 122.26 | | |
| Storm water discharges | NPDES permit standards may apply if it is determined that stormwater discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the U.S. | |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| 4O CFR Part 125<br>Subpart A | | |
| Criteria and Standards for Imposing Technology based Treatment Requirements Under Sections 309(B) and 402 of the Act | Standards of control for direct dischargers must meet technology based requirements. Beat conventional pollution control technology (BCT) is applicable to conventional pollutants. Best available technology economically achievable (BAT) applies to toxic and non conventional pollutants. | For CERCLA altos, BCT/BAT requirements are determined on a case by case basis using best professional Judgment (BPJ). |
| 40 CFR Part 126<br>Subpart K | Best management practices (BMPs) must be observed when undertaking Industrial activities which may result in significant amounts of pollutants reaching surface waters. | BMPs are applicable to control the release of hazardous pollutants Into surface waters during the smelter cleanup. |
| 40 CFR Part 126<br>Subpart M | | |
| Ocean Discharge Criteria | Discharges to marine waters are permitted as long as the discharge will not cause unreasonable degradation of the marine environment. | NPDES permit is not required if the discharge is within the site boundaries, however, substantive requirements that would otherwise be required under a permit are ARARs. A monitoring program may be required to essess impact of a discharge. Such a requirement is "relevant and appropriate". |
| 40 CFR Part 6, App. A | | |
| Statement of Procedures on Floodplain Management and Wetlands Protection | Requires federal agencies to conduct its activities to avoid, if possible, adverse impacts associated with the destruction or modification of wetlands and occupation or modification of floodplains. | |
| WASHINGTON INDIAN (PUYALLUP) LAND CLAIMS SETTLEMENT | | |
| 25 U.S.C. § 1773 | Requires protection of fisheries through control of discharges to Commencement Bay. Compliance with the Settlement Act generally is attained through compliance with ARARs under federal or state law on discharges to surface water. | |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| RIVERS AND HARBORS ACT OF 1899 | | |
| 33 U.S.C. § § 401 et seq. | | |
| 33 U.S.C. § 403 | | |
| Obstruction of navigable waters generally; wharves; piers, etc.; excavation and filling in. | Controls the alteration of the navigable waters (i.e., waters subject to ebb and flow of the tide shoreward to the mean high water mark). Activities controlled include construction of structures such as piers, berms, and installation of pilings. | Some minor activities may occur on site along the shoreline during remediation. No permit is required for on site activities. |
| SAFE DRINKING WATER ACT | | |
| 42 U.S.C. § § 300(f) et seq. | | |
| 40 CFR Part § 41 Subpart B | | |
| Maximum Contaminant Levels | Maximum contaminant levels (MCLs) are enforceable drinking water standards which are protective of human health. The standards take into account available treatment technology and cost. | |
| 40 CFR Part 141 Subpart F | | |
| Maximum Contaminant Level Goals | Maximum contaminant level goals (MCLGs) are enforceable health based goals for drinking water quality and are non enforceable. CERCLA § 121 (d)(2) outlines use of MCLGs in remedial actions (see also 55 FR 8750.53). | |
| CLEAN AIR ACT | | |
| 42 U.S.C. § 7401 et seq. | | |
| 40 CFR Part 50 | | |
| National Primary and Secondary Ambient Air Quality Standards | These regulations set forth the National Primary and Secondary Ambient Air Quality Standards (NAAQS) which were developed to protect the public health (allowing an adequate margin of safety). | Some on site remedial activities, such as handling contaminated soil and using an air stripper may be minor sources of air emmissions. |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| ENDANGERED SPECIES ACT | | |
| 16 U.S.C. §§ 1531 et seq. | Federal agencies must ensure that actions they authorize, fund, or carry out are not likely to adversely modify or destroy critical habitat of endangered or threatened species. | |
| MARINE MAMMAL PROTECTION ACT | | |
| 16 U.S.C. §§ 1361 et seq. | EPA must ensure that its actions do not involve the unauthorized taking of marine mammals. | |
| HAZARDOUS MATERIALS TRANSPORTATION ACT | | |
| 49 U.S.C. Ap. §§ 1801 et seq. | | |
| 49 CFR Parts 171 177 | | |
| U.S. Dept. of Transportation Subchapter C. Hazardous Materials Regulations | Regulations provide for packaging, documentation, and transport of hazardous waste. | These regulations are requirements for any hazardous waste shipped off site for disposal during remediation. |
| NATIONAL HISTORIC PRESERVATION ACT | | |
| 16 U.S.C. §§ 470 et seq, | This statute requires EPA to consider effects of remedial actions on historic properties. (This evaluation was conducted in connection with demolition activities.) | The administrative procedural requirements, such as the Cultural Resources Plan, are not ARARs. |
| ARCHAEOLOGICAL AND HISTORICAL PRESERVATION ACT. | | |
| 16 U.S.C. §§ 4699 1 | In the event that significant scientific, prehistorical, or archaeological data is present on a site, EPA must approve the remedial activities so that such data is preserved. | |
| STATE ARARS | | The following state statutes and regulations are ARARs only if they result in more stringent standards than those required under federal statutes end regulations. (Requirements under federal programs that |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| MODEL TOXICS CONTROL ACT | | |
| Chapter 70.105D RCW | | |
| WAC 173 340 360 | | |
| Selection of cleanup actions | Requires that cleanup actions, to the extent practicable, comply with cleanup standards, use permanent solutions, provide for reasonable time frames, minimize amount of untreated hazardous substances, restore ground water, and utilize long term monitoring and institutional controls if on site disposal occurs. | Administrative requirements in this section regarding a cleanup action plan and public participation are not ARARs. |
| WAC 173 340 440 | | |
| Institutional controls | These measures are undertaken to limit or prohibit activities that may interfere with the integrity of a containment area or some other cleanup action. | |
| WAC 173 340 705 | | |
| Use of Method B | Method B cleanup levels are potentially applicable to all sites. Standards must be at least as stringent as applicable state and federal law and they must not result in adverse impact of aquatic and terrestrial life. For hazardous substances for which sufficiently protective standards have not been established, standards can be established by estimations which result in no acute or chronic toxic effects using s hazard quotient of (1); or for carcinogens, concentrations with upper bound excess cancer risk of 1 X 10 6. | At this Site, Method B Is applicable in setting cleanup levels. |
| WAC 173 340.706 | | |
| Use of Method C | Method C cleanup levels may be established at concentrations equal to background or at concentrations which minimize overall threats if attainment of A or B levels will increase the threat to human health and the environment. These levels must be estimated by using a hazard quotient of (1) and a 1 X 10 5 cancer risk for carcinogens. | |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173.340.707 | | |
| Analytical considerations | When the cleanup level is below the practical quantitation limit (PQL), the PQL will become the standard as long as it is not greater than 10X the method detection limit. | |
| WAC 173.340.708 | | |
| Human health risk assessment procedures | This section sets forth the risk assessment framework utilized to establish cleanup standards. | Methodologies for determining background concentrations are potential ARARs. |
| WAC 173.340 720 | | |
| Ground water cleanup standards. | This section sets forth guidelines for ground water cleanup levels, points of compliance, and the ground water classification system. Ground water cleanup levels are based upon the highest beneficial use (i.e. drinking water) unless the ground water is not a potential source due to high concentrations of dissolved solids or insufficient yield. Further, if there is an extremely low probability that the ground water will be a future source of drinking water, the cleanup levels may be based on protection of nearby surface water. | |
| WAC 173 340 730 | | |
| Surface water cleanup standards | Method A cleanup levels are based on the state and federal water quality criteria. Method B cleanup levela require compliance with these criteria unless it can be shown that they are not relevant to the specific water body. Also cleanup levels that are estimated must result in no acute or chronic effects on fish or shellfish and a cancer risk less than or equal to 1 x 10 6. Less stringent Method C levels may be used if consistent with applicable laws, all practicable methods of treatment are utilized, and Institutional controls are implemented. This section also sets forth points of compliance and requires compliance monitoring. | At this Site, Method B is applicable to discharges to surface water. |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173 340 740 | | |
| Soil cleanup standards | This section sets forth residential cleanup levels. For sites undergoing routine cleanup, Table 2, in this section, sets forth applicable standards. Method B allows cleanup standards not already established, to be calculated using concentrations that will not result in toxic effects, contamination of ground water, or a cancer risk that is no greater than 1 X 10 8. | |
| WAC 173 340 745 | | |
| Soil cleanup standards for Industrial sites | Industrial cleanup levels are less stringent than those set for residential areas. To be classified as an industrial site, the following criteria must be satisfied: the site is zoned Industrial use; site was historically used for industrial purposes; adjacent property is currently used or designated Industrial; the site will be zoned industrial for the foreseeable future; and the cleanup action provides for institutional controls. An amendment to state law provides that industrial properties include properties that are or have been characterized by or committed to traditional industrial uses. | |
| WAC 173 340 750 | | |
| Cleanup standards to protect air quality | Removal and containment measures which release hazardous substances to the air must be conducted in accordance with air standards. Residential standards are most stringent. Industrial standards may be established on a case by case baals as long as concentrations result in no toxic effects and cancer risk is no greater than 1 X 10 5. | |
| WATER POLLUTION CONTROL | | |
| WAC 173 201 035 | | |
| General considerations | Guidelines are set forth which apply to water quality criteria and classifications such as the antidegradation policy and criteria for short term modification of water quality standards. | |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173 201 045 | | |
| General water use and criteria classes | This section sets forth water quality criteria for each type of water classification. Criteria considered includes fecal coliform, dissolved oxygen, dissolved gas, temperature, pH, turbidity, toxics, and aesthetics. | |
| WAC 173 201 047 | | |
| Toxic substances | Water quality standards (fresh and marine water) are set forth for several substances deemed toxic. Such substances may not be introduced above natural background if they adversely affect characteristic water uses, public health, or cause acute or chronic conditions. | |
| WAC 173 216 060 | | |
| Prohibited Discharges | Discharges to a municipal sewage system must not interfere with the system's operation. | |
| WAC 173 220 120 | | |
| Prohibited discharges | Prohibits specific discharges into waters of the state such as pollutants that impair anchorage and navigation, and toxic pollutants prohibited under CWA § 307. | |
| WAC 173 220.130 | | |
| Effluent limitations, water quality standards, and other requirements and/or permits | This section sets forth substantive requirements for NPDES permits such as effluent limitations based on known, available, and reasonable methods of treatment. Effluent limitations may be more stringent than those standards developed under the CWA when necessary to meet water quality standards. | |
| WAC 173 220 210 | | |
| Monitoring, recording and reporting | Monitoring is required to ensure that discharges comply with effluent limitations. | Recording and reporting requirements in this section are administrative and, therefore, are not ARARs. |
| Chapter 173 240 WAC | | |
| Submission of Plans and Reports for Construction of Wastewater Facilities | Construction requirements are set forth for wastewater facilities. | The engineering report and plan requirements in this section are administative and, therefore, are not ARARs. |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| POLLUTION DISCLOSURE ACT OF 1971 | | |
| Chapter 90.52 RCW | | |
| RCW 90.52.040 | | |
| Wastes to be provided with available methods of treatment prior to discharge into waters of the State. | Regardless of water quality and minimum water quality standards, all wastes must undergo all known, available, and reasonable methods of treatment prior to discharge, except as provided below. | |
| RCW 90.54.020 | | |
| General dedaration of fundamentals for utilization and management of waters of the state. | Regardless of water quality, all discharges to the waters of the state must be provided with all known, available, and reasonable methods of treatment, except where overriding considerations of the public interest will be served. | |
| CONSTRUCTION PROJECTS IN STATE WATERS | | |
| Chapter 220.110 WAC | | |
| Hydraulic Code Rules | Requirements are set forth for construction projects along waterways, such as bulkhead construction and piling installation, that are designed to protect marine life. | A hydraulic project approval is not required since it is a type of administrative permit. |
| WELLWATER CONSTRUCTION | | |
| Chapter 18.104 RCW | | |
| WAC 173 160, Part 1 | | |
| General requirements | Requirements are set forth which pertain to design and construction of wells generally; such as preservation of natural barriers to prevent water flow between aquifers and permanent sealing. | Permit requirements and other administrative provisions in this section are not ARARs. |

TABLE B 8. ARARs ANALYSIS (Continued)

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173 160, Part 3 | | |
| Resource protection wells | Specific design and construction requirements are set forth for the drilling and use of monitoring and observation wells. | |
| UNDERGROUND INJECTION CONTROL PROGRAMS | | |
| Chapter 173 218 WAC | This program requires that injection wells not adversely affect the beneficial use of an underground source of drinking water. | If an injection well is utilized on the smelter site it will be used to inject salt water for treatment purposes and will not adversely affect existing groundwater. These walls would be considered Class V wells that do not inject waste fluids. |
| HAZARDOUS WASTE MANAGEMENT ACT | This statute provides statutory authority for the Dangerous Waste Regulations (DW) described below. | |
| Chapter 70.105A RCW | | |
| WAC 173 303 016 | | |
| Identifying solid waste. | Guidelines are set forth which identify solid wastes that are also dangerous wastes. | |
| WAC 173 303.020 | | |
| Applicability | Dangerous waste regulations apply to generators, transporters, and owners and operators of TSD facilities. | According to the State's Area of Contamination (AOC) Policy, the movement of DW within an area of contamination is not considered generation. Therefore, the DW regulations are not automatically triggered but may be relevant and appropriate. Similarly, containment, treatment, and disposal of consolidated wastes within an AOC does not automatically trigger the DW regulations. (Interprogram Policy dated September 6, 1991). |
| WAC 173 303 060 | | |
| Notification and Identification numbers | An ID# is required if any dangerous waste is shipped off site. | Not an ARAR for on site movement of wastes. |
| WAC 173 303.070 | | |
| Designation of dangerous waste | Procedure for determining whether or not a solid waste is a dangerous waste (DIN) or an extremely hazardous waste (EHW). | |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173 303 071 | | |
| Excluded categories of waste. | Certain categories of waste may be excluded from the requirements of the dangerous waste regulations. For example, under subsection (3)(i), PCB waste whose disposal 18 regulated pursuant to 40 CFR § 761.60 is exempt from most DW regulations. | |
| WAC 173 303 081 | | |
| Discarded chemical products. | A waste is designated a DW if it is a residue from management of chemicals listed on the Discarded Chemical Products List at WAC 173 303 8903. | |
| WAC 173 303 082 | | |
| Dangerous waste sources. | All wastes or residues from wastes listed on the Dangerous Waste Sources List are to be designated either DW or EHW depending on the circumstances. | |
| WAC 173 303.084 | | |
| Dangerous waste mixtures. | A waste mixture that has not been designated a DW must be evaluated to determine whether or not toxic constituents, specific hydrocarbons, or carcinogens are present. If present in sufficient quantities, they are to be treated as DW. | |
| WAC 173 303 090 | | |
| Dangerous waste characteristics | If a waste has characteristics of ignitability, corrosivity, reactivity, or toxicity, it could be designated a DW. | |
| WAC 173 303 100 | | |
| Dangerous waste criteria. | If a person has established that his waste meets the DW criteria, he is a generator and must comply with appropriate DW regulations for generators. | This requirement applies only to those DW which are transported off site. |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173 303 101 | | |
| Toxic dangerous wastes. | Methods are set forth for determining the toxicity of waste and whether it is a DW or EHW. | |
| WAC 173 303 102 | | |
| Persistent dangerous wastes. | Procedure is set forth to designate wastes that contain halogenated hydrocarbons and/or polycyclic aromatic hydrocarbons with more than three rings and less than seven rings (PAHs) as either DW or EHW. | |
| WAC 173 303 103 | | |
| Carcinogenic dangerous waste. | Method for designating a waste as carcinogenic. | |
| WAC 173 303 104 | | |
| Generic dangerous wastes. | Sets forth the DW number for each of the DW criteria designations. | This requirement is only relevant for wastes shipped off site for disposal. |
| WAC 173 303 120 | | |
| Recycled, reclaimed, and recovered wastes. | Exempts some recycled DW from the DW regulations if it does not pose a threat to public health and the environment. For example, scrap metal is exempt from DW regulations. | |
| WAC 173 303 140 | | |
| Land disposal restrictions | May require some type of treatment of DW prior to off site disposal. Treatment of EHW may be required prior to on site disposal if practicable. | Pursuant to the State's Area of Contamination Policy, the State LDRs are not applicable unless DW is shipped off site for disposal. Ecology and EPA have agreed to jointly decide the extent of treatment necessary prior to on site or off site disposal of EHW. |
| WAC 173 303 141 | | |
| Treatment, storage, or disposal of dangerous waste. | DW shipped off site for disposal must be shipped to a properly permitted TSD facility. | On site disposal of DW 18 subject to the state's AOC policy. |
| WAC 173 303 150 | | |
| Division, dilution, and accumulation. | The intent of the DW regulations may not be evaded by dividing or diluting wastes. | |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173 303 160 | | |
| Containers. | Applicable procedure for measuring waste quantity when containers are utilized for shipment of DW off site. | |
| WAC 173 303 161 | | |
| Overpacked containers (labpacks). | Requirements for overpacked drums such as use of non leaking inside containers and use of non reactive material for shipping of DW off site. | |
| WAC 173 303 180 | | |
| Manifest. | Manifesting is required when DW is generated. | Manifesting required only if DW is transported off site. |
| WAC 173.303 270 | | |
| Discharge during transport. | Notification requirements apply if a transporter spills DW during transport. | These requirements apply only in the event of a spill during transportation of DW off site. |
| WAC 173 303 283 | | |
| Performance standards. | A DW facility must be designed and constructed, to the maximum extent practical, to prevent: degradation of ground water quality and air quality, destruction of flora and fauna, excessive noise, negative aesthetic impact, unstable hillsides, and endangerment of employees. Processes used must treat, detoxify, recycle, reclaim, and recover waste material to the extent economically feasible. | |
| WAC 173 303 550 | | |
| Special requirements for facilities managing special waste. | Guidelines by which Ecology will approve less stringent standards for facilities which handle "special wastes". | Special wastes are those that are not considered hazardous waste, under RCRA but are designated a DW under the more stringent state standards. |
| WAC 173 303 560 | | |
| Minimum standards for facilities managing special waste. | Minimum standards are set forth which Ecology may approve for "special waste" facilities. | |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173 303 600 | | |
| Final facility standards. | This section specifies which TSD facilities are subject to closure requirements. | |
| WAC 173 303 610 | | |
| Closure and postclosure. | Closure and performance standards require that a facility be closed to minimize need for further maintenance and control, minimize, or eliminate the escape of DW to the environment. The land must also be returned to the appearance and use of surrounding land to the degree possible. All contaminated soils, equipment, and structure must be disposed of properly. Notice of disposal of waste must be recorded on the deed. | Survey plate, closure plan and certificate requirements in this section are administrative and, thus, are not ARARs. Monitoring to ensure closure integrity is required. Such a requirement is "relevant and appropriate." |
| WAC 173 303 645 | | |
| Releases from solid waste management units. | This section sets forth ground water monitoring requirements for postclosure periods for facilities that are closed without all DW removed. Criteria is listed by which dangerous constituents are identified and concentration limits are determined. Such requirements are "relevant and appropriate." | |
| WAC 173 303 660 | Requirements for temporary storage of dangerous waste, e.g., protection from precipitation. | |
| Waste Plies | | |
| WAC 173.303 665 | | |
| Landfills. | Landfills must be constructed with a liner and leachate collection system. There must be system to control run on and run off. Upon closure, the landfill must be covered with final cover that provides long term integrity. | |
| WAC 173 303 9903 | | |
| Discarded chemical products list. | Lists of chemicals which are designated as either EHW Or DW. | |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173 303 9904 | | |
| Dangerous waste sources list. | All wastes listed are designated as DW. | |
| WAC 173 303.9905 | | |
| Dangerous waste constituents list. | List of chemically distinct components of a dangerous waste stream or mixture. | |
| WAC 173 303 9906 | | |
| Toxic dangerous waste mixtures graph. | Graph is utilized to determine whether a mixture containing toxics is either a DW or EHW. | |
| WAC 173 303 9907 | | |
| Persistent dangerous waste mixtures graph. | Graph is utilized to determine whether wastes containing certain percentages of persistent DW constituents are DW or EHW. | |
| Solid Waste Management Reduction and Recycling | | |
| Chapter 70.95 RWC | | |
| WAC 173 304 130 | | |
| Location Standards for Disposal Sites. | This section sets forth locational standards regulating proximity of facilities to faults, groundwater, surface water and floodplains. | |
| WAC 173 304 407 | | |
| General closure and post closure requirements. | Closure performance standards are set forth which require that the need for further maintenance be minimized and threats to human health and the environment be controlled or eliminated. | The closure and post closure plan requirements and other administrative procedures in this section are not ARARs. |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WAC 173 304 480 | | |
| Landfilling standards, | These standard, do not apply to inert wastes and demolition wastes but they do apply to problem wastes. Minimum functional standards require that landfill, not contaminate ground water or surface water. A leachate collection system and liner is required. Also facilities located In floodplains must not restrict the flow of the base flood. Water run on and run off must be controlled. Also, dangerous waste disposal is prohibited in a solid waste landfill. | The documentation requirements such as operating plans are administrative and, therefore, are not ARARs. |
| WAC 173 304 461 | | |
| Inert waste and demolition waste landfilling facility requirements. | This section requires that fugitive dust be controlled, that combustible waste be covered to avoid a fire hazard, and that the site be leveled to the extent practicable at closure. | The permitting requirement and other documentation requirements in this section are administrative and, therefore, are not ARARs. |
| WAC 173 304 490 | | |
| Groundwater Monitoring Requirements. | Monitoring is required to ensure that groundwater quality 18 not affected by disposal site. | This requirement Is "relevant end appropriate." |
| SHORELINE MANAGEMENT ACT OF 1971 | | |
| Chapter 90.58 RCW | Local shoreline master programs are set out substantive requirements that apply to construction activities within 200 feet of the shoreline. | Permitting requirements are not ARARs for on site construction activities. |

**TABLE B-8. ARARs ANALYSIS (Continued)**

| ARARs | Summary | Comment |
|---|---|---|
| WASHINGTON CLEAN AIR ACT | | |
| Chapter 70.94 ROW | | |
| WAC 173 400 040 | | |
| General standards for maximum emissions | All "emission units" (i.e. any activity that emits contaminants to air) are required to use reasonably available control technology. Emissions must not violate opacity standards or cause particulate matter to deposit on adjacent properly which interferes with its enjoyment. Further, reasonable precautions must be taken to prevent fugitive emissions and dust and to reduce odors. No emission is permitted that causes detriment to health, safety, and welfare of any person. | |
| WAC 173.46O | | |
| Controls For New Sources of Toxic Air Pollutants | An acceptable source impact level is set forth for arsenic. This standard may be an applicable and relevant requirement during the construction phase of the remediation. | |
| PSAPCA REGULATION 1 | | |
| Section 9.15 | | |
| Fugitive Dust: Emission Standard | Beat available control technology must be used to control fugitive emissions. Dust emissions are prohibited if they are injurious to human health, plant or animal life or interfere with enjoyment of property. | |

**APPENDIX C**

**SUMMARY OF ADDITIONAL SOIL TREATABILITY PILOT-PROJECT FINDINGS**

# PILOT SCALE TREATABILITY TESTING

# OF PLANT SITE SOILS AT THE ASARCO TACOMA SMELTER

## ANALYTICAL SUMMARY SUPPLEMENT

Prepared for:

Mr. Thomas L. Aldrich
Plant Site Manager
ASARCO Incorporated
P.O. Box 1677
Tacoma, WA 98401

Prepared by:

Hydrometrics, Inc.
2727 Airport Rd.
Helena, MT 59601

December 1994

## 5.0 SUMMARY

As outlined in the Pilot Scale Treatability Sampling and Analysis Plan, specific objectives of the pilot scale testing project included:

1. establish an analytical testing program to assess the effectiveness of the treatment in reducing contaminant leachability;

2. optimize additive mix proportions so as to provide lowest cost treatment which meets or exceeds preliminary remediation goals;

3. evaluate sensitivity of treatment effectiveness to variations in feed material quality;

4. refine process operating ranges and monitoring procedures to assure consistent performance during full scale operation.

Extensive chemical and physical tests have been performed to characterize the effectiveness of the treatment method in reducing contaminant leachability. Leach test results on field control lot samples and laboratory compaction samples suggest that the ARCHON solidification/ stabilization process successfully immobilized contaminants, resulting in undetectable or low leachable concentrations of Ag, As, Cd, Cu, Ni, Pb, Sb, Se, TI and Zn. This reduction in leachability was maintained for all treatment mixes, independently of any variations in pre-treatment soil feed or treatment mix percentages.

Physical parameter test results were less conclusive, as physical tests performed on sample molds are apparently not completely representative of actual large scale post-treatment physical properties. Differences in heat generation/retention and associated curing processes are believed to cause observed differences in percent volume change calculations, and may also result in differences between laboratory and field values of permeability and/or compressive strength. Although tests conducted may provide some insight on the physical characteristics of poster soil samples, it should be noted that conditions in the field are likely to be different than those implied by mold test results.

**APPENDIX D**

**ASARCO SMELTER SITE ON-SITE CONTAINMENT FACILITY EVALUATION**

<IMG SRC 1095122H>

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

Reply to
Attn of: HW-106 FEB 2 4 1995

MEMORANDUM

SUBJECT: Asarco Smelter Site
On-site Containment
Facility (OCF)

FROM: Catherine Massimino
Senior RCRA/Superfund
Technical Specialist

TO: Piper Peterson
Regional Project Manager
SF Management - II

This is in response to your request for assistance in reviewing the impact of treatment of 15% of the contaminated soils prior to placement in a landfill at the Asarco Smelter Site in Tacoma, Washington.

An evaluation of potential percolation from an on-site containment facility (OCF) located in the central area of the Asarco site as shown on Figure 6-3-6, of Asarco's Smelter Site January 1993, Remedial Investigation Report (RI), was performed. This evaluation bracketed an expected design scenario meeting RCRA landfill standards (hereafter referred to as Scenario A-OCF Good Cap and Liner), and a scenario reflective of long-term deterioration Scenario A of the OCF (hereafter referred to as Scenario B-OCF Poor Cap and No Liner). Both scenarios reflected 25 feet of waste and a landfill surface area of 18 acres. This will accommodate two (2) feet of contaminated soil in addition to the amount that Asarco had approximated on Exhibit A5-3-2 Volume 4-Appendices Asarco Tacoma Plant Feasibility Study (FS) of its conceptual OCF design as necessary to accommodate 240,000 cubic yards of wastes. This additional two (2) feet of waste should allow about a 10% safety factor for waste volume.

This review was performed utilizing the Hydrologic Evaluation of Landfill Performance (HELP) model Version 3.01 The OCF Good Cap and Liner configuration and layers modeled in this review are very similar to the scenario evaluated by Asarco under Appendix 5-2b of Volume 4 of the FS with the following major' exceptions: a) used model synthetically generated precipitation data from Olympia, refined to include monthly precipitation data from Seattle-Tacoma International Airportinstead of 20 years of historic daily precipitation data from Seattle-Tacoma International Airport, a waste layer depth of 25 feet versus 30 feet, a surface area of 18 acres, including OCF liner and cap components versus 10.5 acres, which including only the contaminated soil, SCS runoff curve number was computed by the model, input of leakage fraction for the flexible membrane liner (FML) was replaced by factoring into the model values reflective of good quality for pinhole density, installation defects and overall placement quality, and the model was run for 100 years versus 20. The detailed model inputs and outputs can be found in Attachment 1 to this memorandum.

The major differences in input values for the two scenarios can found on Table 1. The largest difference being the assumption for the Poor Cap and No Liner Scenario B that the bottom liner has so deteriorated that it is no longer functioning as a liner and the percolation being evaluated is from the bottom of the waste. The results of this modeling are summarized in Table 2.

The above HELP modeling results were utilized to estimate contaminate loading from the OCF into Commencement Bay without any pretreatment of the contaminated soils and with 15% of the contaminated soils pretreated. Based on this comparison, which is presented in Table 3, the difference between the arsenic loading from the OCF Scenario B (worst case percolation) of 106 grams per day, when none of the waste is treated versus 15% treated of 90 grams per day, is very minimal. Based on this evaluation, treatment of 15% of the waste can not be justified. As the HELP model is designed to be a comparative evaluation tool this data is not appropriate for use in performing an evaluation of the impact of this loading to Commencement Bay. In addition, it should be noted that this loading comparative determination did not account for dilution or absorption in the soil column of the contaminant during the travel of the percolation out of the OCF to Commencement Bay.

**TABLE 1**

**HELP MODEL MAJOR INPUT VALUE DIFFERENCES BETWEEN SCENARIOS A & B**

| INPUT VALUES | A. OCF GOOD CAP AND LINER | B. OCF POOR CAP AND NO LINER |
|---|---|---|
| Hydraulic conductivity of low permeability soil layer in cap | 1 X 10-7 cm/sec | 1.2 X 10-6 cm/sec |
| FML | | |
| Pinhole density | .75 holes/acre | 1 hole/acre |
| Installation defects | 2.0 holes/acre | 15 holes/acre |
| Placement Quality | Good | Poor |
| SCS Runoff Curve # | 50.40 based on a good stand of grass | 74.40 based on a poor stand of grass |
| Maximum Leaf Area Index | 3.5 based on a good stand of grass | 1.0 based on a poor stand of grass |
| Bottom Liner System | Leachate Collection and Removal System FML<br><br>Low permeability soil layer<br>Leak Detection Collection and Removal System FML<br>Low permeability soil layer | No functional bottom liner system |

**TABLE 2**

**HELP MODELING AVERAGE ANNUAL PERCOLATION RESULTS**

| OCF SCENARIO | CUBIC FEET/YEAR | CUBIC FEET/DAY |
|---|---|---|
| A. OCF GOOD CAP AND LINER | .2 | 0 |
| B. OCF POOR CAP AND NO LINER | 59,176 | 162 |

**TABLE # 3**

**ARSENIC CONTAMINATION LOADING TO WATERWAY**

| LOADING SCENARIO | LOADING TO WATERWAY (GRAMS/DAY) |
|---|---|
| OCF SCENARIO B<br>0% TREATMENT<br>ARSENIC 23 PPM (TCLP)1<br>(UNTREATED) | 106 |
| OCF SCENARIO B<br>15% TREATMENT<br>ARSENIC 23 PPM (TCLP)1<br>(UNTREATED)<br>ARSENIC > 5.0 PPM (TCLP)<br>(MINIMUM ACCEPTABLE TREATMENT) | 93 |
| OCF SCENARIO B<br>15% TREATMENT<br>ARSENIC 23 PPM (TCLP)1<br>(UNTREATED)<br>ARSENIC .07 PPM (TCLP)1<br>(LOWEST TREATMENT LEVEL ACHIEVED) | 90 |

1. Pilot Scale' Treatability Testing of Plant Site Soils at the Asarco Tacoma Smelter, December 1994.

**ATTACHMENT 1**

**OCP HELP MODEL INPUTS AND OUTPUTS**

```
            HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
            HELP MODEL VERSION 3.01     (14 OCTOBER 1994)
               DEVELOPED BY ENVIRONMENTAL LABORATORY
                  USAE WATERWAYS EXPERIMENT STATION
           FOR USEPA RISK REDUCTION ENGINEERING LABORATORY

PRECIPITATION DATA FILE:        c:\help3\asar1.D4
TEMPERATURE DATA FILE:          c:\help3\ASAR2.D7
SOLAR RADIATION DATA FILE:      c:\help3\ASAR3.D13
EVAPOTRANSPIRATION DATA:        c:\help3\ASAR4.D11
SOIL AND DESIGN DATA FILE:      c:\help3\asar5.D10
OUTPUT DATA FILE:               c:\help3\asar7.OUT

TIME:     9:5        DATE:     2/23/1995


        TITLE:  ASARCO OCF-GOOD CAP AND LINER

        NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
                 COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                                LAYER 1
                                -------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER    4
        THICKNESS                            24.00    INCHES
        POROSITY                              0.4370  VOL/VOL
        FIELD CAPACITY                        0.1050  VOL/VOL
        WILTING POINT                         0.0470  VOL/VOL
        INITIAL SOIL WATER CONTENT            0.3896  VOL/VOL
        EFFECTIVE SAT. HYD. COND.        0.170000002000E-02 CM/SEC
      NOTE:   SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.63
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2
---

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

| | | |
|---|---|---|
| THICKNESS | 12.00 | INCHES |
| POROSITY | 0.4170 | VOL/VOL |
| FIELD CAPACITY | 0.0450 | VOL/VOL |
| WILTING POINT | 0.0180 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.4170 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.999999978000E-02 | CM/SEC |
| SLOPE | 15.00 | PERCENT |
| DRAINAGE LENGTH | 600.0 | FEET |

LAYER 3
---

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

| | | |
|---|---|---|
| THICKNESS | 0.04 | INCHES |
| POROSITY | 0.0000 | VOL/VOL |
| FIELD CAPACITY | 0.0000 | VOL/VOL |
| WILTING POINT | 0.0000 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.0000 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.199999996000E-12 | CM/SEC |
| FML PINHOLE DENSITY | 0.75 | HOLES/ACRE |
| FML INSTALLATION DEFECTS | 2.00 | HOLES/ACRE |
| FML PLACEMENT QUALITY | 3 - GOOD | |

LAYER 4
---

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

| | | |
|---|---|---|
| THICKNESS | 24.00 | INCHES |
| POROSITY | 0.4270 | VOL/VOL |
| FIELD CAPACITY | 0.4180 | VOL/VOL |
| WILTING POINT | 0.3670 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.4270 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.100000001000E-06 | CM/SEC |

LAYER 5
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

| | | |
|---|---|---|
| THICKNESS | 300.00 | INCHES |
| POROSITY | 0.6710 | VOL/VOL |
| FIELD CAPACITY | 0.2920 | VOL/VOL |
| WILTING POINT | 0.0770 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.2920 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.100000005000E-02 | CM/SEC |

LAYER 6
---

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

| | | |
|---|---|---|
| THICKNESS | 12.00 | INCHES |
| POROSITY | 0.4170 | VOL/VOL |
| FIELD CAPACITY | 0.0450 | VOL/VOL |
| WILTING POINT | 0.0180 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.0451 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.999999978000E-02 | CM/SEC |
| SLOPE | 1.50 | PERCENT |
| DRAINAGE LENGTH | 600.0 | FEET |

LAYER 7
---

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

| | | |
|---|---|---|
| THICKNESS | 0.06 | INCHES |
| POROSITY | 0.0000 | VOL/VOL |
| FIELD CAPACITY | 0.0000 | VOL/VOL |
| WILTING POINT | 0.0000 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.0000 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.199999996000E-12 | CM/SEC |
| FML PINHOLE DENSITY | 0.75 | HOLES/ACRE |
| FML INSTALLATION DEFECTS | 2.00 | HOLES/ACHE |
| FML PLACEMENT QUALITY | 3 - GOOD | |

LAYER 8
---

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

| | | | |
|---|---|---|---|
| THICKNESS | 12.00 | INCHES | : |
| POROSITY | 0.4270 | VOL/VOL | |
| FIELD CAPACITY | 0.4180 | VOL/VOL | |
| WILTING POINT | 0.3670 | VOL/VOL | |
| INITIAL SOIL WATER CONTENT | 0.4270 | VOL/VOL | |
| EFFECTIVE SAT. HYD. COND. | 0.100000001000E-06 | CM/SEC | |

LAYER 9
---

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

| | | |
|---|---|---|
| THICKNESS | 12.00 | INCHES |
| POROSITY | 0.4170 | VOL/VOL |
| FIELD CAPACITY | 0.0450 | VOL/VOL |
| WILTING POINT | 0.0180 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.0450 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.999999978000E-02 | CH/SEC |
| SLOPE | 1.50 | PERCENT |
| DRAINAGE LENGTH | 600.0 | FEET |

LAYER 10
---

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEX NUMBER 35

| | | |
|---|---|---|
| THICKNESS | 0.06 | INCHES |
| POROSITY | 0.0000 | VOL/VOL |
| FIELD CAPACITY | 0.0000 | VOL/VOL |
| WILTING POINT | 0.0000 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.0000 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.199999996000E-12 | CM/SEC |
| FML PINHOLE DENSITY | 0.75 | HOLES/ACRE |
| FML INSTALLATION DEFECTS | 2.00 | HOLES/ACRE |
| FML PLACEMENT QUALITY | 3 - GOOD | |

LAYER 11
---

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

| | | |
|---|---|---|
| THICKNESS | 36.00 | INCHES |
| POROSITY | 0.4270 | VOL/VOL |
| FIELD CAPACITY | 0.4180 | VOL/VOL |
| WILTING POINT | 0.3670 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.4270 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.100000001000E-06 | CM/SEC |

GENERAL DESIGN AND EVAPORATIVE ZONE DATA
---

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 15.% AND A SLOPE LENGTH OF 600. FEET.

| | | |
|---|---|---|
| SCS RUNOFF CURVE NUMBER | 50.40 | |
| FRACTION OF AREA ALLOWING RUNOFF | 100.0 | PERCENT |
| AREA PROJECTED ON HORIZONTAL PLANE | 18.000 | ACRES |
| EVAPORATIVE ZONE DEPTH | 24.0 | INCHES |
| INITIAL WATER IN EVAPORATIVE ZONE | 9.350 | INCHES |
| UPPER LIMIT OF EVAPORATIVE STORAGE | 10.488 | INCHES |
| LOWER LIMIT OF EVAPORATIVE STORAGE | 1.128 | INCHES |
| INITIAL SNOW WATER | 0.000 | INCHES |
| INITIAL WATER IN LAYER MATERIALS | 133.780 | INCHES |
| TOTAL INITIAL WATER | 133.780 | INCHES |
| TOTAL SUBSURFACE INFLOW | 0.00 | INCHES/YEAR |

# EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
SEATTLE WASHINGTON

| | |
|---|---|
| MAXIMUM LEAF AREA INDEX | 3.50 |
| START OF GROWING SEASON (JULIAN DATE) | 126 |
| END OF GROWING SEASON (JULIAN DATE) | 287 |
| AVERAGE ANNUAL WIND SPEED | 9.10 MPH |
| AVERAGE 1ST QUARTER RELATIVE HUMIDITY | 75.00 % |
| AVERAGE 2ND QUARTER RELATIVE HUMIDITY | 69.00 % |
| AVERAGE 3RD QUARTER RELATIVE HUMIDITY | 70.00 % |
| AVERAGE 4TH QUARTER RELATIVE HUMIDITY | 79.00 % |

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OLYMPIA WASHINGTON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 8.50 | 5.77 | 4.85 | 3.13 | 1.85 | 1.44 |
| 0.76 | 1.34 | 2.36 | 4.68 | 7.58 | 8.70 |

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 39.10 | 42.80 | 44.20 | 48.70 | 55.00 | 60.20 |
| 64.80 | 64.10 | 60.00 | 52.50 | 44.80 | 41.00 |

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON

STATION LATITUDE 47.25 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| **PRECIPITATION** | | | | | | |
| TOTALS | 8.48 | 5.55 | 4.95 | 3.47 | 1.83 | 1.43 |
| | 0.73 | 1.17 | 2.24 | 4.85 | 7.17 | 8.99 |
| STD. DEVIATIONS | 2.48 | 1.86 | 1.62 | 1.29 | 0.92 | 0.75 |
| | 0.55 | 0.91 | 1.28 | 1.98 | 2.42 | 2.67 |
| **RUNOFF** | | | | | | |
| TOTALS | 0.471 | 0.096 | 0.007 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.007 | 0.095 |
| STD. DEVIATIONS | 1.093 | 0.512 | 0.065 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.070 | 0.368 |
| **EVAPOTRANSPIRATION** | | | | | | |
| TOTALS | 0.887 | 1.166 | 2.109 | 2.786 | 2.124 | 2.672 |
| | 0.803 | 0.963 | 1.843 | 1.378 | 0.854 | 0.781 |
| STD. DEVIATIONS | 0.130 | 0.124 | 0.234 | 0.561 | 0.713 | 0.733 |
| | 0.639 | 0.656 | 0.896 | 0.310 | 0.095 | 0.101 |
| **LATERAL DRAINAGE COLLECTED FROM LAYER 2** | | | | | | |
| TOTALS | 6.6818 | 5.5886 | 5.1586 | 3.3013 | 1.6522 | 0.8300 |
| | 0.3824 | 0.1291 | 0.0756 | 0.2970 | 2.4738 | 5.2597 |
| STD. DEVIATIONS | 1.3233 | 1.0815 | 0.9991 | 0.9407 | 0.5661 | 0.2387 |
| | 0.1023 | 0.0345 | 0.0815 | 0.3890 | 1.3277 | 1.3733 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 4** | | | | | | |
| TOTALS | 0.0009 | 0.0008 | 0.0006 | 0.0003 | 0.0002 | 0.0001 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0003 | 0.0007 |
| STD. DEVIATIONS | 0.0003 | 0.0002 | 0.0002 | 0.0001 | 0.0001 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0002 | 0.0003 |
| **LATERAL DRAINAGE COLLECTED FROM LAYER 6** | | | | | | |
| TOTALS | 0.0003 | 0.0003 | 0.0004 | 0.0004 | 0.0004 | 0.0004 |
| | 0.0003 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0003 |
| STD. DEVIATIONS | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | 0.0001 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 8** | | | | | | |
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

LATERAL DRAINAGE COLLECTED FROM LAYER 9

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

PERCOLATION/LEAKAGE THROUGH LAYER 11

| | | | | | | |
|---|---|---|---|---|---|---|
| TOTALS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 23.0939 | 21.6862 | 15.6914 | 8.3893 | 3.8451 | 1.9959 |
| | 0.8900 | 0.3004 | 0.1817 | 0.6942 | 6.6162 | 16.3563 |
| STD. DEVIATIONS | 6.7204 | 6.1436 | 5.4720 | 3.2647 | 1.3175 | 0.5740 |
| | 0.2380 | 0.0804 | 0.1960 | 0.9121 | 4.3865 | 6.7256 |

DAILY AVERAGE HEAD ACROSS LAYER 8

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.0073 | 0.0087 | 0.0096 | 0.0097 | 0.0093 | 0.0086 |
| | 0.0078 | 0.0070 | 0.0063 | 0.0056 | 0.0053 | 0.0059 |
| STD. DEVIATIONS | 0.0014 | 0.0015 | 0.0016 | 0.0016 | 0.0015 | 0.0014 |
| | 0.0013 | 0.0011 | 0.0010 | 0.0009 | 0.0009 | 0.0011 |

DAILY AVERAGE HEAD ACROSS LAYER 11

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| STD. DEVIATIONS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 50.86 | ( | 6.475) | 3323272.0 | 100.00 |
| RUNOFF | 0.676 | ( | 1.5808) | 44185.56 | 1.330 |
| EVAPOTRANSPIRATION | 18.367 | ( | 1.9076) | 1200101.62 | 36.112 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | 31.83005 | ( | 4.97177) | 2079775.620 | 62.58217 |
| PERCOLATION/LEAKAGE THROUGH FROM LAYER 4 | 0.00395 | ( | -.00083) | 257.638 | 0.00776 |
| AVERAGE HEAD ACROSS TOP OF LAYER 4 | 8.312 | ( | 1.829) | | |
| LATERAL DRAINAGE COLLECTED FROM LAYER 6 | 0.00392 | ( | 0.00062) | 255.990 | 0.00770 |
| PERCOLATION/LEAKAGE THROUGH FROM LAYER 8 | 0.00001 | ( | 0.00000) | 0.575 | 0.00002 |
| AVERAGE HEAD ACROSS TOP OF LAYER 8 | 0.008 | ( | 0.001) | | |
| LATERAL DRAINAGE COLLECTED FROM LAYER 9 | 0.00001 | ( | 0.00000) | 0.409 | 0.00001 |
| PERCOLATION/LEAKAGE THROUGH FROM LAYER 11 | 0.00000 | ( | 0.00000) | 0.164 | 0.00000 |
| AVERAGE HEAD ACROSS TOP OF LAYER 11 | 0.000 | ( | 0.000) | | |
| CHANGE IN WATER STORAGE | -0.016 | ( | 2.8735) | -1048.51 | -0.032 |

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.21 | 275081.406 |
| RUNOFF | 2.375 | 155191.7810 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.32559 | 21273.99410 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.000046 | 2.98295 |
| AVERAGE HEAD ACROSS LAYER 4 | 36.000 | |
| DRAINAGE COLLECTED FROM LAYER 6 | 0.00002 | 1.23588 |
| PERCOLATION/LEAKAGE THROUGH LAYER 8 | 0.000000 | 0.00233 |
| AVERAGE HEAD ACROSS LAYER 8 | 0.013 | |
| DRAINAGE COLLECTED FROM LAYER 9 | 0.00000 | 0.00145 |
| PERCOLATION/LEAKAGE THROUGH LAYER 11 | 0.000000 | 0.00045 |
| AVERAGE HEAD ACROSS LAYER 11 | 0.000 | |
| SNOW WATER | 5.93 | 387674.5310 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4370 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0371 |

FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 7.7436 | 0.3226 |
| 2 | 5.0039 | 0.4170 |
| 3 | 0.0000 | 0.0000 |
| 4 | 10.2480 | 0.4270 |
| 5 | 87.6000 | 0.2920 |
| 6 | 0.5435 | 0.0453 |
| 7 | 0.0000 | 0.0000 |
| 8 | 5.1240 | 0.4270 |
| 9 | 0.5400 | 0.0450 |
| 10 | 0.0000 | 0.0000 |
| 11 | 15.3720 | 0.4270 |
| SNOW WATER | 0.000 | |

```
          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
          HELP MODELVERSION 3.01     (14 OCTOBER 1994)
               DEVELOPED BY ENVIRONMENTAL LABORATORY
                USAE WATERWAYS EXPERIMENT STATION
          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY


PRECIPITATION DATA FILE:        c:\help3\asar1.D4
TEMPERATURE DATA FILE:          c:\help3\ASAR2.D7
SOLAR RADIATION DATA FILE:      c:\help3\ASAR3.D13
EVAPOTRANSPIRATION DATA:        c:\help3\ASAR4.D11
SOIL AND DESIGN DATAFILE:       c:\help3\asar10.D10
OUTPUT DATA FILE:               c:\help3\asar11.OUT

TIME:  12:23     DATE:  2/23/1995



    TITLE:  ASAR-OCF POOR CAP AND NO LINER

    NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
             COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                                   LAYER 1
                                   -------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER 4
       THICKNESS                                24.00    INCHES
       POROSITY                                  0.4370  VOL/VOL
       FIELD CAPACITY                            0.1050  VOL/VOL
       WILTING POINT                             0.0470  VOL/VOL
       INITIAL SOIL WATER CONTENT                0.3946  VOL/VOL
       EFFECTIVE SAT. HYD. COND.           0.170000002000E-02 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
              FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER 2
                                   -------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER 1
       THICKNESS                                12.00    INCHES
       POROSITY                                  0.4170  VOL/VOL
       FIELD CAPACITY                            0.0450  VOL/VOL
       WILTING POINT                             0.0180  VOL/VOL
       INITIAL SOIL WATER CONTENT                0.4170  VOL/VOL
       EFFECTIVE SAT. HYD. COND.           0.999999978000E-02 CM/SEC
       SLOPE                                    15.00    PERCENT
       DRAINAGE LENGTH                         600.0     FEET
```

LAYER 3
---

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

| | | |
|---|---|---|
| THICKNESS | 0.04 | INCHES |
| POROSITY | 0.0000 | VOL/VOL |
| FIELD CAPACITY | 0.0000 | VOL/VOL |
| WILTING POINT | 0.0000 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.0000 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.199999996000E-12 | CM/SEC |
| FML PINHOLE DENSITY | 1.00 | HOLES/ACRE |
| FML INSTALLATION DEFECTS | 15.00 | HOLES/ACRE |
| FML PLACEMENT QUALITY | 4 - POOR | |

LAYER 4
---

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 28

| | | |
|---|---|---|
| THICKNESS | 24.00 | INCHES |
| POROSITY | 0.4520 | VOL/VOL |
| FIELD CAPACITY | 0.4110 | VOL/VOL |
| WILTING POINT | 0.3110 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.4520 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.120000004000E-05 | CM/SEC |

LAYER 5
---

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

| | | |
|---|---|---|
| THICKNESS | 300.00 | INCHES |
| POROSITY | 0.6710 | VOL/VOL |
| FIELD CAPACITY | 0.2920 | VOL/VOL |
| WILTING POINT | 0.0770 | VOL/VOL |
| INITIAL SOIL WATER CONTENT | 0.2585 | VOL/VOL |
| EFFECTIVE SAT. HYD. COND. | 0.100000005000E-02 | CM/SEC |

GENERAL DESIGN AND EVAPORATIVE ZONE DATA
---

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 15.% AND A SLOPE LENGTH OF 600. FEET.

| | | |
|---|---|---|
| SCS RUNOFF CURVE NUMBER | 74.40 | |
| FRACTION OF AREA ALLOWING RUNOFF | 100.0 | PERCENT |
| AREA PROJECTED ON HORIZONTAL PLANE | 18.000 | ACRES |
| EVAPORATIVE ZONE DEPTH | 24.0 | INCHES |
| INITIAL WATER IN EVAPORATIVE ZONE | 9.472 | INCHES |
| UPPER LIMIT OF EVAPORATIVE STORAGE | 10.488 | INCHES |
| LOWER LIMIT OF EVAPORATIVE STORAGE | 1.128 | INCHES |
| INITIAL SNOW WATER | 0.000 | INCHES |
| INITIAL WATER IN LAYER MATERIALS | 102.873 | INCHES |
| TOTAL INITIAL WATER | 102.873 | INCHES |
| TOTAL SUBSURFACE INFLOW | 0.00 | INCHES/YEAR |

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
SEATTLE WASHINGTON

| | |
|---|---|
| MAXIMUM LEAF AREA INDEX | 1.00 |
| START OF GROWING SEASON (JULIAN DATE) | 126 |
| END OF GROWING SEASON (JULIAN DATE) | 287 |
| AVERAGE ANNUAL WIND SPEED | 9.10 MPH |
| AVERAGE 1ST QUARTER RELATIVE HUMIDITY | 75.00 % |
| AVERAGE 2ND QUARTER RELATIVE HUMIDITY | 69.00 % |
| AVERAGE 3RD QUARTER RELATIVE HUMIDITY | 70.00 % |
| AVERAGE 4TH QUARTER RELATIVE HUMIDITY | 79.00 % |

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OLYMPIA WASHINGTON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 8.50 | 5.77 | 4.85 | 3.13 | 1.85 | 1.44 |
| 0.76 | 1.34 | 2.36 | 4.68 | 7.58 | 8.70 |

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

| JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|
| 39.10 | 42.80 | 44.20 | 48.70 | 55.00 | 60.20 |
| 64.80 | 64.10 | 60.00 | 52.50 | 44.80 | 41.00 |

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON

STATION LATITUDE 47.25 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

| | JAN/JUL | FEB/AUG | MAR/SEP | APR/OCT | MAY/NOV | JUN/DEC |
|---|---|---|---|---|---|---|
| **PRECIPITATION** | | | | | | |
| TOTALS | 8.48 | 5.55 | 4.95 | 3.47 | 1.83 | 1.43 |
| | 0.73 | 1.17 | 2.24 | 4.85 | 7.17 | 8.99 |
| STD. DEVIATIONS | 2.48 | 1.86 | 1.62 | 1.29 | 0.92 | 0.75 |
| | 0.55 | 0.91 | 1.28 | 1.98 | 2.42 | 2.67 |
| **RUNOFF** | | | | | | |
| TOTALS | 0.759 | 0.211 | 0.020 | 0.000 | 0.000 | 0.000 |
| | 0.000 | 0.001 | 0.000 | 0.016 | 0.102 | 0.268 |
| STD. DEVIATIONS | 1.248 | 0.611 | 0.074 | 0.002 | 0.000 | 0.000 |
| | 0.000 | 0.007 | 0.001 | 0.042 | 0.245 | 0.489 |
| **EVAPOTRANSPIRATION** | | | | | | |
| TOTALS | 0.905 | 1.192 | 2.135 | 2.799 | 1.971 | 1.667 |
| | 1.830 | 0.946 | 1.840 | 1.417 | 0.896 | 0.804 |
| STD. DEVIATIONS | 0.135 | 0.128 | 0.239 | 0.562 | 0.723 | 0.655 |
| | 0.594 | 0.625 | 0.784 | 0.311 | 0.093 | 0.102 |
| **LATERAL DRAINAGE COLLECTED FROM LAYER 2** | | | | | | |
| TOTALS | 6.0866 | 5.2809 | 5.0379 | 3.2242 | 1.5906 | 0.6625 |
| | 0.4098 | 0.3022 | 0.1549 | 0.3263 | 2.3414 | 4.9313 |
| STD. DEVIATIONS | 0.8787 | 0.8563 | 0.9630 | 0.9714 | 0.5746 | 0.2241 |
| | 0.1305 | 0.0716 | 0.0932 | 0.3827 | 1.2727 | 1.1089 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 4** | | | | | | |
| TOTALS | 0.1734 | 0.1474 | 0.1187 | 0.0632 | 0.0312 | 0.0140 |
| | 0.0091 | 0.0069 | 0.0038 | 0.0070 | 0.0476 | 0.1189 |
| STD. DEVIATIONS | 0.0541 | 0.0446 | 0.0434 | 0.0246 | 0.0103 | 0.0043 |
| | 0.0026 | 0.0015 | 0.0019 | 0.0074 | 0.0299 | 0.0479 |
| **PERCOLATION/LEAKAGE THROUGH LAYER 5** | | | | | | |
| TOTALS | 0.0976 | 0.0942 | 0.0939 | 0.0696 | 0.0424 | 0.0366 |
| | 0.0589 | 0.0809 | 0.0830 | 0.0849 | 0.0807 | 0.0828 |
| STD. DEVIATIONS | 0.0579 | 0.0490 | 0.0554 | 0.0556 | 0.0645 | 0.0646 |
| | 0.0626 | 0.0486 | 0.0411 | 0.0407 | 0.0376 | 0.0373 |

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

| | | | | | | |
|---|---|---|---|---|---|---|
| AVERAGES | 22.9199 | 21.7227 | 15.5777 | 8.2423 | 3.7024 | 1.5931 |
| | 0.9538 | 0.7033 | 0.3726 | 0.7612 | 6.1819 | 15.6073 |
| STD. DEVIATIONS | 7.4144 | 6.8048 | 5.9889 | 3.4758 | 1.3393 | 0.5390 |
| | 0.3036 | 0.1667 | 0.2241 | 0.8942 | 4.1311 | 6.6014 |

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

| | INCHES | | CU. FEET | PERCENT |
|---|---|---|---|---|
| PRECIPITATION | 50.86 | ( 6.475) | 3323272.0 | 100.00 |
| RUNOFF | 1.377 | ( 1.8037) | 89991.96 | 2.708 |
| EVAPOTRANSPIRATION | 18.403 | ( 1.8619 ) | 1202469.50 | 36.183 |
| LATERAL DRAINAGE COLLECTED FROM LAYER 2 | 30.34872 | ( 4.43701) | 1982985.250 | 59.66967 |
| PERCOLATION/LEAKAGE THROUGH FROM LAYER 4 | 0.74124 | ( 0.16771) | 45432.398 | 1.45737 |
| AVERAGE HEAD ACROSS TOP OF LAYER 4 | 8.195 | ( 1.963) | | |
| PERCOLATION/LEAKAGE THROUGH FROM LAYER 5 | 0.90567 | ( 0.58497) | 59176.180 | 1.78066 |
| CHANGE IN WATER STORAGE | -0.174 | ( 2.9367) | -11351.36 | -0.342 |

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

| | (INCHES) | (CU. FT.) |
|---|---|---|
| PRECIPITATION | 4.21 | 275081.406 |
| RUNOFF | 2.396 | 156543.9220 |
| DRAINAGE COLLECTED FROM LAYER 2 | 0.24520 | 16021.60160 |
| PERCOLATION/LEAKAGE THROUGH LAYER 4 | 0.008608 | 562.45880 |
| AVERAGE HEAD ACROSS LAYER 4 | 35.941 | |
| PERCOLATION/LEAKAGE THROUGH LAYER 5 | 0.021394 | 1397.89368 |
| SNOW WATER | 5.93 | 387674.5310 |

| | |
|---|---|
| MAXIMUM VEG. SOIL WATER (VOL/VOL) | 0.4370 |
| MINIMUM VEG. SOIL WATER (VOL/VOL) | 0.0406 |

FINAL WATER STORAGE AT END OF YEAR 100

| LAYER | (INCHES) | (VOL/VOL) |
|---|---|---|
| 1 | 8.5417 | 0.3559 |
| 2 | 5.0039 | 0.4170 |
| 3 | 0.0000 | 0.0000 |
| 4 | 10.8480 | 0.4520 |
| 5 | 61.1068 | 0.2037 |
| SNOW WATER | 0.000 | |

**APPENDIX E**

**STATE DEPARTMENT OF ECOLOGY'S CONCURRENCE LETTER**

<IMG SRC 1095122I>

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 ! Olympia, Washington 95504-7600 ! (206) 407-6000 ! TDD Only (Hearing Impaired) (206) 407-6006

March 22, 1995

Mr. Randy Smith
US EPA Region X
1200 Sixth Avenue
Seattle, WA 98101

Dear Mr. Smith:

Re: Record of Decision for the Asarco Tacoma Smelter Facility

The State of Washington concurs with the selected remedy and phased approach described in this Record of Decision for the Asarco Tacoma Smelter facility. The combination of measures to excavate and consolidate the more highly contaminated soils and debris in a containment facility with design equivalent to federal hazardous waste disposal standards, to cap the entire site, and to provide certain site restrictions is appropriate and protective against exposure to such soils.

The current ROD provides for measures to divert surface waters from contact with contaminants, however, the ROD provides for additional remedial measures to be taken on surface water, should such further measure be necessary. The current ROD is an interim action for ground water. Final ground water remediation will be addressed in a separate, second-phase ROD that will be prepared after the impacts of the soils actions and water diversion measures have been evaluated. This approach and the selected remedy are deemed to be in compliance with the environmental laws and regulations of the state.

If you have any questions, please contact Bruce Cochran at (360)407-7227.

Sincerely,

<IMG SRC 1095122J>

Mary E. Burg, Program Manager
Toxics Cleanup Program

MEB:gj

cc: Bruce Cochran, Ecology

**APPENDIX F**

**ADMINISTRATIVE RECORD INDEX**

Due to its large size,
the administrative record index is not included
but may be obtained from the Region.

# Appendix B

# (Sediments ROD)

**EPA/ROD/R10-00/051**
**2000**

# EPA Superfund
# Record of Decision:

**COMMENCEMENT BAY, NEAR SHORE/TIDE FLATS**
**EPA ID: WAD980726368**
**OU 19**
**PIERCE COUNTY, WA**
**07/14/2000**

# Contents

Page

Acronyms and Abbreviations .....v

**PART I DECLARATION**

Site Name and Location .....1
Statement of Basis and Purpose .....1
Assessment of the Site .....1
Description of the Selected Remedy.....1
Groundwater .....1
Sediment .....2
Statutory Determinations .....3
Data Certification Checklist .....4
Authorizing Signature .....4

**PART II DECISION SUMMARY**

**Introduction .....1-1**
1 Site Name, Location, and Description .....1-2
1.1 General Facility Description .....1-2
1.2 Groundwater Conditions .....1-3
1.3 Marine Sediments .....1-4

2 Site History and Enforcement Activities .....2-1
2.1 Historical Site Activities .....2-1
2.2 Historical Enforcement Activities .....2-1
2.3 Key Documents .....2-3

3 Community Participation .....3-1

4 Scope and Role of Operable Units .....4-1
4.1 Selected Remedies for the Other Asarco OUs .....4-1
4.2 Relationship of the OU 02 and OU 06 Remedial Actions .....4-2

5 Site Characteristics .....5-1
5.1 Production and Distribution of Slag .....5-1
5.2 Contaminant Source Areas .....5-1
5.3 Site Investigations .....5-1
5.4 Groundwater .....5-2
5.5 Marine Sediments and Environment .....5-5

6 Current and Potential Future Land and Resource Uses.....6-1
6.1 Proposed Development Plans .....6-1
6.2 Potential Groundwater Use .....6-2
6.3 Marine Use .....6-2

7 Summary of Site Risks .....7-1
7.1 Human Health Risk Assessment .....7-1
7.2 Ecological Risk Assessment .....7-4

8 Remedial Action Objectives .....8-1
8.1 Groundwater .....8-1
8.2 Sediment .....8-1

9 Description of Alternatives .....9-1
9.1 Groundwater .....9-1

9.2 Sediment .....9-1

10 Summary of Comparative Analysis of Alternatives .....10-1
10.1 Overall Protection of Human Health and the Environment .....10-2
10.2 Compliance with Federal and State Environmental Standards .....10-3
10.3 Long-Term Effectiveness and Permanence .....10-4
10.4 Reduction of Toxicity, Mobility, or Volume Through Treatment ....10-5
10.5 Short-Term Effectiveness .....10-5
10.6 Implementability .....10-6
10.7 Cost .....10-7
10.8 State/Tribal Acceptance .....10-7
10.9 Community Acceptance .....10-8

11 Principal Threat Waste .....11-1

12 Selected Remedy .....12-1
12.1 Groundwater .....12-1
12.2 Sediment .....12-7
12.3 Expected Outcomes of the Selected Remedy .....12-10
12.4 Summary .....12-11

13 Statutory Determinations .....13-1
13.1 Protection of Human Health and the Environment .....13-1
13.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) .....13-1
13.3 Cost-Effectiveness .....13-6
13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable .....13-6
13.5 Preference for Treatment as a Principal Element .....13-7
13.6 Five-Year Review Requirements .....13-7
13.7 Documentation of Significant Changes from Preferred Alternative of Proposed Plan 13-7

**PART III RESPONSIVENESS SUMMARY**

Introduction .....1
Site Risk .....2
Sediment Impact/Remediation Area .....3
Alternatives to Sediment Capping .....5
Protectiveness and Effectiveness of Sediment Capping Remedy .....6
Sediment Cap Thickness .....7
Sediment Dredging .....11
Institutional Concerns Regarding Sediment Capping .....15
Groundwater Extraction and Treatment .....17
Remediation Goals/Levels (Groundwater) .....17
Remediation Goals/Levels (Sediment) .....24
Remedy Costs .....26
Endangered Species Act and Biological Assessment Issues .....26
Natural Resource Mitigation .....27
Long-Term Monitoring .....29
Other Comments .....35

**References** .....R-1

**Appendices**

A Trend Plots of DMA-Related Organic Compounds
B Summary of Sediment Sampling Results
C Outcome of Preponderance of Evidence Approach for Marine Sediments

D Comment Letters Received During the Proposed Plan Public Comment Period

**Tables**

5-1 Maximum Metal Concentration in Sediment
9-1 Groundwater Alternatives
9-2 Sediment Remedial Alternatives for the Nearshore/Offshore Area
9-3 Sediment Remedial Alternatives for the Yacht Basin (76,000 square yards; 15.5 acres)
9-4 Sediment Remedial Alternatives for the Northshore Area (7,000 square yards; 1.5 acres)
12-1 Groundwater Cleanup Levels
12-2 Sediment Cleanup Levels for the Yacht Basin

**Figures**

1-1 Asarco Facility Location Map
1-2 Operable Unit 06 Site Boundary
1-3 Former Facility Layout
1-4 Conceptual Cross Section
1-5 Habitat Areas Defined by Benthic Infauna Sampling
5-1 Source Areas and Selected Remedy
5-2 Monitoring Well Locations
5-3 Slag Wells, Dissolved Arsenic in Groundwater, September 1999
5-4 Intermediate Wells, Dissolved Arsenic in Groundwater, September 1999
5-5 Slag Wells, Dissolved Copper in Groundwater, September 1999
5-6 Intermediate Wells, Dissolved Copper in Groundwater, September 1999
5-7 Box Plots for Arsenic and Copper, Slag Wells
5-8 Box Plots for Arsenic and Copper, Intermediate Wells
5-9 Arsenic and Copper Trend at Well MW- 139A
5-10 Sediment Station Locations
5-11 Sediment Chemistry Comparison to State SMS Criteria
5-12 Summary of Bioassay Results that Exceed One or More State SMS Criteria
7-1 Cleanup Level Evaluation Areas OU 06
9-1 Contaminant Effects Area
9-2 Marine Sediment Remedy Units
12-1 Selected Remedy, Marine Sediment

## Acronyms and Abbreviations

| | |
|---|---|
| AKART | all known available and reasonable methods of treatment |
| AOC | Administrative Order on Consent |
| ARAR | applicable or relevant and appropriate requirement |
| BMPs | Best Management Practices |
| CAD | confined aquatic disposal |
| CB/NT | Commencement Bay Nearshore/Tideflats (Superfund Site) |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 |
| COC | chemicals of concern |
| CSF | cancer slope factor |
| CSL | cleanup screening level |
| DMA | Dimethylaniline or N,-dimethylaniline |
| DNR | Washington State Department of Natural Resources |
| Ecology | Washington State Department of Ecology |
| EPA | U. S. Environmental Protection Agency |
| ESD | Explanation of Significant Difference |
| FS | Feasibility Study |
| ft/sec | feet per second |
| IRIS | Integrated Risk Information System |
| m/sec | meter per second |
| MCL | maximum contaminant levels |
| MHHW | mean higher high water |
| MSL | mean sea level |
| MTCA | Model Toxics Control Act |
| NCP | National Contingency Plan |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollution Discharge Elimination System |
| NPL | National Priorities List |
| NTR | National Toxics Rule |
| O&M | operation and maintenance |
| OMMP | Operation, Maintenance, and Monitoring Plan |
| OU | Operable Unit |
| PQL | practical quantitation limit |
| PSAPCA | Puget Sound Air Pollution Control Authority |
| RAO | remedial action objective |
| RD/RA | remedial design/remedial action |
| RfD | Reference Dose |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| SARA | Superfund Amendments and Reauthorization Act of 1986 |
| SMS | Sediment Management Standards |
| SQS | Sediment Quality Standard |
| TDS | total dissolved solids |

**PART I**

# Declaration

## Site Name and Location

Commencement Bay Nearshore /Tideflats (CB/NT) Superfund Site

Asarco Sediments /Groundwater Operable Unit 06

Tacoma and Ruston, Washington

U. S. Environmental Protection Agency (EPA) ID No. WAD980726368

## Statement of Basis and Purpose

This decision document presents the Selected Remedy for Asarco Sediments/Groundwater Operable Unit 06 (OU 06) in Tacoma and Ruston, Washington. The Selected Remedy was chosen in accordance with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for this Site.

The State of Washington Department of Ecology (Ecology) concurs with the Selected Remedy.

## Assessment of the Site

The response action selected in this Record of Decision (ROD) is necessary to protect public health, welfare, or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

## Description of the Selected Remedy

The Asarco Sediment/Groundwater Operable Unit (OU 06) Site ("Site") is one of the operable units that specifically addresses contamination coming from, or related to, the Asarco Smelter Facility ("Facility") in Ruston and Tacoma, Washington. The Selected Remedy for the Asarco Sediments/Groundwater Operable Unit 06 includes the following elements:

**Groundwater**

Groundwater at the Asarco Facility was originally studied in an RI/FS concluded in 1993 (Hydrometrics, August 1993). The Asarco Tacoma Smelter ROD (OU 02 ROD) identified the selected remedy for onsite waste materials, contaminated soil, and surface water (EPA, 1995). However, the OU 02 ROD deferred a remedy decision for groundwater and called for further monitoring. This ROD for OU 06 identifies the Selected Remedy for groundwater.

Although the Selected Remedy for groundwater was not addressed by the OU 02 ROD, a number of elements in the OU 02 remedy will directly benefit groundwater quality. These elements include capture of shallow groundwater in selected areas, construction of a low-permeability cap across the Facility, and excavation of the most highly contaminated source materials (selected slag material and contaminated soils) and consolidation of these materials into an On-site Contaminant Facility. These OU 02 remedy elements will (1) remove a significant source of contamination that would otherwise impact groundwater quality and (2) significantly reduce the flow of contaminated groundwater to Commencement Bay by minimizing recharge of the shallow aquifer system (e.g., surface water controls and the low-permeability cap will reduce infiltration).

EPA has determined that additional remedial actions, over and above those already being implemented under OU 02, are not necessary to address groundwater under this ROD for OU

06. As a result this ROD summarizes the elements of the remedy for OU 02 that will benefit groundwater and identifies other elements of the groundwater remedy not previously addressed. These other remedy elements include finalization of the groundwater remedial action objectives (RAOs), identification of cleanup levels and groundwater point of compliance, and long-term monitoring requirements.

Specifically, the Selected Remedy for groundwater, as represented by the RODs for OU 02 and OU 06, includes the following elements:

- Reduce groundwater flow and related contaminant loading to Commencement Bay by removing the most significant source materials and limiting groundwater recharge to aquifers beneath the smelter portion of the Facility. Groundwater control will be achieved by intercepting groundwater with subsurface drains in selected locations, diverting surface water and installing a low-permeability cap over the smelter portion of the Facility. These controls will minimize infiltration and recharge of onsite aquifers. (These remedy elements are being accomplished under OU 02 cleanup.)

- Continue to monitor groundwater to evaluate the long-term effects that the Facility cleanup will have on future groundwater quality. (Addressed for the first time in this ROD for OU 06.)

- Implement institutional controls to restrict future use of Facility groundwater. (Addressed for the first time in this ROD for OU 06.)

**Sediment**

The Selected Remedy for marine sediments includes the following elements:

- Dredge contaminated sediment in the Yacht Basin and place the dredged sediment beneath a low-permeability soil cap to be constructed on the upland portion of the Facility (i.e., OU 02). The sediments will be contained under the low-permeability cap at an elevation such that groundwater will not come in contact with the sediment.

- Monitor the dredged area in the Yacht Basin to verify that it does not become recontaminated.

- Cap contaminated sediments in selected offshore areas.

- Monitor the sediment caps to confirm that they remain in place, continue to isolate the underlying contaminated sediment, become recolonized with healthy biological communities, and do not become recontaminated.

- Use institutional controls to prevent activities that could damage the sediment caps.

- Monitor the areas outside the capped and dredged areas to confirm that these areas meet RAOs.

The Selected Remedy for the Asarco Sediments/Groundwater OU 06 has been chosen to complement the remedy previously selected for OU 02 (EPA, March 1995). The OU 02 remedy is currently being implemented.

## Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost- effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable with the following exceptions.

The federal National Toxics Rule (NTR) standard for arsenic of 0.14 ug/L (40 CFR Section 131.36) is a relevant and appropriate requirement for groundwater but is being waived for reasons discussed in Part II of this ROD (Section 12.1.1 of the Decision Summary).

The Selected Remedy for OU 06 does not satisfy the statutory preference for treatment as a principal element of the remedy for the following reasons:

- **Groundwater.** Groundwater treatment is not viable or cost-effective because source materials remain on the Site. Further, a pump and treat remedy for containment purposes would be inefficient due to the direct hydraulic connection that the Site aquifers have with the waters of Commencement Bay. Treatment would require groundwater extraction in perpetuity at very high pumping rates. The most significant source of groundwater contamination is the slag material that is present below the water table throughout most of the Facility. This source material will continue to leach contaminants to groundwater. The Selected Remedy focuses on restricting recharge to, and flow through, the affected water-bearing zones such that the volume of groundwater discharged to Commencement Bay is reduced to the maximum extent practicable.

- **Sediments.** Treatment technologies were evaluated for possible application to sediment cleanup, but were not carried forward because: (1) there are currently no effective and appropriate in situ treatment technologies (i.e., treating in place) for sediments similar to those at the Site, and (2) any ex situ treatment would require significant material handling (e.g., dredging, de-watering, transporting, processing) and treatment processing at extreme cost (e.g., construction costs could be as high as $75 million to $100 million), with little or no additional benefit to the effectiveness of the remedy.

Because the Selected Remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

## Data Certification Checklist

The following information is included in the Decision Summary of this ROD (Part 2). Additional information can be found in the Administrative Record for this Site.

- Chemicals of concern and their respective concentrations — **Sections 5 and 7.**
- Baseline risk represented by the chemicals of concern — **Section 7.**
- Cleanup levels established for chemicals of concern and the basis for these levels — **Section 12.**
- How source materials constituting principal threats are addressed — Section 11.
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD — **Sections 6 and 7.**
- Potential land and groundwater use that will be available at the Facility as a result of the Selected Remedy — **Section 6.**
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, and the number of years over which the remedy cost estimates are projected — Sections 9 and 12.
- Key factors that led to selecting the remedy — **Section 12.**

## Authorizing Signature

Chuck Findley Date
Acting Regional Administrator

**[Original signed by Chuck Findley on July 14, 2000]**

**PART II**

# Decision Summary

## Introduction

This Decision Summary provides a description of the site-specific factors and analyses that led to selection of the remedy for the Asarco Sediments /Groundwater Operable Unit 06 at the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site. In identifying the Selected Remedy, the U. S. Environmental Protection Agency (EPA) considered many factors, including information about the Site background, the nature and extent of contamination, the assessment of human health and environmental risks, and the identification and evaluation of remedial alternatives.

The Decision Summary also describes the involvement of the public throughout the Remedial Investigation/Feasibility Study (RI/FS) process, and the environmental programs, regulations, and statutes that may relate to or affect the cleanup alternatives considered for this Site. The Decision Summary concludes with a description of the Selected Remedy and a discussion of how it meets the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ( CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 ( SARA), and to the extent practicable, the National Contingency Plan ( NCP).

This Decision Summary is presented in 13 sections as follows:

- Section 1 — Site Name, Location, and Description
- Section 2 — Site History and Enforcement Activities
- Section 3 — Community Participation
- Section 4 — Scope and Role of Operable Units
- Section 5 — Site Characteristics
- Section 6 — Current and Potential Future Land and Resource Uses
- Section 7 — Summary of Site Risks
- Section 8 — Remedial Action Objectives
- Section 9 — Description of Alternatives
- Section 10 — Summary of Comparative Analysis of Alternatives
- Section 11 — Principal Threat Waste
- Section 12 — Selected Remedy
- Section 13 — Statutory Determinations

Documents supporting this Decision Summary are included in EPA's Administrative Record for the CB/NT Superfund Site, Asarco Sediments /Groundwater Operable Unit 06.

## 1 Site Name, Location, and Description

The former Asarco copper and lead smelter facility (the "Facility") is located along the Commencement Bay shoreline in Tacoma and Ruston, Washington (Figure 1-1). The Facility is part of the CB/NT Superfund Site. This ROD addresses the Asarco Sediments/Groundwater Operable Unit 06 (OU 06 or the "Site") at the Facility. The general boundary of OU 06 is shown in Figure 1-2. OU 06 is one of four OUs associated with the Facility. Additional information on the Facility OUs and their interrelationships is provided in Section 4. OU 06 is also one of seven OUs located within the larger CB/NT Superfund Site. The CB/NT Superfund Site was nominated to the National Priorities List (NPL) in 1982 and placed on the final NPL in 1983. The EPA identification number for the Site is WAD980726368.

EPA is the lead regulatory agency for the Site. The Washington State Department of Ecology (Ecology) has supported the EPA at the Site throughout the CERCLA process. One responsible party, Asarco, has publicly acknowledged its intent to conduct the cleanup for OU 06; however, a consent decree for the cleanup of OU 06 has not yet been negotiated.

## 1.1 General Facility Description

The Facility is located within the municipal boundaries of Ruston and Tacoma, Washington. The site is located on the northeast side of the Point Defiance Peninsula and borders Commencement Bay (Figure 1-1). The general area consists of steep slopes extending down to Commencement Bay producing bluffs along portions of the shoreline.

The onshore portion of the Facility is approximately 67 acres in size. In addition, approximately 30 acres of offshore intertidal and subtidal lands are under Asarco ownership. The State of Washington also owns a portion of the offshore lands within OU 06. State-owned aquatic lands are managed by the Washington State Department of Natural Resources.

Surface water features within the Facility boundaries include springs and seeps which emanate from the face of the shoreline bluff from shallow groundwater bearing strata, and impoundments in drainage bottoms south and west of the main plant complex. Elevation across the Facility ranges from sea level to as high as 250 feet above mean sea level (MSL). Steep drainages are located in the vicinity of railroad tracks that cross the Facility in an east-west direction. There are areas of dense vegetation, primarily on steep drainage slopes and along the bluff slope above Commencement Bay.

Much of the Facility was constructed on slag fill, a waste byproduct of smelting arsenic- and lead-bearing ores. The slag fill was used to modify and extend the pre-existing shoreline by approximately 500 feet into Commencement Bay. In addition, the Breakwater Peninsula (see Figure 1-2) is composed of slag. The slag beneath the Breakwater Peninsula is up to 125 feet thick (Hydrometrics, January 1993). See Section 5.1 for additional information on the production and distribution of slag.

Prominent surface features on the Facility included a 562- foot- high stack and numerous buildings and structures associated with copper smelting and refining. The stack and most of the buildings have been demolished in recent years. A car tunnel, a railroad tunnel, and a pond formerly used for storage of process cooling water (the Cooling Pond) remain on the Facility. Also onsite is the Fine Ore Bins building, which is currently used to store demolition debris and contaminated soil that will eventually be moved to an onsite waste containment facility being constructed as part of the OU 02 remediation. The former Facility layout is depicted in Figure 1- 3.

Surrounding land use is primarily suburban residential or recreational (Tacoma Yacht Club and Point Defiance Park) with commercial land uses nearby. Areas south and west of the plant complex consist primarily of single family residences. Shoreline areas to the southeast were previously industrial, but are currently developed as park areas, public fishing areas, and restaurants.

## 1.2 Groundwater Conditions

OU 06 includes groundwater beneath the Facility. The local occurrence and movement of groundwater on the Point Defiance Peninsula is dictated by the distribution and properties of glacially derived sediments that dominate the area geology. Glacial outwash deposits consisting of relatively clean sand and gravel form groundwater flow pathways. The complex glacial stratigraphy results in a number of isolated perched aquifers in the more permeable units separated by less permeable tills and lacustrine deposits. The fine-grained lacustrine sediments of the Kitsap Formation underlie the near-surface glacial outwash deposits and consist of silt and clay with few gravelly zones. The Kitsap Formation is not a groundwater flow pathway.

Shallow and deep aquifer systems **1** have been identified at the Facility (Figure 1-4). The deep aquifer is located approximately 70 to 100 feet below ground surface. The shallow aquifer is located within 10 to 50 feet of the ground surface. The deep and shallow aquifers are separated by the thick, low-permeability silt and clay of the Kitsap Formation. This low-permeability zone inhibits groundwater flow between the shallow and deep aquifer systems. Depending on location and depth, the shallow aquifer generally consists of sand and gravel alluvium (in the higher elevations in the southwestern portion of the upland Facility), slag fill (ranging up to approximately 45 feet thick near the shoreline), and native marine sands (underlying the slag). The shallow aquifer system beneath the Facility is largely recharged by infiltration of precipitation and surface water run-on and, to a minor extent, by lateral flow of groundwater from the southwest (Ruston area).

Groundwater beneath the Facility generally flows in a northeasterly direction toward Commencement Bay, the ultimate groundwater discharge point. Some shallow groundwater discharges to the ground surface as seeps and springs in the upper elevations of the site, specifically along the steeper slopes on the southwest side of the Facility.

## 1.3 Marine Sediments

OU 06 includes marine sediments that extend approximately 1,000 feet offshore into Commencement Bay. Intertidal and subtidal slopes range from relatively flat to steep inclines (slopes to approximately 50 percent). The steepest submarine slopes were generally formed by placing molten slag directly into the water where it hardened in massive forms. Water depths in the steepest gradient areas within OU 06 are up to approximately 300 feet deep.

Current patterns and water circulation in and around OU 06 were investigated as part of the Draft Phase 2 Refinement of Options Report — Expanded Remedial Investigation and Feasibility Study (Parametrix, December 1996) and the draft Biological Assessment (BA) of the Site (Parametrix, May 2000). Strong, tidally generated currents are characteristic of the area. Analysis of storm wave and tidal current conditions at the Site shows currents as high as 3.3 feet per second (ft/sec), or 1 meter per second (m/sec), occur near the bottom with tidal and wave forces acting in the same direction. Nearshore tidal currents could be higher, up to 4 ft/sec (1.24 m/sec.). The predominant flow patterns are westerly north of the Facility and southeasterly to the south of it. Water movement within the Yacht Basin is considerably less than that within adjacent areas outside the basin.

The marine sediments of interest occur in an area directly offshore of the Facility, extending into Commencement Bay. These sediments, seaward of the Facility, generally consist of coarse-grained material. Sediments inshore of the Breakwater Peninsula (Figure 1-2) in the Yacht Basin, tend to be more fine- grained.

Aquatic habitats in OU 06 include shallow and deep subtidal coarse sediment (including slag material), sand ( with some slag particles), and mud communities. The coarse sediment habitats, particularly in the areas of larger slag particles function as rock and gravel substrates attracting fauna such as sea urchins, crab, shrimp, anemones, and scallops. The sandy sediment habitats include aquatic communities composed of tube-dwelling organisms, burrowing animals, and mobile epifauna (e.g. sea cucumbers, sea stars, sea urchins, snails and crabs). The mud habitats are characterized by burrowing and sediment-eating organisms. Figure 1-5 presents the locations of these habitats within OU 06.

**1** Various Site documents reference the slag, marine sand, and intermediate aquifers. All of these aquifers are considered to be within the "shallow aquifer system" as the term is used in this ROD.

Fish species commonly observed in the nearshore areas include juvenile and adult sanddabs (Citharichthys sp.), rock sole (Lepidopsetta bilineata), C-O sole (Pleuronichthys coenosus), English sole ( Parophrys vetulus), buffalo sculpin (Enophrys bison), staghorn sculpin (Leptocottus armatus), striped surf perch (Embiotica lateralis), shiner surf perch (Cymatogaster aggregata), pile perch (Rhacochilus vacca), Pacific herring (Clupea harengus pallasi), gunnels (Pholis spp.) and mosshead warbonnets (Chirolophis nugator).

Macroflora commonly observed at the Site include red algae (Callophyllis edentata, Gigartina sp. Indet., and Porphyra sp. Indet.) and green algae (Ulva, Monostroma and Enteromorpha spp.), and kelp ( Laminaria saccharina and Nereocystis leutkeana).

Listed and proposed threatened and endangered species that may be present within the general project area include:

- Chinook Salmon, Puget Sound Stock (Oncorhynchus tshauwytscha) — Threatened
- Coho Salmon, Puget Sound Stock (O. kisutch) — Candidate species for listing
- Sea-run Cutthroat Trout (O. clarki clarki) — Proposed Threatened
- Bull Trout (Salvelinus confluentus) — Threatened
- Humpback Whale (Megaptera novaeangliae) — Endangered
- Steller Sea Lion (Eumetopias jubatus) — Threatened
- Leatherback Sea Turtle (Dermochelys coriacea) — Endangered

Of these, chinook salmon are considered to be a species of concern because the juveniles are expected to occur along the shoreline of the Site during their outmigration period ( i.e., from February through July).

# 2 Site History and Enforcement Activities

## 2.1 Historical Site Activities

From 1890 through 1912, the Facility was a lead smelter and refinery. Asarco, Inc., purchased the property in 1905. By-products of the smelting operations were refined to produce other marketable products, such as arsenic, sulfuric acid, and liquid sulfur dioxide. Asarco ended operations at the Facility in 1986.

The following is a brief chronological summary of operations at the former Asarco Tacoma Complex:

1890 — Under ownership of the Tacoma Smelter Company, operation as a lead smelter commenced.

1902 — Copper production commenced.

1905 — Asarco purchased the smelter.

1917 — The plant was rebuilt, a stack was constructed, and electrostatic precipitators were added.

1930 — The blast furnace smelting operations were discontinued and replaced with reverberatories that produced slag as a by-product.

1974 — A liquid sulfur dioxide plant began operation, using a dimethylaniline process.

1977 — A baghouse was installed to handle dust from the arsenic kitchen and metallic arsenic plant.

1979 — The electrolytic refinery ceased operation.

1985 — Copper smelting operations were discontinued.

1986 — Arsenic production was discontinued, and the Facility ceased all manufacturing operations.

Since 1987, Asarco has completed two phases of demolition activities at the Facility. Structures in the stack area associated with copper smelting and the production of both arsenic trioxide and metallic arsenic were demolished in 1987 and 1988. The majority of the remaining buildings and structures, including the smelter stack, were demolished during the period of 1992 to 1994. Much of the Facility (where historical manufacturing processes were located) has been leveled and, to some extent, graded. Remedial actions required by the OU 02 ROD began in 1999 when construction of the On-Site Containment Facility began. The remaining remedial action required for OU 02 and OU 06 (this ROD) will extend through 2005.

## 2.2 Historical Enforcement Activities

The history of regulatory activities affecting the former Asarco Tacoma Smelter began in the late 1960s with the passage of air emission standards by the Puget Sound Air Pollution Control Authority (PSAPCA). Although PSAPCA began regulating sulfur dioxide and arsenic emissions in 1968, variances to the standards were granted to Asarco until 1975. EPA requirements such as national Pollution discharge Elimination System (NPDES) permits, which regulate point source water discharges, were applied in 1975. EPA Also began enforcement proceedings in the early 1980s to regulate air emissions. Federal and State standards and variances continued to be issues of contention until the smelter colsed in the mid-1980s.

In July, 1983, EPA issued proposed standards for arsenic under Section 112 (National Emissions Standards for Hazardous Air Pollutants) of the Clean Air Act. Inorganic arsenic had been designated as a hazardous air pollutant in 1980 and the Asarco Smelter was a major source of arsenic. The proposed standard for Asarco was modified to require better management practices in handling arsenic-contaminated materials. These regulations were never implemented due to a decision by Asarco to cease copper refining in 1985.

In September 1986, Asarco signed an Administrative order on consent with EPA pursuant to Section 106 (a) of CERCLA, in which Asarco agreed to conduct a Remedial Investigation and Feasibility Study (RI/FS) and to perform immediate site-stabilization activities. Asarco's contractors began the RI/FS in 1987 under EPA oversight. Site stabilization, Phases I and II, were both conducted based on the information collected during the initial investigation of the Facility.

In December 1990, EPA issued a ROD for demolition of structures and construction of a surface water diversion system. Asarco agreed to perform this work in a Consent Decree dated May 18, 1992.

The field investigation and evaluation of remedial alternatives for a final RI/FS for OU 02 (including groundwater) was concluded by Asarco in 1993. The RI for the offshore marine sediments was concluded in 1996; the FS process was concluded in 200. The results of both RI/FS processes were used to develop the remedy for OU 06.

The following is a brief chronological summary of CERCLA enforcement activities associated with the former Asarco Tacoma smelter.

1986 Administrative Order on consent (AOC) for RI/FS and Phase I site stabilization signed.

1988 Phase I site-stabilization (demolition) activities completed.

1989 Draft RI/FS submitted.

1990 Notice of Violation for RI/FS issued.

1990 Interim ROD for Phase II site-stabilization (demolition) and surface water controls issued.

1991 Additional investigation of soil and groundwater contamination commences.

1992 Notice of Violation resolved.

1992 Consent decree for demolition entered in federal court.

1993 Two stipulated penalties for late draft FS submittals paid by Asarco.

1993 ROD for Ruston/North Tacoma Study Area issued.

1993 Unilateral Administrative Order for Ruston/North Tacoma Study Area issued.

1993 Final RI/FS report for OU 02 (including groundwater) submitted and approved.

1994 AOC for Groundwater, Surface Water, Soil and Marine Sediments monitoring and sampling signed.

1995 ROD for OU 02 signed.

1996 Remedial Design for OU 02 initiated.

1996 Phase 1/Phase 2 Expanded RI/FS Sediment Activities completed.

1997 Placement of pilot cap in a small portion of the offshore contaminated sediments area.

1999 Asarco Sediment/Groundwater Task Force concludes their evaluation of potential groundwater impacts to Commencement Bay waters and sediments.

1999 Remedial Action for OU 02 initiated.

2000 Year 2 Pilot Cap Monitoring Report completed.

2000 Refinement of the Proposed Remedy Report completed.

## 2.3 Key Documents

Documents related to the RI/FS for OU 06 are available in the Administrative Record. Key documents include the following:

- *Historical Summary of the Evaluation of Groundwater Remedial Alternatives, Asarco Tacoma Smelter Site* (Hydrometrics, June 2000)
- *Documentation of the Feasibility Study Process for the Sediments Portion of the Asarco Sediments Operable Unit* (Parametrix, January 2000)
- *Refinement of the Proposed Remedy Report* (Parametrix, January 2000)
- Copper in Nearshore Marine Water, Technical Memorandum (Parametrix, June 1999)
- Group 5 Technical Memorandum, Asarco Sediment/Groundwater Task Force (Hydrometrics, April 1999)
- *Draft Phase 2 Refinement of Options Report, Expanded Remedial Investigation and Feasibility Study* (Parametrix, December 1996)
- *Ecological Risk Assessment and Seafood Consumption Screening Risk Assessment* (Roy F. Weston, October 1996)
- *Phase 1 Data Evaluation Report and Phase 2 Sampling and Analysis Approach, Asarco Sediments Superfund Site, Expanded Remedial Investigation and Feasibility Study* (Parametrix, April 1996)
- *Phase 2 Refinement of Options Report, Asarco Sediments Superfund Site, Expanded Remedial Investigation and Feasibility Study* (Parametrix, December 1996)
- Draft Disposal Site Inventory (Parametrix, March 1995)
- *Supplemental Feasibility Study — Commencement Bay Nearshore/Tideflats Asarco Sediment Site* (Roy F. Weston, Inc., October 1993)
- *Asarco Tacoma Plant Remedial Investigation, Tacoma, Washington* (Hydrometrics, August 1993)
- *Asarco Tacoma Plant Feasibility Study, Tacoma, Washington* (Hydrometrics, August 1993)
- *Asarco Tacoma Plant Yacht Club Breakwater Remedial Investigation, Tacoma, Washington* (Hydrometrics, January 1993)

# 3 Community Participation

Throughout the CERCLA process, EPA has taken steps to inform and involve the public in activities at the Site. EPA conducted the activities summarized in this section because the agency believes that community participation in the decision-making process is a key element in achieving a successful remedy.

In addition to cleaning up contamination at the Site, the community has been very interested in the future use of the property. EPA's primary mission is to identify a Selected Remedy that protects human health and the environment. However, EPA believes this can be accomplished while concurrently considering the future development potential of the property.

In order to provide a variety of opportunities for public participation in the cleanup decision process, EPA developed a communications strategy in 1993 for its activities related to the overall Asarco Facility, including OU 6 which is addressed by this ROD. This strategy supplemented the existing Community Relations Plan, which included the larger CB/NT and South Tacoma Channel Superfund Sites.

EPA has complied with the specific requirements for public participation under CERCLA by publishing a Proposed Plan for public comment. The Proposed Plan, Asarco Sediments/ Groundwater Operable Unit 06 (Proposed Plan) was published on January 26, 2000 (EPA, January 2000a). A fact sheet summarizing the Proposed Plan was also published at that time. Both the Proposed Plan and fact sheet were made available at local information repositories. The initial public comment period went from January 26 through February 25, 2000. In response to a request from the Washington State Department of Natural Resources, the comment period was extended 30 days to March 27, 2000. During the comment period, EPA held a public meeting in Ruston, Washington, on February 10, 2000. EPA also published newspaper advertisements in the Tacoma News Tribune to announce the availability of the Proposed Plan, the comment period, and the public meeting. Comments received during the public comment period are summarized along with EPA's responses in the Responsiveness Summary (Part 3 of this ROD).

In addition to the February public meeting and comment period addressing the Proposed Plan for OU 06, the following outreach activities have been conducted by EPA in recent years to inform the public about remedial activities at other related and adjacent operable units (e.g., OU 02, Asarco Tacoma Smelter and Breakwater Peninsula, and OU 04, Asarco Off-Property [Ruston/North Tacoma Study Area]):

- **Small Group Meetings.** EPA staff has attended meetings with groups upon request to share information about the agency's cleanup proposal and to address the public's need for information about the Facility. These groups include Black Collective Association, Izaak Walton League, Association of Builders and Contractors, Tacoma Environmental Commission, National Association of Women in Construction, Association of General Contractors, American Institute of Architects Southwest Washington, Environmental Task Force of Tacoma- Pierce County Chamber of Commerce, Kiwanis Club, and Rotary Club.

- **Personal Interviews** . In November 1993, EPA staff met with individual citizens to better understand community concerns regarding the cleanup.

- **Availability Sessions** . In October, November and December 1993, EPA and Asarco held sessions for citizens to visit one-on-one with EPA and Asarco staff to discuss cleanup plans.

- **Community Workgroup Briefing.** On May 19, 1994, EPA held a meeting for the Ruston/ North Tacoma Community Workgroup. This workgroup was formed in 1989 to provide an avenue for citizens to become involved in residential investigation and cleanup activities.

- **Public Meetings.** EPA held two public meetings in 1994 during the 90-day public comment period for the Proposed Plan addressing OU 02. As indicated above, a public meeting and 60- day public comment period were provided in early 2000 to present information about and respond to any comments concerning the preferred remedy for OU 06.

- **Periodic Briefings.** Briefings have been held for representatives from the Town of Ruston, City of Tacoma, Tacoma Environmental Commission, the Office of Congressman Dicks, and other interested local government officials.

- **Information Repositories.** EPA has established and periodically updates various local document repositories where citizens can review detailed information about EPA's Superfund activities. As new materials become available, they are added to these repositories. Documents reflecting public comments can also be found in these locations. The location and subject of the repositories are frequently advertised in fact sheets and in newspaper notices prepared by EPA.

- **Fact Sheets and Brochures.** EPA has periodically distributed fact sheets to members of the affected community to provide current information on the status of Facility activities.

- **Coordinating Forum.** The Ruston/North Tacoma Coordinating Forum was formed in March 1991 to facilitate discussion and coordination among the various entities involved and/ or affected by the Ruston/North Tacoma Residential Study Area project. In July of 1993, the Forum turned its attention to evaluating cleanup options for the Asarco Tacoma Smelter.

To address issues associated with cleanup and future redevelopment of the Asarco Smelter Facility, two subcommittees were formed from the Coordinating Forum. The two subcommittees addressed land use and technical issues, respectively. The subcommittees included members of the public and staff from regulatory agencies and other government and private organizations. Both subcommittees worked for over a year on issues related to developing a cleanup plan for the Facility. EPA participated directly in the technical subcommittee and received input from the land use subcommittee. Input from both of these subcommittees has been used by EPA to develop both the OU 02 and OU 06 RODs. The following parties participated in the subcommittees.

**Land Use Subcommittee**

Asarco, Inc.
City of Tacoma
Metropolitan Parks District
Town of Ruston

**Technical Subcommittee**

Agency for Toxic Substances and Disease Registry
Citizens for a Healthy Bay
Community Representative
Environmental Protection Agency
Puget Sound Air Pollution Control Authority
Puyallup Tribe of Indians
Tacoma-Pierce County Health Department
U. S. Fish and Wildlife Service
Washington Fish and Wildlife Service
Washington Department of Ecology
Washington Environmental Council
Washington Department of Health
Members of the Land Use Committee

- **Technical Assistance Grant.** In 1991 EPA awarded a Technical Assistance Grant ( TAG) to the Citizens for a Healthy Bay. Citizens for a Healthy Bay has used these funds to hire technical experts to review and comment on cleanup design documents, prepare information for the general public on cleanup work, and prepare information for non-English speaking people who may fish or work on Commencement Bay. Citizens for a Healthy Bay maintains an office in downtown Tacoma which is open to the public and

serves as an information repository for the CB/ NT Superfund Site. Citizens for a Healthy Bay also publishes a quarterly newsletter that addresses a wide range of environmental issues of potential concern to the citizens of Tacoma.

# 4 Scope and Role of Operable Units

The CB/NT Superfund Site has been divided into seven OUs. Superfund sites are often divided into OUs to more easily address individual areas within a large site, accommodate differing site conditions and remedies, or schedule phases of investigations and cleanup actions. Of the seven OUs designated within the CB/NT Superfund Site, four OUs are associated with the Facility:

- OU 02, Asarco Tacoma Smelter and Breakwater Peninsula — Consists of the "upland" portion of the former Asarco Smelter Facility. The media of primary concern are surface water and soils (including mixtures of soil and waste materials).

- OU 04, Asarco Off-Property (Ruston/North Tacoma Study Area) — Consists of the properties in Ruston and Tacoma adjacent to the Asarco Facility that have been contaminated by airborne fallout of emissions from the former Asarco stack. The medium of primary concern is soil.

- OU 06, Asarco Sediments/Groundwater — Consists of marine sediments located offshore of the Asarco Smelter Facility and groundwater underlying OU 02. The marine sediments in the Yacht Basin adjacent to the Facility are also included. The media of primary concern are sediments and groundwater.

- OU 07, Asarco Demolition — Consists of the Asarco buildings and infrastructure (e.g., underground utilities) subject to demolition and within the boundaries of OU 02. There are no environmental media associated with OU 07.

The approximate boundaries of OUs 02 and 06 are shown in Figure 1-2. The groundwater portion of OU 06 extends beneath the entirety of OU 02, which is also indicated in Figure 1-2.

## 4.1 Selected Remedies for the Other Asarco OUs

This ROD addresses the Selected Remedy for OU 06, Asarco Sediments/Groundwater. EPA has previously selected the following remedies for the other three Asarco OUs.

### 4.1.1 OU 02, Asarco Tacoma Smelter and Breakwater Peninsula

The Selected Remedy for OU 02 focuses on removal of source materials (waste material and highly contaminated soils) from the former Asarco Smelter Facility. The excavated source materials are to be contained in an onsite engineered repository referred to as the On-Site Containment Facility. Capping, surface water controls, shoreline armoring, and habitat restoration in selected inter-tidal areas are also integral to the OU 02 remedy. The Facility will be covered with a low-permeability cap to significantly reduce infiltration and percolation of precipitation that would otherwise recharge the groundwater system. The shoreline armoring will reduce the potential for erosion and transport of slag into Commencement Bay where it could recontaminate sediments.

### 4.1.2 OU 04, Asarco Off-Property

The Selected Remedy for OU 04 involves removal of arsenic-and lead-contaminated soils from residential yards and public spaces in Ruston and North Tacoma. The remedial action program began in 1994 and is ongoing.

### 4.1.3 OU 07, Asarco Demolition

The Selected Remedy for OU 07 included the demolition of buildings and other structures within the boundaries of OU 02. At this writing, all demolition is substantially complete with the exception of the Fine Ore Bins building. The Fine Ore Bins building is currently used to stockpile demolition debris and contaminated soils destined for permanent

containment in the On- Site Containment Facility. The Fine Ore Bins building will be demolished concurrent with future OU 02 remediation activities.

## 4.2 Relationship of the OU 02 and OU 06 Remedial Actions

EPA identified the Selected Remedy for OU 02 in a 1995 ROD (EPA, March 1995). Remediation of OU 02 began in 1999 and will be essential to the successful cleanup and long- term protection of groundwater and marine sediments included in OU 06. For example, OU 02 contaminants leaching to underlying groundwater in OU 06 are transported by prevailing groundwater flow to Commencement Bay where they are discharged and threaten marine waters and sediments. Similarly, erosion and transport of slag particles from the nearshore areas of OU 02 into Commencement Bay results in deposition of these materials onto, and eventual mixing with, existing sediments.

Many elements of the OU 02 remedy will have direct benefits to the quality of groundwater and marine sediments within OU 06. These beneficial elements include collection and diversion of groundwater and surface water in selected areas to the surface water treatment system, construction of a site-wide low-permeability cap, and removal of the mostly highly contaminated source materials (selected slag material and contaminated soils). In particular, the OU 02 remedy will significantly reduce the flow of contaminated groundwater to Commencement Bay by minimizing recharge of the shallow aquifer system (e.g., surface water controls and the low-permeability cap will reduce infiltration). An estimated 75 to 95 percent reduction in OU 06 groundwater flow and contaminant loading to Commencement Bay is expected from the OU 02 remedy.

# 5 Site Characteristics

Past smelting operations at the Asarco Facility have resulted in contamination of soil, groundwater, surface water, and marine sediments. Wastes generated by the former smelter, particularly slag, have acted as a continuing source of contamination to groundwater and marine sediments.

## 5.1 Production and Distribution of Slag

Slag was produced as a waste product during the smelting of copper from arsenic-and lead-bearing ores. The slag at the Site is generally composed of dark brown iron-rich silicates that include metals such as arsenic, copper, and lead. The slag is similar in appearance to volcanic rock. It is either massive or granular, depending on the way it was processed and placed on the Site. Massive slag is present where molten slag was poured directly into the waters of Commencement Bay. Contact with the cold water solidified the molten material in place. Granular slag was intentionally produced by passing molten slag through cold water streams to produce a sand-to gravel-sized material. This granular slag was then used as fill material throughout the Facility. The slag was used to extend the shoreline by approximately 500 feet outward into Commencement Bay. In addition, the Breakwater Peninsula (see Figure 5-1) is comprised entirely of slag.

## 5.2 Contaminant Source Areas

In addition to the slag, principal threats to human health and the environment posed by the Facility are the contaminated materials that occur within the six "source areas," as identified in Figure 5-1. These areas contain buried waste materials and have either the highest measured concentrations of contaminants in soils, are primary sources of contamination to groundwater and sediments, and/ or comprise large amounts of contaminated material based upon the historical uses of these areas. These six areas are:

- Stack Hill
- Copper Refinery
- Cooling Pond
- Fine Ore Bins Building
- Arsenic Kitchen
- Southeast Plant Area

The slag material that underlies much of the Facility is characterized by high concentrations of arsenic and other metals, which can also impact the groundwater and sediment. The source materials in the above-referenced six areas are being addressed as part of the OU 02 remedial action and are therefore not covered by this ROD for OU 06.

## 5.3 Site Investigations

Under EPA's oversight, Asarco began an RI/FS in 1987. The following OU 06 media were investigated:

- Groundwater
- Marine sediments and biological environment
  - Marine sediment chemistry
  - Marine waters
  - Marine tissue (fish and benthic tissue)
  - Bioassays and benthic community structures

The RI/FS for groundwater was completed in 1993 and the RI/FS for sediments was completed in 1996.

In 1996, EPA formed the Asarco Sediments Groundwater Task Force (Task Force) to address the relationship between groundwater and sediment contamination. The Task Force addressed

two questions:

1. "Does groundwater that is discharging from the Facility negatively impact the marine sediments and waters of Commencement Bay?"

2. "Would a sediment cap remain stable (e.g., stay in place) in the presence of strong currents in this part of Commencement Bay?"

The first question was addressed by the Asarco Sediments Groundwater Task Force (Task Force). The Task Force evaluated the impacts of discharging groundwater on the marine sediments and waters of Commencement Bay. The second question was addressed by the placement and monitoring of a pilot-scale sediment cap to determine how well the test cap would physically remain in place over a 2-year period (Parametrix, February 2000). The pilot-scale cap was constructed offshore of the Facility, immediately northeast of the Fine Ore Bins building (Figure 5-1). The purpose of the cap was to determine the physical, chemical, and biological characteristics of two sediment plots, one with a thickness of 30 centimeters and the other with a thickness of 60 centimeters.

The key site characterization findings relating to groundwater and marine sediments as determined by the RI/FS, Task Force, and pilot-scale sediment cap study are summarized in the following sections.

## 5.4 Groundwater

Groundwater conditions at the Asarco Facility were initially characterized in the late 1980s and early 1990s during the RI for the upland portion of the Facility. Since that time, monitoring of groundwater quality has continued throughout the Facility as part of the post- RI Monitoring Program. (The post-RI monitoring program includes sampling selected onsite wells on a bi-annual basis, usually in March and September.) A summary of groundwater quality conditions as indicated by the results from the post-RI monitoring program is provided below.

### 5.4.1 Shallow Groundwater

Groundwater at the Site occurs in the shallow and deep aquifer systems as discussed in Section 1 and depicted conceptually in Figure 1-4. Monitoring indicates that Site groundwater flows from the southwest to northeast and ultimately discharges to Commencement Bay. The general groundwater flow direction is depicted in Figure 1-4 and 5-1. Near the shoreline, groundwater levels constantly fluctuate in response to the tide in Commencement Bay.

Groundwater has been adversely impacted by direct contact with contaminated source materials or indirectly impacted by infiltrating waters transporting contaminants to groundwater. In turn, Site groundwater discharges to Commencement Bay and the Yacht Basin where the contaminants are released to the marine environment.

Figure 5-2 shows monitoring wells that either are, or have been, included in the post-RI monitoring program. Groundwater in the shallow aquifer system is contaminated by elevated concentrations of metals including arsenic, cadmium, copper, lead, nickel, and zinc. Historical data show that distribution of elevated metals concentrations are generally well represented by arsenic and copper results.

The natural groundwater background concentrations for arsenic and copper in the Tacoma vicinity are 6 and 40 micrograms per liter (ug/L), respectively (EPA, April 1993). Arsenic and copper have been detected above their respective background levels frequently. Arsenic concentrations have exceeded the background level of 6 ug/L in approximately 90 percent of the groundwater samples collected since the RI For copper, nearly 40 percent of the samples have exceeded the background level of 40 ug/L. With a marine chronic criterion of 3.1 F ug/L, copper is a concern with respect to the potential threat posed by groundwater

discharging to Commencement Bay waters. Approximately 60 percent of the groundwater samples collected since the RI have exceeded the 3.1 ug/L marine chronic criterion for copper. Other metals also exceed applicable marine water or drinking water criteria, but less frequently and usually where either arsenic or copper is also elevated.

Figures 5-3 through 5-6 depict isoconcentration contours for dissolved arsenic and copper in the "slag" and "intermediate" wells based on samples collected during September 1999 (latest monitoring period for which data are available). Both the slag and intermediate wells monitor the shallow aquifer system as depicted in Figure 1-4. The slag wells are screened in slag and the intermediate wells are screened in either shallow alluvium, non-slag fill, or in the marine sands underlying the slag. Figures 5-7 and 5-8 show box plots depicting the range of arsenic and copper concentrations in the slag and intermediate wells during the post-RI monitoring period (1994 to 1999).

As evident in the above-referenced figures, historical arsenic and copper concentrations in groundwater range up to several tens of thousands of parts per billion in some locations. Concentrations are highest in and around the former smelter processing areas. Metal concentrations decrease approaching the Commencement Bay as evidenced by data from nearshore monitoring wells and shoreline monitoring stations. (The shoreline monitoring stations consist of sampling tubes located along the shoreline, which are intended to sample groundwater as close as possible to the point of discharge to Commencement Bay and the Yacht Basin.) September 1999 data for the shoreline monitoring stations indicate that arsenic concentrations range from 5 to 29 ug/L (Figure 5-3) and copper concentrations range from 4 to 23 ug/L (Figure 5-5). The reduction in metal concentrations near the shoreline is caused by dispersion and attenuation of the contaminants as they move toward the bay. Dilution effects due to seawater entering the nearshore portions of the aquifers also have a significant impact on the reduction in metals concentrations.

Samples from the nearshore areas of Commencement Bay provide yet another indication of how groundwater discharging from the site may be affecting marine surface water. Data collected by Asarco in September 1999 show that existing (pre-remedial action) copper concentrations in Commencement Bay water immediately adjacent to the slag shoreline face are below the 3.1 ug/L marine chronic criterion in most locations sampled. The exception is the Yacht Basin where samples exceed the copper marine chronic criterion as far as 200 feet from shore (measured copper concentration of 8.38 ug/L based on average of high and low tide samples collected in September 1999). This is not unexpected given the proximity of the Yacht Basin to the defunct Copper Refinery Area (see Figure 5-1), a source of copper contamination within the upland portion of the Facility.

The presence of oxygen in seawater that invades the nearshore portions of the aquifers has a favorable impact on the fate of arsenic by promoting its precipitation. Copper, however, responds differently than arsenic to the effects of the more highly oxygenated seawater. Copper tends to be more readily mobilized from the slag into the groundwater when dissolved oxygen levels increase; however, copper is still subject to dilution as groundwater mixes with seawater as it approaches Commencement Bay. In spite of the increased mobilization of copper in the presence of higher dissolved oxygen levels, the net effect is a reduction in copper concentrations in groundwater approaching the shoreline due to the dilution effect.

In the Southeast Plant Area (Figure 5-1), slag was placed over wood waste originating from a former sawmill operation. Later, Asarco used an organic chemical called dimethylaniline (N, N-dimethylaniline or DMA) in this area for the production of concentrated sulfuric acid and liquid sulfur dioxide. Shallow aquifer groundwater in this Southeast Plant/DMA area has some of the lowest pH values and highest copper and arsenic concentrations found at the Site (Figures 5-3 through 5-6). DMA-related organic compounds, such as aniline, are also present in the shallow aquifer system. Appendix A includes charts showing the trend of various DMA-related compounds with time. As discussed above for arsenic and copper, concentrations of DMA-related compounds are highest near the center of the Southeast Plant/DMA area and decline significantly near the Commencement Bay shoreline. For example, aniline is present at approximately 100,000 ug/L near the center of the Southeast

Plant/DMA area (well MW-B37 in Figure 5-2) but is either not detected or detected at part-per-billion levels in samples collected from nearshore monitoring wells located directly downgradient. Data for DMA-related compounds are depicted graphically in Appendix A.

#### 5.4.2 Deep Groundwater

In comparison to the shallow aquifer, elevated contamination of the deep aquifer is limited in extent and concentration. Contamination in the deep aquifer is present near a former production well that provided water for the Facility (see location in Figure 5-1). It is believed that metals migrated from the shallow aquifer to the deep aquifer through the well casing. This well was sealed in 1994 to inhibit the movement of contaminants between the shallow and deep aquifer systems. Arsenic and copper data from deep monitoring well MW-139A, located approximately 75 feet from the former production well, is shown in Figure 5-9 and shows a decreasing concentration trend over the last 9 years.

### 5.5 Marine Sediments and Environment

Since the Asarco Facility was first included in the CB/ NT Superfund Site, many studies have been completed to characterize and assess the potential effects of sediment contamination to human health and to the environment. In 1996, an expanded RI/FS investigation of offshore sediments was completed to better define contaminant effects at the site. Analyses of samples collected at the Facility as part of these investigations included sediment chemistry (inorganic and organic chemical analyses), surface water chemistry, pore-water chemistry, fish tissue analyses, benthic tissue analyses, bioassays, and benthic community structure analyses. A brief summary of these results are provided below; specific details can be found in *Phase 1 Data Evaluation Report and Phase 2 Sampling and Analysis Approach, Asarco Sediments Superfund Site, Expanded Remedial Investigation and Feasibility Study (Parametrix, April 1996); Phase 2 Refinement of Options Report, Asarco Sediments Superfund Site, Expanded Remedial Investigation and Feasibility Study, Appendix A — Phase 2 Data Evaluation Report (Parametrix, December 1996);* and *Supplemental Feasibility Study, Commencement Bay Nearshore/Tideflats Asarco Sediments Site* (Roy F. Weston, Inc., October 1993).

#### 5.5.1 Marine Sediment Chemistry

The Washington State Sediment Management Standards (SMS) are used to evaluate contaminated sediments. The long-term goal of the SMS is "to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from surface sediment contamination." To this end, the SMS include numerical standards for chemical and biological effects for the protection of marine animals living in the sediments (the "benthic community").

The SMS defines two levels of chemical and biological criteria. The most stringent level, the Sediment Quality Standard (SQS), corresponds to the long-term goal of "no adverse effects" on the benthic community. The less stringent level, the Cleanup Screening Level (CSL), corresponds to "no adverse effects" on this community. At contaminant levels above the CSL, more significant effects are predicted, and a sediment cleanup decision is required.

The chemical criteria are numerical values derived from Puget Sound test data. The test data revealed specific adverse biological effects associated with chemical concentrations. Cleanup areas may be defined using chemical criteria alone. However, the SMS recognize that the chemical data may not accurately predict biological effects for all sediment locations. Biological testing (bioassays and benthic evaluation), allowed under the SMS, can be conducted to determine whether biological effects predicted by the chemical concentrations are occurring. The biological testing must include two tests for acute toxicity to marine organisms and one for chronic biological effects. If all three biological criteria are met for a given area, this area is not included in the cleanup

area and does not require cleanup under the SMS for the protection of benthic organisms. Failure to meet the biological criteria, confirms the potential for adverse impacts to the benthic community.

During the Supplemental FS, 100 surface sediment stations were sampled for sediment chemical data. During the Phase 1 Expanded RI/FS a total of 62 sediment stations were sampled for chemical, physical and biological characteristics in order to identify an appropriate remedy for sediments. An additional 10 subsurface sediment samples were analyzed for chemistry and conventional parameters during the Phase 2 Expanded RI/FS. Figure 5-10 presents the sediment station locations from which these samples were collected.

Eleven inorganic chemicals were analyzed in surface sediment samples: arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, silver, zinc, and mercury. Nine inorganic chemicals were analyzed in the subsurface sediments: arsenic, cadmium, chromium, copper, lead, nickel, silver, zinc, and mercury. Table B-1 in Appendix B summarizes the inorganics data obtained during the RI/FS. Tables B-2 and B-3 present the metals results from the Expanded RI/FS Phase 1 and 2 data evaluations, respectively (Parametrix, April 1996 and December 1996). Inorganics were detected in sediments at significant concentrations in areas of the Site. Arsenic, cadmium, chromium, copper, lead, mercury silver and zinc were found in sediments at concentrations above the SMS. Chemicals of concern (COCs) in sediment were determined to be arsenic, copper, lead, and zinc. These metals or metalloids were contaminants with the highest concentrations encountered in surface and subsurface sediments. Concentrations of arsenic found in sediment samples were as high as 26,410 milligrams per kilogram (mg/kg). Maximum concentrations of the other three COCs are summarized in Table 5-1. Figure 5-11 presents the sediment station locations where samples with sediment chemistry in excess of state cleanup criteria were collected. A significant amount of slag was found in sediment samples off the Breakwater Peninsula and immediately off the former smelter property. Slag contains the highest concentrations of metals including arsenic and lead but in a rock-like form.

Although numerous sediment samples at the site contain high concentrations of metals and metalloids, there is site- specific evidence (e.g., pore water chemistry, pore water bioassays, sequential extraction of slag) that bulk sediment chemistry results are not indicative of actual toxicity or are a reliable measure of the extent and magnitude of contaminant effects. This is because the bioavailability of metals and metalloids in slag to potential receptors may be low. Therefore the chemistry may have high concentrations yet the biological community could be healthy.

Tables B-4 and B-5 in Appendix B summarize the organic compounds detected in subsurface sediments from the Site. Out of 24 organic compounds tested, only individual polynuclear aromatic hydrocarbons and phthalates (butyl benzyl and bis-2-ethylhexyl) were detected above the SMS. No organic COCs were identified at the Site because the detections of these compounds were isolated and did not suggest a defined area of contamination. Furthermore, their limited occurrence corresponded to sediment sample stations that exhibited inorganic chemical contamination. Therefore it is believed that remedial responses for the inorganics would address incidental contamination by organics.

**5.5.2 Marine Waters**

Marine surface water samples have been collected from various locations offshore of the Facility over a period of years. Recent sampling conducted in March, April, and September 1999 indicates that only copper exceeds its corresponding marine chronic criteria for surface water (Parametrix, June 1999; Hydrometrics, March 2000). Sediment pore-water samples were previously collected from 11 stations at the Site and 2 reference stations in 1994 and 1995. The chemicals detected above EPA’s marine acute and chronic criteria included arsenic, copper, and ammonia (Parametrix, April 1996). Table B-6 in Appendix B presents the chemistry results for sediment pore water.

**5.5.3 Marine Tissue**

Rock Sole (Lepidopsetta bilineata) whole fish and fillet samples were collected from five sample stations at the Site and a reference site (Browns Point, east of the Site). The whole-fish body results indicated consistent detections of arsenic, chromium, copper, and lead at levels higher than the reference sample (see Table B-10 and B-11 in Appendix B). The fillet sample results revealed arsenic and copper at concentrations substantially greater than the reference sample.

Benthic invertebrate samples were analyzed for nine metals (arsenic [including As+ 3, As+ 5, and total As], cadmium, chrornium, copper, mercury, nickel, lead, silver, and zinc. The benthic organisms tested were sea cucumbers (Stichpus californianus), sea slugs (Evasterias troschelii and Mediaster aequalis), and sand shrimp ( Crangon alas kensis). Table B-12 (Appendix B) presents the results of these tissue analyses.

As presented in Table B-12, arsenic, copper, and lead were consistently detected at levels above background in tissue samples obtained from the Site.

**5.5.4 Bioassays and Benthic Community Structures**

Bioassays are acute and/or chronic tests that measure the response of a living organism to a test substance such as a suspected contaminant. Sediment bioassays were conducted using samples from 62 stations across the Site, and included three different tests: amphipod, echinoderm larvae, and polychaete growth tests. Table B-7 and B-8 in Appendix B contains the results of these tests. The results of these tests indicate that the majority of bioassay results exceeding SMS occur immediately off the shoreline of the former Smelter Facility. Figure 5-12 depicts the locations of the areas where bioassay results exceeded SMS criteria.

Benthic infauna form the base of many marine food chains; therefore, their overall health, as indicated by abundance and diversity, is a good measure of the health of the sediment ecosystem. Impacts to benthic communities were evaluated using measures of abundance, richness, and diversity. The sediments that suggested moderate to severe impacts (i.e., multiple exceedances of the state sediment biological effects criteria) occurred immediately off the shoreline of the former Smelter. These effects included abundance and richness depressions, diversity indices less than their reference, community structures suggestive of impacts, and/or species-level data suggestive of impacts. Tables B-8 and B-9 in Appendix B summarize the biological data obtained from benthic infauna abundance studies for the Site.

# 6 Current and Potential Future Land and Resource Uses

The Asarco Smelter terminated operations in the mid- 1980s. Since that time, most of the former the buildings and structures have been demolished as part of the remedial action for OU 07 (Asarco Demolition; see Section 4). The Fine Ore Bins building (Figure 5-1) still exists and is used to store demolition debris and contaminated soil until the On-Site Containment Facility is ready to accept these materials. The Smelter property is also used to stockpile contaminated soils excavated from OU 04 (Asarco Off-Property). These contaminated soils are contained and protected by temporary covers. Construction activities associated with the OU 02 remediation began in 1999 and will be substantially complete in 2003 with final completion in 2005.

## 6.1 Proposed Development Plans

Proposed upland development at the Facility has been the subject of seven years of land use planning focusing on coordinated cleanup and redevelopment. The resulting Master Development Plan (Merrit+Pardini/Sasaki Associates, August 1997) adopted by Asarco, the City of Tacoma, Town of Ruston, and Metropolitan Park District of Tacoma in 1997 describes the basic framework of redevelopment. The following seven fundamental elements of the plan complement Facility cleanup:

- **Development Sites.** The Master Plan provides for development of seven fully served "pad ready" development sites totaling approximately 37 acres. These sites will accommodate commercial to light industrial development including buildings, parking, and landscape areas, controlled by local zoning.
- **Parks and Pedestrian Promenade** . The Master Plan includes a publicly accessible waterfront promenade and system of park areas connecting the existing waterfront walkway on Ruston Way to the south with Point Defiance Park to the north. The promenade and associated pedestrian areas will be concrete paved. The shoreline on the Commencement Bay side of the promenade will be armored to prevent shoreline erosion. Other park areas are to be turf and plant bed areas.

- **Streets and Utilities.** The Master Plan makes provision for new streets and utilities to serve all of the development sites and parks envisioned by the plan. Asarco will construct streets and utilities to prevailing municipal design standards.

- **Ruston Promontory Park.** The Master Plan includes development of a new 4- acre public view park located on a promontory over the capped On- Site Containment Facility. The Promontory Park will include both paved and turf areas. Steep embankment slopes on the sides of the promontory will be treated with erosion. control plantings.

- **New Boat Ramp and Peninsula Park.** The Master Plan includes development of new parks on Metropolitan Park District land, including a day-use park on the breakwater peninsula, and renovation of the boat ramp/boat launching facility near the existing Washington State ferry dock. Park areas will consist of a combination of paved and turf areas, with some plant beds and a few smaller park structures. Site development plans do not call for any change in the future use or operation of the Yacht Basin.

- **Re-vegetated Steep Slopes.** As part of site cleanup, Asarco will establish vegetative cover on slopes facing Commencement Bay. The re-vegetation effort will meet EPA requirements for capping steep slopes and will attempt to reestablish the appearance of forested hillsides similar to those to the north and south of the site.

- **Shoreline Restoration and Protection.** Approximately 7 acres of shoreline along the Breakwater Peninsula will be enhanced with clean natural rock riprap and "fish mix" (a substrate that enhances juvenile salmonid habitat). The shoreline adjacent to the entire Facility will be armored and extend to the mean higher high water (MHHW) level to protect the upland low-permeability cap to be constructed under OU 02. A slag beach will be excavated to create 1.2 acres of new intertidal habitat. This

will produce a more biologically enhanced and productive habitat.

In addition to the uses identified in the Master Plan, there has recently been discussion by Asarco about the possibility of incorporating residential use into the site development plans. At this time, EPA has not been presented with specific plans for residential use. The appropriateness of residential uses would be subject to evaluation under the requirements of the existing OU 02 ROD. Should residential use occur, it is not expected to affect the remedy for marine sediments and groundwater as addressed by this ROD for OU 06.

## 6.2 Potential Groundwater Use

Groundwater at the Asarco Facility is not currently used for drinking water or industrial purposes. Groundwater in the shallow and deep aquifer systems is classified as either Class II (potable; not currently used for drinking purposes) or Class III (non-potable due to total dissolved solids [TDS] in excess of 10,000 mg/L). In general, shallow groundwater located within approximately 400 to 500 feet from the shoreline has TDS concentrations greater than 10,000 mg/L and is therefore deemed Class III. Shallow groundwater in certain areas located further than approximately 400 to 500 feet from the shoreline has TDS concentrations less than 10,000 mg/L. However, there are no known water-bearing zones of adequate transmissivity in the shallow aquifer system to provide dependable and significant yield to a water production well.

Based on the monitoring wells screened in the deep aquifer, TDS concentrations in the deep aquifer are less than 10,000 mg/L indicating Class II groundwater. The former Asarco water production well (abandoned and sealed in 1994) was screened in the deep aquifer indicating this water-bearing zone is adequately transmissive to yield significant quantities of water.

Based on the proposed plans listed earlier in this section, there is no reason to believe that site development will alter the classification or potential use of groundwater in the shallow or deep aquifer systems. Drinking water for the Asarco Facility and for the surrounding residential and commercial areas is, and will continue to be, supplied by Tacoma Public Utilities.

## 6.3 Marine Use

The Site is not commonly used for recreational harvesting of shellfish and finfish. A recreational salmon fishery is located offshore of the northern portion of the Breakwater Peninsula. In addition, usual and accustomed fishing for the Puyallup Tribe occurs in this area. Recreational boating services are provided by the Tacoma Yacht Club and the Breakwater Marina. Marine sediment conditions will be preserved and restored and will continue to provide habitat for biological resources. Present and future recreational, commercial, and tribal fishing will continue.

<first portion of Section 7 is missing>

Potential human health impacts associated with ingestion of or direct exposure to groundwater were estimated for a hypothetical residential setting and for industrial and commercial workers. The risk assessment results showed that estimated cancer risks and non- cancer health effects from the Site are the highest under the residential use scenario from drinking Site groundwater concentration from birth to age 30 (the reasonable maximum exposure or RME) have total excess cancer risks on the order of 10-3 to 10-1 and noncarcinogenic hazards of 8 to 1,019 depending on the area of the Site. Risks from drinking water, however, were second to soil ingestion risks for all receptors. Drinking water was only evaluated quantitatively at the wells where the two highest carcinogenic and noncarcinogenic risks were located. Arsenic is responsible for virtually 100 percent of the carinogenic risks in groundwater with an excess cancer risk of 4 x 10-2, and 90 percent of the noncarcinogenic hazard (total hazard index of 181).

Potential acute hazards from fish exposed to chronic, undiluted concentrations in groundwater were also considered in the human health risk evaluation of groundwater. Results of a screening comparison showed hazards to recreational fisherpersons from four metals: arsenic, mercury, manganese, and beryllium.

Human health risks associated with dimethylaniline (N, N-dimethylaniline or DMA) and related breakdown products (methylaniline [N-methylaniline] and aniline) were evaluated qualitatively in the 1992 risk assessment. As stated in Section 5.4.1, DMA- related compounds occur in Class III groundwaters at the Site. The risk assessment acknowledged that such groundwater was considered a hypothetical drinking water pathway for purposes of assessing risks associated with DMA and related compounds. The human health threat was found to be low. Further, exposure and hazards to recreational fisherpersons due to the release of DMA to Commencement Bay by the discharge of Class III groundwater from the Facility was also found to be minimal (Kleinfelder, December 1992).

The complete human health risk assessment is presented as Appendix M of the RI report (Hydrometrics, August 1993). A summary of the 1992 risk assessment is also presented in Section 6 of the 1995 ROD for OU 02 (EPA, March 1995).

**7.1.2 Seafood Ingestion Risks**

A human health screening risk assessment was performed to address risks attributed to consumption of fish taken from water at and adjacent to the Site (Roy F. Weston, October 1996). It was assumed that human consumption of fish was the most likely and only route of exposure associated with contaminated sediment and surface waters of Commencement Bay. Only ingestion was considered because dermal contact with the sediments or respiratory exposure to sediment vapors was considered improbable for saturated sediments. It was also assumed that fishing for demersal resident finfish (e.g., sole, sculpin, etc.) Would be similar to the fishing opportunities and access provided at the public pier (south of the Asarco Facility on Ruston Way). Salmon were not addressed, as these fish are transient and mobile.

Samples of rock sole (whole body and fillets) were collected from five areas near the Asarco shoreline as well as from one reference area near Brown’s Point. Rock sole were selected because they are one of the few species that could be readily obtained at the Site and are year-round residents within the area. All of the samples were analyzed for several metals. The samples from Brown’s Point were used to represent background conditions and assess if concentrations of metals in the fish from the water offshore of Asarco are above background levels. Because the sample fish catch was limited and because only one background sample was available, this assessment was considered a screening analysis.

Tables B-10 and B-11 in Appendix B summarize the chemical concentrations detected in the sole body and fillet tissue respectively. The inorganic arsenic level in the Brown’s Point sample (0.034 mg/kg) was less than the average of the five samples (0.056, range of 0.022

to 0.0083 mg/kg) collected from the waters at and adjacent to the Site, but it was higher than and/ or comparable to the level found in two of the five individual Asarco samples (0.022 and 0.038 mg/kg). Arsenic was the only metal evaluated in the risk assessment because it was the only contaminant detected in all of these fish samples that exceeded its respective risk-based screening concentration developed by EPA Region III (EPA, October 1995).

For the risk assessment, cancer risks and non-cancer health impacts from inorganic arsenic were estimated using the maximum fish concentration found in the five samples. This maximum arsenic concentration was then used to assess the risk associated with a range of fish ingestion rates (e.g., ingestion rates for subsistence and recreational fisherpersons). The low end of this range (1 gram per day of fish) was selected to represent the consumption of an infrequent sports fisherperson, who might eat fish from the waters at and adjacent to the Site a few times a year. A high-end assumption (292 grams per day of fish over 24 years; 350 days per year) was selected to represent the consumption of a subsistence fisherperson.

The potential non-cancer health impacts were evaluated by comparing the exposures calculated form eating fish to EPA's Reference Dose (RfD). The RfD represents an exposure level that an individual may be exposed to without experiencing any health impacts. All of the exposures, using the range of ingestion rates (infrequent sports fisherperson ingesting 54 grams/day to subsistence fisherperson ingesting 292 grams/day), were below the RfD for both the Site and reference samples. Therefore, noncancer health impacts from eating finfish and considered unlikely.

The potential cancer risk estimated for the sports fisherperson from eating fish taken from waters at or adjacent to the Site was about 6x 10-6, while the potential cancer risks for the subsistence fisherperson was estimated to be approximately 2x 10-4.

A risk assessment was also done using the Brown's Point reference sample. The estimated cancer risk for a subsistence fisherperson for this reference sample was approximately 7x10- 5. Therefore, the cancer risks from consuming fish taken from waters at or adjacent to the Site appear to be slightly higher than that from consuming fish from the reference area. This conclusion, however, is somewhat uncertain because of the limited sampling done in the reference area.

### 7.1.3 Summary of Human Health Risk Uncertainties

Every aspect of a risk assessment contains sources of uncertainty. "Typical" risks are calculated as a comparison to provide conservative estimates. Some of the uncertainties for the human health risk assessments results from the following factors:

- The amount and type of fishing that may occur at the Site in the future is uncertain.
- The assumption that cancer risks are higher at the Site may be a disputed conclusion because comparable sampling data available for the reference area is limited.
- In the human health risk assessment for sediments, health-protective assumptions (e.g., subsistence ingestion rates, maximum fish contaminant levels) were used to estimate the potential cancer risk and non-cancer health impacts. The impacts from consuming rock sole from the water adjacent to the Site are believed to be conservative.
- There is a lack sample data representing additional species of finfish and other aquatic life from near the Site that may be consumed by humans.

## 7.2 Ecological Risk Assessment

Ecological risk was evaluated by the Asarco Sediment/Groundwater Task Force. Sections 7.2.1 and 7.2.2 describe the associated findings for groundwater and sediments, respectively.

**7.2.1 Groundwater**

As addressed in Section 5.1.1, Site groundwater ultimately discharges to Commencement Bay. Therefore, possible groundwater-related risk to aquatic life in the waters and marine sediments of Commencement Bay were evaluated.

In 1996, the Asarco Sediment/Groundwater Task Force was formed to conduct additional evaluations related to groundwater and its potential impact on the aquatic life in Commencement Bay. The Task Force, consisted of personnel from EPA, Ecology, National Oceanic and Atmospheric Administration (NOAA), and other Trustee agencies. Specifically, the Task Force considered possible effects of metals loading to marine sediments and bay waters under both pre-and post-remediation conditions.

The RI/FS process considered a wide range of organic compounds and metals that could potentially affect ecological receptors. With respect to organics, the RI and post-RI groundwater monitoring determined that, with the exception of compounds related to DMA (e.g., aniline) present in the Southeast Plant/DMA area, organic constituents are detected infrequently and typically at low concentrations (See Section 5 and Appendix A). The risk assessment work conducted during the RI indicated that DMA-related compounds do not accumulate in fish and have a negligible contribution to human health risk. Monitoring data collected over the years since the RI indicate that the concentrations of DMA-related compounds decrease to very low or non-detectable levels before they reach Commencement Bay. Organic constituents are therefore not considered COCs for OU 06, due to their isolated numbers and distribution, low concentrations near the shoreline, and negligible risk.

Specific in organics in groundwater have been regularly evaluated through the RI/FS process and the post-RI groundwater monitoring program. Most recently, the Asarco Sediment/ Groundwater Task Force re-assessed the list of COCs by reevaluating the following metals: arsenic, cadmium, copper, lead, nickel, and zinc. Based on modeling and post- RI monitoring data, the Task Force determined that arsenic and copper represent the primary COCs for groundwater discharging to Commencement Bay (Hydrometrics, April 1999).

The findings of the Task Force regarding the impact of groundwater on the sediments and waters of Commencement Bay are summarized as follows.

- Under current (pre-remediation) conditions, metals loading ( in particular arsenic and copper) to Commencement Bay by groundwater and surface water discharge results in potential risks to aquatic organisms in the water column as indicated by exceedance of applicable water quality criterial.

- Contaminants present in marine sediments at the Site are believed to be primarily associated with historical contaminant source other than groundwater (e.g., historical surface water discharges and erosion and deposition of slag particles). However, the Task Force did not attempt to quantify the importance or magnitude of these historical contaminant sources.

**7.2.2 Sediment**

Based on information obtained during the Asarco Remedial Investigation (RI), EPA recognized that the Asarco OU 06 Site had characteristics that set it apart from other Operable Units in the Commencement Bay/Nearshore Tideflats area. Asarco sediments are different from most other sediments in Commencement Bay due to the presence of slag. Slag has high concentrations of metals, but these metals are bound in a rock-like form, which are not necessarily available to the benthic community. Therefore, the sediment chemistry could have high concentrations, yet the biological community could be healthy. This

difference was first noted in the Commencement Bay/Nearshore Tideflats ROD (EPA, September 1989) and later in the Upland Smelter Facility ROD (EPA, March 1995). The difference was further addressed by the Sediment Design Group, with representatives from EPA, Ecology, and NOAA.

Supplemental marine sampling and analyses conducted at the Asarco Sediments Site (OU 06) in 1989 and 1990 more clearly defined the peripheral areas where biological effects were observed (Parametrix, 1990 and 1991). An additional supplemental marine survey determined that benthos in the Yacht Basin were exhibiting toxic effects; however, it could not be determined what caused these effects. EPA produced a Supplemental Feasibility Study (SFS) that was based on this previously collected data (Roy F. Weston, October 1993).

To further define the areas and types of chemicals associated with potential contaminant effects, EPA, Asarco, and agencies participating in the Asarco Sediment/Groundwater Task Force agreed that an expanded RI/FS should be conducted. The chemical and biological data used to complete the SFS and the Expanded RI/FS investigations were obtained from 62 sampling stations in the offshore area (Figure 5-10). EPA used the data from these 62 sampling stations to characterize potential ecological risks as presented in the Ecological Risk Assessment and Seafood Consumption Screening Risk Assessment (Roy F. Weston, October 1996).

All of the data and evaluation measures were correlated and used in a "preponderance-of-evidence" approach to more fully identify current and potential impacts and risks to aquatic receptors. Because of the presence of slag, the bulk sediment chemistry results may not be representative of the actual toxicity of the sediments. Based on this difference between sediments at the Asarco Sediments Site and most other sediments in Commencement Bay, the Sediment Design Group relied upon best professional judgement, and gave greater weight to the benthic evaluation than to the chemistry and bioassay data. Table C-1 in Appendix C presents a summary of the chemical and biological factors that we used to define potential ecological risk. This was accomplished by developing a range of possible impacts that were based in part upon state SMS biological and chemical criteria. A total of five impact categories were assigned to the Site. The locations of these five categories are plotted by sediment station in Figure 7-1. The relative locations of the categories at the Site were then assembled into three zones called Impact Stations, which are described as follows:

- **Non-Impacted/ Minimally Impacted Stations.** Approximately 61 percent of the stations are within the non-impacted/minimally impacted stations (Figure 7-1). The non-impacted and minimally impacted stations fall into three subcategories:

  - Stations that are considered to be currently unimpacted and pose no potential future risks to the aquatic organisms (e.g., fish and other bottom-dwelling animals) because contaminant concentrations were below state SQS.

  - Stations that are considered to have no current impacts, but may have impacts in the future (i.e., these stations have chemical concentrations greater than state standards but biological testing showed no adverse impacts).

  - Stations that have a current minimal impact and may have impacts in the future (i.e., these stations had minor biological CSL exceedances, but no chemical CSL exceedances.

- **Moderately Impacted Stations.** Moderately impacted stations are those that have a limited number of adverse biological impacts (i.e., a bioassay result indicated an impact of benthic abundance in a sediment sample that was significantly different from a reference sample), but the overall health of the biological community does not appear to be substantially impacted. For example, there were stations that had chemical and bioassay exceedances above corresponding SMS criteria, but a healthy biological community. These stations included approximately 28 percent of the locations sampled (Figure 7-1).

- **Severely Impacted Stations.** Stations were considered severely impacted when sediment chemical concentrations exceeded CSLs and multiple biological impacts (e.g., more than one biological test exhibited a significant effect) were observed. In addition, every station that had a benthic community structure that indicated a stressed environment was included in this category. Approximately 11 percent of the stations (170,000 square yards or approximately 35 acres) exhibited these characteristics. The severely impacted stations are shown in Figure 7-1.

### 7.2.3 Summary of Ecological Risk Uncertainties

As mentioned previously, every aspect of a risk assessment contains sources of uncertainty. The uncertainties associated with the ecological risk assessment are summarized as follows:

- The chemical analytical laboratory detection limits differed over time.
- The bioassay laboratory sample handling methods and testing procedures differed over time.
- Ample benthic data from site investigations are not available.
- Sample results were assumed to represent conditions over larger areas than the samples that were collected.
- The benthic community was assumed to be continuously exposed to a prescribed level of contaminants, even though there is variability in contaminant distribution at the Site.
- Bioassays, since they are performed in a laboratory, do not necessarily represent Site conditions.
- There were small variations observed between the reference area conditions and Site conditions.

# 8 Remedial Action Objectives

The groundwater and sediment investigations for OU 06 have identified contamination from the release of hazardous substances to the environment that may present an inminent and substantial endangerment to public health, welfare or the environment. The need for action was determined based on the results of the human health and ecological risk assessments. In addition, contaminant levels in groundwater exceed Washington State's Model Toxics control Act (MTCA) standards and marine water SQSs and marine sediments are contaminated at level above the state SMS. The remedial action objectives (RAOs) for 06 are presented below.

## 8.1 Groundwater

EPA's RAOs for groundwater are as follows:

- Prevent ingestion of groundwater containing contaminant concentrations above federal maximum contaminant levels (MCLs) or above risk-based goals for those substances for which MCLs have not been established and prevent direct contact with groundwater containing contaminant concentrations above applicable risk- based goals.

- Prevent discharge to Commencement Bay of groundwater containing contaminants at concentrations exceeding applicable marine surface water quality standards, risk-based levels protective of human health, or background concentrations (if background concentrations are higher than the applicable standards).

The RAOs for groundwater are based on the intended site development uses described in Section 6 and consistent with applicable or relevant and appropriate requirements (ARARs) described in Section 13.

The first ROA for groundwater protects human health by limiting groundwater ingestion and contact. In particular, the RAO addresses the potential risk associated with human exposure to arsenic, the primary human health risk driver identified in the risk assessment (Section 7.1).

The second RAO protects marine life in Commencement Bay by limiting contaminants in groundwater such that marine chronic criteria are not exceeded at the point of groundwater discharge to marine waters. In addition, risk to human health through the fish consumption pathway is addressed by limiting the concentration of contaminants available to marine organisms.

Specific groundwater cleanup levels protective of human health and the environment are discussed in Section 12.

## 8.2 Sedment

EPA's RAO for sediment is as follows:

- Restore and preserve aquatic habitats by limiting and/ or preventing the exposure of environmental receptors to sediments with contaminants above Washington State SMS (WAC 173-204).

The RAO for sediment is based upon predicted offshore uses as described in Section 6 and is consistent with ARARs (see Section 13).

The RAO protects human health by restricting and limiting contaminant concentrations available to marine biological resources that could be a source of seafood for recreation and subsistence users.

The RAO protects marine life in the sediments of Commencement Bay by limiting exposure to

contaminated sediments by capping and dredging and by inhibiting discharge of contaminated groundwater to the bay.

Sediment cleanup levels that are protective of human health and the environment are discussed in Section 12.

# 9 Description of Alternatives

The various feasibility study documents prepared by Asarco and EPA identify a range of alternatives to address the Sediments/Groundwater OU 06. These alternatives include active cleanup options (e.g., capping and dredging) and institutional controls (e.g., limiting access).

An Operation, Maintenance, and Monitoring Plan ( OMMP) is necessary to ensure the continued effectiveness of any remedy. Important components of the OMMP include maintaining the integrity of the remedy and monitoring the sediments to verify they are meeting the RAOs. Expectations for this longterm monitoring program are summarized in Section 12 of this document; a detailed OMMP will prepared in parallel with the remedial design/remedial action (RD/RA) process, with a final long-term monitoring program in place by the remedial action is complete.

## 9.1 Groundwater

The groundwater alternatives discuss in this section were originally presented in the Asarco Plant Feasibility Study for OU 02 (Hydrometrics, August 1993). The alternatives addressed in the 1993 FS were reviewed again in 2000 in light of groundwater information that has become available in the intervening seven years (see Historical Summary of the Evaluation of Groundwater Remedial Alternatives; Hydrometrics, June 2000). Certain elements of the groundwater alternatives presented here are actually part of the Selected Remedy identified in the 1995 ROD for OU 02 (EPA, March 1995). For example, contaminant source removal, surface water controls, and site capping are part of the Selected Remedy for OU 02. Although these remedy elements are required to meet the RAOs for OU 02, they also directly benefit the OU 06 groundwater present immediately beneath OU 02. Specifically, these OU 02 remedy elements will minimize transfer of contaminant load discharge to Commencement Bay through groundwater. See Section 4 of this ROD for more information on the relationship between the four OUs associated with the Asarco Facility, including the close relationship between OUs 02 and 06.

Table 9-1 present four remedial action alternatives identified for OU 06 groundwater. As discussed above, this list is based on alternatives that were first identified in the 1993 FS and later refined in the Historical Summary of the Evaluation of Groundwater Remedial Alternatives (Hydrometrics, June 2000).

## 9.2 Sediment

In evaluating cleanup action alternatives, the EPA relied on the SMS that considers net environmental impacts, technical feasibility, and cost (WAC 173-204-570(4). Based on the unique nature of slag (i.e., metal contamination not necessarily available to the biological community), and as the benthic community is a good measure of the health of the sediment ecosystem, the benthic results were used to identify the most highly impacted areas where remedial action is necessary. The severely impacted sediment stations (Figure 7-1) are identified as the “Contaminant Effects Area” (Figure 9-1). Active remediation is necessary in the Contaminant Effects Area.

The presence of relatively healthy benthic communities in areas outside of the Contaminant Effects Area suggest that active cleanup outside of the Contaminant Effects Area may not be appropriate. Active cleanup might result in greater net negative impacts through destruction of existing habitats than if not remediated. The moderately impacted sediment stations (Figure 7-1) are identified as the “Moderate Impact Area” (Figure 9-1) and will not receive active remediation. Monitoring is deemed the most appropriate action for the Moderate Impact Area.

Five general remedial action alternatives were considered for the marine sediments in the Contaminant Effects Area. These were:

- No action — No action is taken.
- Natural Attenuation — Reliance on natural deposition of clean sediment over time to cover the contaminated sediment.
- Capping — Covering contaminated sediments with clean material to prevent exposure of humans and marine organisms to contaminants.
- Dredging and Nearshore Confinement — Dredging of contaminated sediment and placement of spoils in a nearshore confined aquatic disposal (CAD) facility.
- Dredging and Upland Disposal — Dredging of contaminated sediment and placement of spoils under the low-permeability upland cap being constructed as part of the remedial action for OU 02.

The Contaminant Effects Area was divided into different remediation areas (Nearshore/Offshore, Yacht Basin, Northshore, and the Breakwater Peninsula), as shown in Figure 9-2. The areas were identified based on the specific characteristics of each remediation area and the potential ability to implement sediment cleanup technologies in those areas. The alternatives considered for the Nearshore/Offshore, Yacht Basin, and Northshore areas are summarized in Tables 9-2 through 9-4. The following discusses the remedial action alternatives that are not suitable for a particular remediation area, including the impracticability of remediating sediments offshore of the Breakwater Peninsula.

### 9.2.1 Nearshore/Offshore and Northshore Area

All five cleanup technologies listed above are considered possible in the Nearshore/Offshore and Northshore areas (Table 9-2 and 9-4).

### 9.2.2 Yacht Basin

Due to navigation concerns, capping was not considered possible for the Yacht Basin (Table 9-3) because a sediment cap would decrease the depth of the waters and potentially interfere with marine navigation.

### 9.2.3 Breakwater Peninsula

The Breakwater Peninsula area comprises the sediments east of the Breakwater Peninsula (Figure 9-2), which is approximately 85,000 square yards or 17.5 acres. The sediment depth off the Breakwater Peninsula in some areas is almost 100 feet deep (within 200 feet from shore). The subtidal slope in this area can be up to 50 percent. The stability of a cap on such steep slopes is questionable, and the construction of a nearshore facility on such a slope would be very difficult (e.g., making a berm stable on a steep slope is difficult). In addition, dredging is not possible because the entire peninsula would need to be removed to provide a post-dredging slope that is flat enough to be stable. Although capping or dredging of the Breakwater Peninsula is not feasible, shoreline armoring will be placed in the intertidal areas where possible, as part of the OU 02 remedy. This will reduce the erosion of slag in this high-energy area.

# 10 Summary of Comparative Analysis of Alternatives

Nine criteria have been used to evaluate the different remediation alternatives individually and against each other in order to select a cleanup remedy. A selected remedy must meet the first two "threshold" criteria. EPA uses the next five criteria as "balancing "criteria for comparing alternatives and selecting a preferred remedy, which is presented in the Proposed Plan. After public comment on the Proposed Plan, EPA may alter its preference on the basis of the last two "modifying" criteria.

The nine criteria are summarized below.

**Threshold Criteria**

1. **Overall Protection of Human Health and the Environment.** How well does the alternative protect human health and the environment, both during and after construction?

2. **Compliance With Applicable or Relevant and Appropriate Requirements (ARARs).** Does the alternative meet all ARARs from state and federal laws? Does the alternative qualify for an ARAR waiver?

**Balancing Criteria**

3. **Long-Term Effectiveness and Permanence.** How well does the alternative protect human health and the environment after completion of cleanup? What, if any, risks will remain at the Site?

4. **Reduction of Toxicity, Mobility, or Volume Through Treatment.** Does the alternative effectively treat the contamination to significantly reduce the toxicity, mobility, and volume of the hazardous substance?

5. **Short-Term Effectiveness.** Are there potential adverse effects to either human health or the environment during construction or implementation of the alternative? How fast does the alternative reach the cleanup levels?

6. **Implementability.** Is the alternative both technically and administratively feasible? Has the technology been used successfully on other similar sites?

7. **Cost.** What are the estimated costs of the alternative?

**Modifying Criteria**

8. **State/Tribal Acceptance.** What are the state's and tribes' comments or concerns about the alternatives considered and about EPA's Preferred Alternative? Do the state and tribes support or oppose the preferred alterative?

9. **Community Acceptance.** What are the community's comments or concerns about the Preferred Alternative? Does the community generally support or oppose the Preferred Alternative?

The remainder of this section addresses the remediation alternatives listed in Section 9 in the context of the nine criteria.

## 10.1 Overall Protection of Human Health and the Environment

### 10.1.1 Groundwater

All of the groundwater alternatives, except the no action alternative, are protective of human health. Institutional controls will prohibit the use of contaminated groundwater at

the Facility. The groundwater discharging to Commencement Bay may exceed the National Toxics Rule (NTR) for fish consumption (0.14 ug/L for arsenic). However, a risk assessment based on data from fish tissue samples collected during the sediment RI indicates slightly higher risks from Site contaminants to people consuming large quantities of fish from the Site as compared to the Reference site. This risk assessment information is based on pre-remediation conditions where groundwater samples collected from wells adjacent to the shoreline indicate arsenic at concentrations of approximately 10 to 30 ug/L. Thus, any human health risk is expected to decline further after to be reduced by the cleanup activities. The remedial alternatives involving active groundwater treatment would likely be more protective than capping and groundwater interception (where groundwater is pumped/treated or treated in situ) since groundwater contaminant levels will be further reduced. The no-action alternative is not protective of human health and thus is not evaluated further.

At present, the quality of groundwater discharging to Commencement Bay is not considered protective of the environment. Specifically groundwater discharging to the Bay contains metals (primarily copper) in excess of their respective marine chronic criteria. Therefore, the no action alternative is not considered protective. Alternative GW-C acceptable levels with properly located extraction wells. Alternatives GWD (In Situ) Groundwater Treatment) and GW-E (In situ Treatment by Seawater Injection) are best suited to precipitate arsenic by oxidation. However, these alternatives may not effectively reduce copper concentrations because copper becomes more mobile as oxygen levels increase. Alternative GW-B, the Preferred Remedy identified in the Proposed Plan (EPA, January 2000a) is believed to have the greatest likelihood of reducing metals loading to Commencement Bay by minimizing groundwater discharge by an estimated 75 to 95 percent.

**10.1.2 Sediment**

Protectiveness is based on how clean the remaining surface sediments will be following cleanup. The assumption that lower contaminant concentrations result in higher sediment quality was primary used to rank the alternatives for overall protection. All of the sediment alternatives, including the No Action alternative, are believed to be protective of human health based on a screening risk analysis (see Section 7.1.2) performed for the Site. The No Action alternative is not protective of the environment and is therefore not further evaluated under the nine criteria. Capping and dredging, however, are expected to achieve EPA’s and Ecology’s acceptable risk criteria.

**Natural Recovery.** Natural Recovery was evaluated as part of the RI/FS (Parametrix, December 1996). Evaluations determined that recovery of the sediments to concentrations lower than the cleanup levels would not occur within a reasonable time frame as defined by the SMS (i.e., less than 10 years). Natural Recovery cannot occur within a reasonable time frame because there is not sufficient sedimentation in this area to cover existing contaminated sediment within the 10-year time frame. The Natural Recovery alternatives (S-1B, S-2B, and S-3B [Tables 9-2, 9-3, and 9-4]) are not considered protective of the environment because they would not prevent aquatic organisms from coming into contact with the contaminants for many years, if ever. Therefore, the natural recovery alternatives are not evaluated further under the nine criteria.

**Capping Versus Dredging.** Capping is the most protective alternative in the Nearshore area, where the depth of contamination is very deep because the shoreline is constructed of slag. Dredging of this area would be difficult due to concerns regarding the stability of subtidal slopes. Furthermore, dredging would inevitably encounter and expose the slag that is impracticable to remove in its entirety. Therefore, the highest degree of protectiveness would be provided by capping the contaminated sediments in the Nearshore, Offshore, and Northshore areas with clean sediment imported from another location (note that the Northshore area may be dredged depending on remedial design considerations).

## 10.2 Compliance with Federal and State Environmental Standards

### 10.2.1 Groundwater

Modeling performed by the Task Force indicates that state and federal laws applicable to protection of marine water quality may not be currently achieved in Commencement Bay waters within a few feet of the shoreline for all metals (Hydrometrics, April 1999). Although model results did indicate some metal concentrations above marine chronic criteria, the Task Force placed more emphasis on empirical data rather than model predictions in assessing current and potential impacts from groundwater discharge. The Task Force concluded that with the exception of copper, groundwater discharge currently does not cause metal concentrations to be higher than marine chronic criteria. Under the Alternative GW-B, metals concentrations in groundwater flowing toward the shoreline are expected to decrease in future years in response to the site-wide changes (i.e., reduced groundwater discharge) affected by the cleanup. These changes are expected to allow all groundwater ARARs to be met in the future.

Alternative GW-C (Pump/Treat and Discharge to Outfalls) is likely capable of achieving ARARs at the point of compliance with properly located extraction wells. It is not certain if Alternatives GW-D and GW-E (In situ Treatment by Seawater Injection and Pump/Treat and Discharge to Outfalls, respectively) would achieve groundwater ARARs. The Task Force findings suggest that these two alternatives could actually increase the copper loading of copper increases with the dissolved oxygen content).

### 10.2.2 Sediment

For sediments, the RAO is to restore and preserve aquatic habitats by limiting and/or preventing the exposure of environmental receptors to sediments with contaminants above Washington State SMS. An isolating cap would achieve the standards, as long as it stayed in place as a physical barrier and does not become recontaminated. Institutional control would help ensure that the integrity of the cap is maintained. The dredging/nearshore confinement and dredging/upland disposal alternatives would also meet the standards if all of the contaminated sediments could be removed. Dredging in the Nearshore/ Offshore area would be less likely to meet ARARs than dredging in the Yacht Basin, since removing all of the contaminated material in this area would be impossible.

The Clean Water Act Section 404 criteria will be met, including any potential need for mitigation and related Endangered Species Act requirements. This is being addressed as part of the Clean Water Act Section 404 analysis and will be completed concurrently with this ROD.

## 10.3 Long-Term Effectiveness and Permanence

### 10.3.1 Groundwater

All of the alternatives will minimize generation of contaminated groundwater by reducing ground water recharge, flow through contaminated source areas, and ultimately the discharge of contaminants to Commencement Bay. The remedial alternatives involving active groundwater treatment would further lower groundwater contaminant concentrations and, therefore, have the lowest residual risk. However, this benefit is not permanent, as it would occur only as long as the treatment systems were operating. Since most of the onsite slag will not be removed by any of the upland cleanup activities, the slag will continue to contribute contaminants to groundwater indefinitely. Therefore, reduction of surface water infiltration and groundwater flow to Commencement Bay is critical to making the Selected Remedy effective as a long-term protection of human health and environment. The in situ groundwater treatment and seawater injection alternatives may be less reliable than the pump and treat alternative because these treatment technologies are generally less proven. These latter treatment methods may not be necessary if effectiveness can be achieved with groundwater and surface water flow reductions combined with selected

contaminant source removals.

#### 10.3.2. Sediment

Removing contaminated sediment and consolidating it upland is considered more reliable than capping in place because removal and placement results in a smaller and more controlled area of contaminated sediments. In addition, an engineered upland disposal facility is easier to inspect, monitor, and maintain than a larger aquatic capped area or aquatic disposal site. Therefore, the greatest degree of long-term effectiveness is provided by dredging the contaminated sediments (assuming all contamination can be removed) and placing them on the upland Facility. In those areas where all contaminated material cannot be removed (i.e., the Nearshore area), in situ capping is best. In these areas, a cap can be designed with appropriately sized material such that it provides long-term isolation of the contamination (i.e., it remains in place and does not wash away with wave action or ship traffic and does not become recontaminated), while providing acceptable aquatic habitat. The cap would also be monitored regularly to ensure it is being effective.

### 10.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

#### 10.4.1 Groundwater

All of the groundwater alternatives, including GW-B, would reduce the toxicity, mobility, and volume of contaminants through treatment. Groundwater intercepted at the On- Site Containment Facility and Stack Hill will be routed through the surface water treatment system, as required, before being discharged to Commencement Bay. The in situ treatment and seawater injection treatment alternatives would promote chemical precipitation of arsenic from groundwater, thereby reducing the arsenic load reaching Commencement Bay. Because all alternatives include capping, groundwater interception, and replacement of leaking subsurface water lines, the mobility of the contaminants and volume discharge to Commencement Bay is expected to be reduced by an estimated 75 to 95 percent.

#### 10.4.2 Sediment

None of the alternatives involve treatment of the sediments. Treatment is not proposed for the sediments for several reasons. First, in order to treat the sediments, they must be removed. This difficult in the Nearshore/Offshore area of OU 06 since the contaminated sediments are located in waters up to approximately 150 feet deep. Therefore, the chance of leaving contamination behind is very high. Second, since slag was poured to create the shoreline in portions of the Nearshore area, dredging in this area would be difficult due to slope stability issues. Third, the net benefit of treating the sediments is questionable as slag particles within the sediment matrix are already in a relatively immobile form (e.g., the slag does not tend to be bioavailable). Fourth, costs associated with treatment of the Yacht Basin sediments prior to upland containment above the groundwater table and under a low- permeability cap would be disproportionate to the incremental benefit that may be achieved if the sediments were contained under an upland cap without treatment.

### 10.5 Short-Term Effectiveness

#### 10.5.1 Groundwater

All of the alternatives present minimal risks to the community and workers during cleanup. Similarly, all of the alternatives have minimal short- term environmental impacts. Best Management Practices (BMPs) would need to be implemented during construction for all alternatives. To limit the short-term impacts, implementation of any of the groundwater alternatives must be coordinated with the other upland cleanup actions. All of the alternatives therefore would require several years to construct, and several years are expected for there to be a noticeable improvement in groundwater quality.

### 10.5.2 Sediment

Short- term environmental impacts include water quality impacts, exposure of marine life to contaminants, and habitat loss (i.e., fisheries impacts) during the implementation of the remedial alternative. Remedial alternatives that involve dredging contaminated sediments would result in a potential for deleterious water quality and fisheries impacts (due to disturbance of contaminated sediment), human exposure to contaminants, and possible worker injury/ exposure resulting from the use of dredging equipment. Remedial alternatives that involve capping contaminated sediments and constructing a confined aquatic disposal area would result in short- term loss of aquatic habitat due to covering the currently existing benthic community. These alternatives also have a potential to suspend contaminated sediment. Overall, capping has the greatest short-term effectiveness (e.g., the least short-term impact) because it requires the least amount of in-water work, and the contaminated material is not significantly disturbed. Dredging and construction of a nearshore facility would have the greatest short-term impacts due to the extensive in-water work required.

Although all these alternatives have short- term impacts, much of the short-term risk associated with both dredging and capping can be significantly reduced by carefully choosing methodology and BMPs (e.g., controlling the dredge depth and speed of dredging, controlling the rate of placement of cap material).

## 10.6 Implementability

### 10.6.1 Groundwater

Compared to the others, the Alternative GW-B is most easily implemented. The pump and treat alternative would be the most difficult to construct and operate since very large quantities of groundwater would require pumping and treatment (i.e., it is estimated that hundreds of gallons per minute would be required due to the incidental capture of seawater by the extraction system). However, pump and treat technology is reliable and available. The remedial alternatives involving in situ groundwater treatment would be easier to construct and operate but are less proven and reliable technologies than pump and treat. The in situ treatment alternatives would require pilot testing to confirm their efficacy at the Site. All of the alternatives would require long- term operation, maintenance, and monitoring.

### 10.6.2 Sediment

Capping and dredging are feasible actions depending on site-specific conditions. Construction of a sediment cap in the Nearshore /Offshore area would occur in relatively shallow water with modest subtidal slopes. The results of the pilot cap study (Parametrix, February 2000) indicate that capping in this area can be accomplished without unusual difficulty. Similar conditions exist in the Northshore area and placement of a sediment cap in that area is also considered feasible.

Dredging is infeasible in the Nearshore/Offshore area for several reasons. First, when the slag was poured, it solidified vertically in some areas, such that sediment removal in these areas could destabilize the bank (i.e., undercut some upland portions of the Facility). Second, if all slag were removed, a cutback of 60 to 120 feet of material would be required, making removal of the entire Breakwater Peninsula necessary. Due to the slag depth of the Breakwater Peninsula (up to 125 feet), removal of this entire peninsula is not considered a viable option. The Yacht Club facilities and parking lot located on the Breakwater Peninsula also prohibit dredging of the Nearshore/Offshore area. Placement of a sediment cap in the area offshore of the Breakwater Peninsula is also impracticable for reasons discussed in Section 9.2.3.

The Yacht Basin has relatively shallow water and gentle subtidal slopes such that dredging in this area can be accomplished. However, the presence of piers and pilings may slow the

work and require the use of hand operated suction dredge equipment. A nearshore confined aquatic disposal (CAD) facility is also feasible but would require more engineering controls. Confined upland disposal of sediment at OU 02 would be more easily implemented than the nearshore confinement alternative because the upland work is already underway and space has been made available under the OU 02 low-permeability soil cap.

## 10.7 Cost

Cost estimates presented in this ROD are intended to be accurate within a range of +50 to -30 percent. Cost estimates are provided in Tables 9-1 through 9-4.

### 10.7.1 Groundwater

Aside from the no action alternative (GW-A), Alternative GW-B is the least costly ($1.8 million). The in situ groundwater treatment alternatives (GW-D and GW-E) are similar in cost ($4.3 million and $4.4 million, respectively). The pump and treat alternative (GW-C) is most expensive ($37.8 million).

Note that additional groundwater interception at the upgradient end of the Facility (southeast of Cooling Pond and Southeast Plant Area, see Figure 5-1) is technically possible under Alternative GW-B. However, Asarco has demonstrated that intercepting additional groundwater at the southwest (uphill) side of the Facility could only be done at a cost that is disproportionately high compared to the limited incremental environmental benefit expected.

### 10.7.2 Sediment

**Nearshore/Offshore Area.** For the Nearshore/Offshore area, dredging with upland disposal (Alternative S-1E) is the most expensive alternative at $26.2 million. Capping (Alternative S-1C, $11.6 million) is slightly less costly than dredging with nearshore confinement in a CAD (Alternative S-1D, $12.8 million).

**Northshore Area.** For the Northshore area, dredging with nearshore confinement in a CAD (Alternative S-3D) is the most expensive alternative at $0.86 million. Dredging with upland disposal (Alternative S-3E, $0.70 million) is slightly less costly than capping (Alternative S-3C, $0.74 million).

**Yacht Basin.** For the Yacht Basin, dredging with upland disposal ( Alternative S- 2D, $ 3.6 million) is less costly than dredging with nearshore confinement in a CAD ( Alternative S-2C, $ 5.1 million).

## 10.8 State/Tribal Acceptance

Ecology staff have reviewed this ROD with respect to governing state statutes and regulations administered by Ecology. Ecology concurs with the Selected Remedy as identified in this ROD.

The Native American tribes have participated in the review of certain major Site documents. No tribal comments were received on the Proposed Plan. It is EPA’s assumption that tribal representatives are in general agreement with the Preferred Remedy identified in the Proposed Plan.

## 10.9 Community Acceptance

EPA received written or verbal comments on the Proposed Plan from a few individuals and from Citizens for a Healthy Bay (see Part 3, Responsiveness Summary). The comments did not identify any issues causing EPA to change the core elements of the Preferred Remedy as presented in the Proposed Plan. Other comments were received from state and federal agencies. All comments, with EPA responses, are presented in Part 3 of this ROD. Based on

the number and nature of comments received, EPA believe's that the Preferred Remedy as identified in the Proposed Plan is acceptable to the public.

# 11 Principal Threat Waste

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). Principal threat wastes include wastes with high concentrations of toxic compounds or wastes that are highly mobile and generally cannot be contained in a reliable manner or would present a significant risk to human health and the environment should exposure occur (EPA, July 1999).

For groundwater and marine sediment at OU 06, the principal threat wastes are the contaminated materials in the six OU 02 source areas, which are identified in Section 5 and Figure 5-1 (the groundwater and sediment themselves are not considered principal threat wastes). The OU 02 source areas are:

- Stack Hill
- Copper Refinery
- Cooling Pond
- Fine Ore Bins Building
- Arsenic Kitchen
- Southeast Plant Area

The principal threat wastes at the Site are addressed by the OU 02 ROD (EPA, March 1995). These materials are being excavated and removed from the subsurface where practicable and placed in the On-site Contaminant Facility as part of the ongoing remedial action for OU 02.

# 12 Selected Remedy

The Selected Remedy for OU 06 includes the implementation of the following four alternatives

- **Groundwater Alternative GW-B.** Source removal, soil capping and surface water controls, groundwater interception /treatment, replacement of leaking subsurface water lines, and institutional controls and monitoring (see Table 9-1). Note that the majority of the remedy elements associated with Alternative GW-B are being addressed by the requirements of the OU 02 ROD (EPA, March 1995). With the exception of stipulating institutional controls and long-term monitoring related to groundwater, this ROD is not requiring additional groundwater remedies over and above those already being implemented under the OU 02 remedial action (see Section 4 for additional information on the relationship between OUs 02 and 06). This ROD also establishes the groundwater RAOs, and identifies the cleanup levels, point of compliance, and long-term monitoring requirements for groundwater.

- Sediments Remedy S-1C for Nearshore/Offshore Area. Sediment capping (Table 9-2).

- **Sediments Remedy S-2D for Yacht Basin.** Dredging and upland disposal (Table 9-3).

- **Sediments Remedy S-3C for Northshore Area.** Sediment capping (Table 9-4). Although capping is currently the Selected Remedy, dredging will be reevaluated for the Northshore area during the remedial design as described in Section 12.2.

The estimated cost of the **Selected Remedy** is $19.2 million. The estimated $19.2 million cost is divided between groundwater and marine sediment remedies as follows:

| | |
|---|---|
| Institutional Controls and Long-Term Monitoring Components of Groundwater Remedy (Alternative GW-B) . . . . . | $ 1.8 million |
| Sediments Remedy, Nearshore/Offshore Area (Alternative S-1C). . . . . | $ 11.6 million |
| Sediments Remedy, Yacht Basin (Alternative S-2D). . . . . | $ 5.1 million |
| Sediments Remedy, Northshore Area (Alternative S-3C). . . . . | $ 0.7 million |
| Total | $ 19.2 million |

The details of the selected remedies are described below for groundwater (Section 12.1) and marine sediments (Section 12.2).

## 12.1 Groundwater

EPA's Selected Remedy for groundwater is Alternative GW-B. Alternative GW-B includes elements currently being implemented under the OU 02 ROD (EPA, March 1995) plus long-term monitoring and institutional control requirements addressed in this ROD. Together, these remedy elements comprise EPA's Selected Remedy for OU 06 This remedy is being selected because evaluations conducted by the Asarco Sediment/Groundwater Task Force indicate that marine sediments and the waters of Commencement Bay will be protected by the remedial actions being implemented under the OU 02 cleanup. Combined with long- term monitoring and institutional controls being added by this ROD, the groundwater remedy is expected to be permanent and to meet the RAOs.

### 12.1.1 OU 02 Groundwater Remedy Elements

The OU 02 remedy is in progress with substantial completion scheduled for 2003 and final completion expected in 2005. The OU 02 remedy elements applicable to groundwater and included in Alternative GW-B are source excavation and placement in the On-site Containment Facility, site capping and surface water controls, groundwater interception/ treatment, and removal of leaking underground piping. Source control measures will reduce the volume of contaminants that are transferred to the groundwater. Capping, surface water

controls, groundwater interception, and removal of leaking pipes is expected to reduce groundwater discharge to Commencement Bay by approximately 75 to 95 percent (Hydrometrics, June 2000).

**Source Removal.** Excavation of principal threat wastes and contaminated soils from the OU 02 Site and permanent disposal of these materials in an On- site Containment Facility. Source control also includes stabilization of the shoreline to reduce slag erosion and its transport to the waters and sediments of Commencement Bay.

**Site Capping and Surface Water Controls.** The OU 02 Site (including the Breakwater Peninsula) will be capped with a low-permeability soil cover system to inhibit infiltration of surface water and precipitation. Run-off from precipitation falling on the cap will be captured in onsite surface water drainage systems and discharged to Commencement Bay. The cap surface will include controls to capture and direct surface water to Commencement Bay. Currently, a large percentage of groundwater discharging to Commencement Bay originates from onsite recharge of precipitation and surface water run- on. As part of the remedial action for OU 02, surface water controls will be constructed to capture surface water that would otherwise run onto the Facility from uphill locations and infiltrate into the shallow aquifer system. The captured surface water will be treated as necessary to meet the requirements of the OU 02 ROD (EPA, March 1995), and discharged to Commencement Bay.

**Groundwater Interception/Treatment.** Subsurface trenches or drains will be installed upgradient of the proposed On-site Containment Facility and railroad tunnel. These subsurface drainage systems will intercept and capture groundwater that would otherwise enter Facility aquifers. By reducing the recharge of Site groundwater, the overall contaminant load transported to Commencement Bay will be reduced. Groundwater captured by the interception trenches and drains will be directed to the Facility's surface water collection system and treated in conjunction with surface water collected as part of operations and maintenance requirements for OU 02. Treatment of the captured groundwater will be subject to the water quality requirements for OU 02 waters being discharged to Commencement Bay. **1**

**Removal of Leaking Underground Piping.** Leakage from underground stormwater, sewer, water, and fire protection lines is believed to contribute a significant volume of recharge to the shallow aquifer system. These underground lines will be either abandoned (sealed) or removed and replaced with new piping as needed. Some of this work has already been completed. Reduction of groundwater recharge from leaking pipes will reduce the overall, contaminant load associated with groundwater discharging to Commencement Bay.

### 12.1.2 Additional Groundwater Remedy Elements

The Selected Remedy includes two elements not previously addressed in the OU 02 ROD (EPA, March 1995). These remedies are institutional controls and long-term, post-remedial action monitoring.

Institutional Controls. Institutional controls for groundwater will include restrictions on groundwater use for domestic or industrial purposes. The objective of the prohibition is to prevent human exposure to contaminated groundwater. This will be achieved by prohibiting the drilling of water wells (other than for environmental monitoring or treatment) and prohibiting the use of groundwater as a drinking water source. Specifically, no water wells will be permitted in the shallow and deep aquifer systems. The prohibition on groundwater use is expected to be in force into perpetuity for shallow groundwater (slag, marine sand, and intermediate aquifers) because source materials (e.g., slag) will remain in place and in contact with shallow groundwater, under the terms of the OU 02 ROD (EPA, March 1995). Therefore, these source materials will continue to be in direct contact with groundwater. A prohibition on use of deep aquifer groundwater will also be implemented by this ROD until such time groundwater quality complies with applicable health-based criteria (e.g., maximum contaminant levels). Prohibitions on groundwater use would only be rescinded or relaxed if groundwater contaminants no longer

exceed acceptable levels as determined by EPA. The prohibition on groundwater use may be implemented through a combination of governmental controls (e.g., zoning restrictions or ordinances) and enforceable use restrictions that run with the land (e.g., a servitude or an easement that includes use restrictions and is properly recorded).

**Long-Term Post-Remedial Action Monitoring.** Long-term groundwater monitoring win occur on a regular basis after the remedial action is complete. The objective of the monitoring program will be to assess the performance of the Selected Remedy over time and to verify that the remedy continues to be protective of human health and the environment. At a minimum, monitoring wells at the downgradient perimeter of the Site (along the Commencement Bay and Yacht Basin shorelines) will be monitored. Monitoring wells upgradient of the Site and near key source areas (or former source areas) win also be required. Monitoring nearshore surface water in Commencement Bay will be required to assess impacts that discharging groundwater may have on the bay water.

**1** The design of this OU 02 water treatment system is in progress. Both polymer- and filtration- based systems designed to remove suspended metals from water are being evaluated. The post- treatment quality of the stormwater will not be determined until ongoing engineering studies are complete. However, design criteria call for the water to meet water quality criteria at the boundary of a defined mixing zone in Commencement Bay.

Details of the groundwater monitoring program will be presented in the OMMP. At a minimum, post-remedial action groundwater monitoring will include measurement of the following:

- Static groundwater level
- General water quality parameters (temperature, pH, conductivity, salinity, total dissolved solids, total suspended solids, turbidity, dissolved oxygen, chloride, and sulfate)
- Metals (arsenic, cadmium, copper, iron, manganese, nickel, lead, zinc)
- Organics (DMA area only; aniline, 4-chloroaniline, N-methylaniline, and N, N-dimethylanihne)

The OMMP will also address the expectations for groundwater quality improvements at the point of compliance (see Section 12.1.4) and identify trigger points at which additional groundwater controls would be considered.

The groundwater monitoring approach will be designed to complement the sediment monitoring program and monitoring required for OU 02 (e.g., monitoring of the On-site Containment Facility will be required under OU 02). The monitoring program will be subject to refinement by EPA based on results of the data collected. Additional details on the anticipated groundwater monitoring requirements are summarized in Section 12.1.5.

No further active remediation beyond those elements listed above are believed necessary at this time to address groundwater in OU 06.

**12.1.3 Groundwater Cleanup Levels**

**Cleanup Levels for Shallow Groundwater.** The cleanup levels identified for groundwater discharging from the Site are 3.1 ug/L for copper and 6 ug/L for arsenic (Table 12-1). These cleanup levels are being set to protect marine organisms in Commencement Bay (copper) and human health via the fish consumption pathway (arsenic). The established regional background (uncontaminated) concentrations for arsenic and copper in groundwater are 6 ug/L and 40 ug/L, respectively (EPA, April 1993).

The arsenic cleanup level of 6 ug/L is higher than the federal National Toxics Rule (NTR) standard of 0.14 ug/L for protection of human health based on a fish consumption pathway (40 C.F.R. Part 131.36). The NTR standard for arsenic (0.14 ug/L is a relevant and appropriate requirement for groundwater but is being waived by EPA for groundwater at OU 06. The natural background concentration of arsenic in groundwater in the Tacoma vicinity is 6 ug/L (EPA, April 1993). Further, the practical quantitation limit (PQL) for arsenic in site groundwater has historically been approximately 2 ug/L. As such, the federal NTR standard (0.14 ug/L is not an achievable or measurable cleanup level for groundwater at OU 06.

EPA is deferring to the State of Washington’s MTCA regulation as the basis for the arsenic cleanup level (6 ug/L). Within the MTCA framework for determining an arsenic cleanup level for this site, Ecology has determined that the federal NTR standard of 0.14 ug/L and MTCA marine surface water criteria of 0.0982 ug/L are both considered applicable. However, MTCA mandates that where a risk-based cleanup value is below a natural background concentration, the cleanup value will be adjusted to equal the natural background concentration (WAC 173-340-700 (4)(d)). Therefore, even though the NTR and MTCA marine surface water standards for arsenic are applicable under MTCA, MTCA supports a 6 ug/L cleanup level for arsenic without a need to waive any MTCA requirement.

The cleanup level of 3.1 ug/L for copper is protective of human health and marine life in Commencement Bay. The background concentration for copper in the vicinity of the Site is significantly higher. at 40 ug/L. However, it is believed that the copper cleanup level of

3.1 ug/L is achievable because concentrations are significantly diluted as groundwater mixes with seawater in the nearshore portions of the Site aquifers.

MCLs are not considered applicable to shallow groundwater at the Site because (1) most of the groundwater is categorized as Class III (non-potable due to high TDS levels) and (2) the Facility is considered a waste management area such that MCLs do not apply inside this area.

**Cleanup Levels for Deep Groundwater.** The cleanup levels applicable to the deep groundwater system are MCLs for metals (Table 12-1). It should be noted that this ROD imposes an institutional control on use of groundwater from the deep aquifer (see Section 12.1.2).

**12.1.4 Groundwater Point of Compliance**

Shallow Groundwater. In accordance with MTCA (WAC 173-340-720(6)(c) and (d)), compliance with the above-referenced cleanup levels for arsenic and copper in groundwater discharging from the Site will be determined at a conditional point of compliance. Normally, MTCA requires that a point of compliance be "established throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site" (WAC 173-340-720(6)(b)). Achieving groundwater cleanup levels "throughout the site," however, is not a reasonable expectation because hazardous substances (e.g., slag and other source materials) win remain on the upland portion of the Facility based on the OU 02 ROD. In such cases, MTCA allows a conditional point of compliance "as dose as practicable to the source of hazardous substances, not to exceed the property boundary" (WAC 173-340-720(6)(c)). Further, at such sites where groundwater discharges into nearby surface water, WAC 173-340-720(6)(d) indicates that (1) the cleanup levels may be based on protection of surface water and (2) "the department may approve a conditional point of compliance" that is located within the surface water as dose as technically possible to the point or points where groundwater flows into the surface water.

WAC 173-340-720(6)(d) further indicates that a conditional point of compliance may be approved when the following four requirements are met:

- **Prohibition on use of a dilution zone to demonstrate compliance (WAC 173-340-720(6)(d)(i)).** Use of a dilution zone to demonstrate compliance with surface water cleanup levels shall not be allowed.

- **Requirement for all known available and reasonable methods of treatment (AKART) (WAC 173-340-720(6)(d)(ii)).** The demonstration of AKART relative to possible groundwater treatment has been met (see Appendix A, "Analysis of Cost and Benefits of Groundwater Controls in Addition to the Upland Remedy," to the Historical Summary of the Evaluation of Groundwater Remedial Alternatives [Hydrometrics, June 2000]).

- **Requirement that groundwater discharges not cause violations of sediment quality standards (WAC 173-340-720(6)(d)(iii)).** Technical evaluations completed by the Task Force demonstrate that Site groundwater discharges are not expected to cause violations of sediment quality standards ( see Group 5 Technical Memorandum, Asarco Sediment/ Groundwater Task Force [Hydrometrics, April 19991]). Furthermore, long-term sediment monitoring will be required to verify that acceptable sediment quality conditions are maintained after the remedial action is complete.

- **Requirement to estimate contaminant flux rates and to address potential bioaccumulation in marine life resulting from groundwater discharging to surface water at constituent concentrations below method detection limits (WAC 173-340-720(6)(d)(iv)).** Post-remedial action monitoring conducted under the OMMP will require estimation of contaminant flux rates and assessment of potential bioaccumulation of metals in marine life resulting from groundwater discharge.

The above-referenced conditions are met at the Site (including the last requirement to

address potential bioaccumulation in marine life, since associated monitoring and evaluations will be required by the OMMP). Based on MTCA regulations cited above, and consultation with Ecology, EPA is setting a conditional point of compliance for groundwater at the interface of the surface water and the shoreline of Commencement Bay and the Yacht Basin. Specifically, the conditional point of compliance for the slag aquifer will be at the interface between the slag (or any overlying shoreline armoring materials) and the surface water.

**Deep Groundwater.** The point of compliance for the deep groundwater system will be throughout the deep aquifer.

#### 12.1.5 Sampling and Analytical Methods for Demonstrating Compliance

Sampling and analytical methods appropriate for demonstrating compliance with groundwater cleanup levels will be established in the OMMP and in cooperation with Ecology. It is envisioned that compliance monitoring will require periodic sampling.

**Surface Water Samples.** Samples will be collected from Commencement Bay and the Yacht Basin, as close as technically possible to the point where groundwater flows into these surface water bodies. The exact location, method, and timing of such sampling will be documented in the OMMP and subject to EPA review and approval.

**Groundwater Samples.** Groundwater will be collected from a series of monitoring wells located near the shoreline. Groundwater quality results from these wells will be compared to surface water quality data collected from adjacent (immediately downgradient) surface water sampling locations described above. Considering the difference between groundwater and surface water sampling results from adjacent locations, a factor will be developed to estimate the degree of dilution/attenuation occurring for each contaminant between the near-shore monitoring wells and the surface water at the conditional point of compliance. The compliance concentration at each nearshore well will be established by adjusting upward the cleanup levels for the protection of the surface water to reflect the dilution and attenuation expected to occur as groundwater flows from a monitoring well to the shoreline. These adjusted cleanup levels will be compared to the monitoring well data for compliance purposes. Appropriate evaluations will be required to determine a technically defensible dilution/attenuation factor for each monitoring well location.

### 12.2 Sediment

EPA's Selected Remedy is a combination of capping in the Nearshore /Offshore and Northshore areas and dredging of the Yacht Basin with onsite upland disposal of the dredged sediments. **2** The affected areas are shown in Figure 12-1. The rationale for the Selected Remedy is provided below. In addition, upland source control activities being conducted under the OU 02 remedial action need to occur prior to sediment remediation so that the possibility of sediment recontamination is minimized.

#### 12.2.1 Sediment Remedy Elements

The Selected Remedy for sediments includes five elements: capping, dredging, no action, institutional controls, and long-term monitoring.

> **2** Current plans call for capping in the Northshore area, however, depending on remedial design consideration, this small area may be dredged.

**Capping.** Capping is the Selected Remedy for the Nearshore/Offshore (Alternative S-1C) and Northshore (Alternative S-3C) areas. Capping is the Selected Remedy because it win isolate contaminated materials from the benthic organisms. Capping is the most practicable solution given the constraints associated with the depth of sediment contamination and the character of the subtidal slopes. Approximately 88,000 square yards (18 acres) of existing contaminated sediments within the severely impacted portion of the Nearshore/Offshore area (including the sediment under and adjacent to the existing piers) will be capped with a minimum of 3 feet of clean sediment. Approximately 7,000 square yards (1.5 acres) of the severely impacted portion of the Northshore area will also be capped with a minimum of 3 feet of clean sediment. **3**

The borrow source(s) for the cap material will be determined during remedial design and will originate from either a marine (in-water) or upland source. The cap will be designed such that it provides chemical isolation, is physically stable, and provide's a cap surface that allows recolonization of benthic communities. In order to achieve this, the design will assess the geotechnical aspects of the area, as well as the erosional nature of the cap materials used, depth of bioturbation, future use of the area, and other design considerations. The results of the pilot cap study (Parametrix, February 2000) will be considered during the remedial design process. Placement of the cap is expected to be relatively easy to implement. Similar caps have been successfully completed elsewhere in the Puget Sound area.

**Dredging.** The Selected Remedy for the Yacht Basin is Alternative 2D, dredging and upland disposal. Dredging is the Selected Remedy for the Yacht Basin because it would remove the contaminated material, and removal tends to be a more controlled remedy than in- water containment. Furthermore, without prior dredging, capping in the marina is not possible because the cap would interfere with and be damaged by navigation.

An area approximately 75,000 square yards (15.5 acres) will be dredged in the Yacht Basin because it was determined to be a severely impacted area. It is estimated that approximately 1 to 2 feet of material (up to 50,000 cubic yards) will require removal. The exact depth of dredging will be based upon information obtained from core samples that are collected during the summer of 2000. Post-dredging confirmatory sampling will also be required to verify that contaminated sediments have been adequately removed. If all of the contaminated sediments in the Yacht Basin cannot be practicably dredged or if slag is encountered, then the remaining contaminated sediment areas will be capped in place to the extent practicable.

The dredged material will be contained upland in OU 02 (Figure 1-2). OU 02 redevelopment activities have reserved capacity for these dredged spoils. The precise location will be detailed in the construction phasing schedule for OU 02. Redevelopment includes site grading and the installation of a lowpermeability soil cap that will contain the sediments dredged from the Yacht Basin.

Material dredged from the Yacht Basin will be contained temporarily on the upland portion of the Facility and dewatered. Dewatered sediments will be permanently contained in an upland location in the central part of the Facility. Sediments contained in the upland location will be permanently covered with the low-permeability cap being installed across the Facility under the OU 02 remedial action. Effluent derived from the dewatering of dredged material will be discharged into the Yacht Basin or into Commencement Bay in accordance with BMPs and applicable water quality requirements. The specific sediment dewatering methods and requirements for management of discharges from dewatering effluent will be defined during remedial design and implemented during construction.

**3** See footnote 2.

The dewatered sediments are currently scheduled to be placed beneath the upland low-permeability cap no later than November 30, 2004 as stipulated by "Amendment Number One" to the Asarco Smelter Consent Decree (Lodged in the District Court of Washington, June 2000) and a "Modification Agreement signed by EPA and Asarco (EPA, November 1999). If either the OU 02 or OU 06 remediation" schedules are such that the marine sediments cannot be placed under the cap by this date, the sediments may need to be permanently disposed of at an appropriate offsite location approved by EPA. Assuming the sediments are permanently contained onsite as planned, the mobility of the contaminants would be minimized as the dredged sediments will not be in contact with water as they will be placed at an elevation above the highest anticipated groundwater level. The operations and monitoring requirements for the OU 02 remedial action will include appropriate monitoring of the upland cap to verify its long-term effectiveness. Further, there will be a plan prepared under the OU 02 operations and monitoring program to address any failure or potential failure of the cap covering the dredged sediments.

**No Action.** No remedial action is planned for sediments offshore of the Breakwater Peninsula area (approximately 85,000 square yards or 17.5 acres). Sediments within this area (Figure 12-1) are within the Contaminant Effects Area. However, no remedial action is planned because of inherent engineering/construction impracticability associated with this area. The presence of steep slopes (as much as 50 percent slope) make capping or dredging infeasible. Further, the stability of a cap on such a steep slope is questionable. In addition, dredging is not possible because the entire Breakwater Peninsula would need to be removed since it is constructed entirely of slag (up to 125 feet thick).

**Institutional Controls.** All offshore capped areas will be designated as "no anchor" zones. This remedy is being selected because it will ensure long-term protection of capped areas. The no anchor designation will apply to commercial vessels using "whale-tail" type anchor, which have the capacity to break through the cap material and expose contaminated sediment. This institutional control will be implemented though federal rule- making by the U. S. Coast Guard and the U. S. Army Corps of Engineers in consultation with the Washington Department of Natural Resources. The rule-making will be subject to public comment.

**Long-Term Post-Remedial Action Monitoring.** Monitoring will occur on a long-term, regular basis after the remedial action is complete to verify the performance of each remediation area and the adjacent areas. This remedy is being selected because long-term monitoring of the offshore sediment cap will be necessary to confirm that the cap is isolating the contaminated sediments from marine life. Long-term monitoring is planned over a period of decades.

Long-term monitoring will occur off the Breakwater Peninsula since it cannot be remediated due to technical impracticability.

Long-term monitoring will also occur in those areas adjacent to the active remediation areas (the Moderate Impacts Area and the Contaminant Effects Area), where RI findings indicate exceedances; of the SMS biological criteria. Monitoring is necessary to evaluate if long- term biological change is occurring in these areas, to monitor the long4errn effectiveness of the sediment remedy, and to ensure the RAOs are being met. These evaluations will be conducted in accordance with the, SMS and the preponderance-of-evidence approach, as discussed in Section 7.2.2. These areas will be monitored over a long duration so trends can be identified and responded to as necessary.

An Operation, Maintenance, and Monitoring Plan (OMMP) will be prepared as part of the remedial design and implemented as part of the remedial action. The OMPP will identify inspection and monitoring procedures to verify that the elements of the remedy are performing as intended or, if they are not, to identify needed repairs on a timely basis. The cap's physical integrity, particularly its thickness, will be verified on a regular basis. Inspections will be also conducted following major storm or earthquake events that could potentially affect the cap. Chemical analysis of cap materials will be conducted to verify that contaminants are not accumulating in the upper part of the cap, where the

marine organisms live. Biological data will also be collected including abundance evaluations, bioassays, and tissue analyses.

The OMMP will identify monitoring requirements and conditions applicable to the moderate impact areas to see that RAOs are achieved in those areas not capped or dredged. For example, if long-term monitoring indicates contamination of marine sediments that is inconsistent with RAOs, or that the cap is eroding, action will be taken as appropriate. Likely responses to cap erosion may be the placement of additional cap material or armoring materials to reduce erosion. Specific actions and associated "trigger" conditions will be identified in the OMMP. In addition, more source control measures could be instituted upland to reduce the rate of cap recontamination (i.e., additional groundwater diversion measures). If EPA determines through long-term monitoring that the selected remedies are not protective, EPA can amend this ROD or issue an Explanation of Significant Difference ( ESD) to modify the remedy as necessary.

### 12.2.2 Sediment Cleanup Levels

Remediation cleanup levels identified for the marine sediments at OU 06 are based upon the characteristics of each specific area and the type of remedy selected for that area. The sediment cleanup levels will also be used to measure compliance under the long-term monitoring program. The State of Washington's SMS (WAC 173-340), including the Sediment Quality Standards (SQS), the Cleanup Screening Levels (CSL), and the biological impact conditions determined by the preponderance-of-evidence approach (Section 7.2.2) will be used as cleanup levels for sediment. The specific remedy units (Figure 9-2) and their corresponding cleanup levels are summarized in Table 12-2 and are described below:

- **Capping for the Nearshore/Offshore and Northshore Areas.** The cleanup levels for these areas have been derived from the results of the preponderance-of-evidence approach, which has also been used to define the extent of active remediation (capping). For long-term monitoring, the SQS will be applied to ensure that the cap is supporting a healthy and diverse biological community.

- **Dredging for the Yacht Basin.** The cleanup levels selected for the Yacht Basin will be the SMS. These will be used to determine the vertical and horizontal extent of the active remediation (dredging). RI data suggest that fine-grained sediments like those present in the Yacht Basin do not typically exhibit biological effects when arsenic and copper concentrations are below the CSL. Therefore, the CSL criteria for these metals will be used as their cleanup levels. RI data also suggest that biological effects in fine-grained sediments may be more sensitive to sediments with zinc and lead contaminants. Therefore, the SQS have been selected as cleanup levels for these two metals. The above referenced cleanup levels for arsenic, copper, lead, and zinc will also be used during long- term monitoring to ensure that the RAOs are met in the Yacht Basin.

- **Moderate Impact and Contaminant Effects Areas.** Long-term monitoring will be required for marine sediments at OU 06 that will not undergo active remediation. Monitoring is required to ensure that sediment conditions continue to meet RAOs. The preponderance-of-evidence approach will continue to be applied to these areas in order to evaluate the long-term biological conditions, monitor the long-term effectiveness of the overall remedy to these portions of the Site, and to ensure the RAOs are being met.

## 12.3 Expected Outcomes of the Selected Remedy

It is expected that the Selected Remedy will protect human health and the environment consistent with the RAOs outlined in Section 8.

Source control measures will reduce the leaching of contaminants to groundwater. Installation of a low-permeability cap, surface and groundwater water controls, and

abandonment or replacement leaking underground piping is expected to reduce groundwater flow recharge. The expected effect is an estimated 75 to 95 percent reduction in the contaminant loading to Commencement Bay from groundwater discharge. It is expected that groundwater cleanup levels for arsenic (6 ug/L) and copper (3.1 ug/L) will eventually be reached at the conditional point of compliance after the remedial action is completed and groundwater conditions have stabilized.

Although achievement of groundwater cleanup levels is expected near the shoreline due to dilution effects of adjacent marine waters, the quality of shallow groundwater over most of the Site is not expected to change significantly. Significant improvements in groundwater quality are not expected because source materials (e.g., slag) will remain in place permanently as part of the OU 02 ROD (EPA, March 1995).

As anticipated by the remedial design for OU 02, the upland part of the Facility will be developed for commercial and recreational use. Public access will be provided to the waterfront and intertidal areas in selected locations. The underlying shallow groundwater included in OU 06 will not be available as a drinking water source. Deep groundwater included in OU 06 will not be available as a drinking water source until such time groundwater quality complies with applicable health- based criteria (e.g., maximum contaminant levels).

It is expected that the remedial measures employed to address sediment contamination will result in attainment of cleanup levels for arsenic, copper, lead, and zinc consistent with SMS (Table 12-2). For areas subjected to active remedial measures (e.g. the Yacht Basin from dredging and the Nearshore/Offshore area and Northshore area from capping), concentrations of COCs will be reduced immediately upon the removal and capping of contaminated sediments. Recolonization of these areas is expected to occur rapidly as demonstrated in the Cap Pilot Study (Parametrix, February 2000). An overall improvement in marine sediments and benthic community structure is expected to occur in all impact areas over several years. The Yacht Basin will continue to be suitable for use by recreational watercraft; however, this use will continue to limit the suitability of this habitat for some organisms.

Long-term monitoring as defined in the OMMP will identify inspections and monitoring procedures to verify that the elements of the remedy are performing as intended.

## 12.4 Summary

The Selected Remedy for OU 06 is composed of four alternatives to address groundwater and marine sediments (Alternatives GW-B, S-1C, S-2D, and S-3). The Selected Remedy complies with statutory requirements under CERCLA, meets the CERCLA threshold criteria, and provides the best balance with respect to CERCLA’s balancing and modifying criteria. EPA believes the Selected Remedy will protect human health and the environment, comply with ARARs (except as waived by this ROD), be cost-effective, and utilize permanent solutions to the maximum extent practicable.

# 13 Statutory Determinations

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy does or does not meet these statutory requirements.

## 13.1 Protection of Human Health and the Environment

The Selected Remedy (Alternative GW-B for groundwater and Alternatives S-1C, S-2D, and S-3C for sediments) will protect human health and the environment by minimizing the discharge of contaminants to Commencement Bay via groundwater and removing or isolating contaminated sediments in Commencement Bay and the Yacht Basin. When combined with the remedy being implemented for OU 02 under the 1995 ROD (EPA, March 1995), the remedy will reduce the threat of exposure to the chemicals of concern to both humans and marine organisms. Cleanup levels for sediment are expected to be met immediately upon completion of the remedial-action activities. However, the biological community will require time to recolonize the areas where sediment is covered by cap material or is impacted by dredging. Contaminant concentrations in groundwater are expected to decrease gradually with time. Cleanup levels for groundwater will not likely be met until several years after the remedial action is complete.

## 13.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The Selected Remedy is expected to comply with federal and state ARARs with the exception of arsenic in groundwater discharging to Commencement Bay, which is not expected to comply with the federal NTR marine water standard of 0.14 ug/L (40 C.F.R. Part 131.36). A list of ARARs for OU 06, including the justification for the NTR waiver for arsenic, are provided below.

State of Washington Model Toxics Control Act (MTCA) (WAC 173-340)

Key sections of MTCA applicable requirements are listed below:

- *WAC 173-340-360(4)* — Identifies the order of preference of cleanup technologies, including treatment as the highest preference.

- *WAC 173-340-360(6)* — Addresses selection of a cleanup that provides for a reasonable restoration time frame and identifies factors to be considered when establishing that time frame.

- *WAC 173-340-440* — Requires institutional controls where active cleanup measures (e.g., treatment) will not attain MTCA cleanup levels or where a cap is used to contain contaminants above MTCA cleanup levels.

- *WAC 173-340-720* — Sets groundwater cleanup standards and guides selection of the point of compliance.

- *WAC 173-340-730* — Sets surface water cleanup standards and guides selection of the point of compliance. Applicable as both sediments and groundwater may impact surface water quality of Commencement Bay.

**Minimum Standards for Construction and Maintenance of Water Wells (R.C.W.§ 18.104, WAC 173-160)**

Well construction regulations establish minimum standards for water wen construction. This regulation will be applicable to wells constructed for groundwater monitoring purposes. This regulation is also applicable to the decommissioning of existing or future wells.

**Regulation and Licensing of Well Contractors and Operators (R.C.W. § 18.104, WAC 173-162)**

These regulations apply to all water well contractors and operators who are providing well installation, maintenance, or abandonment services within the State of Washington.

**General Regulations for Air Contaminant Sources (WAC 173-400)**

This regulation requires Best Management Practices to be employed, including covering stockpiles, cleaning trucks prior to leaving the Site, and monitoring air emissions. As an example, these regulations will be applicable to handling and dewatering dredged sediments.

**U. S. Fish and Wildlife Coordination Act (16 U.S.C. § 661 et seq.)**

Commencement Bay provides potential habitat for certain endangered species and is used as a salmonid migratory route. This Act prohibits water pollution with any substance deleterious to fish, plant life, or bird life, and requires consultation with the U. S. Fish and Wildlife Service and appropriate state agencies prior to construction of the remedy. Criteria are established regarding site selection, navigational impacts, and habitat remediation. This statute is applicable to capping and dredging to be performed in Commencement Bay.

**Safe Drinking Water Act (42 U.S.C. § 300)/National Primary Drinking Water Regulations (40 C.F.R. Part 141 Subpart B)/Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200-040)**

The federal primary drinking water standards adopted by the State of Washington set maximum contaminant levels (MCLs). MCLs are the maximum permissible levels of contaminants allowed in drinking water based on the prevention of adverse health effects. Class III groundwater (non-potable due to total dissolved. solids greater than 10,000 mg/L) prevail in the shallow aquifer system and are not subject to MCLs. However, MCLs are applicable for those portions of the deep aquifer where Class II ( potable) groundwater is present.

**Federal Water Pollution Control Act/Clean Water Act (33 U.S.C. § § 1251-1376; 40 C.F.R. Parts 100-149)**

Acute marine criteria are relevant and appropriate requirements to control discharges to marine surface water during cap placement and sediment dredging.

**Federal Clean Water Act (33 U.S.C. § 1251 et. seq.)/Washington State Water Quality Standards for Surface Waters (WAC 173-201A)**

Surface water quality standards for protection of human health and the aquatic life will be applicable to discharges to surface water during cap placement and sediment dredging. The water quality standards also guide the quality of groundwater that will discharge to Commencement Bay for purposes of protecting marine organisms.

**National Toxics Rule (40 C.F.R. Part 131.36)**

The federal NTR standard for arsenic of 0.14 µg/L (40 C.F.R. Part 131.36) is a relevant and appropriate requirement for groundwater. EPA is waiving the NTR for arsenic because compliance with the requirement is technically impracticable from an engineering standpoint because the NTR level is neither achievable nor measurable at this site (40

C.F.R. Part 3000.430 (f)(ii)(C)(3)). Specifically, the NTR standard is being waived because the natural background concentration of arsenic in groundwater in the Tacoma vicinity is 6 µg/L (EPA, April 1993). Further, the PQL for arsenic in site groundwater has historically been approximately 2 µg/L. See Section 12.1.3 for additional discussion addressing the basis for this ARAR waiver.

**Washington Sediment Management Standards (WAC 173-204)**

Chemical concentration and biological effects criteria are established for Washington State, including Puget Sound sediments, and are applicable to sediment remediation.

**State Water Pollution Control Act (R.C.W. § 90.48)/Water Resources Act (R.C.W. § 90.54)**

Requirements for the use of all known, available, and reasonable technologies for treating wastewater prior to discharge to state waters are applicable to any dewatering of marine sediment prior to upland disposal. Section 401 requires certification for activities conducted under Section 404 authorities. The substantive requirements of a certification determination are applicable.

**Construction in State Waters, Hydraulic Code Rules (R.C.W. § 75.20; WAC 220-110)**

Hydraulic project approval and associated requirements for construction projects in state waters have been established for the protection of fish and shellfish. Substantive permit requirements are applicable to cap placement. The technical provisions and timing restrictions of the Hydraulic Code Rules are applicable to cap placement and dredging.

**State Discharge Permit Program/ NPDES Program (WAC 173-216 and-220)**

The Washington State NPDES program provides conditions for authorizing direct discharges to surface waters and specifies point source standards for such discharges. As an example, these standards are applicable to discharges to surface waters resulting from sediment dewatering operations during dredging and disposal work.

**Whole Effluent Toxicity Testing and Limits (WAC 173-205)**

Establishes whole effluent toxicity limits in accordance with R.C.W. § 90.48.520, 40 C.F.R. Part 122.44( d), and 40 C.F.R. Part 122.44(e) for inclusion into National Pollutant Discharge Elimination System (NPDES) permits to protect aquatic life through the implementation of all known, available, and reasonable methods of prevention, control and treatment of toxicants and through the attainment of state water quality standards. The requirements are applicable if it is determined that the substantive requirements of a NPDES permit must be met for diversion of contaminated and treated water from sediment dewatering.

**Federal Clean Water Act Dredge and Fill Requirements; Sections 401 and 404 (33 U.S.C. § 401 et seq., 33 U.S.C. § § 1251-1316; 33 U.S.C. § 1413; 40 C.F.R. Parts 230 and 231; 33 C.F.R. Parts 320-330)**

These regulations provide requirements for the discharge of dredged or fill material to waters of the U. S. and are applicable to any in-water work. The sediment dredging and capping elements of the Selected Remedy are subject to the requirements of Section 404(b)(1). Mitigation requirements associated with the remedy selected for OU 06 will be addressed as part of the 404 process. A Biological Assessment (BA) is currently being prepared by EPA to meet the substantive requirements of the Section 404 Permit. Mitigation is also required to compensate for the loss of approximately 0.2 acre of intertidal habitat in the Yacht Basin.

**Federal Endangered Species Act of 1973 (16 U.S.C. § 1531 et seq., 50 C.F.R. Parts 200 and 402)/Marine Mammal Protection Act (16 U.S.C. § 1361 et. seq.)**

This regulation is applicable to any remedial actions performed at the Site, as this area is potential habitat for threatened and/or endangered species. Best Management Practices (BMPs) required to ensure full compliance with ESA requirements will be addressed and implemented. EPA is currently preparing a BA to meet the substantive requirements of the Section 404 Permit. At this time EPA is informally consulting with the National Marine Fisheries and the U. S. Fish and Wildlife Service on the remedial actions.

**Rivers and Harbors Appropriations Act (33 U.S.C. § 403, 33 C.F.R. Part 322)**

Section 10 of this Act establishes permit requirements for activities that may obstruct or alter a navigable waterway; activities that could impede navigation and commerce are prohibited. These substantive permit requirements are applicable to dredging and capping.

**Shoreline Management Act (R.C.W. § 90.58, WAC 173-14 through 173-28); Coastal Zone Management Act (16 U.S.C. § 1451 et seq., 15 C.F.R. Part 923)**

These statutes and regulations are applicable to capping activities in the shoreline area.

**State Aquatic Lands Management Laws (R.C.W. § 79.90-79.96, WAC 332-30)**

The State Aquatic Lands Management Laws are applicable. The final remedy must be consistent with state laws that promote environmental protection, public access, water dependent uses, and uses of renewable resources that generate revenue to the state in a manner consistent with these management goals.

**Resource Conservation and Recovery Act (40 C.F. . Part 261.4(g))**

This regulation is applicable and provides an exemption in determining that contaminated sediments dredged under the requirements of Section 404 of the Clean Water Act are not classified as RCRA hazardous waste.

**Native American Land Claims Acts Including Washington Indian (Puyallup) Land Claims Settlement Act (25 U.S.C. § 1773)/Puyallup Tribe of Indians Settlement Act of 1989**

The Puyallup Tribe of Indians Settlement Act of 1989 is relevant and appropriate in that the Puyallup Tribe maintains certain rights pertaining to fisheries resources and associated habitat.

**Archeological and Historical Preservation Act (16 U.S.C. § 4699)**

This statute is applicable and requires that significant scientific, pre-historical, or archeological data be preserved if present on the Site.

**Federal Clean Air Act (42 U.S.C. § 7401 et. seq., 40 C.F.R. Part 50)/Washington Clean Air Act (R.C.W. § 70.94, WAC 173-400 and-460)**

Air quality statutes and regulations would be applicable if dust is generated as part of sediment dewatering/handling or if emissions are created by facilities used to treat water produced during sediment dewatering.

**To Be Considered (TBCs)**

TBC items are state and local ordinances, advisories, guidance documents or other requirements that, although not ARARs, may be used in determining the appropriate extent and manner of cleanup. Generally, TBC requirements are used when no federal or state requirements exist for a particular situation. A list of TBCs for the Site include:

- **Puget Sound Water Quality Management Plan.** Defines objectives for standards regarding the confined disposal of contaminated sediment. Although the Selected Remedy does not include a CAD, the standards presented in the Puget Sound Water

Quality Management Plan may be useful with respect to the design and construction of a sediment cap (e. g., selection of import cap material).

- **Standards for Confined Disposal of Contaminated Sediments, Washington Department of Ecology (January 1990).** Guidelines for assessing the suitability of dredged material for unconfined disposal relevant to cap material specifications.

- **Area of Contamination Interprogram Policy, Washington Department of Ecology.** Guidelines for management of dredged sediment meeting the criteria as a state dangerous waste.

- **Sediment Cleanup Standards Users Manual, Washington Department of Ecology.** Guidance for implementing the sediment cleanup decision process for contaminated sediments.

- **Sediment Source Control Standards Users Manual, Washington Department of Ecology (June 1993).** Guidance for implementing the Sediment Source Control Standards.

- **Local Shoreline Master Program.** Guidelines for managing development of shorelines to preserve natural resources while protecting public access and navigation.

- **Development of Sediment Quality Criteria for the Protection of Human Health: Tier I Report, Washington State Office of Toxic Substances (1995).** Proposes draft sediment quality standards based on risks to humans.

## 13.3 Cost-Effectiveness

The estimated present worth cost for the Selected Remedy is $19.2 million and is considered cost-effective. The $19.2 million estimated cost is divided between groundwater and marine sediment remedies as follows:

| | |
|---|---|
| Institutional Controls and Long-Term Monitoring Components of Groundwater Remedy (Alternative GW-B) | $ 1.8 million |
| Sediments Remedy, Nearshore/Offshore Area (Alternative S-1C) | $ 11.6 million |
| Sediments Remedy, Yacht Basin (Alternative S-2D) | $ 5.1 million |
| Sediments Remedy, Northshore Area (Alternative S-3C) | $ 0.7 million |
| Total | $ 19.2 million |

This estimate does not include the cost for any OU 02 remedy element that may benefit groundwater.

In making a determination regarding cost-effectiveness, the following definition was used: "A remedy shall be cost- effective if its costs are proportional to its overall effectiveness." (NCP, Section 300.430(f)(1 )(ii)(D)). This was accomplished by evaluating the " overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR- compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money to be spent.

## 13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment

and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of trade- offs in terms of the five balancing criteria, while also considering, the statutory preference for treatment as a principal element. EPA also considered the bias against offsite treatment and disposal, and considered state and community acceptance when selecting the preferred remedy.

### 13.5 Preference for Treatment as a Principal Element

Treatment of contaminated sediment to reduce toxicity or mobility of contaminants is not considered feasible. As stated previously, treatment was evaluated for sediment cleanup, however it was not considered further for the following reasons: First, in order to treat the sediments, they must be removed. This is difficult in the Nearshore /Offshore area of OU 06 because the contamination is very deep. Therefore, the chance of leaving contamination behind is very high. Second, since slag was poured to create the shoreline in portions of the Nearshore area, dredging in this area would be difficult due to slope stability issues. Third, the net benefit of treating the sediments is in question as the slag pieces within the sediment matrix are already in a relatively immobile form (e.g., the slag does not tend to be bioavailable; see discussion in Section 5.2). Fourth, costs associated with treatment of the Yacht Basin sediments would be disproportionate to the costs associated with the current upland disposal plan.

### 13.6 Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment. Additional groundwater interception or other controls may be required in the future if it is determined that groundwater cleanup levels are not being met and additional groundwater capture is practicable considering the expected reduction in risk to human health and the environment. This issue will be assessed as part of the Five- Year Review process.

### 13.7 Documentation of Significant Changes from Preferred Alternative of Proposed Plan

The Proposed Plan for the Asarco Sediments/ Groundwater OU 06 was released for public comment in January 2000. A public meeting was held on February 10, 2000, to present the preferred remedy and solicit comments from the public. The Proposed Plan identified the Preferred Remedy for OU 06 as comprising Alternative GW-B (groundwater) and Alternatives S-1C, S-2D, and S-3C (sediments). EPA carefully reviewed all written and oral comments provided during the comment period. Based on the comments received, two minor changes have been incorporated into the Selected Remedy:

- **Reduction of Sediment Cap Thickness from 1 Meter to 3 Feet.** The Preferred Remedy identified in the Proposed Plan called for a 1-meter (39-inch) cap in the Nearshore/Offshore Area (18 acres). The Selected Remedy identified in this ROD calls for this area to be capped with 3 feet (36 inches) of clean material. This change is based on a reevaluation of the depths to which burrowing organisms are reported to penetrate the cap. This re- evaluation determined that a 36-inch cap will effectively isolate the contaminated sediments from the biota and overlying water as well as a 39-inch cap. Therefore, the Selected Remedy will be protective of human health and the environment.

- Possible Dredging of the Northshore Area. The Preferred Remedy identified in the Proposed Plan called for capping contaminated sediments in the Northshore area (1.5 acres). The Selected Remedy calls for this area to be capped but acknowledges that dredging may be determined to be appropriate depending on engineering considerations assessed during the remedial design. As such, dredging will be reevaluated as part

of the remedial design process. Either capping or dredging would be protective of human health and the environment.

The above-referenced remedy modifications could have been reasonably anticipated based on the information in the Proposed Plan. Therefore, additional public comment on these changes is not required.

**PART III**

# Responsiveness Summary

## Introduction

This Responsiveness Summary provides EPA's responses to comments on the Proposed Plan for the Asarco Sediments/Groundwater Operable Unit 06 (EPA, January 2000a). Comments were received from citizens, corporate and community organizations, and government agencies. The Responsiveness Summary includes responses to both written and oral comments received during the 60- day comment period (January 26 to March 25, 2000). Copies of the written comments received are provided in Appendix D. Oral comments were received during the public meeting on February 10, 2000. The transcript from this meeting is available in EPA's Administrative Record for the Asarco Sediments/Groundwater Operable Unit 06.

EPA has grouped the comments and corresponding responses into 15 topics:

- Site Risks
- Sediment Impact/Remediation Area
- Alternatives to Sediment Capping
- Protectiveness and Effectiveness of Sediment Capping Remedy
- Sediment Cap Thickness
- Sediment Dredging
- Institutional Concerns Regarding Sediment Capping
- Groundwater Extraction and Treatment
- Remediation Goals/Levels (Groundwater)
- Remediation Goals/Levels (Sediment)
- Remedy Costs
- Endangered Species Act and Biological Assessment Issues
- Natural Resource Mitigation
- Long-Term Monitoring
- Other Comments

The Responsiveness Summary addresses each comment received. The comments are numbered for convenience and cross-referencing purposes. They are reproduced as received by EPA (written comments) or as cited in the transcript of the February 10, 2000 public meeting (oral comments). Exceptions are EPA annotations in the comments; these are noted as italicized text within brackets (e.g., [EPA annotation ...]). Comment letters or oral comments addressing more than one issue have been divided and presented under the above-referenced topic headings. Each comment is presented in non-italicized font. EPA responses are italicized. Also note that references to page and section numbers in the comments refer to the Proposed Plan.

## Site Risks

**Comment No. 1**

**Comment:** Pg. 9, 3rd full para. This paragraph compares site tissue concentrations to reference tissue concentrations and ignored the sections of the Phase 1 Data Report that showed "... the site station tissue chemistry was found to be indistinguishable from the reference station tissue chemistry in all cases (see Table 8-3)." In other words, the differences were not statistically significant. Further, it is not appropriate to state that tissue concentrations are elevated without providing any risk context. Anyone that only gets this far reading the document may not learn that these tissue concentrations are acceptable using EPA's risk criteria, as stated later in the Proposed Plan.

**Response:** EPA acknowledges that extensive details regarding site risk are not provided in the Proposed Plan. However, the text in the Proposed Plan is accurate as written, and the reader is referred to the Phase 1 report for additional details regarding site risk.

**Comment No. 2**

**Comment:** 5.1 Human Health Screening Risk Assessment

Sediments: In determining human health risks associated with eating fish caught within the site, the low end range (1 gram per day of fish) was selected to represent the consumption of an infrequent sports fisherperson who might eat fish from the waters off the facility a few times each year. The greater Commencement Bay area hosts a number of ethnic communities who routinely fish for subsistence. Because of easy access, the waters along Ruston Way/Asarco/Point Defiance are a popular fishing spot for members of these communities. We believe that the assumption of 1 gram per day of fish does not consider the subsistence harvest practiced by members of these communities and needs to be increased accordingly.

**Response:** EPA concurs. The risk associated with recreational and subsistence users was addressed in the risk assessment. In this risk assessment, EPA assumed 290 grams per day of fish consumption for the subsistence user. This risk is discussed in the third paragraph on page 12 of the Proposed Plan and Section 7 of this ROD.

**Comment No. 3**

**Comment:** (Section 8.1) Do you understand why fish tissue remained below risk thresholds even though groundwater exceeds human health risk based levels for fish consumption? If not, how can you be sure that the environmental conditions which allow this to happen will remain constant?

**Response:** The human health risk values were calculated from fish tissue collected at the Site. In other words, the fish collected were exposed to site groundwater and the waters and marine sediments of Commencement Bay. The fish collected were not just exposed to groundwater. Therefore, collection of site-specific tissue data is the most representative of actual site conditions. The groundwater risk numbers referenced above assume that the organisms will be exposed to contaminated groundwater only, and not to surface water and sediment as well. Therefore, the data collected as part of the site investigations are most applicable to the actual site conditions.

As for future site conditions, EPA believes that the conditions at the Site will, at least, remain the same, or improve due to the remedial actions planned for the Site.

## Sediment Impact/Remediation Area

**Comment No. 4**

**Comment:** As Asarco understands the Expanded RI/ FS data and the Proposed Plan, all impacted areas that require remediation and can practicably be remediated will be remediated. However, the use of the terms “moderately impacted” and “minimally impacted” in the Proposed Plan are potentially misleading and may imply that some impacted areas will not be remediated. These terms also seem to ignore the sophisticated approach that EPA and Asarco have taken to identify and characterize areas with contaminant effects. Asarco would prefer that areas simply be identified as “ impacted” and “non-impacted” as determined by the preponderance of evidence approach and the extensive sediment effects data.

The approach to identification of impacted areas presented by Asarco in Phase 1 of the Expanded RI/FS was substantially more complex and complete than the approach described in the Proposed Plan. In comparison to the Phase 1 approach, it is extremely simplistic to use “benthic results to identify the most highly impacted areas....” Asarco prefers to base impact determinations on all of the detailed sampling and data analysis work that Asarco and EPA have conducted rather than the highly simplistic approach described in the Proposed Plan, which is only a slight modification of the Sediment Management Standards (SMS).

In Phase 1, Asarco evaluated measures of chemistry, bioassays, benthic community results and other types of sampling (e.g., pore water chemistry, pore water bioassays, tissue chemistry, sequential extraction analyses of slag) to determine those measures that appeared to be most highly correlated. The benthic results were evaluated in many ways including relatively simplistic SMS measures and much more powerful data analysis tools (e.g., proportional similarity index and principal coordinates analysis). All of these measures were evaluated and chemistry, sediment bioassays, and numerous measures of benthic abundance and diversity were used in the final preponderance-of-evidence approach. In this approach, some benthic community measures were given greater weighting than other benthic measures, sediment bioassays, and chemistry. Bulk sediment chemistry results were given the least weight in the preponderance-of-evidence approach. Some other evidence was judged to be inappropriate for use in cleanup decisions.

The purpose of the preponderance-of-evidence approach was to define those areas exhibiting contaminant effects. No "moderate impact areas" were defined in the Phase 1 Report. The preponderance-of-evidence either "tipped the scale" into contaminant effects designation or it did not. Thus, one significantly different bioassay result or a particularly high chemistry result does not indicate a "moderately impacted" area. In such cases, the preponderance of other evidence (mainly various measures of the benthic community) indicates that this area is not impacted. Defining stations that have one significantly different bioassay and/or chemistry result as "moderately impacted" ignores all of the evidence presented in the Phase 1 and 2 Reports that clearly indicate the effects of slag may confound typical SMS interpretations of bioassay and particularly bulk sediment chemistry results. The preponderance-of-evidence approach was not designed to define "in between" or "moderately impacted" areas (see Responses to comments on Phase 1 Report). Consequently, Asarco has never agreed to the proposed definitions of moderately impacted areas.

In the Proposed Plan, the only areas that receive the designation "non-impacted" are those that do not exceed the bulk sediment chemistry Sediment Quality Standard (SQS). Asarco has collected and reported a vast amount of information indicating that where slag particles are present, bulk sediment chemistry is often irrelevant to the actual toxicity of the sediments. Some sediment stations at the Asarco site were well above the SQS and showed no other evidence by any measure of contaminant effects, yet in Section 5.2 of the Proposed Plan these stations are defined as "minimally impacted." Because there is no evidence of contaminant effects, it is inappropriate to define these stations as impacted in anyway.

The reason described for the minimal impact designation is that the sediments "may have impacts in the future" However, EPA provides no scientific evidence to clarify what action or event might reasonably be expected to cause these sediments to have impacts in the future. There is no evidence available from any of the numerous studies completed to support this supposition of potential future impacts. All available information, particularly regarding slag metals availability (e.g., the sequential extraction analysis) and the present healthy state of the benthic community, do not support this supposition. Because there is no evidence that these sediments would reasonably pose future impacts, these sediments should be designated as "non-impacted."

Similarly, Asarco does not agree that stations with "minor biological CSL exceedances" should be designated as "minimally impacted." As stated in the previous comment, Asarco believes this simplistic approach ignores the preponderance of evidence for these stations ( all the other benthic and / or bioassay measures) that indicate these stations are not impacted in any way. These stations should also be designated as "non-impacted."

Finally, consistent with the above comments, the remediation area should be defined simply as "impacted stations" not "severely impacted stations."

Response: A range of biological effects were identified at the various sampling locations. There are many areas that show some impact, but not sufficient impact to warrant active remediation. It is incorrect to ignore these "gray" areas, and only use the terms "impacted" and "non-impacted." Therefore, EPA will continue to use the terms "moderately"

and "minimally" impacted when discussing the site sediments. The fact that the Phase 1 report did not use these terms is irrelevant, since one of the main goals of that report was to identify areas requiring active remediation.

The goal of the preponderance of evidence approach was to assess each station using all possible data. The goal was not to assess all stations from the " black and white" perspective as either "in" or "out" of the cleanup area (e.g., EPA never determined that this approach would only result in two categories of stations: impacted and non-impacted). EPA has used the information from the preponderance of evidence approach, and has assigned a category to the range of results received from that approach. EPA will therefore continue to use the terms "moderately impacted" and "minimally impacted."

**Comment No. 5**

Comment: 7.2 Sediment
In addition to the remedial alternatives presented in the proposed cleanup plan, additional actions are required in the Non-Impacted /Minimally Impacted Stations and Moderately Impacted Stations to ensure that these stations are remediated to meet all State of Washington Criteria. (see 5.2 above)

Response: Based on the preponderance of evidence approach, the stations in the minimally impacted and moderately impacted areas will be monitored to ensure they meet RAOs. Based on this approach, these stations indicate some impact, but do not warrant active cleanup.

**Comment No. 6**

Comment: 5.2 Ecological Risk Assessment
Sediment:

Non-Impacted/Minimally Impacted Stations

Stations that have chemical concentrations greater than the state standards must be cleaned up to meet Washington State standards. Additionally, those areas with minor biological CSL exceedances must be remediated as well.

Moderately Impacted Stations

Stations falling within this category need to be remediated to meet Washington State cleanup standards.

Response: As discussed above, based on the preponderance of evidence approach, the stations in the minimally impacted and moderately impacted areas will be monitored to ensure they meet RAOs. Based on this approach, these stations indicate some impact, but do not warrant active cleanup. As stated in our previous responses, EPA has determined that active cleanup in these areas would have a net negative environmental impact.

## Alternatives to Sediment Capping

**Comment No. 7**

Comment: The proposed plan does not define the design life for the remedy. It is uncertain how long monitoring will occur, under what conditions monitoring will be enhanced or curtailed, and what will trigger contingency actions now and in the future. These and other concerns lead to uncertainty regarding the permanence of the remedy and to questions regarding how exhaustively more permanent solutions were explored.

For example, the proposal to cap the north nearshore unit is not supported by the information and analysis. The costs shown demonstrate that dredging and upland disposal, a more permanent remedy, is less expensive. Costs associated with mitigation for habitat impacts due to cap design, as well as a number of additional costs - including potential compensation for use of public aquatic lands - not included in the existing analysis, will

increase the costs associated with the capping alternative. We therefore do not support capping of this unit.

We also believe that permanent solutions such as treatment are viable. Vendors are providing treatment rates of around $29 per cubic yard. We encourage EPA to further evaluate treatment as part of the decision-making process.

Response: The caps will be designed to cover the contaminated sediments into perpetuity. Monitoring and assessment of the caps will occur regularly as required by the Operation, Maintenance, and Monitoring Plan (OMMP). The OMMP will be developed by Asarco as part of the remedial design process. The OMMP will identify thresholds where new or revised monitoring, maintenance, or remedial actions will be triggered.

DNR is correct that dredging with upland disposal (assuming it is placed onsite) is slightly less expensive than capping. EPA will require that dredging be considered for this area during remedial design. The ROD acknowledges that dredging of the Northshore area may occur in lieu of capping depending on the outcome of remedial design evaluations.

Mitigation is not included in the cost for any alternative, because it has not been determined what mitigation is required.

Potential treatment of marine sediments was evaluated by EPA as part of the Feasibility Study process. Several technologies groups were evaluated including thermal destruction, thermal desorption, chemical separation, sediment washing, and in- place solidification/ stabilization. As part of this evaluation, EPA did not identify any established treatment options for sediments that are reliable and cost-effective.

**Comment No. 8**

Comment: The proposal for the sediments unit does not adequately provide for long- term isolation of materials. For example, the porous slag slopes and incomplete armoring will result in continued release of fine-grained slag particulates to the nearshore sediments. More innovative alternatives to reduce the slopes to allow more effective armoring or to isolate the peninsula in some other way need to be more thoroughly analyzed. The benefits and total costs (including on-going source control, long-term operation and maintenance, and contingency actions) associated with all potential alternatives need to be fully evaluated in order to make well-informed decisions.

Response: The comment appears to be focused on the possibility of slag particles being eroded from the slag face and deposited on the cap material or other sediments. Armoring of the slag slopes at the shoreline was specifically addressed by the 1995 ROD for Operable Unit 02 (i.e., Asarco Tacoma Smelter and Breakwater Peninsula ROD, which addressed upland conditions). At present, the remedial design for the shoreline armoring system is nearly complete. The design incorporates engineering features to minimize erosion of the slag face.

## Protectiveness and Effectiveness of Sediment Capping Remedy

**Comment No. 9**

Comment: (Section 9.2.1) The likely static and dynamic slope stability risks indicate the need for a more permanent solution.

Response: The stability of the sediment cap and associated perimeter side slopes will be addressed during remedial design.

**Comment No. 10**

Comment: (Section 9.2.4) What is the contingency for heavy erosion of the cap?

Response: The responsible parties will be responsible for maintaining an isolating cap at the Site. The Operations, Maintenance, and Monitoring Plan (OMMP) will address contingency

actions for erosion of the cap (e.g., placement of additional material should a significant amount of material erode from the cap).

**Comment No. 11**

Comment: Pg. 22, Sec. 8.1 Overall Protection of Human Health and the Environment, Groundwater: There isn't any discussion of how the range of alternatives will protect the environment of Commencement Bay, which receives the discharging groundwater. The marine habitat of Commencement Bay is composed of the waters of Commencement Bay as well as the sediments.

Response: Comment noted. Section 10 of the ROD addresses how the remedy for groundwater is protective of the marine environment of Commencement Bay.

**Comment No. 12**

Comment: Pg. 25, Sec. 8.3, Long-Term Effectiveness and Permanence, Sediment: NOAA agrees with the analysis in the Proposed Plan and supports the preferred approach which is to dispose dredged contaminated sediments in the upland containment facility with other contaminated materials. The consolidation of contaminated site materials into a few engineered upland facilities is expected to make long-term operation, maintenance and monitoring of these disposal facilities more efficient and reliable than would disposal into near- shore or sub- aquatic disposal facilities.

Response: Comment noted.

## Sediment Cap Thickness

**Comment No. 13**

Comment: EPA's Proposed Plan for the Asarco Sediments /Groundwater Operable Unit provides for sediments to "be capped with a minimum of 1 meter of clean sediment from an upland source." None of the information Asarco has developed during the sediment investigations justifies the "minimum of 1 meter" thickness. Asarco is concerned that EPA has specified a considerably thicker cap than is necessary for protection of the environment of Commencement Bay and human health.

EPA proposes a minimum cap thickness rather than a nominal cap thickness as well as an increase from the 0.6 m (60 cm or 2 ft) cap proposed in the Refinement of Remedy (Parametrix, 2000) to the thicker 1 m cap. These increases represent almost twice as much cap material as originally considered by Asarco and evaluated in the pilot cap tests. Thus, the EPA proposal would be considerably more expensive than the Asarco proposal of a nominal cap thickness of 0.6 m.

No evidence has been provided by EPA that the considerably thicker cap will provide greater protection of the environment in Commencement Bay. Requiring the minimum cap thickness of 1 m requires technical or scientific justification that this increase would provide a substantial increase in protection. No such justification has been provided by EPA or any other entity in the Asarco Sediments evaluations. It appears then, that EPA's requirement for a minimum 1 meter cap is arbitrary, capricious and beyond the scope of the agency's authority given the persuasive evidence for a nominal 0.6 meter cap in the pilot study. Also, under the National Contingency Plan, selected remedies are required to be cost- effective. If a remedy is both protective of human health and the environment, and meets ARARs, it must also be cost-effective. 40 CFR § 300.430(f)(1)(ii)(D). Under the regulation, cost-effectiveness is determined by evaluating three criteria - long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness. One then compares overall effectiveness with cost to see whether the cost is proportional to effectiveness. Both a nominal 0.6 meter cap and a minimum 1 meter cap are protective of human health and the environment and meet ARARs. However, the cost increase attributable to the minimum 1 meter cap is disproportionate to its effectiveness given that the nominal 0.6 meter cap is equally effective. If the remedy is not cost- effective, EPA can't select it.

The rationale for requirement of a minimum cap thickness of 1 m appears to have its origins in the Navy Homeport deliberations of the 1980' s. At that time, deepwater disposal and capping of Everett Harbor sediments dredged from the Homeport site was proposed. Opponents to this action maintained that a minimum cap thickness of 1 m should be required to eliminate any potential that the contaminated harbor sediments would be exposed if ghost shrimp should burrow into the cap. This was based on the theory that ghost shrimp can burrow up to nearly 1 m deep, and that their burrowing would move sufficient quantities of contaminated sediments to the surface to incur a risk to the marine environment.

Asarco has searched, but been unable to find factual information that supports this concern. There appears to be a misconception that the burrowing shrimps (ghost shrimp and /or blue mud shrimp) are a demonstrated threat to a sediment cap in Puget Sound. The potential threat of these shrimp is that their burrowing activities will lead to sufficient contaminated sediment redistributed to the surface layers of the cap to raise contaminant levels above biological effects concentrations. This would require the shrimp to:

- Burrow to depths that would penetrate well into the existing sediments or
- Actively burrow within the contaminated sediments moving large volumes of the contaminated sediment to the surface, or
- Pump large amounts of water through the contaminated sediments extracting substantial concentrations of metals.

None of these actions are probable.

It is valuable to review what is known about the local species of burrowing shrimp. There are two species of subtidal burrowing shrimp in Puget Sound, ghost shrimp (Neotrypaea californiensis formerly Callianassa californiensis) and the blue mud shrimp (Upogebia pugettensis). Neotrypaea lives primarily at middle intertidal levels, commonly decreasing in abundance at lower intertidal elevations due to predation ( Posey 1985, Posey 1986, Swinbanks and Luternauer 1987). Upogebia also tends to be intertidal but is found commonly at lower elevations. Both species are also found in subtidal areas. Neotrypaea is a deposit feeder that actively burrows in the top 10 cm of the sediments where it also constructs a single less active extension of its burrow generally about 30 cm deep, but sometimes as deep 40-50 cm (Swinbanks and Murray 1981). Upogebia is a filter feeder that forms a lined burrow that remains constant over time. Its burrow is Y shaped with the lower extension reaching as deep as 50- 60 cm. Upogebia appears to actively pump water through the U shaped upper portion of its burrow to obtain food.

To our knowledge there have been no investigations demonstrating that sufficient numbers of ghost shrimp are likely to burrow to sufficient depths and move sufficient material to represent any demonstrated risk to the marine environment. We believe it is more likely that small numbers of ghost shrimp might burrow as deep as 60 cm in a cap, and that if they did the quantity of material they would move would not raise surface concentrations of metals to near the sediment quality standards. Upogebia does pump water through the upper portions of its burrows to provide food and oxygen. Because its burrows are lined and the active pumping is likely restricted to the upper U shaped portion of their burrows, there is little reason to expect that this water flow would extract measurable levels of contaminants even if the bottom of the burrow did extend into contaminated sediments.

Asarco has been unable to find any reports of burrowing shrimp actually changing the contaminant concentrations of sediments within a cap, or at the surface of a cap. The concern for contaminant redistribution appears to be theoretical rather than demonstrated.

Asarco also believes there is little risk in providing a 60-cm cap. Additional cap material can be added at a later date if monitoring determines there is actual evidence

that ghost shrimp or other means are moving contaminants to the upper layer of the cap. The Proposed Plan (page 31) provides for the addition of material if monitoring indicates additional material is warranted.

Response: Based on the depth of burrowing organisms known to be present at the Asarco facility, EPA supports the placement of a 3- foot cap at the Site. This cap thickness (3 feet or approximately 90 centimeters) is slightly different from the thickness proposed in the Proposed Plan (1 meter or 100 centimeters). As supported by the information below, EPA believes a 3-foot cap is necessary to protect human health and the environment and to ensure long-term effectiveness and permanence, but yet still be cost-effective. The EPA's preferred alternative is not "arbitrary and capricious and beyond the scope of EPA's authority," as stated in the above comment. For the reasons described below, EPA does not believe that the 0.6-meter (2-foot) cap proposed by Asarco is protective of the environment or effective in the long term.

EPA's rationale for placing a 3-foot cap at the Site is based on the fact that bioturbation at this Site may extend to depths of approximately 30 inches (0.75 meter). The depth of bioturbation, which is based on the type of organisms that may inhabit the cap after cleanup, may be significant at the Site due to the presence of Neotrypaea californiensis (formerly Callianassa californiensis). This shrimp has been documented at the pilot cap, and tends to build extensive burrows with multiple entrances. Burrowing activities are significant in the upper 50 centimeters (20 inches) of sediment (Hornig et al 1989, Griffis 1991, Swinbanks et al 1987, Posey 1986, and Ott et al 1976), and some research states that burrows can extend to depths of approximately 30 inches ( or 0.75 meters) (Kaestner 1980, Hornig et al 1989). Further, both the depth of potential burrowing activity and the impact of the burrowing activities on sediment characteristics need to be taken into account when selecting a cap thickness for the Site. Even if a shrimp does not penetrate the entire cap, the burrows alter the characteristics of the sediment ( higher water content, finer grained) such that the sediment may become more prone to erosion and transport from the Site.

In addition, Callianassa are capable of redistributing a significant volume of subsurface sediment to the surface if they colonize a cap. At the Denny Way cap in Elliott Bay, Callianassa were found at densities of 8-10/m2 at six months after capping, and between 38-66/m2 at 18 months after capping. At the latter density at the Denny Way Cap, Callianassa was estimated to be redistributing 1.2 to 5.4 kg/m2/day of subsurface sediment to the cap surface. Further, as indicated by the results of the pilot cap study conducted at the Site, a few inches of mixing occurs within the bottom of the clean cap material during cap placement. To insure an effective cap, these local data (regarding the volume of sediment moved by organisms and the amount of mixing that occurs during cap placement) indicate that a minimum cap thickness of 3 feet is appropriate to minimize disturbance and recycling of the contaminated sediments to the surface.

In conclusion, since the presence of these burrowing organisms has been documented at the Site, and there is evidence to indicate these organisms burrow to approximately 30 inches, EPA supports a minimum 3-foot (36 inch) cap. A cap of this thickness would provide the long- term isolation that is necessary for this remedial action.

Further, the Refinement of Remedy Report (Hydrometrics, January 2000) proposed a minimum cap thickness of 2 feet, not a nominal thickness of 0.6 meter (or approximately 2 feet), as stated in the comment. EPA is currently proposing a cap with a minimum thickness of 3 feet. This difference in cap thickness does not represent twice the volume of material as stated in the comment.

**Comment No. 14**

Comment: (Section 8.1) Were the full range of potential organisms considered when determining the thickness of cap necessary to prevent recontamination due to bioturbation?

Response: Yes. See the response (above) to Comment No. 13.

**Comment No. 15**

Comment: Pg. 29, Sec. 9.2.1 In Situ Sediment Capping: [As stated in the Proposed Plan] "In situ capping is the Preferred Alternative for the Nearshore /Offshore area and Northshore area. Approximately 88,000 sq. yd. (18 acres) of existing contaminated sediments in the Nearshore /Offshore area will be capped with a minimum of 1 meter of clean sediment from an upland source and approximately 7,000 sq. yd. (1.5 acres) of existing contaminated sediments in the Northshore area will be capped with a minimum of 1 meter of clean sediment. The cap thickness will be designed such that it provides chemical isolation, is stable, and provides a cap surface that will allow recolonization of benthic communities."

While NOAA was originally pessimistic about the feasibility of capping the contaminated sediments in the remaining Nearshore and Offshore Units, the initial results of the Pilot Project supports this approach. Obviously, a fairly coarse material (sand and gravel) will be needed; such materials are often low in organic content (usually in the silt and clay fractions). However, it would be desirable if there is some way that increased organic content could be incorporated into the capping material to enhance biological repopulation. This is a challenge since the organics are usually associated with the finer components which can be swept away by the currents during emplacement. EPA should keep the goal of benthic recolonization in mind during design.

NOAA believes that nothing less than a 1- meter cap will effectively isolate contaminated sediment at the ASARCO site. One of the objectives for the sediment component of the remedy is "Restore and preserve aquatic habitats by limiting and/or preventing the exposure of environmental receptors to sediments with contaminants above Washington State Sediment Management Standards (SMS, WAC 173-204)" (See bottom of pg. 16). In order to accomplish this goal, the habitat value of the sediments must be restored. It is likely that burrowing organisms will recolonize the cap material soon after it is placed, as occurred in the pilot study cap at the site (see the monitoring reports prepared for Asarco by Parametrix, Inc.). One organism thought to inhabit the sediment offshore of the Asarco facility is a ghost shrimp (also called mud shrimp). This organism is known to construct burrows 2 feet deep (Garman, personal communication). Other researchers report that ghost shrimp burrow to a depth of three feet (Ricketts and Calvin, 1962). Based on this information, we conclude that one meter is the minimum cap thickness that would be effective. It is necessary to isolate contaminated sediment from ghost shrimp and other burrowing organisms to prevent the biota from facilitating transfer of the contaminants to the sediment surface, the water column, and to higher trophic level organisms (G. F. Riedel et. al., 1989).

Response: EPA concurs with NOAA's comment. Benthic recolonization will be considered during design of the cap, and EPA continues to support a 3-foot-thick cap for the Site.

## Sediment Dredging

**Comment No. 16**

Comment: The Proposed Plan describes dredging to a depth of approximately 2 feet. This is an acceptable depth to use to develop a conservative estimate of dredging volume. However, it needs to be made clear that actual dredging depth will depend on the actual depth of contamination that is verified to be present during Remedial Design and during actual dredging. There is no evidence of sediments exceeding cleanup screening levels ( CSLs) below a depth of 1 ft in the marina.

As part of the Phase 2 Expanded RI/FS, subsurface sediment chemistry core samples were collected by divers at stations 5-0 and 5.5-0 in the yacht basin (Parametrix 1996). The upper layer of sediment that contains metals higher than CSLs was visually distinctive from the deeper sediments that did not exceed CSLs. Cores were observed to contain black sand in the upper 0.4 ft and gray sand from 0.4 to 1.9 ft. Core samples from the upper 1.0 ft exceeded CSLs for arsenic, copper, and zinc. Samples from 1.0 to 1: 9 ft were below CSLs.

Divers collected two additional core samples from the shallow, shoreward side of the basin in 1997. Rather than dividing the cores into 1- ft segments, these cores were sectioned according to visually distinctive changes in sediment type. The core from station 5-0.9 was described as a dark olive colored sandy gravel in the upper 17 cm (0-6 ft). The 17 to 18 cm section was gravel with shell debris. Copper exceeded the CSL in the upper section and all metals tested were below CSLs in the 17 to 18 cm section. The other core sample contained olive colored fine sand in the upper 21 cm (0.7 ft). The 21 to 37.5 cm section (0.7 to 1.2 ft) was silty sand with gravel and cobbles. The upper section exceeded CSLs for copper and mercury and the lower section was less than the CSLs for all metals analyzed.

Additional core samples will be collected in the spring of 2000 as part of the preliminary design analyses for yacht basin dredging. These analyses will help determine whether metals exceeding CSLs are limited to the upper 1 ft of sediments, or if deeper sediments exceed CSLs in any areas of the yacht basin.

Response: EPA acknowledges Asarco's comment. The exact depth of dredging will depend on the existing core information, as well as the core information that will be collected in the spring of 2000. Post-dredging confirmatory sampling will also be required to confirm adequate removal of contaminated sediments.

**Comment No. 17**

Comment: Page 20, Table 7-3. The note for alternative S- 2D states: "As a contingency, if all the contaminated material cannot be removed from the Yacht Basin, dredging in the Basin followed by placement of clean material may occur." EPA should acknowledge that slag will remain in the Yacht Basin following dredging and that this material, though it may exceed CSLs, has been shown to not exhibit contaminant effects at other areas of the Site. It would not be possible to remove all the slag exceeding CSLs from the basin without removing the entire breakwater peninsula, and dredging at the base of the peninsula will need to be designed so that it does not destabilize steep slopes. Placement of clean material over the slag will not be necessary because the metals in slag are bound in a rock- like form and are not necessarily available to the benthic community.

Response: EPA will depend on a tiered sampling approach for determining if additional action in the Yacht Basin is necessary after initial dredging is complete. As discussed in Asarco's comment above, it is anticipated that the sediment below 1 to 2 feet in the Yacht Basin does not contain chemical concentrations above state Sediment Quality Standards ( however, an exception may be immediately next to the Breakwater Peninsula). Should conditions warrant, however, EPA may require placement of a cap over a dredged surface as one possible option for remediating parts of the Yacht Basin. Contingencies for addressing these types of situations will be developed during the remedial design.

**Comment No. 18**

Comment: EPA + Asarco should consider deeper dredging between the road and a dock to remove contaminants and to facilitate passage of deeper draught Boats - contaminated sediments have accumulate from Asarco property to fill this area in to a disadvantageous degree.

Response: EPA's goal is to dredge the sediment where samples indicate adverse biological effects. The exact depth of dredging will be further refined in late 2000, after additional sampling has occurred in the Yacht Basin. As for dredging to accommodate passage of deeper draught boats, Asarco has committed to work directly with Tacoma Yacht Club members on this issue. This collaborative effort will ensure the needs of boat owners are being addressed.

**Comment No. 19**

Comment: Make sure any Dredging Plan for the Yacht Basin includes indemnification for damage to Boats + houses and dockage. Make sure provision for temporary moorage for

displaced boats is made available.

Response: It is EPA's understanding that Asarco will work directly with the Yacht Basin owners on indemnification and temporary moorage issues.

**Comment No. 20**

Comment: Pg. 30, Sec. 9.2.2 Yacht Basin: [As stated in the Proposed Plan] "For the dredging alternative, the material would be dewatered, and then placed in a controlled, upland location (known as Crescent Park, in the central part of the upland Facility), that will be monitored for many years. This allows for the long-term effectiveness of the remedy to be monitored. Further, the mobility of the contaminants would be reduced, as the sediment would be in a location that does not have contact with water. There will also be contingency plans should the upland cap begin to fail (i.e., get cracks in it)."

Comment: NOAA supports the preferred alternative because it permanently removes contamination from a site area that is perturbed by marina activities and only dredging to remove the contamination will allow the marina to continue operations in the future without restrictions on dredging. In addition, isolating the contaminated materials in an upland facility with contingencies for any incipient failure of the containment structure should be easy to monitor and implement because these upland site areas also win be used for isolation of contaminated soils and/ or debris.

Response: EPA acknowledges NOAA's support for the proposed remedies.

**Comment No. 21**

Comment: (Oral comment provided at the February 10, 2000 public meeting)
Well, I have a voice that doesn't need a microphone. I would like to once again address the materials that have come down on the site close to the shore both inside of the breakwater and along our A dock, the part down there.

Those sediments have come down and the glacial till has come down with sediments because it's been blessed with those for decades as well. It has caused us a problem that will be a problem with our agreement with the park board. We lease this property from the park board.

And when this project as totally dreamed up comes to pass that there is a walkway, a pedestrian walkway along there, we have unattractive boathouses on that side so that you can see them from that walkway. And the reason for that is that it is shallow there.

This land that has come down has made the water shallow so larger boats, larger sailboats cannot come in there. Only small boats, inexpensive boats, can go in there because they're capable of backing out and turning around in a normal tide, where a larger boat can't do it because it's too shallow there.

So we have, one, the problem that, I think, that the sediments must be deeper there because it's been built up over a period of time and not sluiced away. But we also have the problem of that material coming down in a way that makes it so that we need that dredged out, that material removed for other reasons, and material that we had nothing to do with depositing there as well as however much arsenic there is.

And we would like to see what kind of help we could get in looking deeper into that particular problem when you consider the depth of the dredging or the amount of the dredging that you are going to do. Thank you.

Response: Comment noted. EPA will take steps to see that Asarco coordinates with the Tacoma Yacht Club to address the coordination of dredging required for environmental protection and possible additional dredging that may be advantageous for navigation or other purposes.

**Comment No. 22**

Comment: (Oral comment provided at the February 10, 2000 public meeting)

Thank you.

Again, as chairman of the board of trustees of Tacoma Yacht Club, I would like to officially put in the record that we want to be included as members of the team that work on planning and designing the way that we would go about dredging. At least being included because of the 300- plus boats our membership has moored here plus the portion of the basin that we lease to a private operator for public moorings. There's another 200- plus boats.

We have a lot of responsibility there, and we don't want to turn that responsibility over without having a say in just exactly how it's going to take place. So we want to officially go on the record as making that request.

We will make the people available. We will make professional people available, and I think probably will be an asset to the team. Bottom line is, we'd like you to leave it alone but I got a hunch you're probably not interested in that so we would want to be involved.

Response: Comment noted. EPA will take steps to see that the responsible parties coordinate with the Tacoma Yacht Club regarding the dredging and associated work that will occur in the Yacht Basin.

**Comment No. 23**

Comment: (Oral comment provided at the February 10, 2000 public meeting)

Thank you. I'm (b) (6) of the Tacoma Yacht Club, and (b) (6) pretty well summed up everything that I wanted to say. I have some concerns about details and that was primarily the closure of the basin and its impact on our use of boats, being able to move them out of the basin when we want to use them.

Also I'd like to make a comment on a subject that was mentioned earlier and that was controlling sediments generated during the dredging operation and the proximity of this basin to the Metro Parks aquarium. There is a tidal current that runs parallel to the shoreline here and it runs up to two knots. It runs right past our clubhouse and goes right on down to the aquarium. It would take any sediment. that escaped out of the basin right down to 5 the aquarium intake.

Response: Comment noted. Suspended sediment caused by dredging will be controlled. The details will be addressed during the remedial design.

## Institutional Concerns Regarding Sediment Capping

**Comment No. 24**

Comment: The current proposal includes the permanent capping of contaminated sediments in place. Siting such permanent caps within the City of Tacoma Harbor Area - as the proposal currently does - is problematic in that the caps may be inconsistent with constitutional, statutory and regulatory directives.

The main issues are:

- Capping as a mechanism for contaminated sediment storage is a non water-dependent use. Non water-dependent uses in harbor areas are considered interim uses and can only be allowed, if defined criteria are met (e.g., compatibility and exceptional circumstance analyses and other factors, Washington Administrative Code (WAC) 332-30-137);

- Institutional controls (i.e., Regulated Navigation Area) likely necessary to maintain the integrity of the capped areas will limit commerce and navigation in a Harbor Area. However, Harbor Areas are reserved for commerce and navigation in the Washington State Constitution; and

- Caps displace navigation and increase present navigational hazards.

In addition, some of the proposed cap appears to extend beyond the outer harbor line. This is especially problematic because Article XV Section 1 of the Washington State Constitution establishes that "the state shall never give, sell, or lease to any private person, corporation, or association any rights whatever in the waters beyond such harbor lines."

If the proposed caps are authorized, the City of Tacoma's Harbor Area will have to be adjusted, a time-consuming process subject to rules detailed in WAC 332-30-116. A Harbor Area relocation should maintain or enhance the type and amount of harbor area needed to meet long- term needs of water dependent commerce. The relocation should also maintain adequate space for navigation beyond the outer harbor line. After these findings are made, there are other issues to be considered (see WAC 332-30-116(2)).

We have identified to EPA the value of the Asarco area as an important functional component to the overall Harbor Area in Commencement Bay. We continue to encourage EPA to define a plan that recognizes this important land use role and that allows a balance between commerce/navigation and habitat functional needs. The cleanup plan should not impact the existing deep draft capability at the site or lessen the current and future capacity for structures associated with navigation and commerce.

Response: EPA offers a six part response:

1. Capping as a Mechanism for Contaminated Sediment Storage is a Non Water-Dependent Use - EPA does not intend capping as a temporary or interim remedy. EPA is, mandated by CERCLA to select the remedies that are permanent to the maximum extend practicable. EPA must also perform five-year reviews to ensure that the cap stays in place and remains protective. EPA will require the cap to be monitored to ensure that it is continuing to protect human health and the environment. If EPA determines that the cap is no longer protective, EPA can amend its ROD or issue an Explanation of Significant Difference (ESD) and modify the remedy if necessary.

EPA also disagrees that capping is a nonwater-dependent use. The regulations define "nonwater - dependent use" as a "use that can operate in a location other than on the waterfront." WAC 332-30-106(42). First, if EPA selects capping as the appropriate remedy then it must take place in the water; that is, it cannot logically exist in any location but on the water, thereby making it water dependent as defined by the regulations. WAC 332-30-106(71). Second, Washington's regulations also define the policy for "nonwater-dependent use" as a "low priority use providing minimum public benefits." WAC 332-30-137. Capping the sediments to prevent harm to human health and the environment does provide " public benefits" and therefore does not fall under the regulatory policy.

2. Institutional Controls — Although EPA must implement institutional controls to maintain the integrity of the cap, EPA does not believe that capping will impede reasonably foreseeable uses of navigation and commerce.

3. Caps Displace Navigation and Increase Present Navigational Hazards — See response to # 2, above.

4. The Proposed Cap Appears to Extend Beyond the Outer Harbor Line — EPA is not seeking to buy, lease, or receive rights to property. By choosing capping as a remedy, EPA is trying to prevent further contamination of the sediments. EPA, or the party performing the work, will need access to the waters to perform

the remediation and subsequent monitoring, but the property shall remain with DNR.

5. Adjustment of the City of Tacoma's Harbor Area — EPA expects that DNR will cooperate in making any necessary and appropriate changes to legal designations and in developing institutional controls to maintain the protectiveness of the remedy so that human health and the environment can be protected.

6. Deep Draft Capability of the Site and Future Capacity for Structures Associated With Navigation and Commerce — See response to # 2, above.

**Comment No. 25**

**Comment:** For public aquatic lands, the state laws, the state Constitution, and the existing policies, strategies, and guidance for implementing these laws do not support the use of public aquatic lands for permanent storage of contaminated material. If contamination is to be temporarily stored on public aquatic lands, the worst of the contamination must be removed for treatment or upland disposal, and the remaining storage site must be designed to allow future removal for treatment or upland disposal once technology makes it feasible to do so. Neither the alternatives analysis nor the resulting proposal to cap recognizes or incorporates these standards for use of public aquatic lands.

**Response:** The laws and policies cited by DNR do not clearly address cleanup issues, including the suitability of capping as a remedy. EPA intends for capping to be a permanent solution for the sediments. EPA will require monitoring of the cap to ensure its stability and effectiveness. If EPA later determines that the cap is not protecting human health and the environment, EPA can amend its ROD or issue an Explanation of Significant Difference (ESD) to modify the remedy.

## Groundwater Extraction and Treatment

**Comment No. 26**

**Comment:** We strongly support alternatives to actively remove and treat contaminated groundwater, and we encourage a commitment to long-term, intensive monitoring to determine effectiveness of the remedy.

**Response:** Alternative GW-C (Pump/Treat and Discharge to Outfalls) was evaluated as part of the Feasibility Study. The pump/treat system would need to be operated into perpetuity because the primary source material (slag) can not be removed and will continue to contribute contaminants to groundwater indefinitely. A pump/treat system such as Alternative GW-C would therefore not provide any permanent environmental solution. In addition to being cost-effective, the preferred alternative (GW-B) has the benefit of reducing groundwater discharge to Commencement Bay by an estimated 75 to 95 percent, thus resulting in a significant reduction in contaminant loading to the marine environment.

**Comment No. 27**

(Section 8.6) Since the following sentence claims that pump and treat is reliable and available, by "difficult" do you mean costly?

**Response:** The pump and treat alternative would be "difficult" to construct and operate in the sense that the layout of the overall system would be extensive and the physical plant facilities large compared to similar systems at other sites. From a hydraulic perspective, a pump and treat system would be inefficient due to the proximity of Commencement Bay (i.e., an extraction system would pump a significant volume of water originating from the bay). From a logistical standpoint, the size and extent of the system would be relatively difficult to operate given the presence of the other remedy elements (low-permeability cap, drainage systems, onsite containment facility, etc.) and the other site uses anticipated for the future. The system would also be costly to build and operate compared

to the other alternatives evaluated.

## Remediation Goals/Levels (Groundwater)

**Comment No. 28**

**Comment:** Asarco strongly prefers that the Preferred Alternative and Proposed Plan result in attainment of Remedial Action Objectives and Remediation Goals ( RGs). Asarco's primary concerns regarding the attainment of RAOs and RGs are:

1. The Remedial Action Objectives for groundwater do not match the RAOs of the Asarco Tacoma Smelter Facility Record of Decision (" Upland") ROD. Since the remedial action is being, and will continue to be, implemented as part of the Upland ROD, it appears that the remedial action must "serve two masters."

2. RAOs are overly broad and ignore site- specific information about the risk from arsenic.

3. The compliance point for attainment of RGs is not specified. Depending on location of groundwater compliance points the RGs may not be attainable.

To remedy these concerns, Asarco proposes that:

- The RAOs for groundwater in the Proposed Plan should complement the RAOs for groundwater in the Upland ROD;

- The RG for arsenic should be based on EPA's Site-specific risk assessment that indicates existing groundwater discharges to Commencement Bay do not cause unacceptable risks to human health and the environment; and

- the compliance point for groundwater discharges should be identified as the point of discharge (i.e., post-remedial action groundwater/seawater interface).

Specifically, Asarco proposes the following groundwater RAOs:

1. Prevent ingestion of potable groundwater containing concentrations above Federal MCLs and direct contact with groundwater containing contaminants in concentrations above risk-based goals.

2. Reduce discharge to Commencement Bay of groundwater that exceeds applicable marine surface water quality standards, <u>risk-based levels protective of human health</u>, or background concentrations (if background concentrations are higher than the standards).

Asarco proposes an arsenic remediation goal of 0.012 mg/ L based m maintenance or improvement of groundwater arsenic concentration at the slag shoreline.

Asarco proposes a compliance point of surface water along the face of the post-RA slag shoreline.

<u>Remedial Action Objectives</u>

The Proposed Plan modifies the earlier RAOs in the Upland ROD for the Site making them overly broad and inappropriate. EPA's remedial action objectives (RAOs) for groundwater in the Proposed Plan are as follows:

1. Prevent ingestion of or direct contact with groundwater containing contaminants.

2. Prevent discharge (to Commencement Bay) of groundwater that exceeds applicable marine surface water quality standards or background concentrations (if background

concentrations are higher than the standards).

For comparison, the Upland ROD RAOs are:

1. Prevent ingestion of potable (Class IIB) groundwater containing contaminants in concentrations above ARARs or above risk-based goals when ARARs are not protective or not available.

2. Reduce discharge to Commencement Bay of contaminated waters containing contaminants in concentrations above ARARs or risk-based goals when ARARs are not protective or not available.

As written, Proposed Plan RAO # 1 is neither achievable nor necessary. EPA has substituted "groundwater" for "potable groundwater" and "groundwater containing contaminants" for "groundwater containing concentrations above ARARs" All groundwater, everywhere, contains "contaminants" but that is not a problem for human health or aquatic life unless concentrations are too high (i.e., above ARARs or risk-based goals). As written the RAO is so broad that it is nearly meaningless and gives no direction to the goals that are to be achieved.

Compared to the Upland ROD RAOs, Proposed Plan RAO # 2:

- Substitutes "prevent discharge to Commencement Bay of groundwater" for "reduce discharge of contaminated water"; and

- Substitutes "background concentrations" for the phrase "risk-based goals when ARARs are not protective or not available."

Prevention of discharge of groundwater from the Site is not technically possible. However, the Preferred Alternative will reduce the discharge of groundwater from the Site to the extent practicable and will reduce the discharge of contaminants to levels that are clearly protective of human health and the environment.

Background concentrations are not appropriate substitutes for risk- based goals for arsenic since Site-specific risk information and protective risk- based goals are available. The Proposed Plan correctly points out that

> "Neither the Maximum Contaminant Limits (MCLs) promulgated under the Federal Clean Water Act nor the State of Washington Model Toxics Cleanup Act (MTCA) groundwater cleanup levels are considered Applicable or Relevant and Appropriate Requirements (ARARs) for the shallow groundwater system at the Facility." page 15, Proposed Plan

In this case, it is appropriate to use risk- based levels and EPA correctly notes that:

> "Currently, the groundwater discharging to Commencement Bay will exceed human health risk based levels for fish consumption (0.14 ug/L for arsenic) (National Toxics Rule; CFR 40, § 131.36). However, past fish tissue sampling indicates low risk from Facility contaminants even to people consuming large quantities of fish from the Facility." page 15, Proposed Plan

However, the RAO and RG for arsenic fail to acknowledge EPA's uncertainty in the National Toxics Rule (NTR) fish consumption limit and fails to acknowledge EPA's Site specific data and risk assessment. The NTR does not reflect the current understanding of arsenic health risks. EPA has been reviewing the NTR arsenic criteria for several years with the intent to revise the criteria. EPA's risk assessment indicates that existing risk from fish consumption is acceptable and will be lowered further by implementation of the Preferred alternative.

CERCLA Section 121(d)(2)(B)(i) provides a standard for determining whether or not any water quality criteria under the Clean Water Act is relevant and appropriate. In making this determination, Section 121 directs that the Agency:

> "shall consider the designated or potential use of the surface or groundwater, the environmental media affected, the purposes for which such criteria were developed, and the latest information available."

The existing human health criteria for arsenic in the NTR does not reflect the latest information available and does not consider Commencement Bay, the environmental media affected. EPA is currently in the process of revising the human health criteria for arsenic in the NTR. Recent information on arsenic risks in Commencement Bay are available in EPA's risk assessment entitled "EPA Ecological Risk Assessment and Seafood Consumption Screening Risk Assessment Asarco Sediment Site - October 1996." Given the uncertainty in the NTR arsenic level and the existence of more recent Site- specific data, Asarco believes that the NTR arsenic level should not be an ARAR for the Site in accordance with CERCLA Section 121(d)(2)(B)(i). In establishing the RAO for arsenic in groundwater, EPA should consider the latest information on the environmental media affected. The latest information available is EPA's risk assessment on Commencement Bay. Asarco proposes that the RAO be revised to include the use of risk-based limits for arsenic.

Remediation Goal for Arsenic in Groundwater

For current arsenic risks EPA's risk assessment (USEPA, October 1996) concluded:

The potential for adverse non-cancer health effects associated with ingestion of fish caught near the site is low (i.e. at or below the hazard quotient benchmark value of 1.0).

For the reasonable maximally exposed individual, inorganic cancer risk estimates are close to but not greater thin the upper end of the risk management range recommended in the NCP (1 x 10-6 to 1 x 10-4) at fish ingestion rates greater than approximately 150 grams per day.

For the average case individual, inorganic cancer risk estimates are within or below the NCP risk management range at all fish ingestion rates considered.

Or as summarized by EPA in the Proposed Plan:

> "... past fish tissue sampling indicates low risk from Facility contaminants even to people consuming large quantities of fish from the Facility." Page 15, Proposed Plan

In light of Site-specific data regarding the low arsenic risk from seafood ingestion, Asarco proposes that an appropriate RG for arsenic would be based on maintaining existing arsenic concentrations in groundwater discharging to Commencement Bay. Since the Preferred Alternative will result in a substantial decrease (to the extent practicable) in the amount of groundwater flow to Commencement Bay, maintaining groundwater arsenic concentrations would result in substantial decreases in the load ( or mass) of arsenic discharged to Commencement Bay. Therefore, the Proposed Remedy with Asarco's proposed RG would result in further reduction to the maximum extent practicable of the already acceptable arsenic risk.

Groundwater Compliance Point

The Proposed Plan does not specify a compliance point for groundwater discharging to Commencement Bay. Asarco proposes that the compliance point for groundwater discharges should be in the surface water as dose as technically possible to the point or points where ground water flows into the surface water. After remediation, the point on the Site that is "as close as technically possible to the point or points where the ground water flows into the surface water" will be surface water along the face of the stabilized and

protected slag shoreline. This compliance point of surface water along the face of the post- RA slag shoreline would protect the water resource at the point of possible human or aquatic life exposure and would comply with MTCA.

Under Washington's Model Toxics Control Act (MTCA), groundwater compliance monitoring points should be selected to be "as close as technically possible to the point or points where the ground water flows into the surface water." (WAC 173-340-720(3)(b)(v)). Furthermore, "At these sites [where the affected ground water flows into nearby surface water], the department may approve a conditional point of compliance that is located within the surface water as." (WAC 173-340-720(6)(d)). Presently, the point where groundwater flows into surface water on the Site is the face of the slag shoreline. During Upland remediation, the face of the slag shoreline will be armored to prevent erosion. After Upland remediation is completed, the point where groundwater flows into surface water on the Site will be the face of the armored shoreline. Therefore, the proposed groundwater compliance point is surface water at the face of the post-RA shoreline.

**Response:** The response to the above comment is been divided into three parts:

- Remedial Action Objectives for Groundwater
- Cleanup (Remediation) Goal for Arsenic in Groundwater
- Point of Compliance for Groundwater

1) <u>Remedial Action Objectives for Groundwater</u>

The comment suggests that the RAOs for groundwater must replicate the RAOs cited in the 1995 ROD for OU 02 (i.e., the "serve two masters" argument). The 1995 ROD specifically defers a cleanup decision for Facility groundwater. Because the remedy selection for groundwater was deferred for 5 years, it is appropriate to reassess the RAOs in context of new information that has become available.

EPA agrees with Asarco's comment indicating that the RAO as presented in the Proposed Plan may be vague with respect to the use of the term "contaminated" without qualification. Therefore, the RAO as stated in Section 8 of this ROD has been revised to read:

> "Prevent ingestion of groundwater containing contaminant concentrations above federal maximum contaminant levels ( MCLs) or above risk- based goals for those substances for which MCLs have not been established and prevent direct contact with groundwater containing contaminant concentrations above applicable risk-based goals."

Regarding the second RAO ("Prevent discharge [to Commencement Bay] of groundwater that exceeds applicable marine surface water quality standards or background concentrations [if background concentrations are higher than the standards]."): The RAO is not meant to suggest that discharge of all groundwater to Commencement Bay can be prevented. Instead, the intended objective is to prevent discharge of groundwater <u>containing contaminants at concentrations in excess of applicable standards or background concentrations</u>. We agree with Asarco's proposed revision of the RAO that recognizes the need to incorporate wording acknowledging the need to protect human health in addition to the marine environment. Therefore, the RAO as stated in the ROD has been revised to read:

> "Prevent discharge to Commencement Bay of groundwater containing contaminants at concentrations exceeding applicable marine surface water quality standards, risk-based levels protective of human health, or background concentrations (if background concentrations are higher than the applicable standards)."

2) <u>Cleanup (Remediation) Level for Arsenic in Groundwater</u>

EPA acknowledges that human health criteria for arsenic is under review. At this writing, however, the National Toxics Rule ( NTR) standard of 0.14 ug/L has not been revised and remains an ARAR for the Site. However, the ROD waives the NTR standard for groundwater and defers to MTCA for determining the cleanup level. Application of MTCA results in a cleanup

level of 6 ug/L for arsenic (see Section 12.1.3 of the ROD).

3) Point of Compliance for Groundwater
The point of compliance for groundwater was recently determined by EPA in cooperation with the Washington State Department of Ecology. The point of compliance will be at the interface of the surface water and the shoreline of Commencement Bay and the Yacht Basin. Specifically, the point of compliance for the slag aquifer will be at the interface between the slag ( or any overlying shoreline armoring materials) and the surface water. This is technically a "conditional" point of compliance as addressed by WAC 173-340-720 (6)(c) and (d). Compliance will be based on a comparison of groundwater data from nearshore monitoring wells with cleanup levels adjusted to reflect a location specific dilution/ attenuation factor. See Section 12.1.4 of the ROD for more information.

**Comment No. 29**

**Comment:** Page 15, Remediation Goals. At a minimum it would seem appropriate for EPA to acknowledge that the NTR arsenic criteria is under revision. It might also be appropriate to establish that if the arsenic RG can not be met, then the revised arsenic criteria would be considered in determining the need for additional groundwater controls/remediation.

**Response:** See the response to Comment No. 28. The ROD acknowledges the on-going review of risk information for arsenic. Improvements in groundwater quality are not expected to occur immediately after remediation is complete. Instead, such improvements are likely to occur over a period of years. To that end, EPA expects that remedy success or failure with respect to meeting cleanup levels can only be determined after collecting post-remediation data for several years. If the cleanup level for arsenic is not being met, the need for supplementary cleanup actions will be assessed as part of the five year review processes. Such actions could include, but are not limited to, relaxation of the cleanup level (if supported by new risk-based standards) or additional remedial actions if they are deemed effective and practicable. EPA expects that the Operation, Maintenance, and Monitoring Plan ( OMMP) will identify an evaluation and decision process for assessing the long-term monitoring data and determining if the cleanup levels are being achieved.

**Comment No. 30**

**Comment:** 6.1 Groundwater Cleanup Objectives

Background contamination levels for copper in the remedial area are held to be 40 ug/L and a question is raised as to whether groundwater cleanup levels of 3.1 ug/L can be met. However, no mention is made as to what the background levels for copper in groundwater are for the Commencement Bay area outside of the Asarco site. Presumably, the higher copper background contaminant level is directly attributable to past smelter operations, and therefore subject to remedial action to correct the problem

**Response:** The 40 ug/L concentration cited for copper is the established "natural" background level. It represents the copper concentration in groundwater in the greater Tacoma area, not just in the vicinity of the Site (for further information on how background levels were determined see Remedial Action Objectives and Preliminary Remediation Goals for the Asarco Tacoma Site, Appendix F, [EPA, April, 1993]).

**Comment No. 31**

**Comment:** (Section 6.1) What happens in the future if and when background concentrations and laboratory detection limits drop? Will cleanup goals track these drops, if they occur, until it reaches the National Toxics Rule standard of 0.14 ug/l for arsenic. Likewise for copper.

**Response:** The five-year review process will assess if the remedy is performing as designed and is still protective of human health and the environment. Cleanup levels could be modi0ed to reflect new risk- based or regulatory criteria.

**Comment No. 32**

**Comment:** Pg. 15, Sec 6.1, Groundwater Cleanup Objectives: [As stated in the Proposed Plan]

- "Prevent discharge (to Commencement Bay) of groundwater that exceeds applicable marine surface water quality standards or background concentrations ( if background concentrations are higher than the standards)."

AND: "The cleanup goal of 3.1 ug/L for copper is protective of human health and marine life in Commencement Bay. It is acknowledged, however, that the background concentration for copper in the vicinity of the Facility is 40 ug/L, and it may not be possible to achieve the 3.1 ug/L cleanup goal. If not, copper in groundwater will be managed to the 40 ug/L background concentration."

These statements are ambiguous. The information provided above documents that the (upgradient groundwater) background concentration for copper is higher than the acute and chronic ambient water quality criteria. On the basis of the wording of the Groundwater Cleanup Objective, this would indicate that for copper in groundwater the cleanup objective is 40 ug/L. However, the ecologic receptors and the applicable criterion apply to waters of Commencement Bay. It is questionable whether a remedy that does not lead to compliance with the water quality criteria is ecologically protective, and it is possible that even if the groundwater copper concentration is controlled to 40 ug/L, that the shoreline waters of Commencement Bay will not meet the water standard. There are other sources of copper (and other metals and metalloids) contamination along the shoreline such as contaminated surface water runoff and the large deposits of slag, but these sources also are affected by former actions of Asarco.

It is the position of NOAA, as the federal Natural Resource Trustee for marine organisms and habitats, that a goal of the overall remedy should be the attainment of water quality criteria for the protection of marine life in all areas of Commencement Bay affected by former site smelting, manufacturing, and/or disposal activities.

**Response:** Comment noted. EPA shares the Natural Resource Trustee's goal to attain water quality criteria for the protection of marine life in Commencement Bay. This is reflected in the stated cleanup level of 3.1 ug/L for copper (equal to the marine chronic criteria for copper). EPA believes that the 3.1 ug/L cleanup level for copper may be achieved before groundwater discharges to Commencement Bay. EPA expects copper concentrations to decline with time due to the benefits of upland contaminant source removal actions, site capping and surface water controls (limiting groundwater recharge), and the ongoing seawater intrusion that occurs in the nearshore portions of the site aquifers (resulting in dilution of copper before groundwater is discharged to Commencement Bay). "Ultra clean" sampling data collected by Asarco in 1999 show that current (pre-RA) copper concentrations in Commencement Bay water immediately adjacent to the slag shoreline face are below the 3.1 ug/L cleanup level in most locations sampled. The significant exception is the Yacht Basin where samples exceed the copper cleanup level as far as 200 feet from shore (8.38 ug/L, average of high and low tide samples collected in September 1999). This is not unexpected given the proximity of the Yacht Basin to the previously existing "Copper Refinery Area," a significant upland source of copper contamination. Source materials are being removed from the Copper Refinery Area as part of the OU 02 remedial action. Further, Yacht Basin sediments containing copper above sediment cleanup levels will be removed by dredging as part of the remedial action for OU 06. With time, these source removal efforts and other upland remedial actions are expected to result in decreased copper concentrations in the Yacht Basin water.

## Remediation Goals/Levels (Sediment)

**Comment No. 33**

**Comment:** The Proposed Plan describes the sediment dean up objectives for remediation as the State Sediment Management Standards (SMS). Asarco agrees that the SMS may be a useful relatively simple initial measure that can be used as a guideline of the success of the

remediation. However, it should not be the sole determination of whether the remediation is successful as defined in Section 6.2 of the Proposed Plan.

As discussed above, the SMS uses bulk sediment chemistry, bioassays, and relatively simplistic measures of benthic abundance. Both the data analysis presented in the Phase 1 Report and EPA's own methodology for determining contaminant effects areas presented in the draft Proposed Plan go beyond the simple SMS approach. It is therefore unreasonable to go back to the SMS approach when evaluating the success of remediation.

If the physical and chemical properties of the sediments (e.g., particularly slag particles) can confound the determination of cleanup areas, they can certainly confound the determination of cleanup success. To be consistent with all of the knowledge gained on Asarco sediments over the years, an achievable reasonable sediment cleanup objective must allow for these potentially confounding effects and go beyond a simple SMS type approach.

Asarco recommends that a preponderance of evidence approach as presented in the Phase 1 Report be used to determine the cleanup success. Because this approach may require extensive sampling and data analysis, cleanup success could be determined through a tiered process. The tiered process would use progressively more complex and accurate analyses to determine whether the sediments have indeed been cleaned up similar to PSDDA and the SMS itself. One possible approach would be as follows:

Tier 1. Compare bulk sediment chemistry to SQS values. If sediment chemistry is below SQS, then cleanup objective has been met. If sediment chemistry is above SQS, proceed to Tier 2.

Tier 2. Conduct bioassays (suite to be determined) and compare results to reference sediments (similar to SMS). If bioassays not significantly different ( exact criteria to be determined) from reference, then the cleanup objective has been met. If bioassays are significantly different, then proceed to Tier 3.

Tier 3. Conduct benthic community analysis and analyze various measures (to be determined but similar to Phase 1 Report) of abundance and diversity. (In this case the simple SMS benthic measures might be used but some other more complex data analysis must also be included).

Immediately after cap construction, only Tiers 1 and 2 could be used, because no benthic community would be present. However, recourse to Tier 3 would be available several years after construction.

In addition, the use of the word "prevent" in the cleanup objective definition appears to be inappropriate. Asarco agrees that the exposure of receptors to contaminant effects can be "limited" or "minimized." However, cleanup success should not be measured in terms of absolute prevention of all exposure to contaminants to all potential receptors. It is possible that minor exposures might take place, but in overall terms the remediation would still be successful. The success of, the remediation should be measure in terms of whether the entire cleanup meets the overall goals of protection of human health and the environment.

**Response:** EPA agrees with the concept that a tiered approach is applicable to determining the success of the remedy. The exact details of this approach will be determined as part of the Operation, Maintenance, and Monitoring Plan ( OMMP).

Asarco's concern regarding the use of the word " prevent" in the cleanup objective is noted by EPA, however EPA believes that as a goal, the word " prevent" is still appropriate. EPA will keep the wording of the cleanup objective as is.

**Comment No. 34**

---

**Comment:** Of greatest concern is that EPA defer to and enforce all Washington State cleanup

standards for groundwater and sediments. As was recently proved in the findings for Asarco at the Asarco Everett facility failure to enforce Washington State standards on one site can have adverse impacts to another site cleanup. As Asarco is a PRP for another Commencement Bay Superfund sediment cleanup action in the Hylebos Waterway, it is imperative that uniform cleanup standards be employed throughout the entire Commencement Bay cleanup area.

**Response:** Comment noted. The cleanup levels selected for this Site are consistent with ARARs (including Washington State cleanup standards for groundwater and sediments) and have been developed based on site-specific conditions and information. Further, the Washington Department of Ecology concurs with the cleanup levels selected for the Site.

**Comment No. 35**

**Comment:** 6.2 Sediment Cleanup Objectives

EPA's stated cleanup objective for sediments is to restore and preserve aquatic habitats by limiting or preventing the exposure of environmental receptors to sediments with contaminant above Washington State Sediment Management Standards.

**Response:** The comment has correctly restated EPA's cleanup objective. EPA assumes that CHB concurs with EPA's objective.

## Remedy Costs

**Comment No. 36**

**Comment:** (Table 7.2 and 7.3) Alternative S-1E: Dredge and Upland Disposal has a present worth cost of $ 26.2 million for 88,000 cy. This is $ 298/cy. Alternative S-2D: Dredging and Upland Disposal has a present worth cost of $ 3.6 million for 55,000 cy of Yacht Basin sediment. This is $ 65/cy. Why is one over 4.5 times more than the other?

**Response:** The difference in the costs for the Dredge and Upland Disposal alternatives for the Yacht Basin versus the Nearshore area is due to the fact that the material from the Yacht Basin can be accommodated under the onsite cap. If material was removed from the Nearshore area, it would need to go offsite, because there is not sufficient capacity onsite to handle all of the nearshore sediment. Offsite disposal is significantly more expensive than onsite disposal.

**Comment No. 37**

**Comment:** (Section 8.7) The sentence "For all sediment areas, upland disposal is less costly than nearshore confinement" is not consistent with Table 7.2.

**Response:** DNR is correct - the statement is incorrect as written. Instead, it should read: "upland disposal is less costly than nearshore confinement when the dredged material can be placed onsite."

## Endangered Species Act and Biological Assessment Issues

**Comment No. 38**

**Comment:** We anticipated that the extension to the comment period would provide the opportunity to review the Proposed Plan in the context of the Commencement Bay Biological Assessment (BA). We view the BA as critical to decision-making at all scales in the bay, including site-specific cleanup actions. Without consideration of the BA, we do not believe that our common goal of achieving cleanup in a broader ecosystem management context can be ensured. We also cannot evaluate the adequacy of the proposed site-specific remedial action in achieving ESA compliance without review by and discussion with EPA and National Marine Fisheries Service of the BA and the biological opinion. Until this information and analysis is available, we remain concerned that the effects of the proposed remedial action on critical habitats for chinook salmon are not resolved at either a site or baywide scale.

For example, we are concerned with the lack of information and guidance on the functional linkages between deep water (>-10 MLLW) epibenthic habitats and the foodweb for young-of-year and immature resident chinook salmon. Recent studies of the polychlorinated biphenyls body burdens for Puget Sound chinook and herring stocks indicate an exposure pathway link between the benthic community and the pelagic foodwebs of these species. This information argues for a very conservative approach to remediating chemicals of concern for bioaccumulation, such as arsenic and mercury.

We are also concerned that the proposal does not restore the healthy nearshore habitats, both as salmonid migration corridors and as intertidal feeding areas, that once existed at the site. In addition, we believe that decisions regarding cleanup objectives are based on incomplete information. We encourage incorporation of the latest information from the federal services - particularly results of current NMFS efforts - on cleanup standards that are protective of trust resources.

Available information suggests that numerous individuals from the White River chinook stock are expected to rear nearshore at the Asarco site for extended periods. The proposed plan does not provide sufficient information to determine the degree to which chinook salmon will be restored and protected. We encourage EPA to more actively integrate the numerous cleanup decisions necessary throughout Commencement Bay within the context of the Commencement Bay BA and biological opinion. We are interested in working with EPA on a management plan for the entire bay that defines both site-specific and baywide implementation actions, with net gain in habitat area and function being one of the primary plan objectives.

**Response:** The Biological Assessment (BA) being performed for Commencement Bay does not address the Asarco sediment site (e.g., it covers the waterways within Commencement Bay only). Instead, DNR is referred to the BA and Endangered Species Act (ESA) assessments being performed specifically for the shoreline armoring being conducted under OU 02 and the sediment capping and dredging proposed for the offshore areas of the Asarco Facility (two separate BAs and ESAs).

As for concerns regarding bioaccumulation of chemicals at the Site, DNR is referred to the tissue sampling (benthic and fish tissue samples) and the benthic community analyses completed by Asarco as part of the Phase 1 sampling program. In addition, Asarco will analyze tissue samples. after cleanup to verify that bioaccumulation is not occurring at an unacceptable level.

**Comment No. 39**

**Comment:** (Section 5.2) It is unclear how healthy biological communities are being defined. How was this determined? Diversity, abundance, both?

**Response:** Both.

## Natural Resource Mitigation

**Comment No. 40**

**Comment:** Finally, we would like to discuss the potential reuse of the treated groundwater as a resource for restoration of a stream delta estuary. Such a delta existed on- site prior to development. The value of these small estuaries as nodes of productivity is becoming more widely recognized. Salmonid species such as chinook, chum, and cutthroat have been documented to preferentially target these areas in their utilization of nearshore corridors. The potential for creation of a stream delta estuary appears to exist on the southeast portion of the site. Integration of planning for such a project with the remedial and damage assessment actions may provide opportunities for an improved, less expensive, more comprehensive project.

**Response:** EPA needs more information from DNR on the development of a stream delta estuary, especially in light of EPA's 1995 ROD for the Asarco Smelter and current plans

for shoreline armoring and habitat restoration being conducted under this previous ROD. The shoreline armoring and habitat restoration plans are available in EPA's Administrative Record for this site.

**Comment No. 41**

As we noted in our recent comments on the Nov. 1999 Explanation of Significant Differences (ESD) for the Commencement Bay Nearshore/ Tideflats Superfund Site (2 Feb. 2000), NOAA has consistently based our evaluation of the Commencement Bay investigations and cleanup plans on five basic principles:

1. That cleanup(s) progress sooner rather than later to reduce continued exposure of trust resources to contaminants;

2. A preference for complete removal of contaminants from the aquatic environment ( most contaminants originated from the uplands);

3. If the aquatic environment must continue to serve as the repository for the contaminated sediments, we prefer that contamination not be transferred from impacted waterways to otherwise clean areas for disposal;

4. Where remedial actions cause adverse impacts ( during cleanup or disposal), mitigation for lost natural resources or their services is required; and

5. Cleanup and disposal decisions must be made under a baywide planning and evaluation effort, especially for threatened /endangered trust resources and their habitats.

This Proposed Plan appears to satisfy our principles 1, 2,3, and 5. Where mitigation is required (principle 4) based on cleanup action details yet to be specified, we would strongly recommend the enhancement of the nearshore/intertidal area immediately south of the slag peninsula along Ruston Way. This could entail the removal of wood wastes from the bottom and re-contouring to allow eelgrass propagation from the existing bed further south. We look forward to reviewing a detailed Clean Water Act 404 analysis and/or mitigation plan.

**Response:** Comment noted. Mitigation requirements associated with the remedy for OU 06 will be addressed as part of the Clean Water Act 404 ( b)( 1) evaluation that is currently being conducted.

**Comment No. 42**

**Comment:** The facility's operations have filled and/ or degraded a substantial acreage of aquatic lands. The values of the public aquatic lands for a broad range of functions and services are damaged. The proposed remedy does not restore those values, and Asarco has not proposed to compensate the State of Washington as a natural resource trustee for past and on-going losses. We will seek natural resource damages for functions and services that are not restored in order to compensate the citizens' natural resource trust values.

The extent of damages will be highly-dependent on the degree to which the functions of aquatic lands have been and will continue to be injured by slag deposition/deposits, groundwater, runoff, point discharges, and other releases of injurious contaminants. We encourage the resolution of natural resource damages claims in conjunction with the remedial action processes at the site.

**Response:** After EPA selects the remedy for the sediments, EPA will begin discussions with the potentially responsible parties (PRPs) for cleanup of the Site. It is not clear how the federal and state natural resource trustees intend to proceed with their potential claims against the PRPs. EPA will cooperate with the trustees in the future to resolve natural resource damage claims.

## Long-Term Monitoring

**Comment No. 43**

**Comment:** Asarco agrees that monitoring of remediated areas is needed to verify cleanup success. However, Asarco does not believe that extensive long-term monitoring of other areas is necessary and believes the cost of this monitoring is substantial given the limited benefit of monitoring non-remediated areas. Asarco believes that EPA's proposed plan for this sampling implies that the RI/FS process was somehow incomplete and that contaminant effects area have not been adequately identified. This is not true. In fact, Asarco and EPA have come to a consistent and scientifically supported decision on areas exhibiting. contaminant effects. Asarco also believes that monitoring constitutes a remedial action for these areas and that EPA does not have authority under CERCLA to require actions for these non-impacted areas.

The Proposed Plan indicates that monitoring of areas outside remediation units will be conducted to "confirm the assumptions and conditions" used to make clean up decisions. The Plan further indicates that based on this monitoring, some further action may be needed. Sediment sampling to "confirm assumptions and conditions" regarding areas and volumes of sediments that may exhibit contaminant effects was conducted during the RI and FS studies consistent with Superfund Guidance. The primary purpose of the Expanded RI/FS process was to determine those areas that exhibit contaminant effects, and therefore, require remediation. Prior to conducting the Phase 1 sampling, an extensive monitoring plan was developed with the full participation of EPA and its consultants including methods for evaluating the results of that sampling. It was agreed at that time that a "preponderance-of-evidence" approach would be used to evaluate the numerous types of sampling and data analysis that were conducted. This original concept is entirely consistent with the Superfund RI process, which should define the areas and volumes of contaminated materials to be remediated. It has been Asarco's position since completion of the Phase 1 Report that the sampling and analysis effort provided more than sufficient information to determine areas where action such as remediation is needed (with some exceptions in the marina and north shore areas, which were addressed in subsequent sampling).

Under CERCLA Section 104, EPA can take action when a hazardous substance is released into the environment or threatened to be released. EPA can also take action if a there is a release or threat of a release of a pollutant or contaminant which may present an imminent and substantial danger to the public health or welfare. A "pollutant or contaminant" is anything that, when released into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains will or may reasonably be anticipated to cause death, disease" or problems with the organism or offspring. 42 USC § 9601(33).

The metals in the sediments outside the contaminant effects area have not been released (they are in the slag matrix), nor are they likely to be released. Moreover, the metals in sediments are not pollutants or contaminants because they are not causing effects. If there is neither a release nor a threatened release of hazardous substances, contaminants or pollutants, the agency cannot compel remedial or response action.

**Response:** Under Section 104 of CERCLA, EPA can take action when a hazardous substance has been released into the environment or is threatened to be released. Arsenic, copper and other hazardous substances were released into the waters and sediments of the Site as a result of smelter activities beginning in the early 1900s. Hazardous substances continue to be released, or threatened to be released, from the slag, groundwater, surface water, and sediments. Accordingly, EPA intends to take action to protect human health and the environment from releases or threatened releases of hazardous substances.

As discussed in the response to Comment No. 4, a "preponderance of evidence" approach was used to evaluate the overall health of the sediment at the Site. This approach resulted in stations which exhibited a wide range of effects. In other words, there were stations that showed no effects, stations that showed some effects, and other stations that showed many

effects. The latter stations (those showing many effects) were selected as stations as requiring active remediation. That means, it was determined that the effects were significant enough that dredging or capping was warranted (e.g., destroying the current habitat and allowing new habitat to recolonize was determined to be appropriate). This area is called the "Contaminant Effects Area." As for those stations with minor biological effects, this area was determined to require monitoring. It was determined that active cleanup might result in greater net negative impacts through destruction of existing habitats than if not remediated. This area is not "clean," as indicated by some biological effects, however, it was not impacted enough to warrant destruction of the existing habitat. This "gray" area, therefore, is determined to require some monitoring to ensure that RAOs are met. Those stations displaying no effects are not proposed for active cleanup or monitoring.

**Comment No. 44**

---

**Comment:** Page 3,5th bullet. This bullet states that Asarco will monitor the dredged area " to ensure that it is not becoming recontaminated." Asarco is responsible for recontamination, if any that originates from the Site, but cannot ensure that the Yacht Basin will not become recontaminated from marina activities.

**Response:** Comment noted. The Operation, Maintenance, and Monitoring Plan (OMMP) will address this issue. Monitoring strategies and procedures will be identified to produce data that will distinguish between contamination sources to the extent possible.

**Comment No. 45**

---

**Comment:** 9.2.4 Long-Term Monitoring

Components of the long-term remedial monitoring plan must include action plans for earthquakes, high-intensity storm events, severe tide/ wind storms, etc.

**Response:** An Operation, Maintenance, and Monitoring Plan ( OMMP) will be prepared as part of the remedial design. The OMPP will identify inspection and monitoring procedures to verify that the elements of the remedy are performing as intended or, if they are not, to identify needed repairs on a timely basis. The OMMP will call for special inspections following major storms or earthquake events.

**Comment No. 46**

---

**Comment:** (Section 7) What is the term of the OMMP?

**Response:** The Operations, Maintenance, and Monitoring Plan (OMMP) will have a duration of decades. The minimum duration of the monitoring period will be determined during development of the OMMP. Extension of the monitoring beyond the minimum period will be dependent. on the monitoring results and associated decision rules will be determined by EPA.

**Comment No. 47**

---

**Comment:** (Section 8.2) The plan should require that institutional controls, maintenance and monitoring results be shared and coordinated with DNR.

**Response:** Discussions between EPA, DNR, and Asarco will address these concerns as the RD/ RA process proceeds. All documents associated with institutional controls, maintenance, and monitoring will be available for public review. Therefore, these documents will be available to DNR.

**Comment No. 48**

---

**Comment:** NOAA appreciates the efforts the two remedial project managers and ASARCO have made to incorporate previous NOAA technical comments and suggestions into the overall cleanup of the former ASARCO Smelter Facility. By combining parts of both operable units, it appears that the sediment remediation will be accomplished sooner than originally

scheduled and the use of the upland disposal site for the Yacht Club sediments further streamlines the cleanup.

The natural resource agencies have expended considerable time and effort providing technical advice to EPA, Ecology, ASARCO, and their consultants - this Proposed Plan suggests that it was worth the effort since most of NOAA's previous concerns about the sediments have been addressed. We want to encourage EPA, Ecology, and ASARCO to continue to seamlessly integrate the sediment remediation with the shoreline stabilization. In this way, there should be no wasted efforts between the two operable units cleanups and the impacts to the natural resources will be minimized while the on-going exposures to contaminants will be curtailed sooner rather than later.

NOAA strongly supports EPA's requirement for long- term monitoring of the remedy. Our only concern with the proposed monitoring is that it does not include measuring contaminant concentrations in the waters of Commencement Bay adjacent to the facility shoreline. As explained in our section-specific comments below, we think that monitoring water quality in Commencement Bay is critical and we recommend that EPA include offshore monitoring in the final plan.

**Response:** The Operation, Maintenance, and Monitoring Plan (OMMP) will include provisions for sampling Commencement Bay waters at the shoreline.

**Comment No. 49**

**Comment:** Pg 2: Elements of the Preferred Alternative, Groundwater: The first item identifies limiting groundwater "loading" to Commencement Bay as a remedial objective. The second item identifies monitoring of groundwater as the method to document success or failure of the remedy. However, the Groundwater-Sediments Task Force determined that two processes at the site complicate calculations of contaminant loading to Commencement Bay from discharging groundwater:

(1) Tidal cycles in Commencement Bay cause significant fluctuations in the hydraulic gradient at the CB shoreline; these tidal waters intermittently enter the fractures in the slag along the shoreline and mix with discharging groundwater, altering the groundwater gradient, discharging water volumes and the concentration of conservative constituents, such as chloride (CI); and

( 2) The solubility of the metal and metalloid (e.g., arsenic) ions that are contaminants of concern at the site varies with changes in pH and/or redox conditions, both of which are altered as the groundwater mixes with saline, oxygenated seawater within the fractured slag before discharging into Commencement Bay. These processes are also described at the bottom of page 7 in the Proposed Plan.

Because measurements of groundwater gradients and contaminant concentrations in upland wells are an incomplete predictor of the contaminant loading to Commencement Bay ( as explained above), and the dilution from tidal mixing at the shoreline is significant but not precisely quantified; the only way to determine if the shoreline water of Commencement Bay is not contaminated by the metal and metalloid contaminants from the site is to sample the shoreline waters of Commencement Bay and analyze for these constituents.

**Response:** The Operation, Maintenance, and Monitoring Plan (OMMP) will include provisions for sampling Commencement Bay waters at the shoreline.

**Comment No. 50**

**Comment:** Pg 5: State Sediment Management Standards - Sediment Cleanup Criteria:

BASIS: Numerous sediment samples at the site had extremely high concentrations of metals and metalloids, variable laboratory bioassay results, and benthic community analyses that did not show any statistically significant differences from reference. The apparent

absence of the expected response (mortality leading to benthic community alterations) at these stations may result from the physical structure of the slag that contains most of the contamination. However, very high concentrations of contaminants remain at the site, and ecological indicators of an adverse response to these contaminants were varied. The toxicity of some of these contaminants can change with changing environmental conditions, e.g. temperature or oxygen availability, and toxicity can vary by organism lifestage. Therefore, it is important that areas where high concentrations of contaminants remain in contact with ecological receptors are monitored over the long-term to demonstrate continued ecological protectiveness.

NOAA supports the proposal not to require active remediation of these areas on the condition that EPA require long-term. monitoring to demonstrate whether this decision continues to be protective. It is recommended that this monitoring be coordinated with the long-term monitoring of benthic communities in remediation areas that are dredged and/ or capped to make efficient use of equipment and labor.

**Response:** EPA concurs. Long-term monitoring will be performed in the "gray" areas that indicated some biological impacts ( but not enough impacts to warrant active remediation). The timing of this monitoring will be addressed in the Operations, Maintenance, and Monitoring Plan (OMMP).

**Comment No. 51**

**Comment:** Pg. 7, Sec. 3.1 Groundwater: [ As stated in the Proposed Plan] "Groundwater at the Facility flows from the southwest to northeast and ultimately discharges to Commencement Bay."

Because Commencement Bay is the ultimate recipient of the contaminated groundwater, and because ecologic receptors along the Commencement Bay shoreline can be adversely affected by these contaminants, NOAA supports the preferred remedy on the condition that long- term monitoring of the site include collection of shoreline water samples for contaminant quantification.

**Response:** Comment noted. The Operation, Maintenance, and Monitoring Plan (OMMP) will include provisions for sampling Commencement Bay waters at the shoreline.

**Comment No. 52**

**Comment:** Pg. 8, Sec. 3.1 Groundwater: [As stated in the Proposed Plan] "DMA-related organic compounds are also present in the shallow groundwater system. However, the DMA, arsenic, and copper in the DMA area do not appear to result in any greater exceedances of surface water criteria in the adjacent Commencement Bay than observed elsewhere at the Facility. For this reason, no special groundwater remedial action is planned for the DMA area. However, groundwater monitoring in the DMA area will be part of the post-remedial action monitoring program."

NOAA can support a decision not to take action to reduce contaminants in groundwater at the DMA area, only if there will be long-term monitoring of the receiving water along the shoreline of Commencement Bay where NOAA trust resources are potentially affected by these contaminants, and with a commitment that if the monitoring data indicate this decision is not protective of the environment, other remedies will be evaluated for the DMA area.

**Response:** Comment noted. The Operation, Maintenance, and Monitoring Plan (OMMP) will include provisions for sampling Commencement Bay waters downgradient of the DMA area.

**Comment No. 53**

**Comment:** Pg. 10, Sec. 3.2, Sediment: [As stated in the Proposed Plan] "Some concentrations of metals and/ or biological impacts (as measured with bioassays) exceeded the CSL outside of the Contaminant Effects Area in what is depicted as the "Moderate Impact Area" (Figure 5). The benthic communities in the Moderate Impact Area appear healthy. Because active cleanup might result in greater net negative impacts through destruction of existing

habitats than if not remediated, long-term monitoring is proposed in these areas to verify that the overall health of the ecosystem (after the upland and offshore cleanup activities are completed) is remaining the same or improving."

NOAA supports the proposal not to require active remediation of these areas on the basis that EPA will require long-term monitoring to demonstrate whether this decision continues to be protective. It is recommended that this monitoring be coordinated with the long-term monitoring of benthic communities in remediation areas that are dredged and/ or capped to make efficient use of equipment and labor.

Response: EPA concurs. Long-term monitoring will be performed in the "gray" areas that indicated some biological impacts ( but not enough impacts to warrant active remediation). The timing of this monitoring will be addressed in the Operations, Maintenance, and Monitoring Plan (OMMP).

**Comment No. 54**

**Comment:** Pg. 13, Sec. 5.2, Ecological Risk Assessment, Groundwater: [As stated in the Proposed Plan] "The findings of the Task Force regarding the impact of groundwater on the sediments and waters of Commencement Bay indicate the following:

- The amount of metals currently being discharged (pre-remediation conditions) by ground-water and surface water discharges to Commencement Bay results in the exceedance of applicable water standards for certain metals (e.g., arsenic and copper) within a few feet of the shoreline. The metals load discharged to Commencement Bay by groundwater is expected to decrease after remediation because the most highly contaminated source materials will have been removed and groundwater flow to Commencement Bay will be reduced."

NOAA agrees with EPA's assessment and strongly supports all efforts to reduce groundwater flows through the site which would continue to transport metals into the marine environment. Early interception of the groundwater upstream of the site should be maximized , the placement of an impervious cap over the site to eliminate surface water percolation downward then seaward is imperative, and co-precipitation treatment of collected runoff waters on site should be emphasized, if this technique removes significant levels of metals. However, we want to emphasize that the only means to ascertain whether the remedial actions have reduced the discharge of metals (and metalloids such as arsenic) along the shoreline of Commencement Bay to bring them into compliance with applicable water standards is to include sampling of the shoreline water of Commencement Bay in the post-remediation monitoring. Only a well-designed sampling plan can demonstrate to all parties that the selected remedy has caused shoreline areas to achieve the applicable water quality criteria.

**Response:** Comment noted. The Operation, Maintenance, and Monitoring Plan (OMMP) will include provisions for sampling Commencement Bay waters at the shoreline.

**Comment No. 55**

**Comment:** Pg. 16, Sec 6.1, Groundwater Cleanup Objectives : [As stated in the Proposed Plan]

- "Long-term monitoring"

NOAA recommends that this be amended to read; "Long-term monitoring of groundwater and (Commencement Bay) receiving water" in order to demonstrate that the water column used by marine organisms along the shoreline of Commencement Bay is protected by the remedy.

**Response:** Comment noted. The ROD indicates that long- term post- remedial action monitoring will include provisions for sampling Commencement Bay waters at the shoreline.

**Comment No. 56**

Comment: Pg. 23-24, Sec. 8.2 Compliance with Federal and State Environmental Standards, Groundwater: [As stated in the Proposed Plan] "Samples of Commencement Bay water collected at the shoreline confirm that current laws for marine water quality are not currently met at all locations and at all times. However, metals concentrations in groundwater flowing toward the shoreline are expected to decrease in future years in response to the site-wide changes (i.e., reduced groundwater discharge) affected by the cleanup. These changes are expected to allow state and federal laws to be met at the end of the remedy."

NOAA agrees with the preceding analysis and believes that monitoring of water quality along the shoreline, where contaminated slag win remain in place, is necessary to demonstrate that the remedy has resulted in compliance with Federal and State Environmental Standards for the waters (and habitats) of Commencement Bay. NOAA recommends that the Washington State Water Quality Criteria for protection of marine life be utilized as benchmarks for protection of the water column component of marine habitat.

**Response:** EPA concurs. Arsenic and copper have been identified as the two constituents of concern for groundwater. The cleanup levels for these two metals are 6 ug/L and 3.1 ug/L, respectively. These levels meet or exceed the Washington State Water Quality Criteria for protection of marine life. Other metals data that may be collected during the long- term monitoring program will also be benchmarked against their respective Washington State Water Quality Criteria in accordance with procedures outlined in the final Operation, Maintenance, and Monitoring Plan (OMMP).

## Other Comments

**Comment No. 57**

**Comment:** (Section 9.1.1) What will be the final quality of treated groundwater?

**Response:** At this time, it is expected that groundwater requiring treatment will be accommodated in the onsite stormwater treatment system to be constructed under the upland remedial action (governed by the 1995 ROD for OU 02). At this writing, the design of this system is in progress. Both polymer-and filtration-based systems designed to remove suspended metals from stormwater are being evaluated by Asarco. The post-treatment quality of the stormwater will not be determined until ongoing engineering studies are complete. However, design criteria call for the stormwater to meet design criteria applicable to OU 02.

**Comment No. 58**

**Comment:** As a long-time resident of North Tacoma, I would like to take this opportunity to comment on the EPA cleanup of the Asarco smelter. I would like to voice my concerns about the long-term effectiveness of the proposed disposal alternatives. I can not see how capping contaminated sediments on-site with 1 meter of clean material represents a safe and reliable solution. Humans have been burying garbage for thousands of years, surely we can do better than this by now? I would like to encourage the EPA to support the development and use of improved treatment methods. I believe the government has an obligation to the future health and well being of humans and the environment to forward progressive solutions. In addition, I am concerned about the storage of contaminated sediments so near the water. Earthquakes and slides could yield potentially disastrous results. Furthermore, there is the corrosive, erosive capacity of the salt air and water to consider. Hopefully, the EPA will continue to re-evaluate conditions at the Site and apply improved treatment measures as they become available.

**Response:** The comment advocates removal (dredging) and treatment of contaminated sediments. Of the total area subject to sediment remediation, approximately 55 percent (Nearshore/Offshore and Northshore areas; 19.5 acres) will be capped and 45 percent (Yacht Basin; 15.5 acres) will be dredged. Capping of the Nearshore/Offshore and Northshore areas was selected as the preferred remedy based on application of the five balancing criteria required by the National Contingency Plan (see page 22 of the Proposed Plan). EPA agrees

that treatment of the sediments, preferably in-place, to destroy contaminants of concern is the most desirable end point. Potential treatment of marine sediments was evaluated by EPA as part of the Feasibility Study process. Several technologies groups were evaluated including thermal destruction, thermal desorption, chemical separation, sediment washing, and in- place solidification/stabilization. As part of this evaluation, EPA did not identify any established sediment treatment options that are reliable and cost- effective. This decision was mostly due to the difficulty in removing these sediments, based on the nature of the sediments (some have large chunks of slag), the extensive depth of contamination, and the steep slopes off the Site. Further, the net benefit of treatment for some of the treatment technologies was limited (e. g., the end result after treatment was not much different than the slag presently on the Site).

**Comment No. 59**

**Comment:** The Proposed Plan specifies an upland source of capping material. There is no justification for specifying that the cap material be derived "from an upland source" and nothing that should preclude an aquatic source of material. Cap material from an aquatic source would be as suitable or more suitable than material from an upland source for biological colonization. There should be no difference in the effectiveness of contaminant isolation with either an upland or an aquatic source. Appropriate material may be available at a lower cost from a marine source. Asarco believes the location and selection of capping material is a Remedial Design task and that the Proposed Plan should not preclude aquatic sources of capping material.

**Response:** Comment noted. EPA agrees that the cap material could originate from either an upland or aquatic source as long as it meets the minimum specifications to be established during remedial design.

**Comment No. 60**

**Comment:** The Proposed Plan delays a final decision on the need for additional groundwater controls pending additional remedial design analysis. Asarco believes that the existing information demonstrates that additional groundwater controls are not appropriate and that ongoing evaluations during Remedial Design are unnecessary.

The hydrologic analyses of the feasibility of additional upgradient groundwater controls have been completed and draft reports have been submitted to EPA. These analyses demonstrate that additional groundwater controls would capture negligible amounts of additional groundwater and contaminants. Capture and treatment would reduce some, but not all metal concentrations in the captured groundwater and would eliminate the current reduction in arsenic concentrations provided by natural attenuation on the Site. Therefore, little or no environmental benefits would be realized by the additional groundwater capture. Costs associated with constructing an interception system and the additional treatment costs would be substantially and disproportionately expensive relative to the environmental benefit received.

**Response:** The Proposed Plan was written before the groundwater diversion issue had been fully explored by EPA and Asarco and prior to Asarco's submission of final reports addressing this issue. Since publication of the Proposed Plan, Asarco has demonstrated that inclusion of additional groundwater diversions at this time (specifically in the vicinity of the Cooling Pond, East Stack Hill drainages, and along Ruston Way) would be impracticable from a cost/benefit standpoint (see Appendix A of the report titled "Historical Summary of the Evaluation of Groundwater Remedial Alternatives, Asarco Tacoma Smelter Site," Hydrometrics, June 2000; this document is part of the Administrative Record). This impracticability demonstration was required to satisfy MTCA remedy selection requirements.

**Comment No. 61**

**Comment:** The Proposed Plan presumes that treatment of groundwater will be necessary. The Proposed Plan should clearly state that treatment is not required unless treatment is necessary to meet Remediation Goals. Moreover, it is important to note that:

Design of the stormwater treatment system is an Upland Remedial Design task.

Design of the stormwater treatment system is based on treating stormwater, not groundwater.

Design of the stormwater treatment system is ongoing.

Therefore, the Proposed Plan needs to be flexible regarding treatment of groundwater by the yet to be designed stormwater treatment system. One area in which the Proposed Plan may unduly constrain design of the surface water treatment system regards the treatment of groundwater during baseflow (i.e. non-stormwater flow) periods. The Proposed Plan needs to allow the potential for bypass of captured groundwater from treatment during baseflow periods if such bypass is consistent with stormwater treatment.

**Response:** EPA agrees that captured groundwater may need to be treated. The quality of groundwater captured in each of the primary diversion systems has not yet been estimated or otherwise measured. Once the quality of this groundwater is known with reasonable certainty, a decision can be made regarding the need for treatment. The Proposed Plan text concerning this issue was intended to mean that groundwater requiring treatment would be treated in the stormwater treatment system to be constructed as part of the remedy for Operable Unit 02. Based on commitments made by Asarco, this is the current approach for providing any required treatment of captured groundwater. Asarco also has the flexibility to process and treat groundwater separately from stormwater. The language previously included in the Proposed Plan has been modified in the ROD to clarify this issue.

**Comment No. 62**

**Comment:** Page 4, 3rd bullet. The Refinement of the Proposed Remedy Report was revised and submitted to EPA on January 5, 1999. This document should be referenced instead of the August 1999 draft.

**Response:** Comment noted. The correct citation has been provided in the ROD.

**Comment No. 63**

**Comment:** Page 4, document list. The Copper in Nearshore Marine Water Technical Memorandum submitted to EPA on June 23, 1999 should be included in the list of documents providing additional detailed information.

**Response:** Comment noted. This document has been included in a list of " key documents" presented in the ROD.

**Comment No. 64**

**Comment:** Page 6, first para. Sentence states "The shallow aquifer system beneath the Facility is largely recharged by lateral flow of groundwater from the southwest (Ruston area) and infiltration of precipitation and surface water run-on."

It would be more accurate to say "The shallow aquifer system beneath the Facility is largely recharged by infiltration of precipitation and surface water run-on and to a minor extent by lateral flow of groundwater from the southwest (Ruston area)."

**Response:** Comment noted. The language previously included in the Proposed Plan has been modified in the ROD to clarify this issue.

**Comment No. 65**

**Comment:** Page 9, last full para. This paragraph seems to state that copper exceeds the marine chronic criteria (MCC) at all locations in Commencement Bay near the Site. This is not true. The best data available to Asarco and EPA indicates that copper concentrations currently exceed the MCC at about half of the sampling locations along the shoreline and only in very close proximity to the slag shoreline. At most locations, seawater a few feet away from the slag meets all aquatic life criteria for copper and all other metals.

In conjunction with the Asarco Sediment/Groundwater Task Force (ASGTF) Asarco conducted two rounds of special seawater monitoring in 1999 to determine copper concentrations in seawater near the Site. This seawater monitoring employed ultraclean sampling and analytical techniques and yielded anal tical sensitivities and accuracies by several orders of magnitude better than techniques previously available. Results of this monitoring were submitted to EPA in a June 1999 Draft Technical Memorandum and in a November 16, 1999 data transmittal. The ultraclean monitoring data demonstrates that copper concentrations do not exceed criteria in all samples; only samples collected near the shoreline in some areas.

**Response:** Comment noted. The language previously included in the Proposed Plan has been modified in the ROD to clarify this issue.

**Comment No. 66**

**Comment:** Page 13, The First Bullet is incorrect regarding Task Force findings related to arsenic. The Task Force found (see page 6-5 of the March 1999 ASGTF Group 5 Technical Memorandum) that groundwater discharges currently cause water column concentrations to exceed only the copper chronic aquatic life criterion. Current water column concentrations of arsenic and other metals are better than the chronic aquatic life criterion.

**Response:** Comment noted. The language previously included in the Proposed Plan has been modified in the ROD to clarify this issue.

**Comment No. 67**

**Comment:** Page 14, 1st para. What does " nonminimally impacted" mean?

**Response:** The word "nonminimally" is a typographical error. It should read " nonimpacted/ mininimally impacted station..."

**Comment No. 68**

**Comment:** Page 16, 2nd para. Deep groundwater does not presently exceed MCLs or MTCA standards for any parameters except possibly arsenic (see Summary and Interpretation of 1994, 1995, 1996, 1997 and 1998 Post-RI Long-Term Monitoring Results (Hydrometrics, 1999) and Table 4-3 in Summary and Interpretation of Production Well Abandonment Action Specific Monitoring Results ( Hydrometrics, June 1997).

**Response:** Comment noted. This language previously included in the Proposed Plan does not appear in the ROD.

**Comment No. 69**

**Comment:** Page 23, last para. The Plan states "Modeling performed by the Task Force indicates that state and federal laws applicable to protection of marine water quality may not be currently achieved within a few feet of the shoreline for all metals." Although model results did indicate some metal concentrations above marine chronic criteria, the Task Force placed more emphasis on empirical data rather than model predictions in concluding impacts from groundwater. The Task Force concluded that with the sole exception of copper, groundwater discharge currently does not cause metal concentrations to be higher than marine chronic criteria (see page 6-5 of the March 1999 ASGTF Group 5 Technical Memorandum).

**Response:** Comment noted. The language previously included in the Proposed Plan has been modified in the ROD to clarify this issue.

**Comment No. 70**

**Comment:** Page 25, 2nd para. States "The in situ treatment and seawater injection treatment alternatives would promote chemical precipitation (i.e., "settling out") of arsenic from groundwater, thereby reducing the arsenic load reaching Commencement Bay." Based on the Asarco Sediment/Groundwater Task Force evaluations, the effectiveness of in situ treatment is uncertain given that seawater already oxidizes and removes arsenic to the extent

practical, with the exception of the Southeast Plant area.

**Response:** Comment noted.

**Comment No. 71**

**Comment:** Page 28, bottom of page. It states "Additional groundwater interception is being considered at the Facility, and may also be considered by EPA at a later date. The need for additional groundwater interception would be based on the results of ongoing groundwater sampling." Earlier in the Proposed Plan (3rd paragraph, pg. 27) it is stated that additional diversions are disproportionately expensive and would only be considered if cleanup goals could not be met. Asarco agrees that additional interception is disproportionately expensive and believes that additional interception should only be considered if cleanup goals are not met.

**Response:** EPA acknowledges the inconsistency on this issue as presented in the Proposed Plan. Since publication of the Proposed Plan, Asarco has demonstrated that inclusion of additional groundwater diversions at. this time (specifically in the vicinity of the Cooling Pond, East Stack Hill drainages, and along Ruston Way) would be impracticable from a cost/benefit standpoint. Additional groundwater interception in the future is possible if it is determined that groundwater cleanup levels are not being met and additional groundwater capture is practicable considering the expected reduction in risk to human health and the environment. EPA expects that this issue would be assessed as part of the Five-Year Review process.

**Comment No. 72**

**Comment:** Page 29, 3rd para. It [the proposed plan] states "At a minimum, monitoring wells at the downgradient perimeter of the Facility ( along the shoreline) will be monitored, including wells near source areas." Rather than "wells near source areas", it would be better to say, "wells near source areas if and to the extent compatible with, protection and maintenance of the cap."

It further states "In addition, should the groundwater indicate high concentrations of metals, contingency actions, such as additional groundwater diversions, may be considered." What is meant by high metal concentrations? Above cleanup goals? Where? It is expected that concentrations will remain above cleanup goals in and near source areas but this occurrence alone should not trigger additional diversions. Given EPA's broad authority under the five year review provisions of the Upland ROD, this last sentence is unnecessary and should be deleted. If the sentence is retained, then EPA should specify the trigger criteria of "high concentrations of metals." Asarco believes appropriate trigger criteria would be remedial action objectives and remediation goals (including Asarco's proposed changes) at a compliance point located in surface water along the armored slag shoreline.

**Response:** Monitoring wells will likely be required near primary source areas (or former source areas). Some of the existing wells may meet these monitoring needs but it is likely that new wells will also be needed in locations not previously monitored or to replace old monitor wells removed to accommodate remedial action construction activities. The technical objectives of the monitoring program will dictate the actual well locations. If installation of a new well (or maintenance of an existing well) is in conflict with protection and maintenance of the cap, the competing needs will be assessed to determine the most appropriate solution.

The text addressing "high concentrations of metals" in groundwater and the possibility of "additional groundwater diversions" was intended to communicate that further groundwater capture may be necessary in the future if groundwater quality goals are not being met. The details of the thresholds and conditions that would trigger such an action (or an evaluation to determine if action is required) need to be determined during development of the Operation, Maintenance, and Monitoring Plan (OMMP). In general, EPA recognizes that groundwater cleanup levels may not be achieved in the slag matrix or immediately

downgradient of other areas where source materials are present. The goal, however, is to manage the contaminant concentrations in groundwater such that applicable marine surface water quality standards and risk-based levels protective of human health are not exceeded in Commencement Bay waters at the shoreline.

**Comment No. 73**

**Comment:** On behalf of Citizens for a Healthy Bay (CHB), an organization representing 850 members of the Tacoma and Greater Commencement Bay community, thank you for the opportunity to comment on the proposed remedial plan for Asarco Smelter site groundwater and sediments. Except as discussed below, CHB generally agrees with the remedial actions proposed for site sediments and groundwater.

**Response:** CHB's general and conditional agreement is noted.

**Comment No. 74**

**Comment:** 7.1 Groundwater

We agree with the stated preferred alternative GW-B involving intercepting and treating site groundwater prior to discharging into Commencement Bay. We are concerned that the remedy be scaled to handle large magnitude storm events and associated increases to groundwater.

Also, use of an on-site cap to limit infiltration of precipitation into the soil will increase the amount of stormwater runoff and contaminants commonly associated with stormwater runoff. How will recontamination of the sediments by toxins such as PAHs, BEPs, fertilizers, herbicides, insecticides, etc. be avoided? We do not wish to see one set of problems exchanged for another.

**Response:** The capacity of the groundwater diversion system will be engineered to accommodate a range of possible flows based on the expected fluctuations in seasonal groundwater conditions. The possible short-term impacts from large storm events will be considered in the engineering assessment.

Stormwater conveyance and treatment systems are being designed under the 1995 ROD for Operable Unit 02. Future stormwater runoff from the Site will be subject to applicable laws and regulations. In addition, the long-term monitoring program will be designed to identify increases in contaminant loading to the sediments or waters of Commencement Bay such that preventive action can be taken if warranted. Further, the stormwater discharged to Commencement Bay is expected to meet marine chronic criteria with treatment and use of a mixing zone.

**Comment No. 75**

**Comment:** Citizens for a Healthy Bay urges you to consider that private citizens, aquatic communities and the improved health of Commencement Bay are the largest stakeholders in the cleanup and disposal of contaminated sediments and groundwater at the former Asarco Smelter site. As a citizen- based representative of that community, Citizens for a Healthy Bay is concerned about the decisions EPA will make regarding remediation at the Asarco site. We urge the Environmental Protection Agency to make decisions that will positively affect the primary stakeholders in the cleanup of Asarco sediments and groundwater.

**Response:** EPA concurs.

**Comment No. 76**

**Comment:** We also encourage removal of any leaking, unused and/ or abandoned pipes and any other debris or unnecessary structures along the shoreline.

**Response:** EPA concurs. The disposition of leaking, unused and/ or abandoned pipes and other debris structures along the shoreline is being addressed as part of the ongoing remedial design for Operable Unit 02 (i.e., the Upland ROD).

**Comment No. 77**

**Comment:** Going through the Fact Sheet on the Former Asarco Smelter cleanup from Jan. 2000, I wish to enter the following written comments on the clean up.

I am a boater and live and have lived in the Yacht Basin for the last 15 yrs. from just before the Smelter shut down. I have seen the Basin so dead and hot you could almost power a light bulb, to today, where electroylsis is almost gone and sea life has come back. Years back we never had much growth on boat bottoms, now we have barnacles and mussels and growth of seaweed. What are you doing, I have faith it is a good job and see nothing to change. I only want to push 2 points that relate to me.

Re: Yacht Basin Area. The bottom is deep mud gunk. In spite of the returned sea life, this life cannot be safe do [sic] to the bottom it lives over. And in some cases on and in.

I wish to strongly push for the dredging of the Basin to at least 2 ft. Absolutely no less and possibly more. I know what this stuff looks like and is.

My only other concern is the slow speed that all of the cleanup is going at. Please no more extensions. Lets just get it done!

**Response:** Comment noted. Regarding the depth of dredging in the Yacht Basin: Asarco will collect additional sediment samples from the Yacht Basin this year. The data will be used to plan dredging depths. For the purpose of site cleanup, dredging will occur to the depth required to meet the cleanup criteria. As such, the final dredging depth is expected to vary by location.

**Comment No. 78**

**Comment:** Tacoma Yacht Club should be formally designated as a stake holder in the design and implementation of the Remediation Plan for the Yacht Basin. The club will formally designate a committee to laison [sic] with E.P.A., Asarco and other active parties.

**Response:** A project of this size and complexity requires coordination between all affected parties. To that end, Asarco has made a commitment to work directly with the Tacoma Yacht Club on Yacht Basin dredging issues. EPA will take steps to see that Asarco coordinates with the Yacht Club to the extent necessary.

**Comment No. 79**

**Comment:** Pg. 21, Sec 7.1 Groundwater: [As stated in the Proposed Plan] "No remedial action is planned for the Slag Peninsula area ( approximately 85,000 yd2 or 17.5 acres) because the water depths and steep slopes make capping or dredging technically impracticable."

NOAA supports EPA's position of not trying to actively remediate the steep portions of the Slag Peninsula Unit located in deep water. Conventional capping techniques do not appear to be productive because of the steep slopes and water depths. NOAA prefers intertidal and shallow subtidal capping to be placed only when equivalent (or more) fill is removed so that there is no net loss of aquatic habitat; for that approach to be used on the slag peninsula it would require the removal of too much of the peninsula before reaching gentle enough slopes for the capping material to repose in perpetuity. We are unaware of any other cost-effective and environmentally- sensitive remediation technology to solve these problems.

**Response:** Comment noted.

**Comment No. 80**

**Comment:** My standpoint, you must understand, comes from a metallurgical engineer who had an opportunity to tour the ASARCO smelter while a young college student. It is unfortunate to the community and the area as a whole that so much toxic substances were released into the environment in the name of progress and the almighty dollar. It should also be remembered that the plant offered employment to numerous workers during its lifetime. It

was a monument to the ingenuity of metallurgists while now becoming a bane to those of us in the profession. It is demoralizing to think that the metals industry has had to cope with changes that sometimes make my training obsolete.

Just as a passing thought; there are plans to remove and store in a landfill, the contaminated soils around the Ruston plant. And the Seattle-Taocma [sic] airport is looking for fill for their third proposed runway. Abra-cadabra! Why not use this soil for their fill and kill two birds with one stone? I had heard some statistics about the amount of fill needed for the SEA-TAC airport and the time needed to complete their plans, much to the consternation of the local residents.

Another thought; why not sell, for refining, the waste products from the ASARCO plant? It used to be that tailings piles from older mines would be reprocessed again and again to remove the smallest traces of valuable metals. Arsenic still has used in rodenticides. Lead is used in storage batteries. Cadmium is used in low-melting point alloys. What other treasures could be gleaned from all the waste?

The EPA plan to cover the site with non-permeable material does not take into account one thing; water seeping UP through the covering layer. This is something that must be considered in our wet Washington weather.

Men have torn down mountains to get to precious metals for a long time. If the material at Ruston is offending, why not dig out a big hole and put it back into those torn- down mountains?

These are my thoughts and suggestions concerning the treatment of the wastesite at ASARCO's Ruston plant. I hope they are doing a better job of not polluting in their new location in the southwestern USA. It was a kick in the butt to see them leave town. That was one less place I could have sought gainful employment from.

**Response:** EPA offers a four part response:

1. Disposal of contaminated soils and sediments at Seattle-Tacoma Airport - We assume that the phrase "contaminated soils around the Ruston plant" refers to both the contaminated terrestrial soils and marine sediments that are scheduled for onsite contaminant at the Site. Plans call for these materials to be disposed of in either the engineered On-Site Containment Facility (OCF) or under the proposed low permeability cap. Soils and waste materials from the upland portion of the Site and soils from the Ruston area were specifically addressed in the 1995 ROD addressing Operable Units 02 and 07 and in the 1993 ROD addressing Operable Unit 04 (OUs 02, 07, and 04 include cleanup of upland portion of the Site, demolition of Asarco facilities, Asarco Off-property soils, respectively). Per the 1995 ROD, EPA has determined that the soils and wastes from OUs 02, 04, and 07 are to be disposed of at the former Asarco facility. EPA did not evaluate the possibility of exporting dredged sediments to Seattle-Tacoma Airport as part of the RI/FS for OU 06 (Sediments/Groundwater). We believe that there are a number of significant difficulties with this approach that make it infeasible. These include the cost of transporting the material from Tacoma to the airport, environmental regulations that preclude disposal of contaminated material at facilities that are not designed for such purposes, and the cost and time associated with negotiating such a proposal with the Port of Seattle and nearby members of the community who may be affected, among others.

2. Recycling waste material - As discussed above, the 1993 and 1995 RODs address all of the terrestrial soils and waste materials associated with the Asarco facility. Remediation is either underway (OUs 04 and 07) or nearly underway (OU 02). A number of physical and chemical treatment processes, some of which included metals reclamation, were evaluated as part of the Feasibility Study for OU 02. It was determined that reliable cost-effective alternatives were not feasible or practicable due to the nature and volume of the waste materials.

3. Seepage through the site cap – The low permeability cap will be placed above the seasonal high groundwater table. In addition, the cap system will include a drainage layer to direct subsurface water to the surface water diversion system.

4. Disposal of contaminated material at former open pit mines – The comment suggests that contaminated soils, wastes, and sediments could be returned to former mine sites for final disposal. As discussed above, the 1993 and 1995 RODs address all of the terrestrial soils and waste materials associated with the Asarco facility. EPA did not evaluate the possibility of exporting dredged sediments to mine sites. Many of the same difficulties and costs addressed in the response to the Seattle-Tacoma Airport comment (above) apply to this alternative.

# References

## References

District Court of Washington, June 2000. United States vs. Asarco, Inc. Commencement Bay Nearshore/Tideflats Superfund Site, Asarco Smelter Consent Decree, Amendment Number One.

Hydrometrics, Inc. January 1993. Asarco Tacoma Plant Yacht Club Breakwater Remedial Investigation, Tacoma, Washington.

Hydrometrics, Inc. August 1993. Asarco Tacoma Plant Feasibility Study, Tacoma, Washington.

Hydrometrics, Inc. August 1993. Asarco Tacoma Plant Remedial Investigation, Tacoma, Washington.

Hydrometrics, Inc. April 1999. Group 5 Technical Memorandum, Asarco Sediment/Groundwater Task Force.

Hydrometrics, Inc. March 2000. Draft September 1999 Data and Annual Report Long- Term Remedial Action Monitoring Plan, Asarco Tacoma Smelter.

Hydrometrics, Inc. June 2000. Historical Summary of the Evaluation of Groundwater Remedial Alternatives, Asarco Tacoma Smelter Site.

Kleinfelder, December 1992. On-Property Baseline Human Health Risk Assessment, Asarco Tacoma Plant, Tacoma, Washington.

Merrit+Pardini /Sasaki Associates, August 1997. Asarco Ruston/Tacoma Smelter Site, Master Development Plan, Stakeholder Approval Draft.

Parametrix, 1987. Asarco Tacoma Smelter Remedial Investigation. Unpublished report to Asarco, Inc., and EPA. Prepared in association with Hart Crowser, TRC, and ETI.

Parametrix, 1989. Asarco Tacoma Smelter Offshore Marine Sediments Feasibility Study.

Parametrix, 1990. Asarco Tacoma Smelter Offshore Feasibility Study, Supplemental Marine Sediment Survey.

Parametrix, 1991. Asarco Tacoma Smelter Marine Sediment Survey, Supplemental Marine Sediment Survey.

Parametrix, 1993. Asarco Tacoma Smelter Marine Survey, Yacht Basin Survey Results.

Parametrix, March 1995. Draft Disposal Site Inventory.

Parametrix, April 1996. Phase 1 Data Evaluation Report and Phase 2 Sampling and Analysis Approach, Asarco Sediments Superfund Site, Expanded Remedial Investigation and Feasibility Study.

Parametrix, December 1996. Phase 2 Refinement of Options Report, Asarco Sediments Superfund Site, Expanded Remedial Investigation and Feasibility Study.

Parametrix, June 1999. Copper in Nearshore Marine Water Technical Memorandum.

Parametrix, January 2000a. Refinement of the Proposed Remedy Report ( as amended by EPA letter of March 14, 2000).

Parametrix, January 2000b. Documentation of the Feasibility Study Process for the Sediments Portion of the Asarco Sediments Operable Unit

Parametrix, February 2000. Asarco Sediments Superfund Site Thin- Layer Cap Pilot Project Year 2 Monitoring Report.

Parametrix, May 2000. Draft Biological Assessment.

Roy F. Weston, Inc., October 1993. Supplemental Feasibility Study, Commencement Bay Nearshore/Tideflats Asarco Sediments Site.

Roy F. Weston, Inc., October 1996. Ecological Risk Assessment and Seafood Consumption Screening Risk Assessment.

United States Environmental Protection Agency ( EPA), September 1989. Commencement Bay Nearshore/Tideflats Record of Decision.

EPA, April 1993. Remedial Action Objectives and Preliminary Remediation Goals for the Asarco Tacoma Site.

EPA, March 1995. Asarco Tacoma Smelter and Breakwater Peninsula ROD.

EPA, October 1995. EPA Region III Risk- Based Concentration Table.

EPA, July 1999. A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents.

EPA, November 1999. United States vs. Asarco, Inc Commencement Bay Nearshore/ Tideflats Superfund Site, Asarco Sites, Modification Agreement, Civil Action No. C91-5528 B, Civil Action No. C94-5714, Docket No. 10-94-0221. Signed by EPA and Asarco.

EPA, January 2000a. Documentation of the Feasibility Study Process for the Sediments Portion of the Asarco Sediments Operable Unit.

EPA, January 2000b. Proposed Plan, Asarco Sediments/ Groundwater Operable Unit 06 Ruston and Tacoma, Washington.

# Tables

**TABLE 5-1**
Maximum Metal Concentration in Sediment

| Contaminant | Max Concentration (mg/kg) | Percentage of Detections > CSLs |
|---|---|---|
| As | 26,410 | 53 |
| Cu | 43,840 | 42 |
| Pb | 22,450 | 32 |
| Zn | 174,000 | 39 |

**TABLE 9-1**
Groundwater Alternatives

| Alternative [1] | Description [2] | Estimated Cost (in millions $) [3] Capital | Annual O&M | 30-Year O&M | Total Present Worth |
|---|---|---|---|---|---|
| GW-A: No Action | No actions are taken | $0 | NA | $0 | $0 |
| GW-B: Source Control, Soil Capping and Surface Water Controls, Groundwater Interception/Treatment, Replacements of Leaking Subsurface Water Lines, Institutional Controls and Monitoring. | Reduce groundwater discharge to Commencement Bay by 1) limiting infiltration of precipitation and surface water, 2) intercepting groundwater at selected locations before it enters the Facility and treating* that groundwater as required prior to discharge to Commencement Bay, and 3) abandoning or replacing leaking underground sewer and water lines. Continued groundwater monitoring and implementation of institutional controls (e.g., restricting future use of Facility groundwater) will also occur. If groundwater cleanup goals are not achieved, contingency actions such as additional diversion, may be constructed.<br><br>*Captured groundwater will be directed to the on-site stormwater treatment system being constructed as part of the upland, OU02 remedy. This treatment system includes particulates removal enhanced by the use of coagulants and flocculants. | $0 | $0.1 | $1.8 | $1.8 |
| GW-C: Pump/Treat and Discharge to Outfalls | Actively remove contaminated groundwater by a series of extraction wells. The groundwater would be treated and discharged to Commencement Bay. Candidate areas for the pump/treat alternative are downgradient of the Arsenic Kitchen, Southeast Plant (DMA) area, Copper Refinery, and Fine Ore Bins. All elements of Alternative GW-B (above) would be included to reduce groundwater discharge to Commencement Bay, protect the deep aquifer, and provide institutional controls. | $28.7 | $0.6 | $9.1 | $37.8 |
| GW-D: *In situ* Groundwater Treatment | *In situ* oxidation of groundwater by air injection to enhance chemical precipitation of arsenic. Nutrient injection would stimulate biological degradation of DMA-related compounds in the Southeast Plant Area. All elements of Alternative GW-B (above) would be included to reduce groundwater discharge to Commencement Bay, protect the deep aquifer, and provide institutional controls. | $2.0 | $0.1 | $2.3 | $4.3 |

**TABLE 9-1**
Groundwater Alternatives

| Alternative [1] | Description [2] | Estimated Cost (in millions $) [3] | | | |
|---|---|---|---|---|---|
| | | Capital | Annual O&M | 30-Year O&M | Total Present Worth |
| GW-E: *In situ* Treatment by Seawater Injection | Injection of seawater to raise pH and provide a more oxygenated subsurface environment conducive to chemical precipitation of arsenic. Candidate areas for seawater injection are the Arsenic Kitchen, Southeast Plant (DMA) area, and Fine Ore Bins. All elements of Alternative GW-B (above) would be included to reduce groundwater discharge to Commencement Bay, protect the deep aquifer, and provide institutional controls. | $2.2 | $0.1 | $2.2 | $4.4 |

Notes:

1) Alternatives GW-1B and GW-3D from the 1993 FS are not addressed in this ROD because soil remedial actions selected previously by EPA have eliminated these alternatives as options. Alternative GW-A, "no action," is retained only for comparative analysis purposes.

2) Although not specifically listed, it is assumed that all alternatives listed this table would be implemented in addition to the selected remedy for OU 02 (i.e., source control, surface water and groundwater diversions, site capping and other OU 02 remedy elements are required in addition to the OU 06 groundwater alternatives listed in this table). The cost for the OU 02 remedy is excluded from the estimated cost shown in this table.

3) Present worth operation and maintenance (O&M) costs assume a 5 percent discount rate over 30-year period.

**TABLE 9-2**
Sediment Remedial Alternatives for the Nearshore/Offshore Area
(88,000 $yd^2$ or 18 acres)

| Alternative | Description | Estimated Cost (in millions $) [1] Capital | O&M | Total Present Worth |
|---|---|---|---|---|
| S-1A: No Action | No actions are taken. | $0 | $0 | $0 |
| S-1B: Natural Recovery | Natural recovery does not involve any active work, but typically includes long-term monitoring to ensure that sediment quality is naturally improving over time (e.g., new clean sediment is covering up the contaminated sediment). | $0 | $0.2 | $0.2 |
| S-1C: Capping | Cover 88,000 $yd^2$ ( 18 acres) of contaminated sediment with a minimum of 3 ft. of clean sand and gravel. In general, the purpose of a cap is to prevent the direct contact of people and marine organisms with contaminated sediment. | $10.3 | $1.3 | $11.6 |
| S-1D: Dredging and Nearshore Confinement | Dredge contaminated sediment and place in nearshore confined aquatic disposal (CAD) facility, which is an underwater cell that keeps the contaminated sediment covered with a cap and isolated from the overlying water. This alternative would require dredging of a minimum of 70,000 $yd^3$ of contaminated sediment with a dredge depth of approximately 1 yd (some of the 88,000 $yd^2$ or 18 acres of contaminated sediment would be covered by the nearshore facility), placement of the dredged sediment within a berm along the shoreline of the Facillity, and placement of a clean sediment cap over the dredged material. The cap and containment berm of the nearshore CAD would be armored to minimize erosion. | $11.8 | $1.0 | $12.8 |
| S-1E: Dredging and Upland Disposal | Dredge a minimum of 88,000 $yd^3$ of contaminated sediment with a dredge depth of approximately 1 yd; placement of the dredged sediment at an off-site location. | $26.0 | $0.2 | $26.2 |

Notes:

1) A discount rate has not been applied to the capital costs because the remedy will be implemented within a short period of time (5 years). Operations and maintenance (O&M) costs are for 20 years.

**TABLE 9-3**
Sediment Remedial Alternatives for the Yacht Basin (75,000 square yards; 15.5 acres)

| Alternative | Description | Estimated Cost (In millions $) [1] Capital | O&M | Total Present Worth |
|---|---|---|---|---|
| S-2A: No Action | No actions are taken. | $0 | $0 | $0 |
| S-2B: Natural Recovery | Natural recovery does not involve any active work, but typically includes long-term monitoring to ensure that sediment quality is naturally improving over time (e.g., new clean sediment is covering up the contaminated sediment). | $0 | $0.3 | $0.3 |
| S-2C: Dredging and Nearshore Confinement | Dredge contaminated sediment and place in nearshore CAD. This alternative would require dredging of approximately 55,000 $yd^3$ of contaminated sediment, with a dredge depth of approximately 2 feet. | $4.9 | $0.2 | $5.1 |
| S-2D: Dredging and Upland Disposal | Dredge an area of 75,000 $yd^2$ (15.5 acres) of contaminated sediment to a depth of 2 feet and place beneath the upland cap in the central portion of the upland part of the Facility. This alternative would require dredging of approximately 55,000 $yd^3$ of contaminated sediment. (Note: As a contingency, if all the contaminated material cannot be removed from the Yacht Basin, dredging in the Basin followed by placement of clean material may occur.) | $3.4 | $0.2 | $3.6 |

Notes:

1) A discount rate has not been applied to the capital costs because the remedy will be implemented within a short period of time (5 years). Operations and maintenance (O&M) costs are for 20 years.

**TABLE 9-4**
Sediment Remedial Alternatives for the Northshore Area (7,000 square yards; 1.5 acres)

| Alternative | Description | Estimated Cost (In millions $) [1] | | |
|---|---|---|---|---|
| | | Capital | O&M | Total Present Worth |
| S-3A: No Action | No actions are taken. | $0 | $0 | $0 |
| S-3B: Natural Recovery | Natural recovery would not involve any active work at the Facility, but would include monitoring to ensure that sediment quality is naturally improving over time (e.g., new clean sediment is covering up the contaminated sediment). | $0 | $0.2 | $0.2 |
| S-3C: Capping | Cover 7,000 $yd^2$ (1.5 acres) of contaminated sediment With a minimum of 1.0 m of clean sand and gravel. In general, the purpose of a cap is to prevent the direct contact of people and marine organisms with contaminated sediment. | $0.5 | $0.2 | $0.7 |
| S-3D: Dredging and Nearshore Confinement | Dredge contaminated sediment and place In nearshore CAD. This alternative would require dredging of approximately 4,500 $yd^3$ of contaminated sediment (7000 $yd^2$ dredged to a depth of 2 feet). | $0.7 | $0.2 | $0.9 |
| S-3E: Dredging and Upland Disposal | Dredge contaminated sediment and place beneath the upland cap. This alternative would require dredging of approximately 4,500 $yd^3$ of contaminated sediment (7000 $yd^2$ dredged to a depth of 2 feet). | $0.5 | $0.2 | $0.7 |

Notes:

1) A discount rate has not been applied to the capital costs because the remedy will be Implemented within a short period of time (5 years). Operations and maintenance (O&M) costs are for 20 years.

**TABLE 12-1**
Groundwater Cleanup Levels

| Constituent | Cleanup Level ($\mu$g/L) | Basis |
|---|---|---|
| Shallow Aquifer System[1] | | |
| Arsenic | 6 | Background concentration in regional groundwater |
| Copper | 3.1 | Marine chronic criteria; WAC 173-201A-040[2] |
| Deep Aquifer | | |
| Metals | MCLs | Maximum contaminant levels; 40 C.F.R. Part 141.62 |

[1] Includes the slag, marine sand, and intermediate aquifers as referenced in various Site documents.

[2] The regional background concentration for copper in groundwater has been established at 40 $\mu$g/L; 3.1 $\mu$g/L will be the targeted cleanup level to be achieved through dilution within marine waters that mix with groundwater in the nearshore areas of the Facility aquifers.

**TABLE 12-2**
Sediment Cleanup Levels for Marine Sediments at OU 06

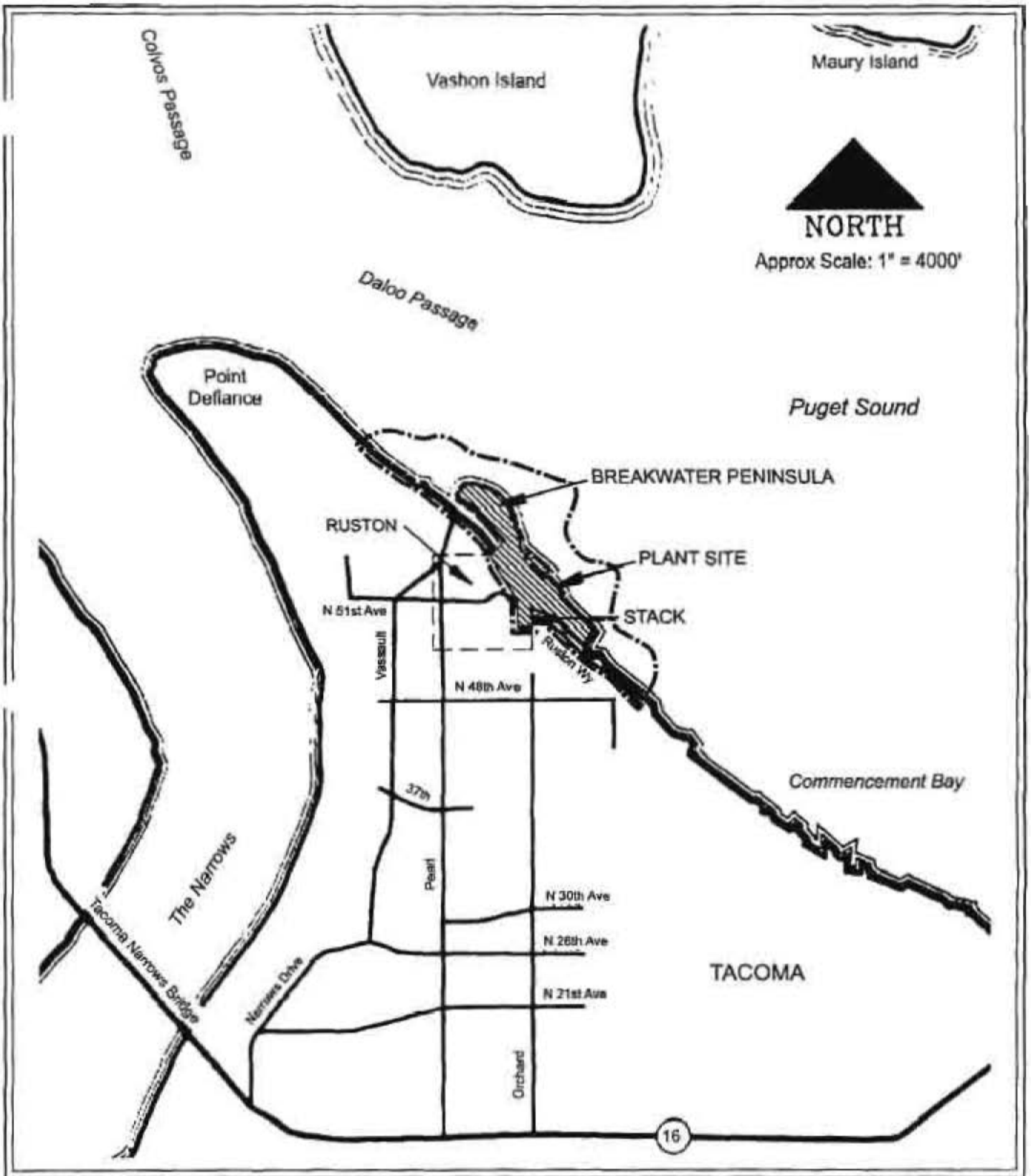
| Remedy Unit | Type of Remedy | Remediation Cleanup Level | Monitoring Cleanup Level |
|---|---|---|---|
| Nearshore/Offshore and Northshore Areas | Capping | Preponderance-of-Evidence Approach[1] | Washington State Sediment Management Standards – SQS (WAC 173-340-320) |
| Yacht Basin | Dredging | | |
| Arsenic[2] | | 93 mg/kg | 93 mg/kg |
| Copper[2] | | 390 mg/kg | 390 mg/kg |
| Lead[3] | | 450 mg/kg | 450 mg/kg |
| Zinc[3] | | 410 mg/kg | 410 mg/kg |
| Moderate Impact Zone and Contaminant Effects Areas | Monitoring | Preponderance-of-Evidence Approach[1] | Preponderance-of-Evidence Approach[1] |

[1] See Section 7.2.2.

[2] CSL; (WAC 173-204-520)

[3] SQS; (WAC 173-204-320)

# Figures




**EXPLANATION**

Operable Unit 06 of Commencement Bay Near Shore Tideflats Superfund Site (Includes Groundwater Beneath OU 02)

Operable Unit 02 of Commencement Bay Near Shore Tideflats Superfund Site

Figure 1-1
**Asarco Facility Location Map**
Asarco Sediments/Groundwater OU 06 ROD

152878.PR 02_E06200000095EA Fig 1-1 Asarco Facility Location Map .jpg

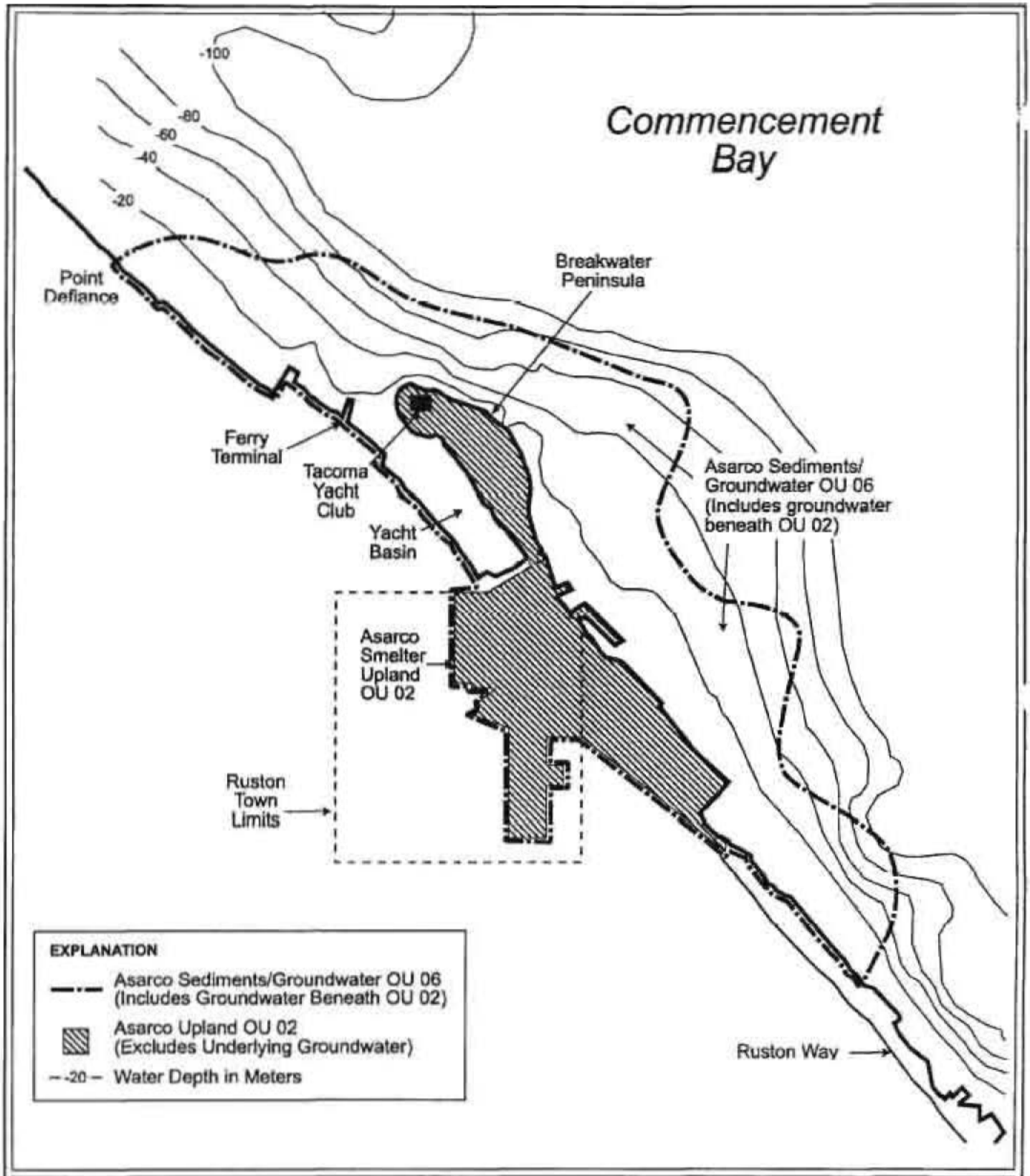


Figure 1-2
**Operable Unit 06 Site Boundary**
Asarco Sediments/Groundwater OU 06 ROD

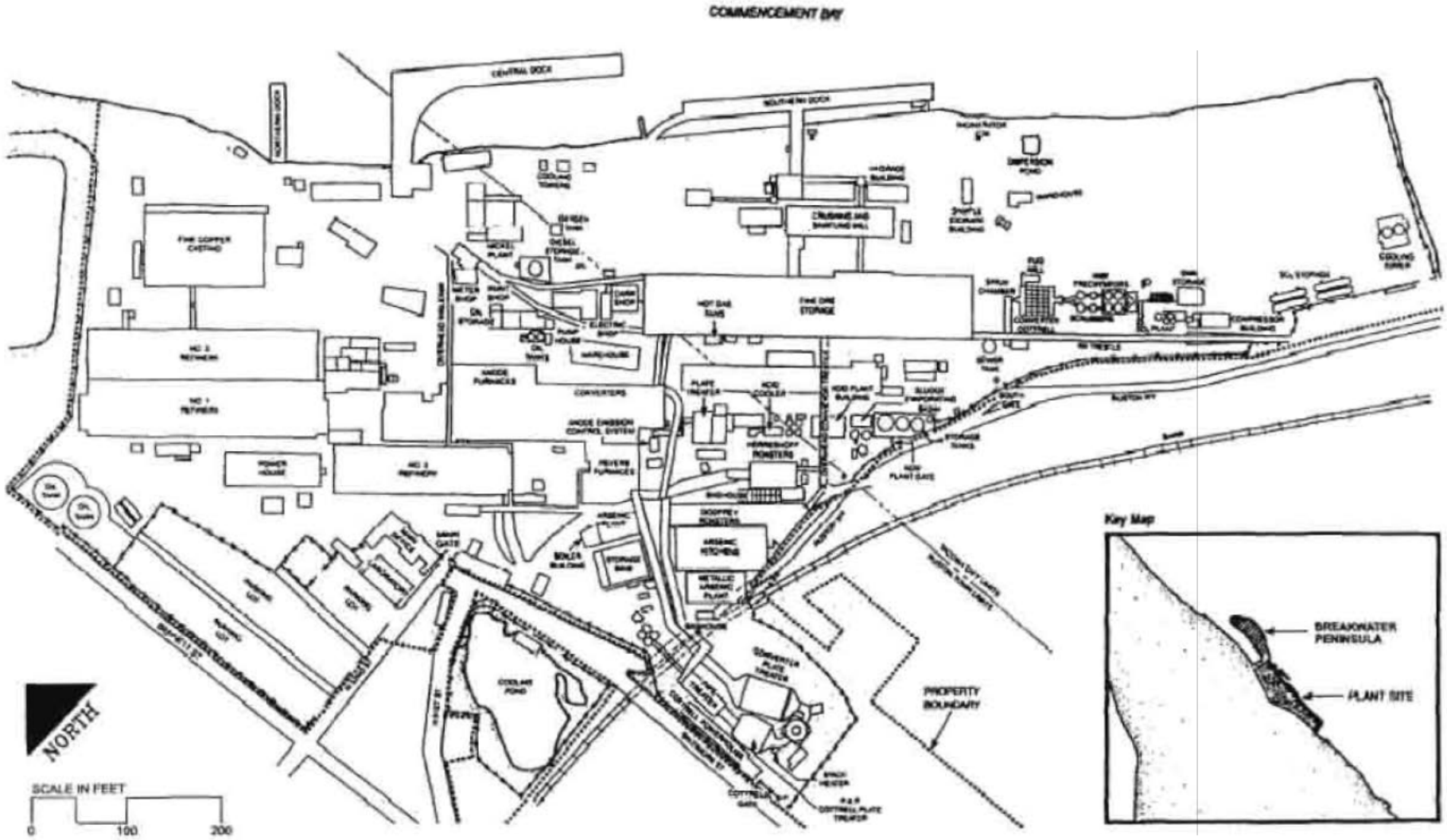
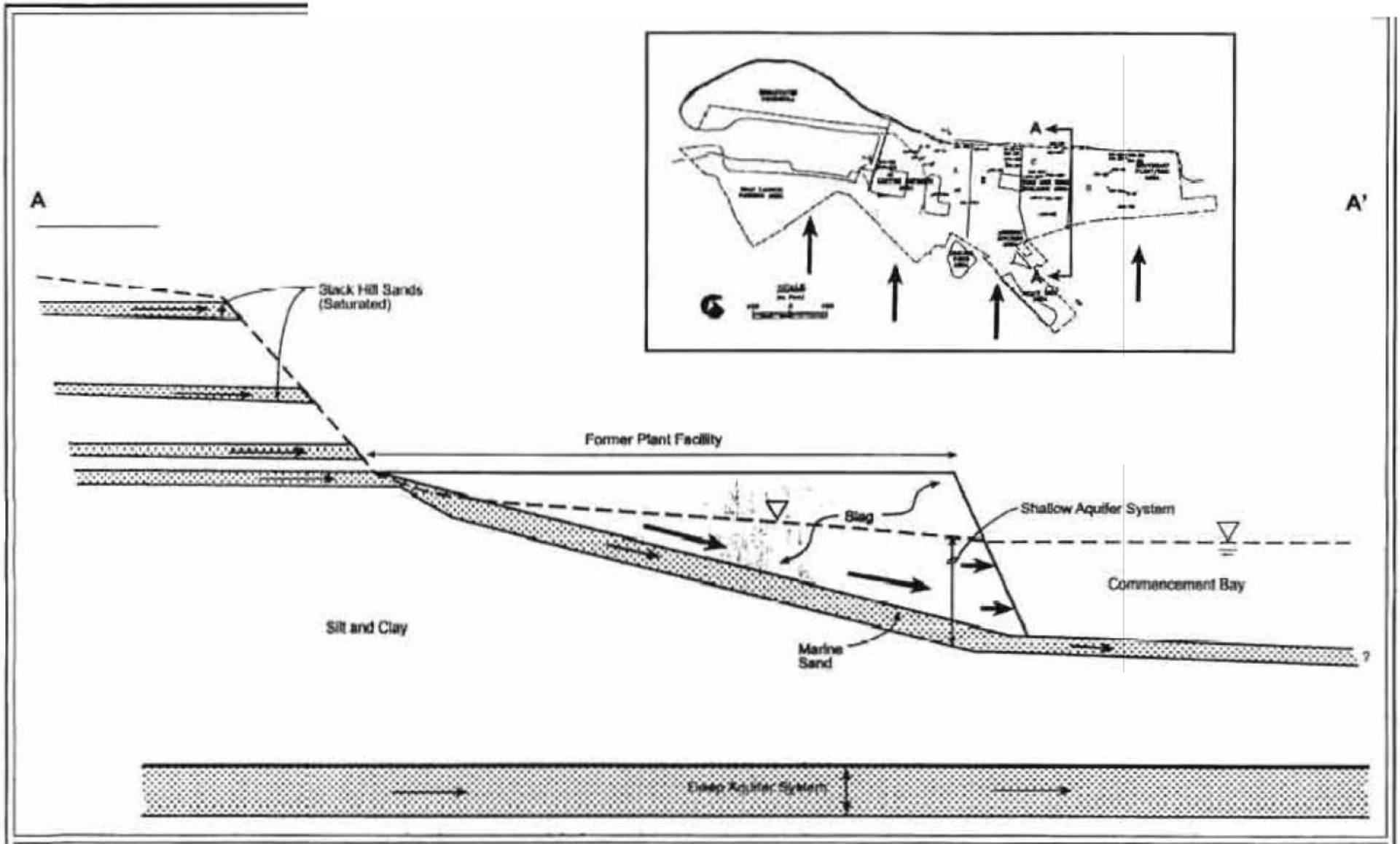



Figure 1-3
**Former Facility Layout**
Asarco Sediments/Groundwater OU 06 ROD

152579 PR 02_E06200000902A Fig 1-3 Asarco Tacoma Smelter Site Former Facility Layout 6-21-00 gr



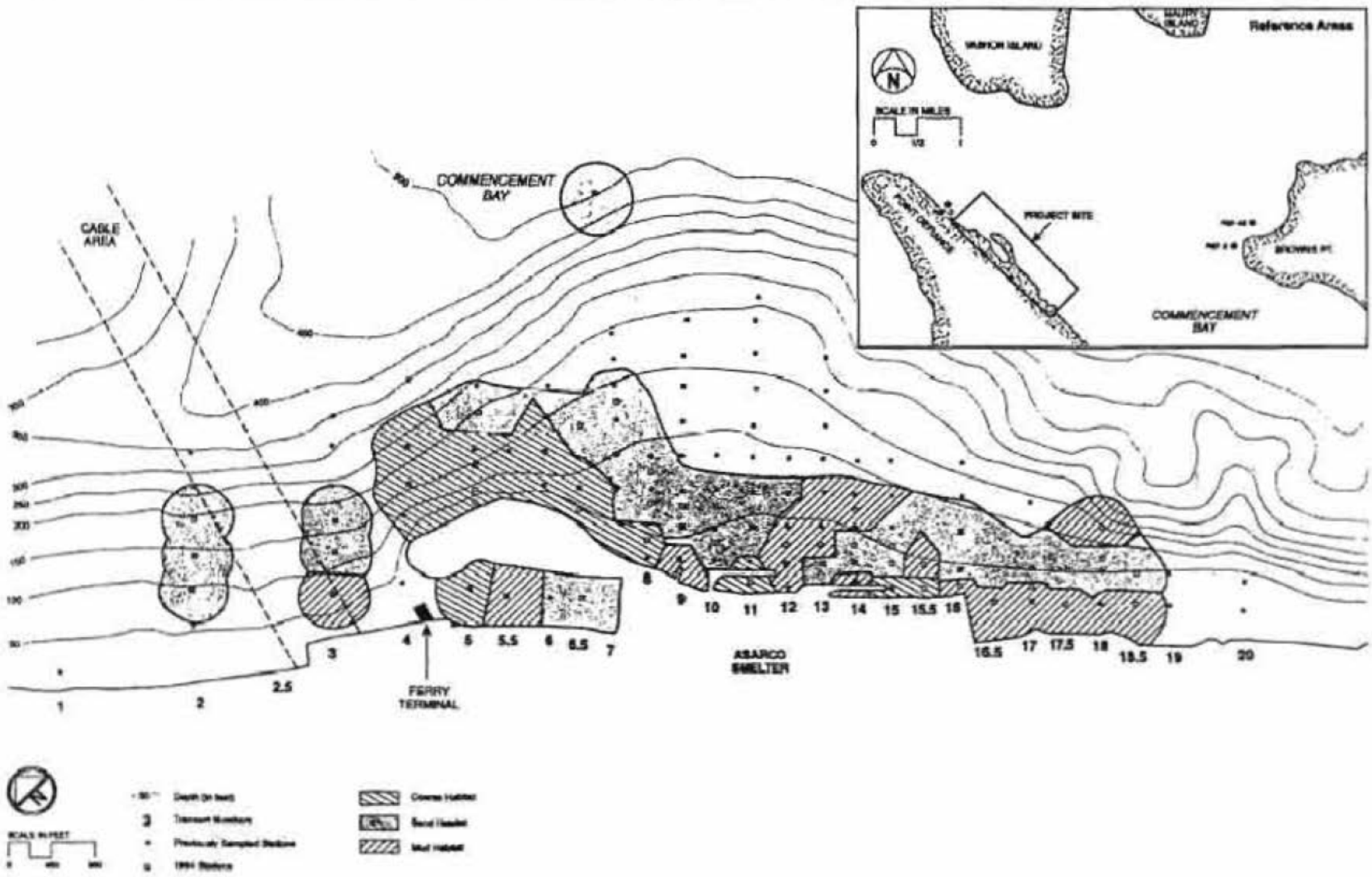

**EXPLANATION**

NOT TO SCALE

Water Level

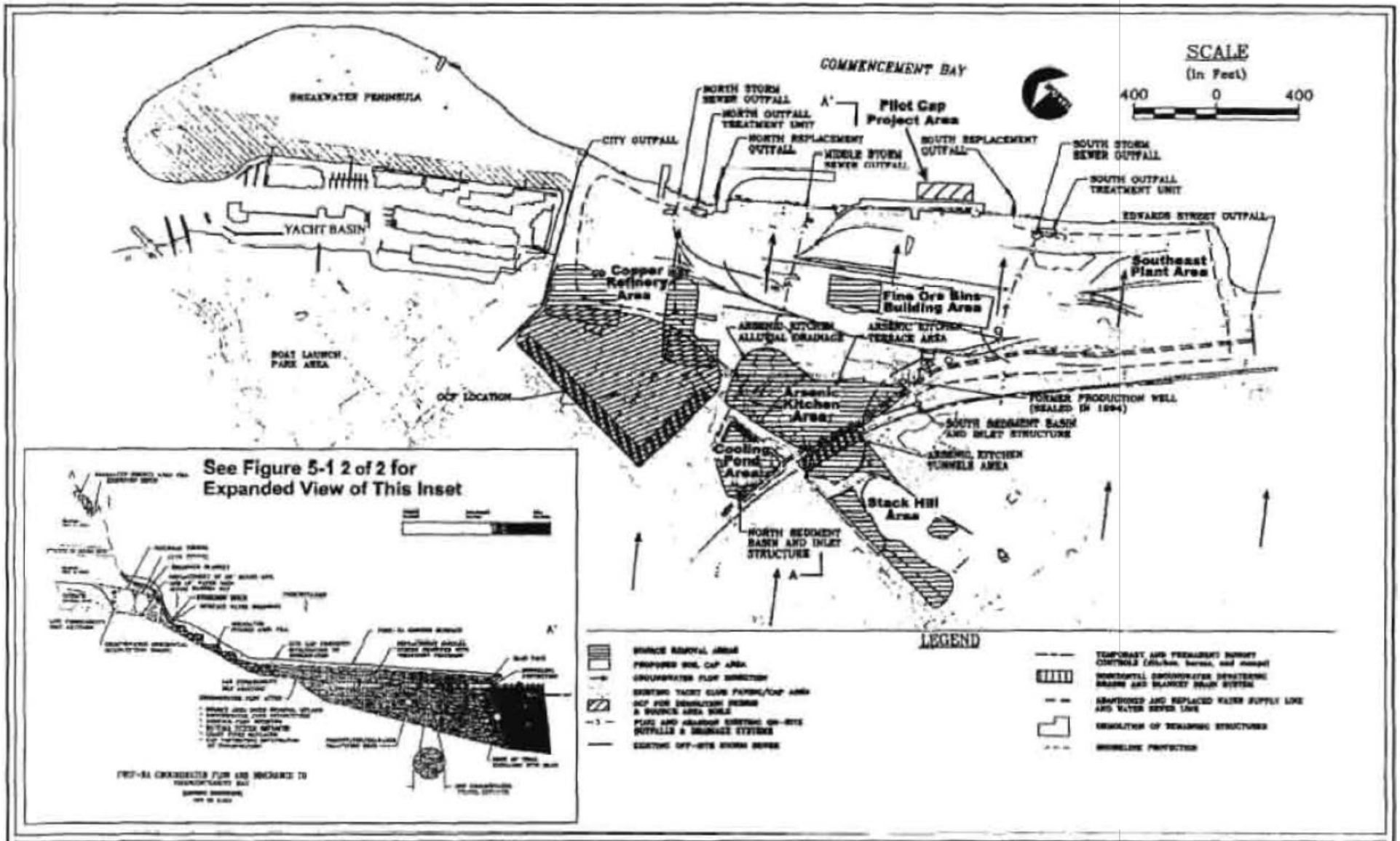
Groundwater Flow Direction

Figure 1-4
**Conceptual Cross Section**
Asarco Sediments/Groundwater OU 06 ROD




Source: Parametrix, Inc., April 1996.

Figure 1-5
**Habitat Areas Defined by Benthic Infauna Sampling**
Asarco Sediments/Groundwater OU 06 ROD



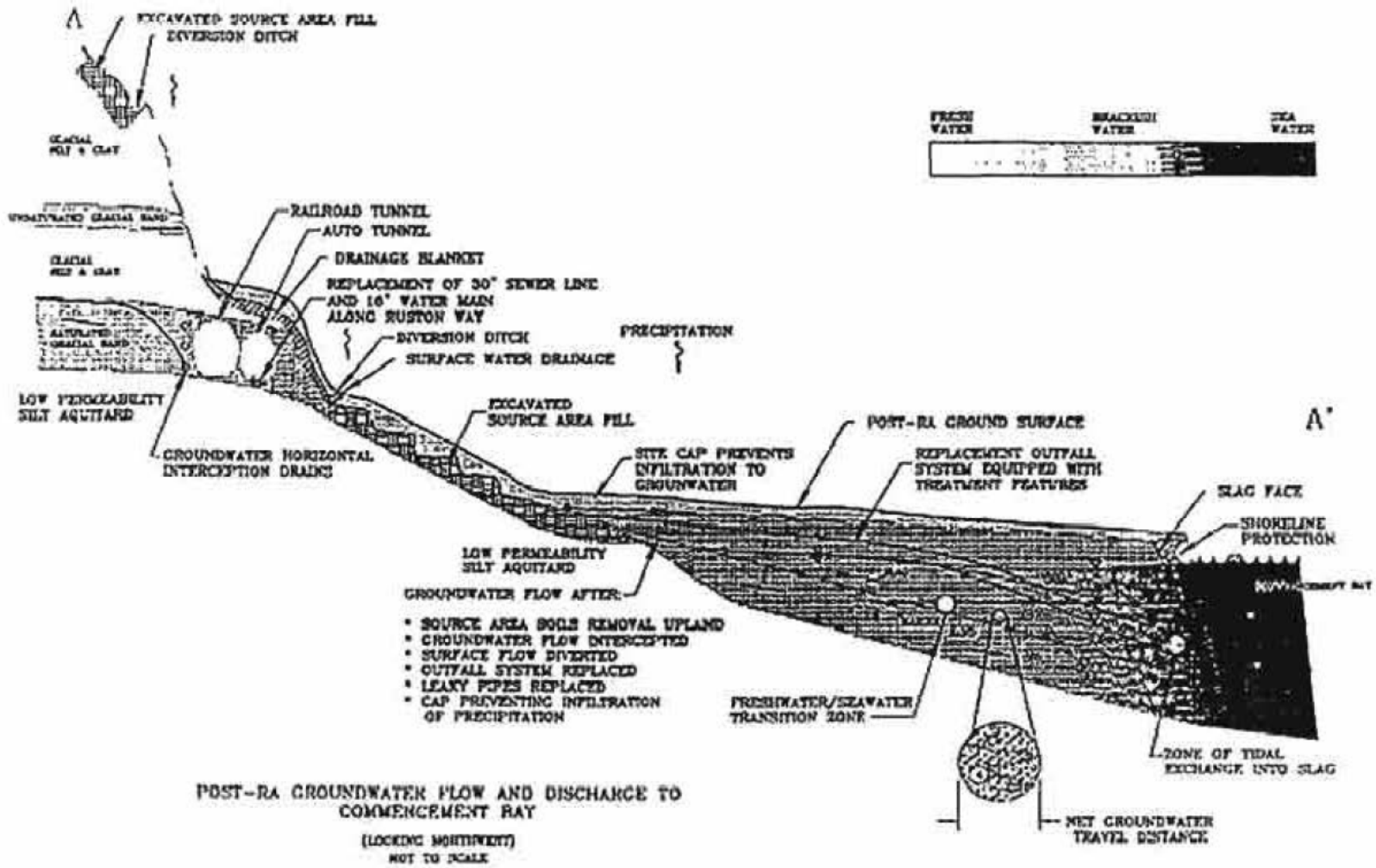

Source: Hydrometrics, Inc.

Figure 5-1 *1 of 2*

**Source Areas and Selected Remedy for Operable Unit 06**

Asarco Sediments/Groundwater OU 06 ROD

Expanded View of Figure 5-1 1 of 2 Inset




POST-RA GROUNDWATER FLOW AND DISCHARGE TO COMMENCEMENT BAY

(LOOKING NORTHWEST)

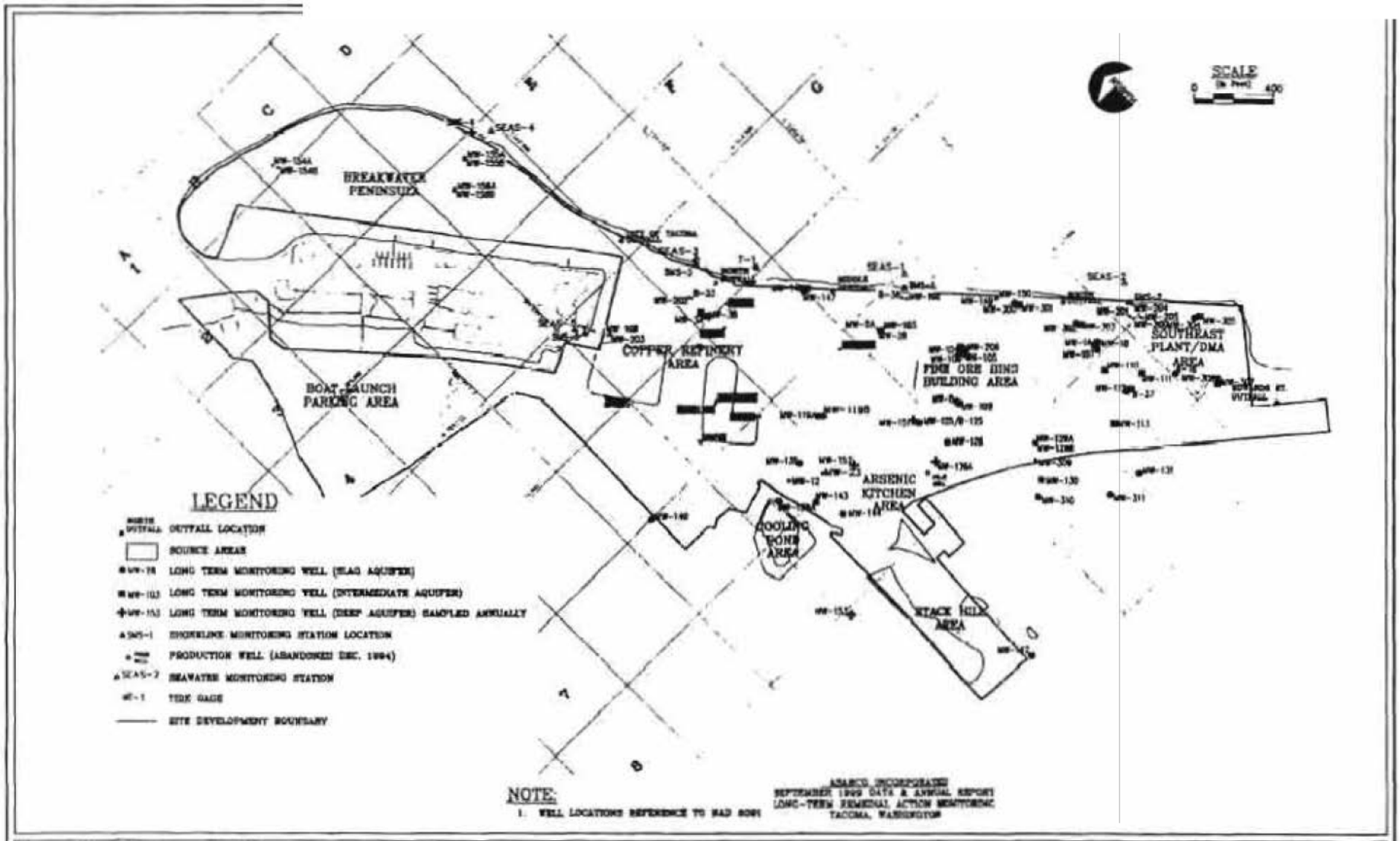
NOT TO SCALE

Source: Hydrometrics, Inc.

Figure 5-1 *2 of 2*

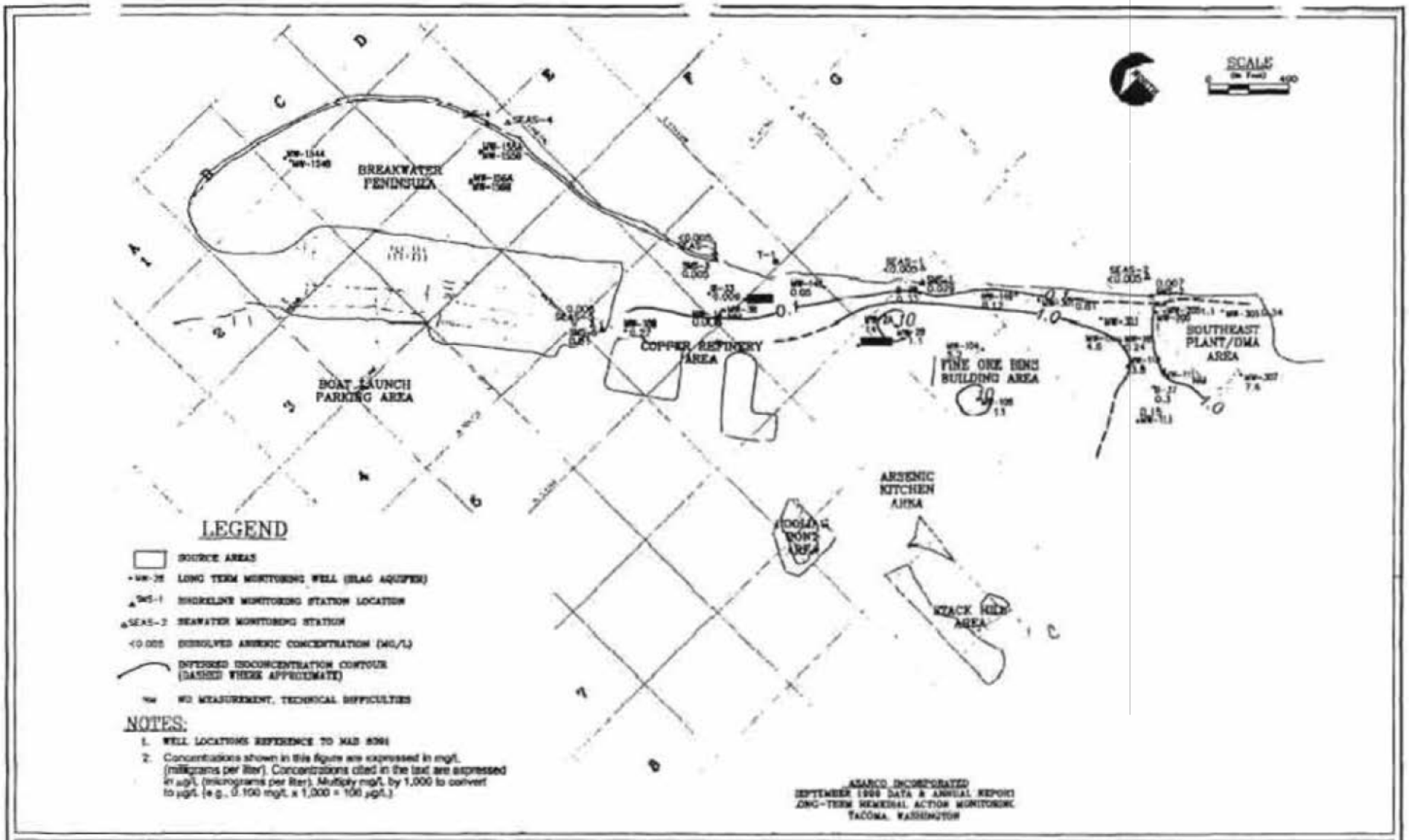
**Source Areas and Selected Remedy for Operable Unit 06**

Asarco Sediments/Groundwater OU 06 ROD




Source: Hydrometrics, Inc., March 2000.

Figure 5-2
**Monitoring Well Locations**
Sediments/Groundwater OU 06 ROD

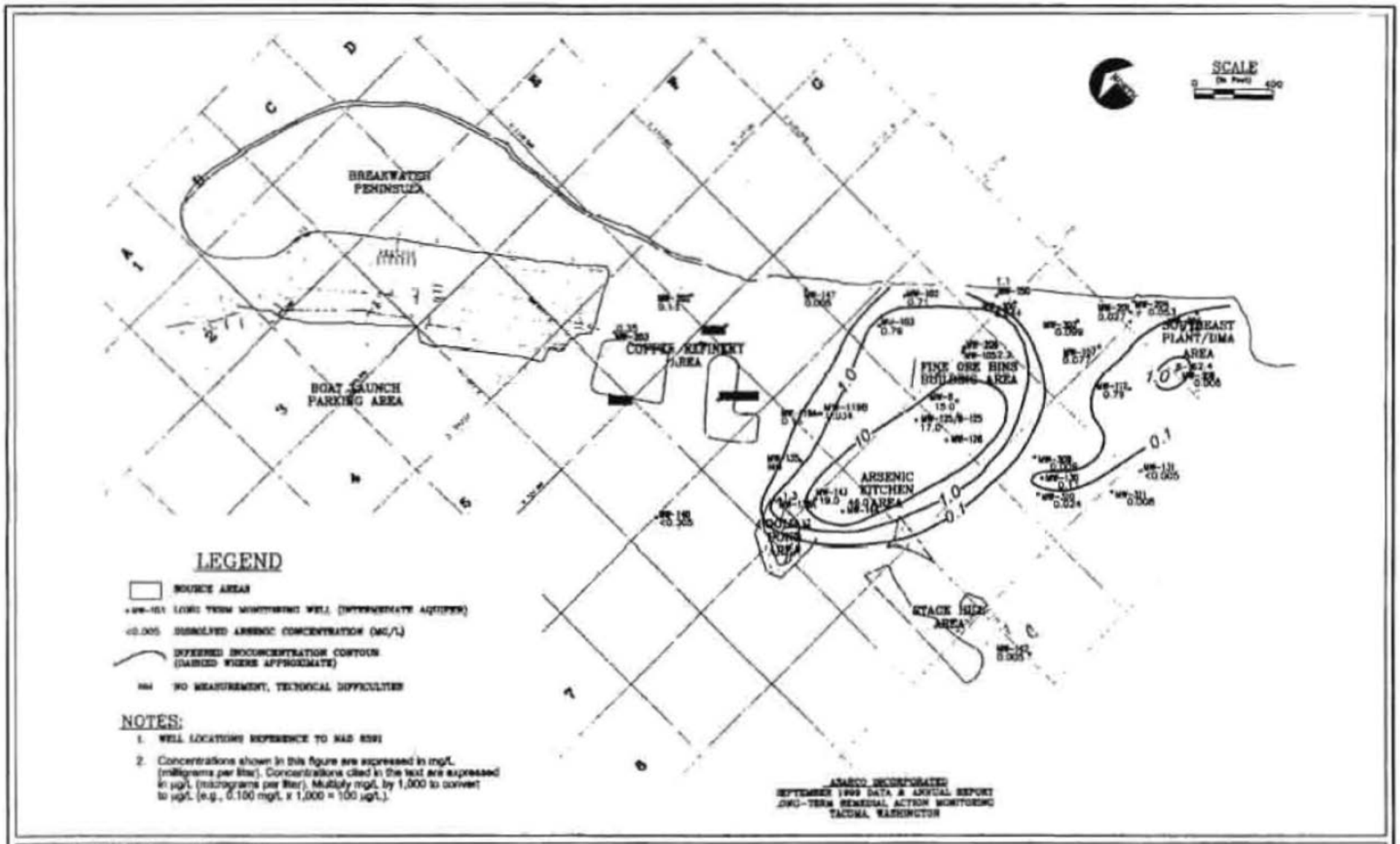



Source: HydroMetrics, Inc., March 2000.

Figure 5-3

**Slag Wells**
**Dissolved Arsenic in Groundwater**
**September 1999**

Asarco Sediments/Groundwater OU 06 ROD

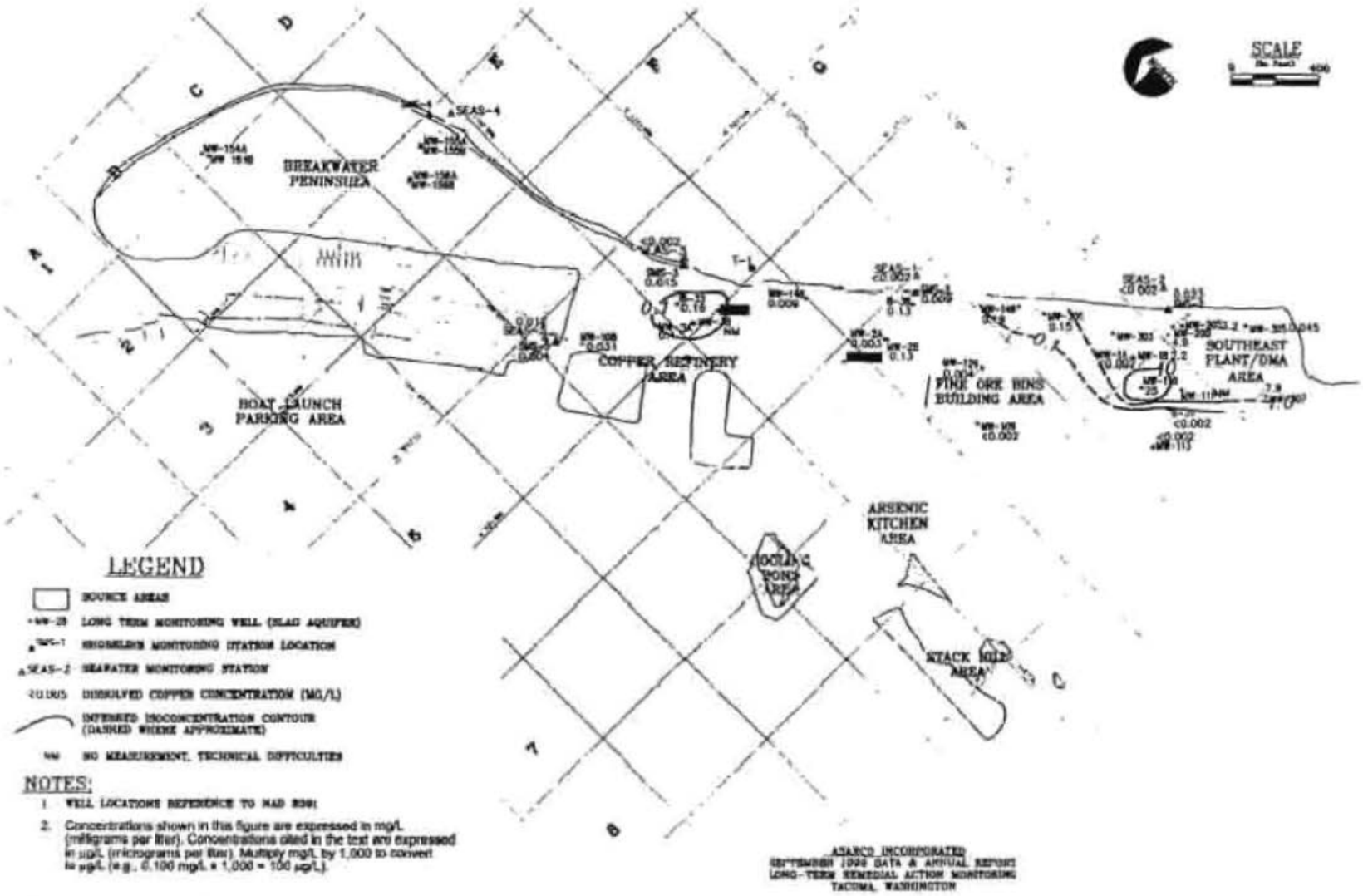



Source: HydroMetrics, Inc., March 2000.

Figure 5-4

**Intermediate Wells**
**Dissolved Arsenic in Groundwater**
**September 1999**

Asarco Sediments/Groundwater OU 06 ROD



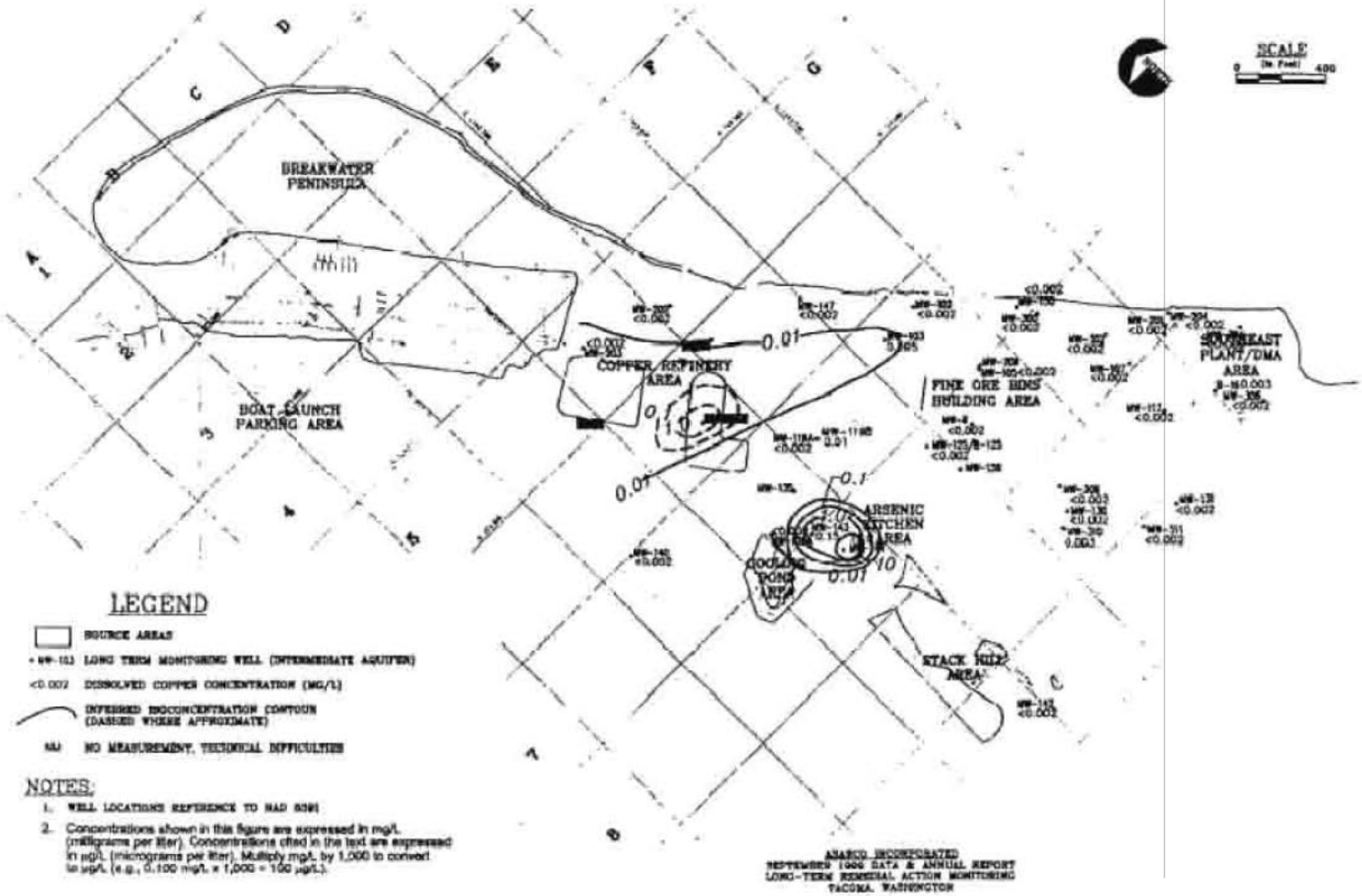

*Source: HydroMetrics, Inc., March 2000.*

Figure 5-5

**Slag Wells**
**Dissolved Copper in Groundwater**
**September 1999**

Asarco Sediments/Groundwater OU 06 ROD

153678.PR 02_E9620000095EA Fig 5-5 Slag Wells Dissolved Copper in Groundwater Sept 1999 . 6-21-00 . gr



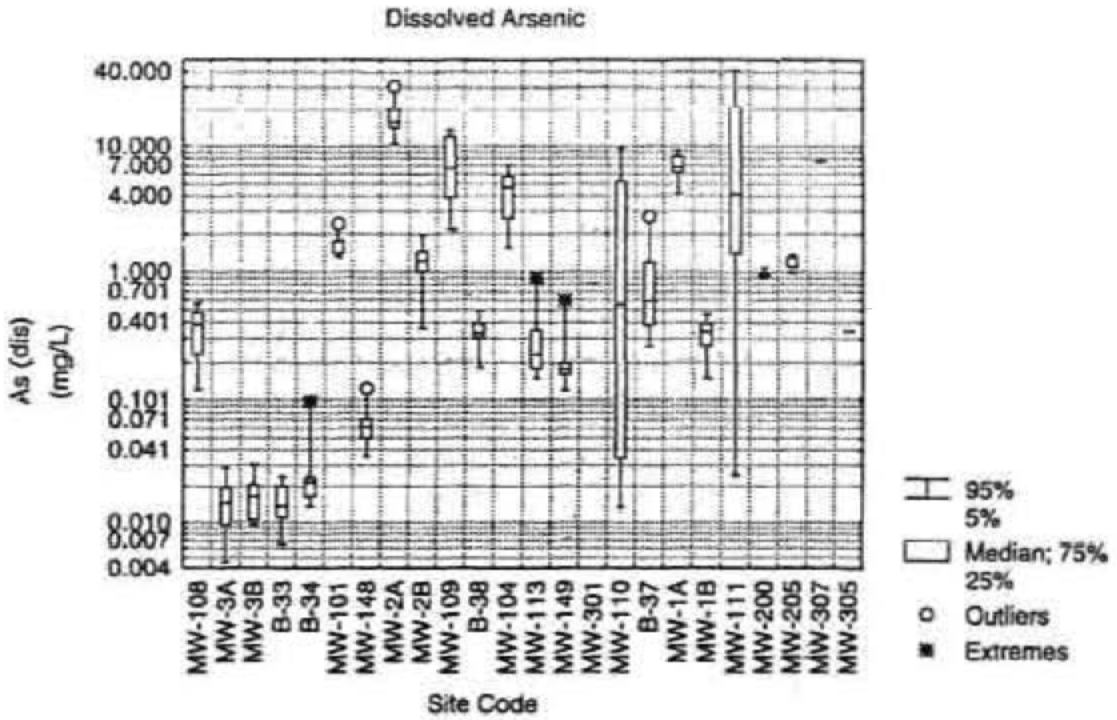

Source: HydroMetrics, Inc., March 2000.

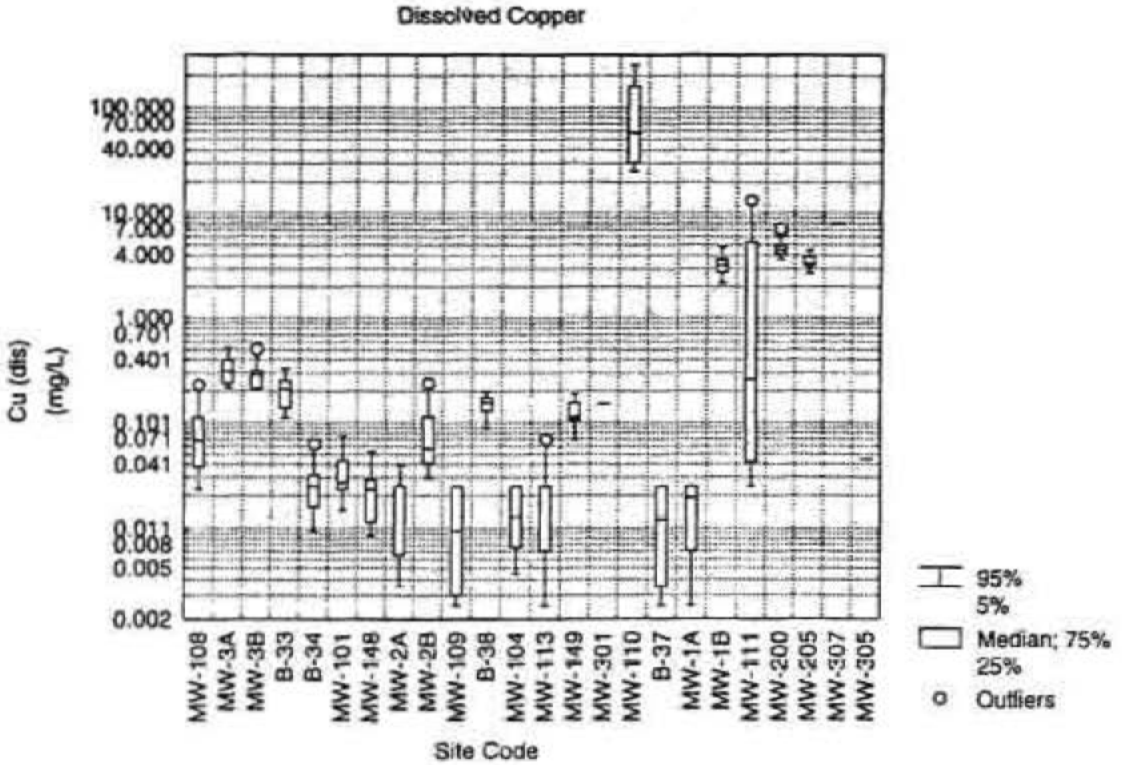
Figure 5-6

**Intermediate Wells**
**Dissolved Copper in Groundwater**
**September 1999**

Asarco Sediments/Groundwater OU 06 ROD

152678 PR 02 '000BSEA: Fig 5-6 Intermediate Wells Dissolved Copper in Groundwater Sept 1999 8-21-00 gr



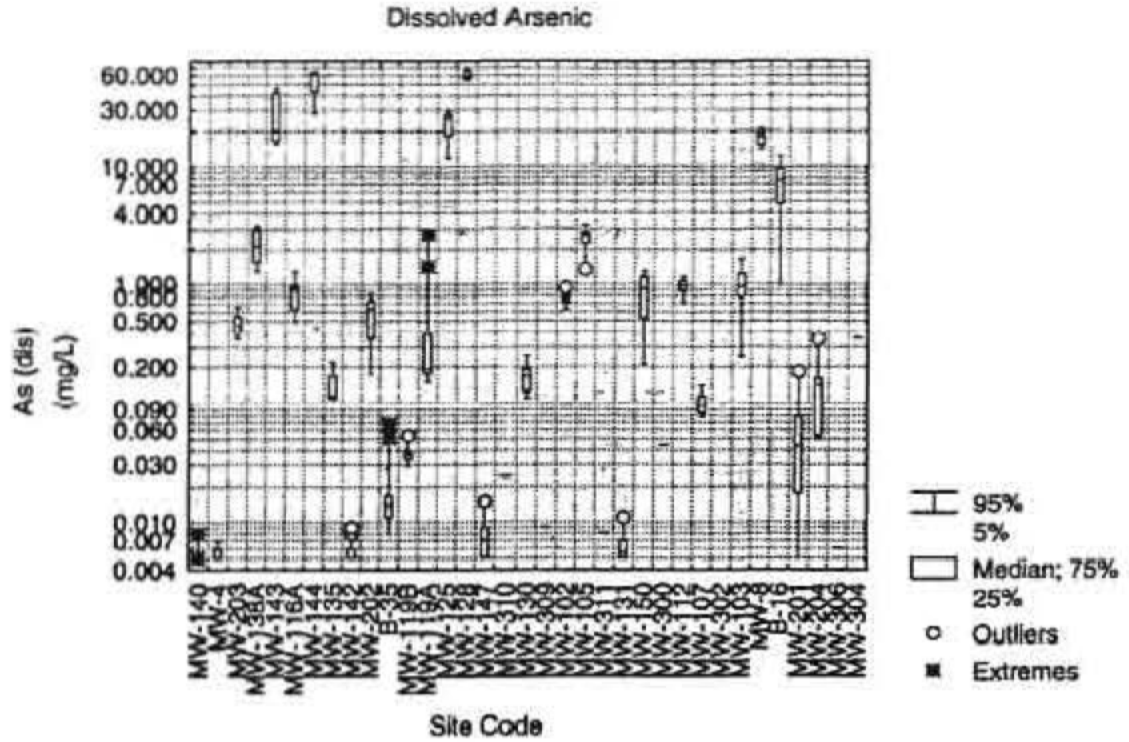



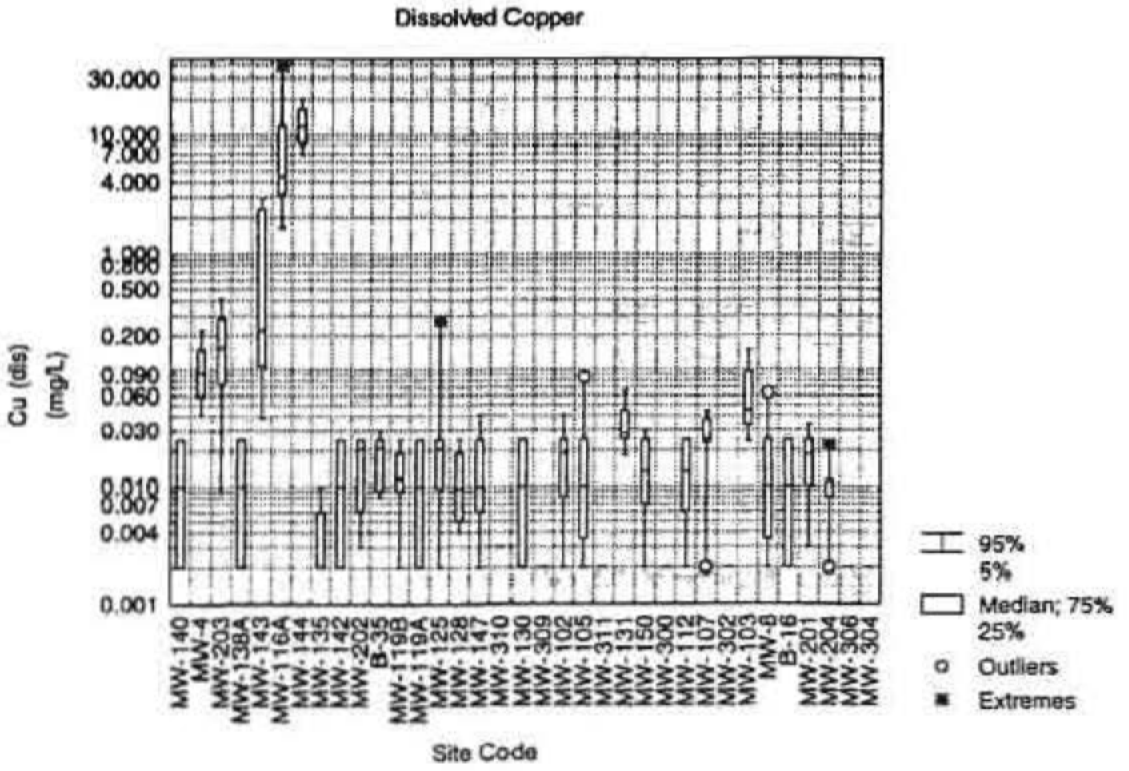

*Source: Hydrometrics, Inc., March 2000.*

NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

Figure 5-7
**Box Plots for Arsenic and Copper, Slag Wells**
Asarco Sediments/Groundwater OU 06 ROD

152878.PR.02_E06200006SEA Fig 5-7 Box Plots for Arsenic Copper Slag Wells 6-20-00 gr




*Source: Hydrometrics, Inc., March 2000.*

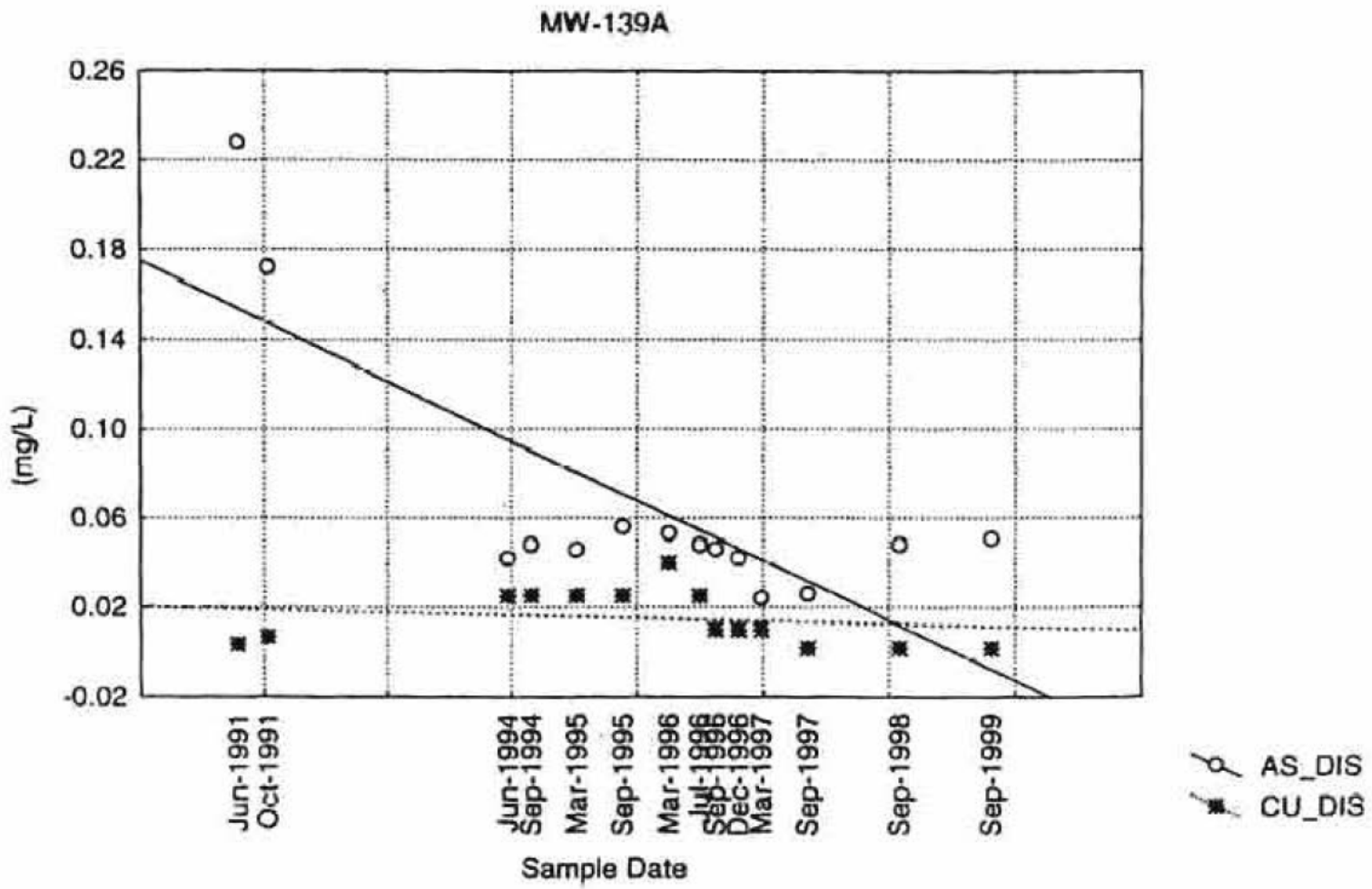
NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

Figure 5-8

**Box Plots for Arsenic and Copper, Intermediate Wells**

Asarco Sediments/Groundwater OU 06 ROD

152078 FR 92_02620B0008SSA, Fig 5-8 Box Plots for Arsenic Copper Intermediate Wells 8-29-00 gr

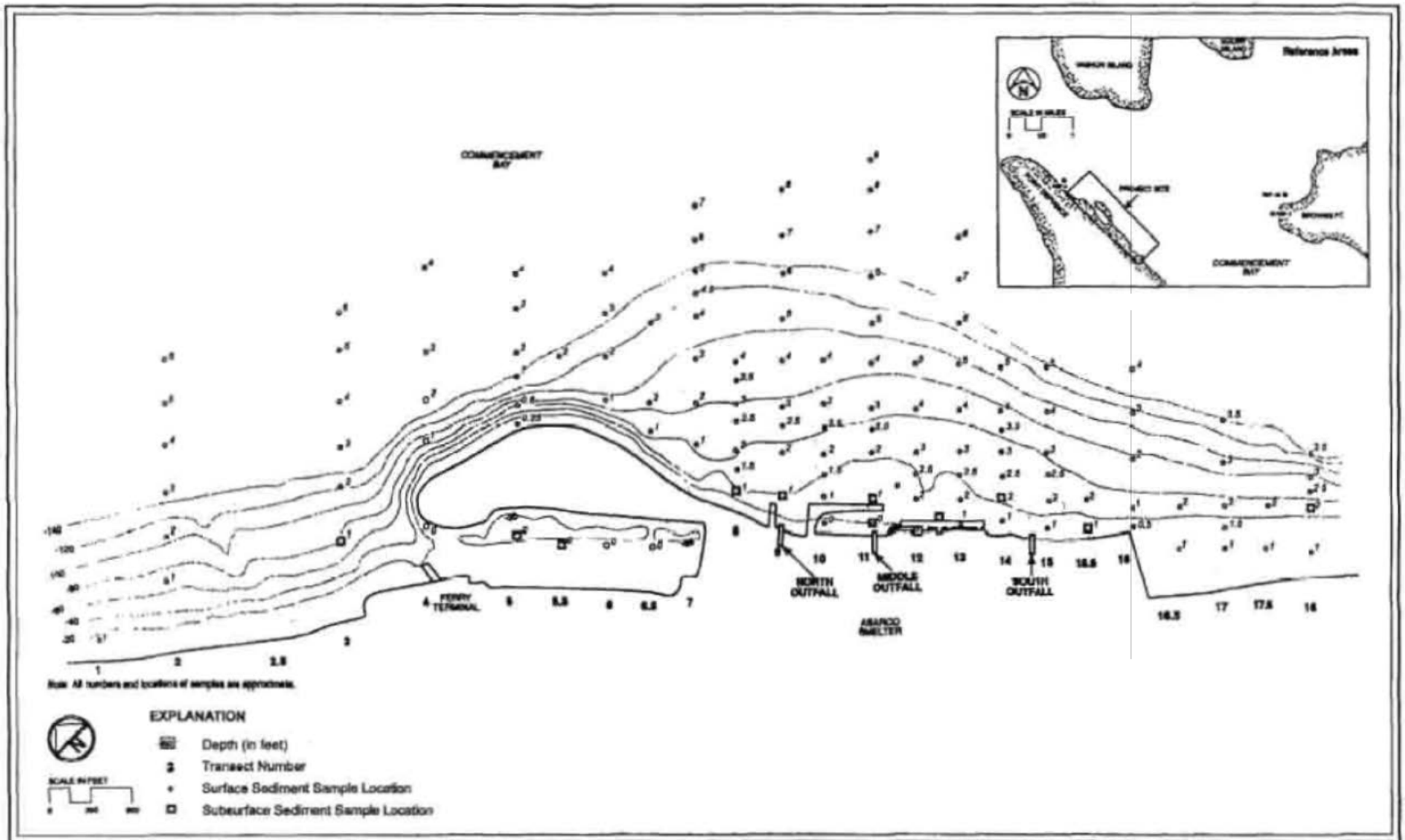



*Source: Hydrometrics, Inc., March 2000.*

NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

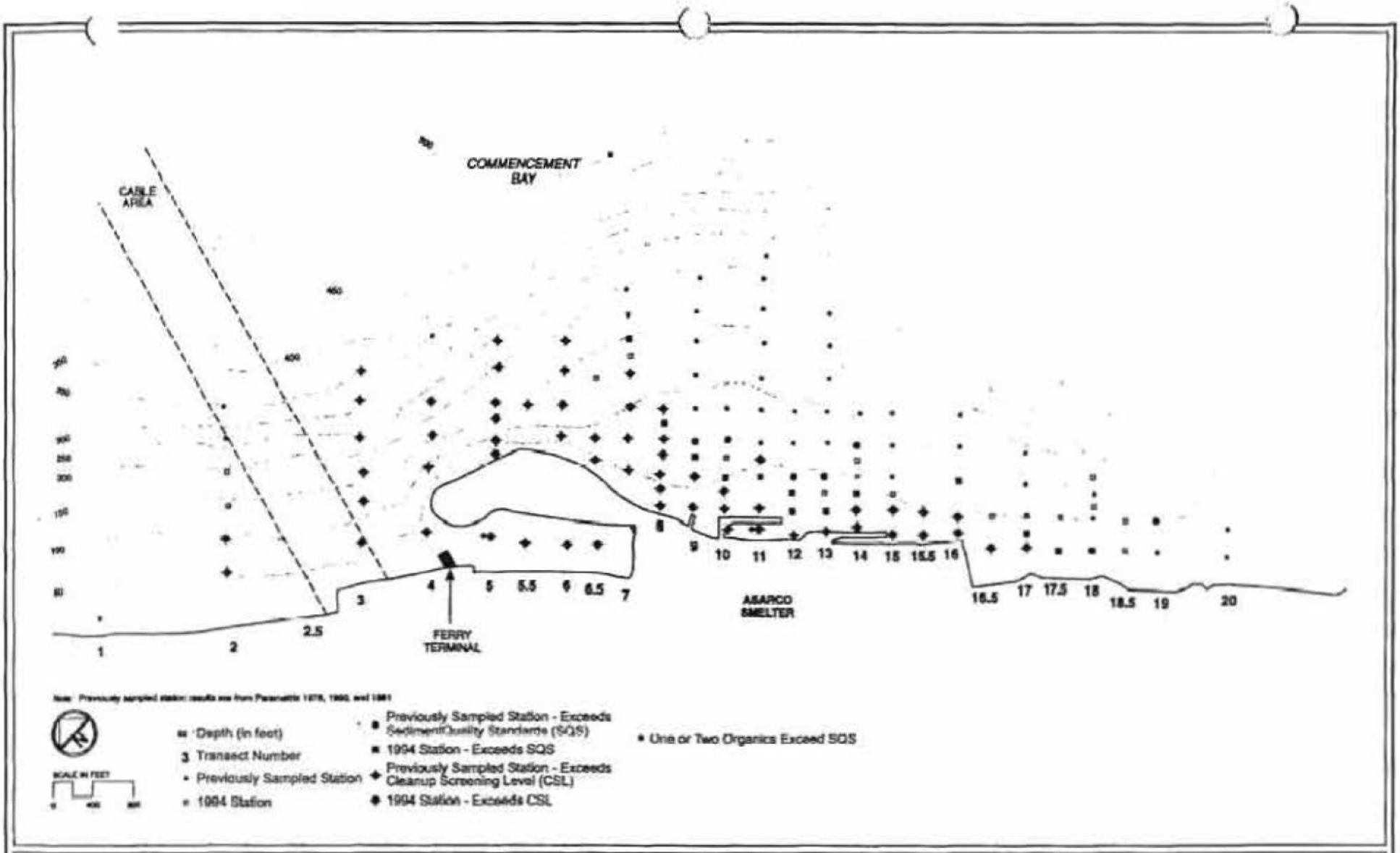
Figure 5-9
**Arsenic and Copper Trend at Well MW-139A**
Asarco Sediments/Groundwater OU 06 ROD

152679 PR 02_E06200000SEA . Fig 5-9 Arsenic and Copper Trend at Well MW-139A . 6-20-00 . gr




Source: *Parametrix, Inc., April 1996.*

Figure 5-10
**Sediment Station Locations**
Asarco Sediments/Groundwater OU 06 ROD

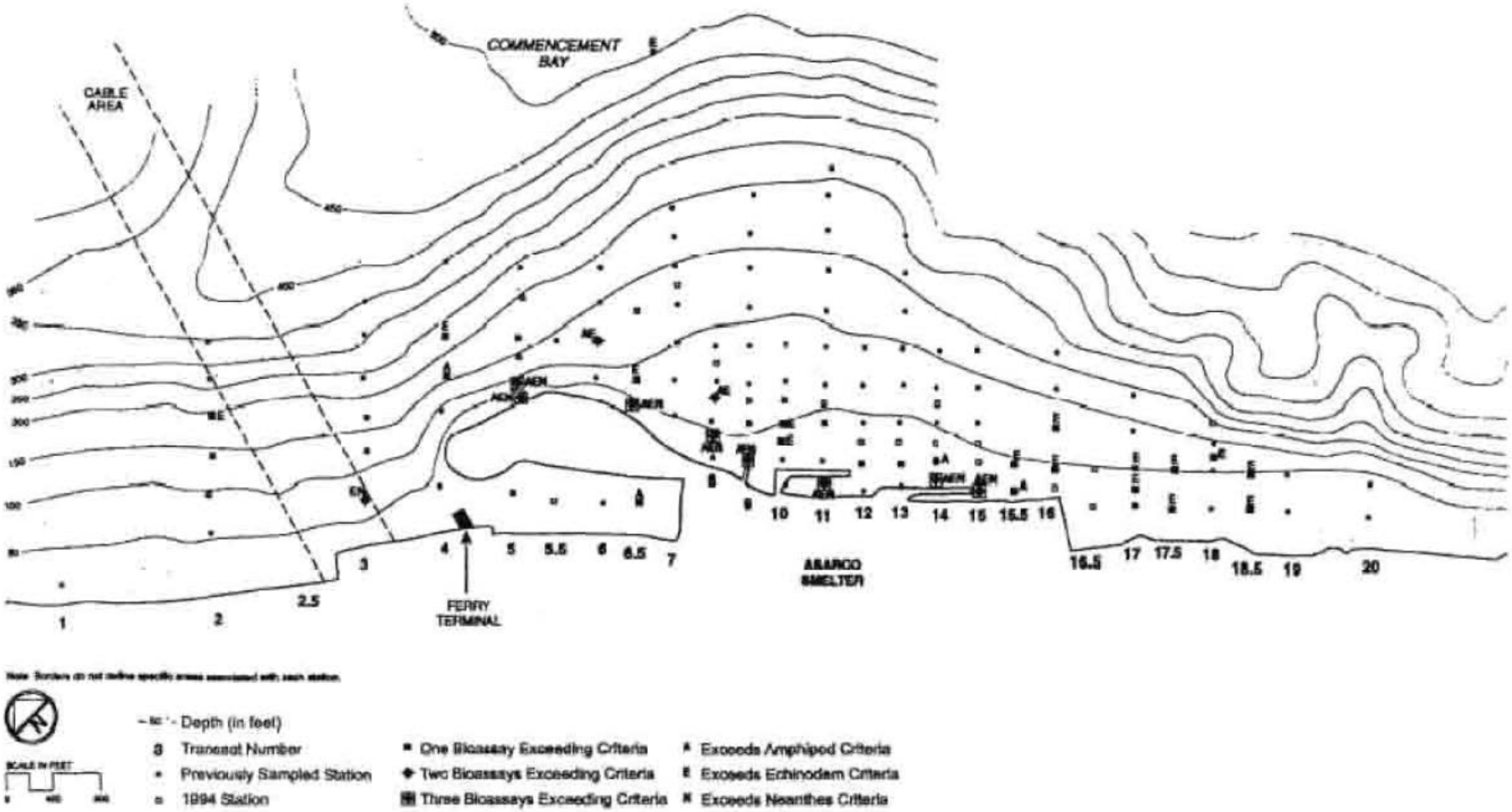



*Source: Parametrix, Inc., April 1996.*

Figure 5-11

**Sediment Chemistry Comparison to State SMS Criteria**

Asarco Sediments/Groundwater OU 06 ROD

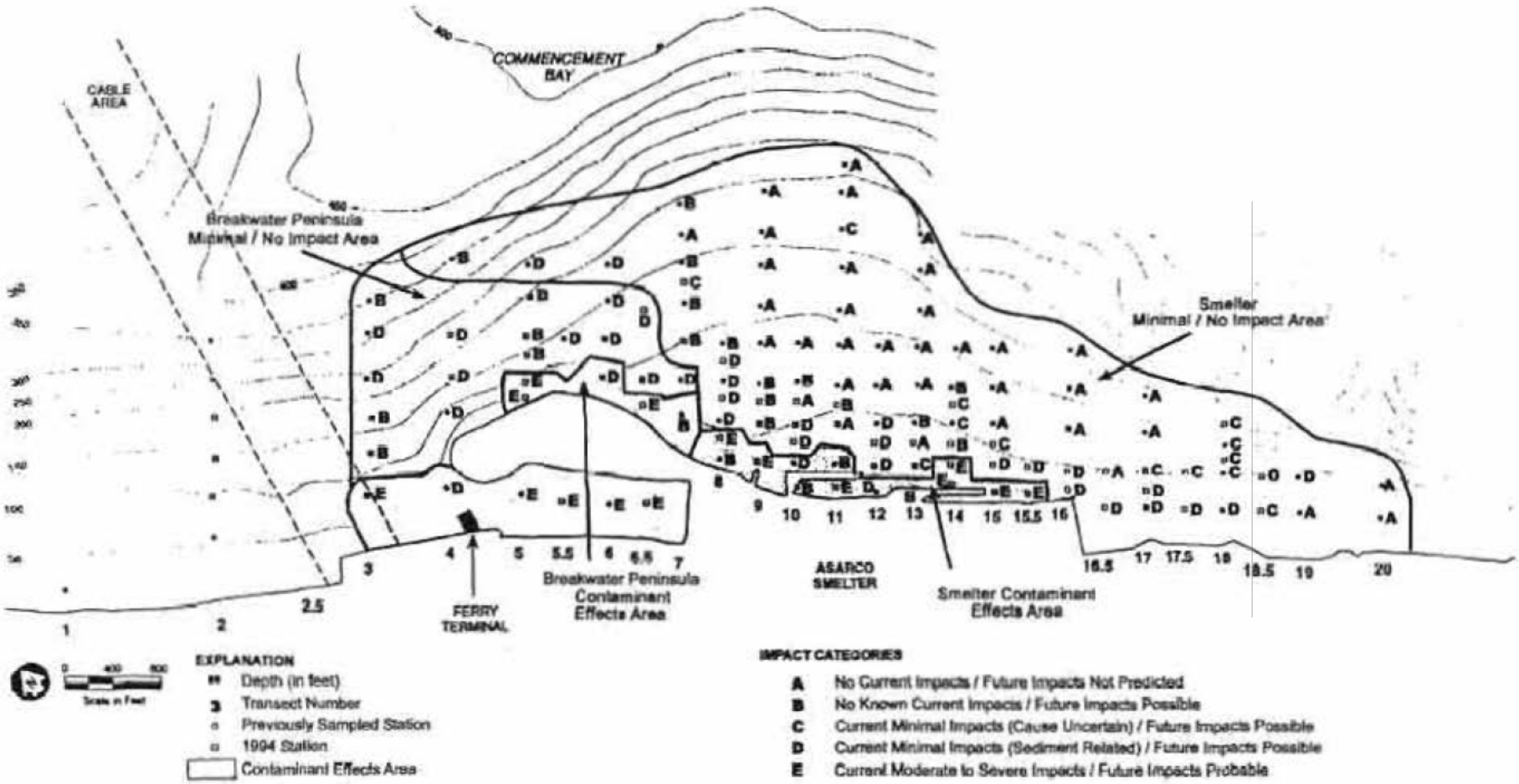



Source: Parametrix, Inc., April 1996.

Figure 5-12

**Summary of Bioassay Results That Exceed One or More State SMS Criteria**

Asarco Sediments/Groundwater OU 06 ROD




Note: Figure adapted from Parametrix, 1995

Figure 7-1
**Cleanup Level Evaluation Areas**
Asarco Sediments/Groundwater OU 06 ROD

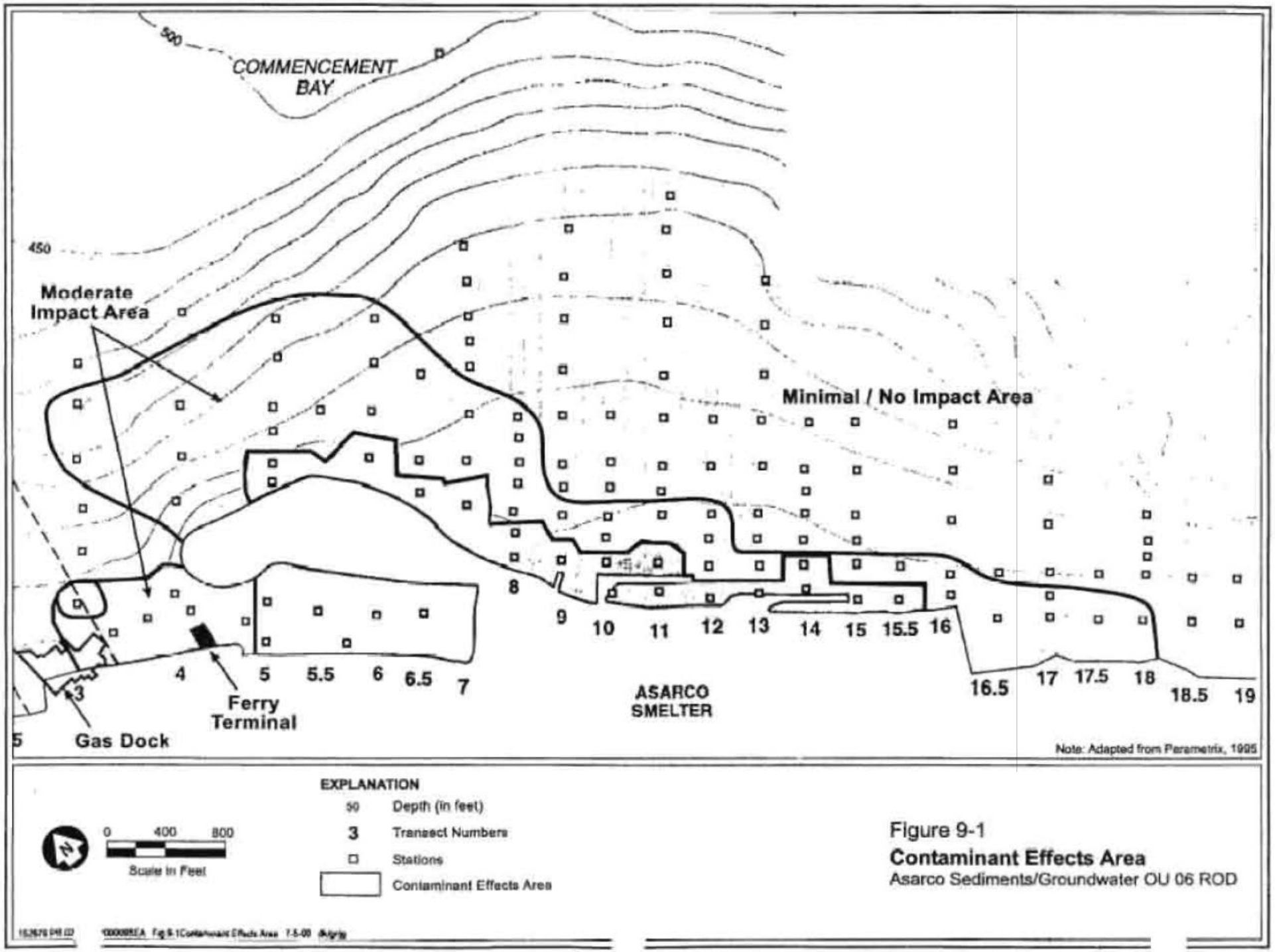
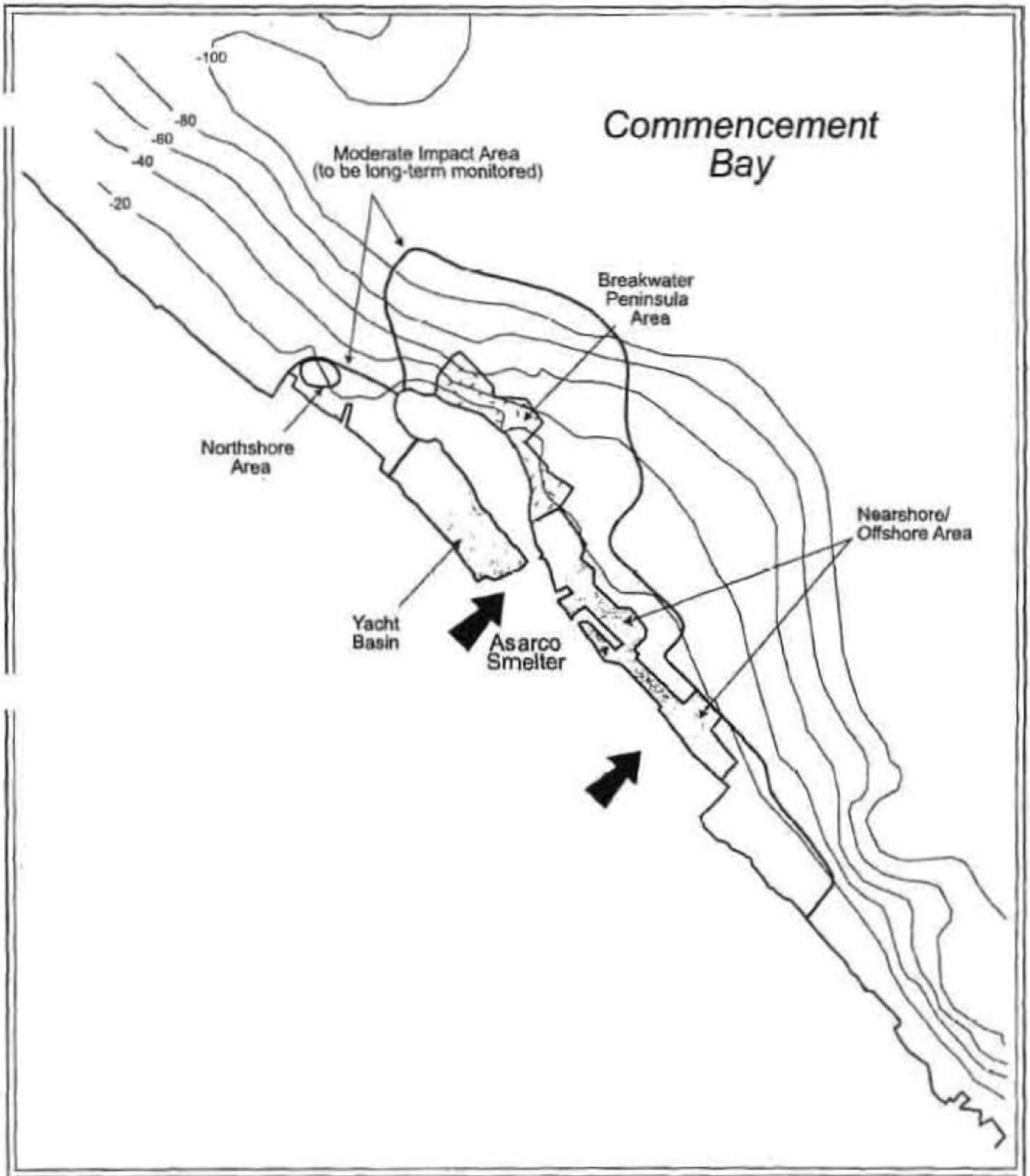


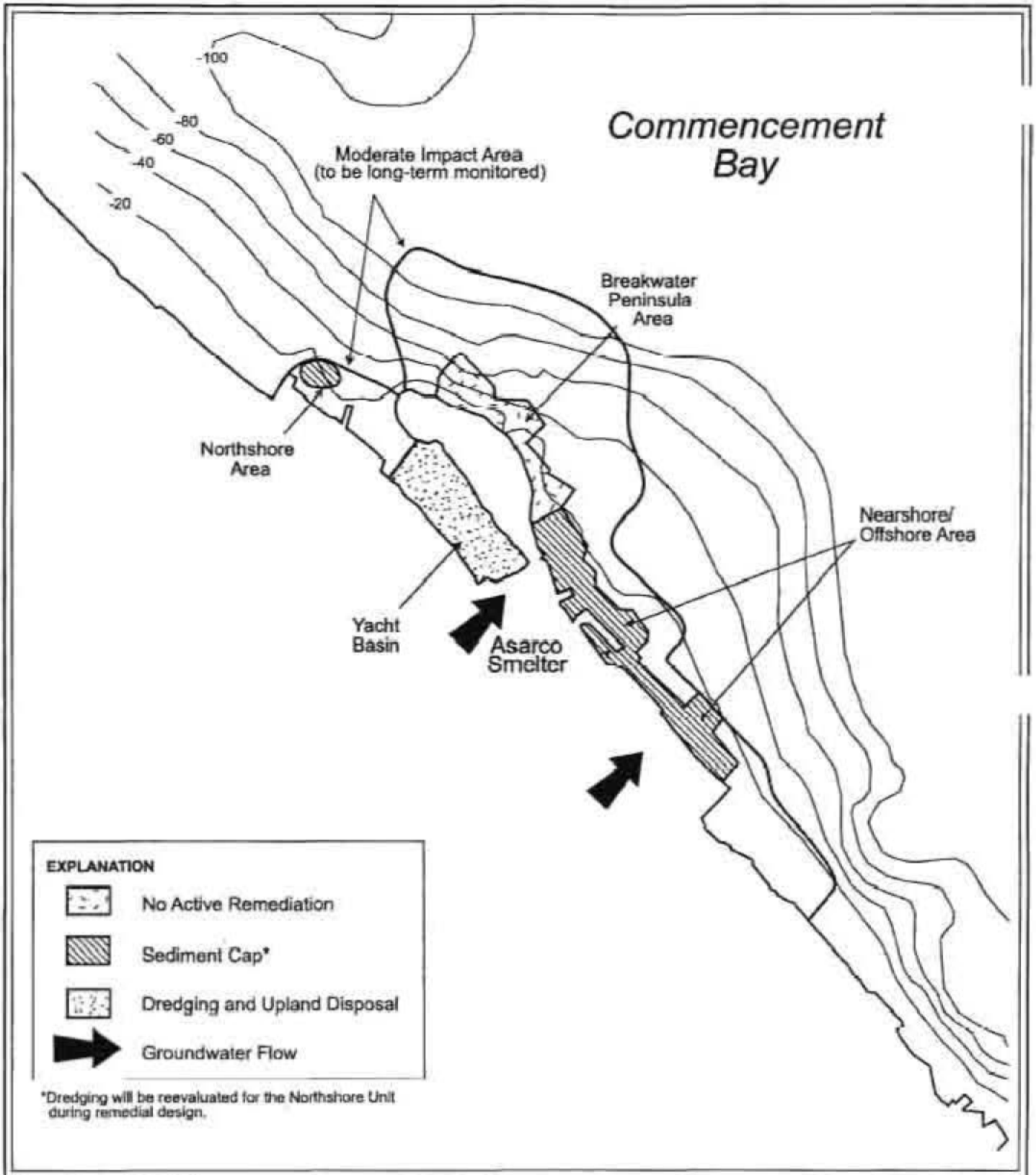

Figure 9-1
**Contaminant Effects Area**
Asarco Sediments/Groundwater OU 06 ROD




Source: Parametrix, Inc., 1999.

0 500 1000
Scale in Feet

Figure 9-2
**Marine Sediment Remedy Units**
Asarco Sediments/Groundwater OU 06 ROD



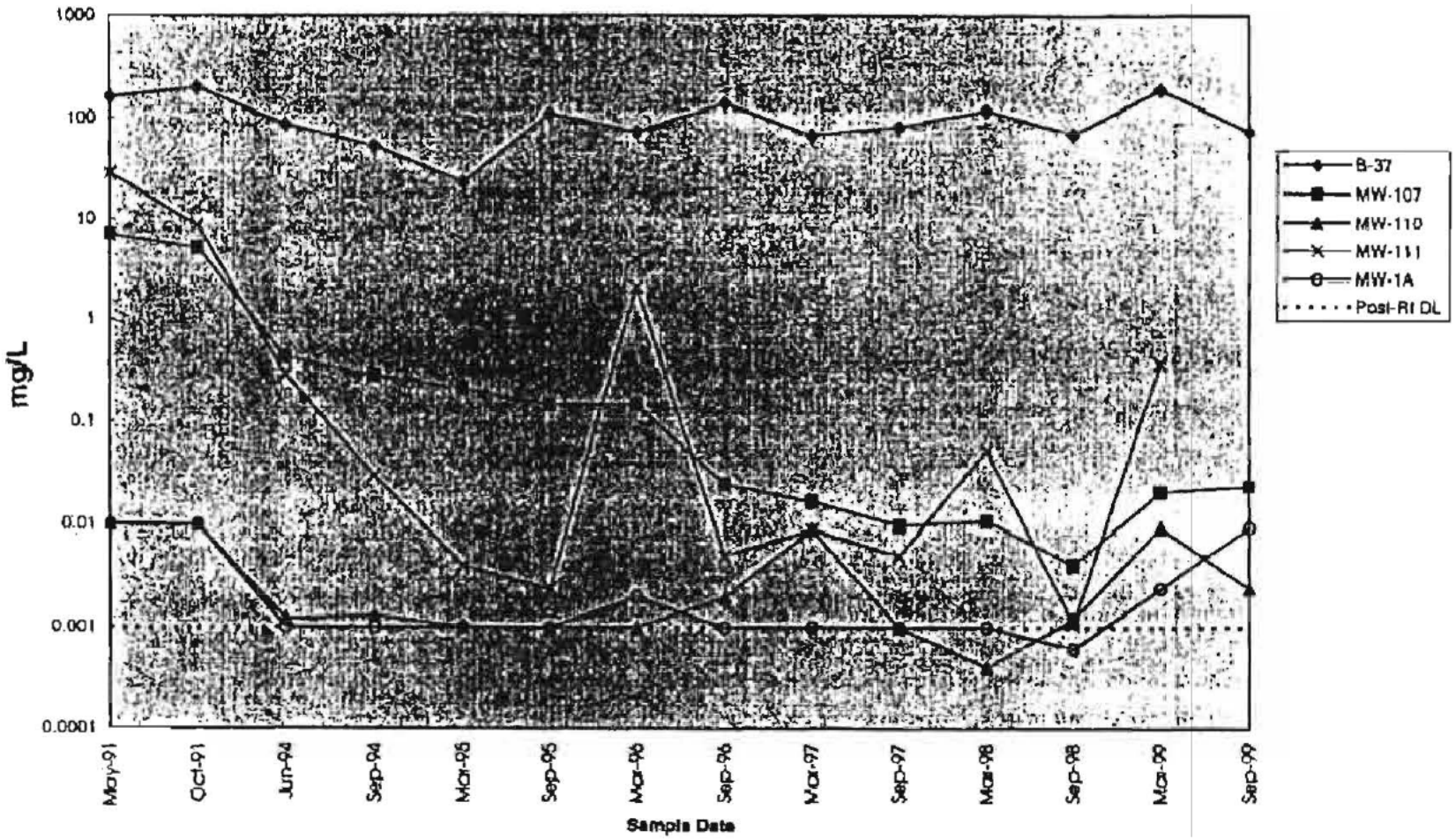

Source: Parametrix, Inc., 1999.

0 500 1000
Scale in Feet

Figure 12-1
**Selected Remedy Marine Sediment**
Asarco Sediments/Groundwater OU 06 ROD

APPENDIX A

# Trend Plots of DMA-Related Organic Compounds




NOTE: The typical detection limit is shown. However, the detection limit was occasionally higher or lower (see Data Validation Report, Appendix B).

*Source: Hydrometrics, Inc., March 2000.*

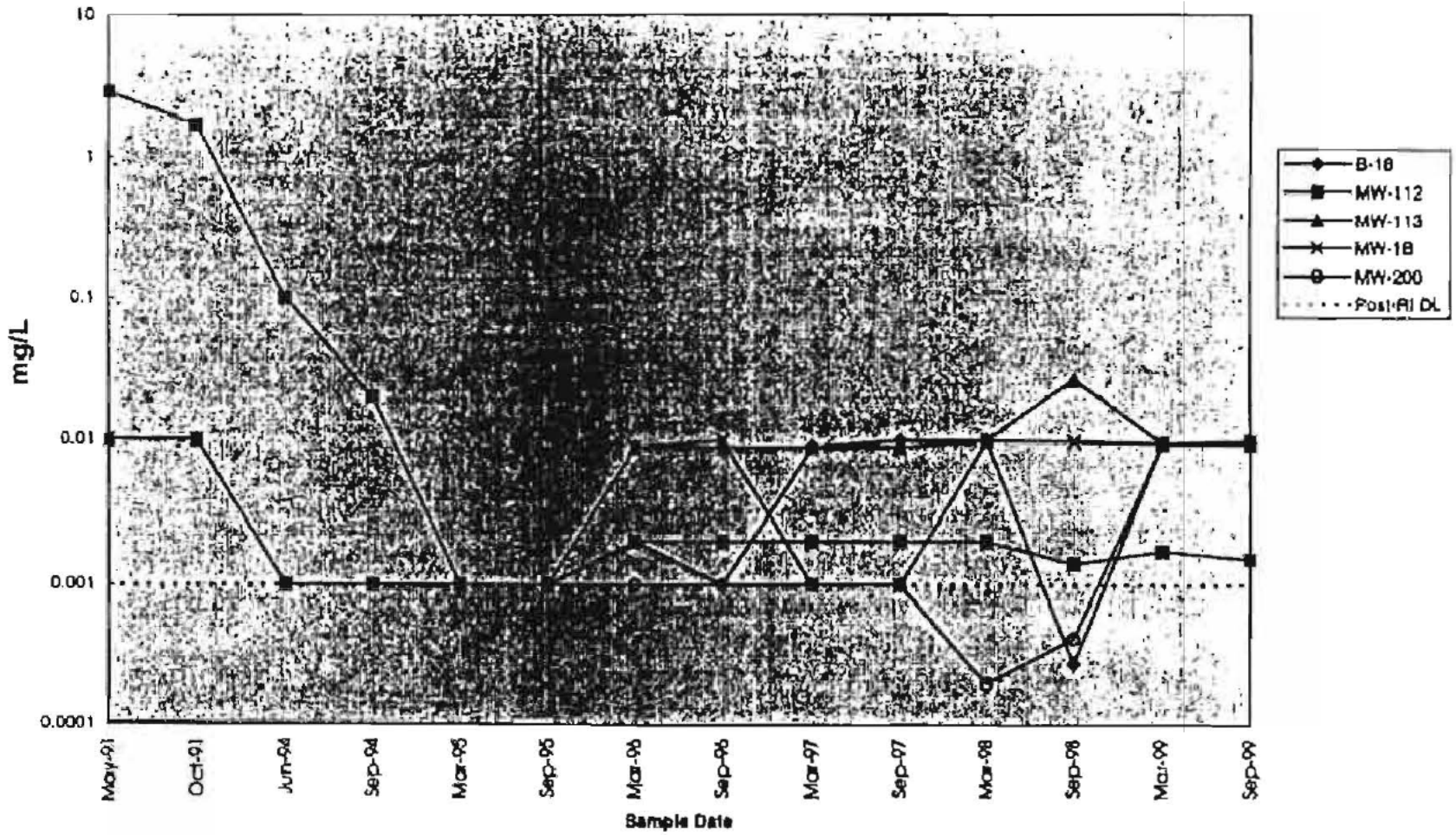
NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

Figure A-1 *1 of 3*

**Aniline Trend Plot**

Asarco Sediments/Groundwater OU 06 ROD

162878.PR02 E0620000093EA. Fig A-1 1of3 Aniline Trend Plot. 6-20-00 gr



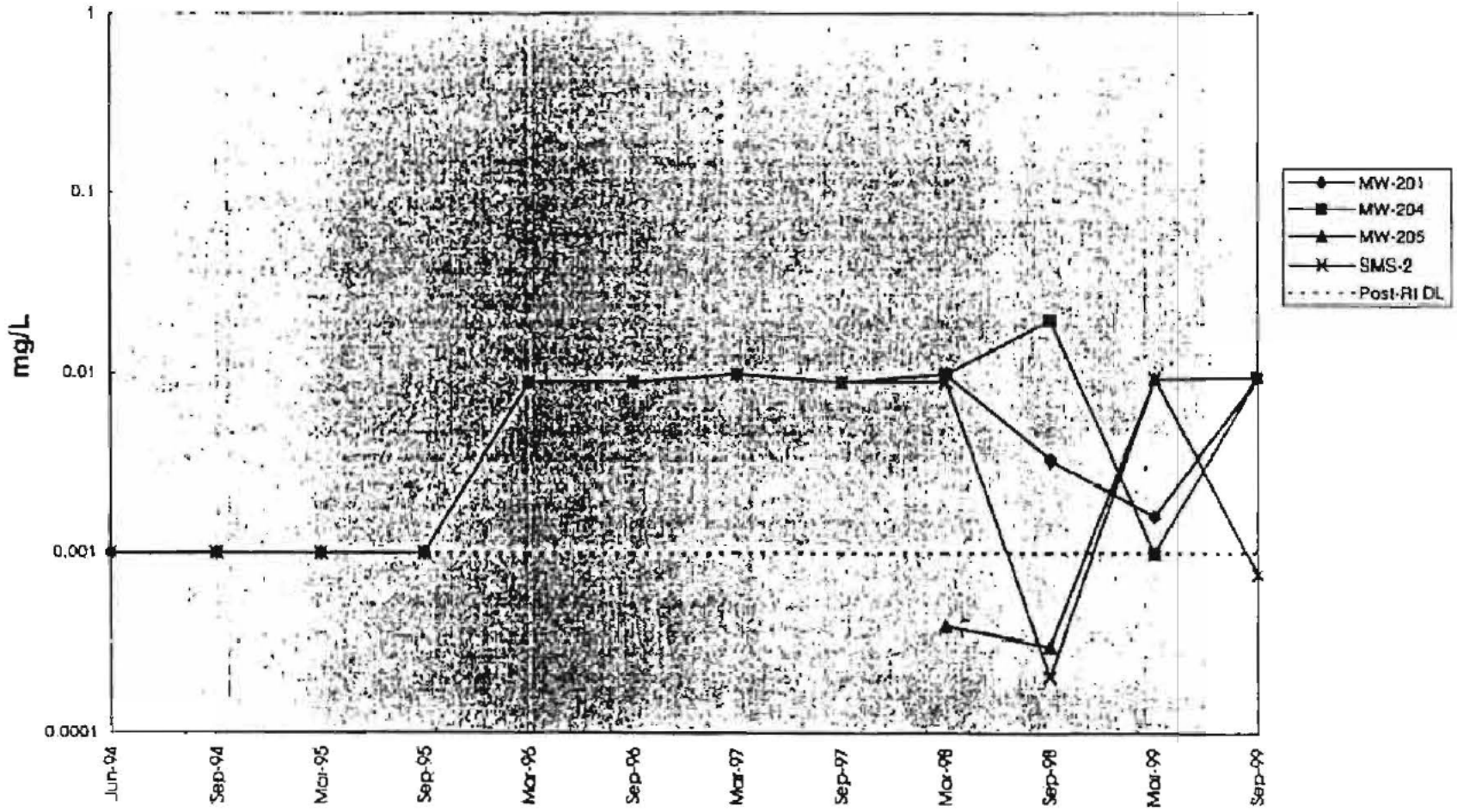

NOTE: The typical detection limit is shown. However, the detection limit was occasionally higher or lower (see Data Validation Report, Appendix B).

Source: Hydrometrics, Inc., March 2000.

NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

Figure A-1 *2 of 3*
**Aniline Trend Plot**
Asarco Sediments/Groundwater OU 06 ROD

152879 PH 02 ' 100008EA Fig A-1 2of3 Aniline Trend Plot , 6-20-00 , gr




NOTE: The typical detection limit is shown. However, the detection limit was occasionally higher or lower (see Data Validation Report, Appendix B).

*Source: Hydrometrics, Inc., March 2000.*

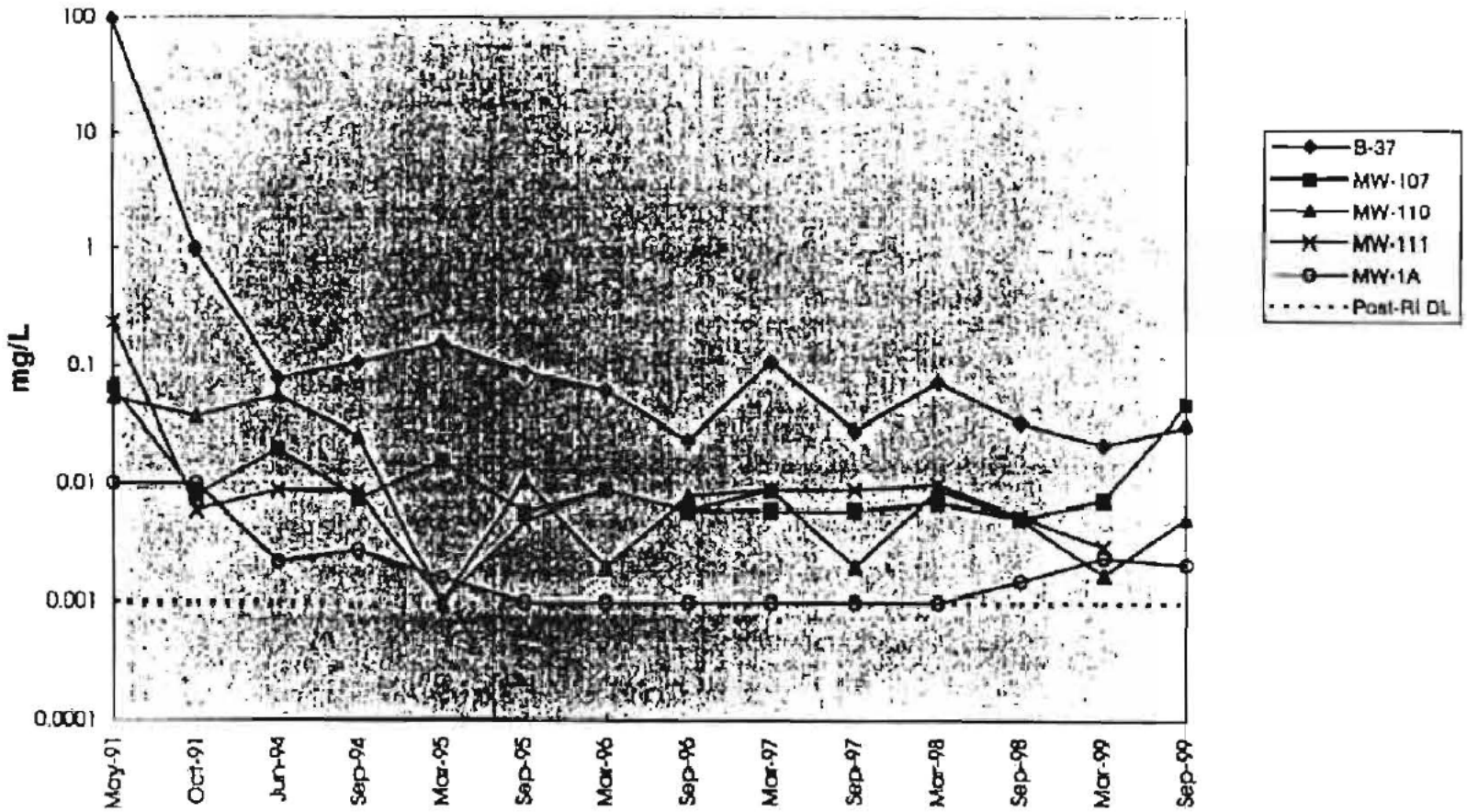
NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L)

Figure A-1 *3 of 3*

**Aniline Trend Plot**

Asarco Sediments/Groundwater OU 06 ROD

1328/79 PR 02 E0620000095EA Fig A-1 3of3 Aniline Trend Plot 8-29-00 gr




NOTE: The typical detection limit is shown. However, the detection limit was occasionally higher or lower (see Data Validation Report, Appendix B).

*Source: Hydrometrics, Inc., March 2000.*

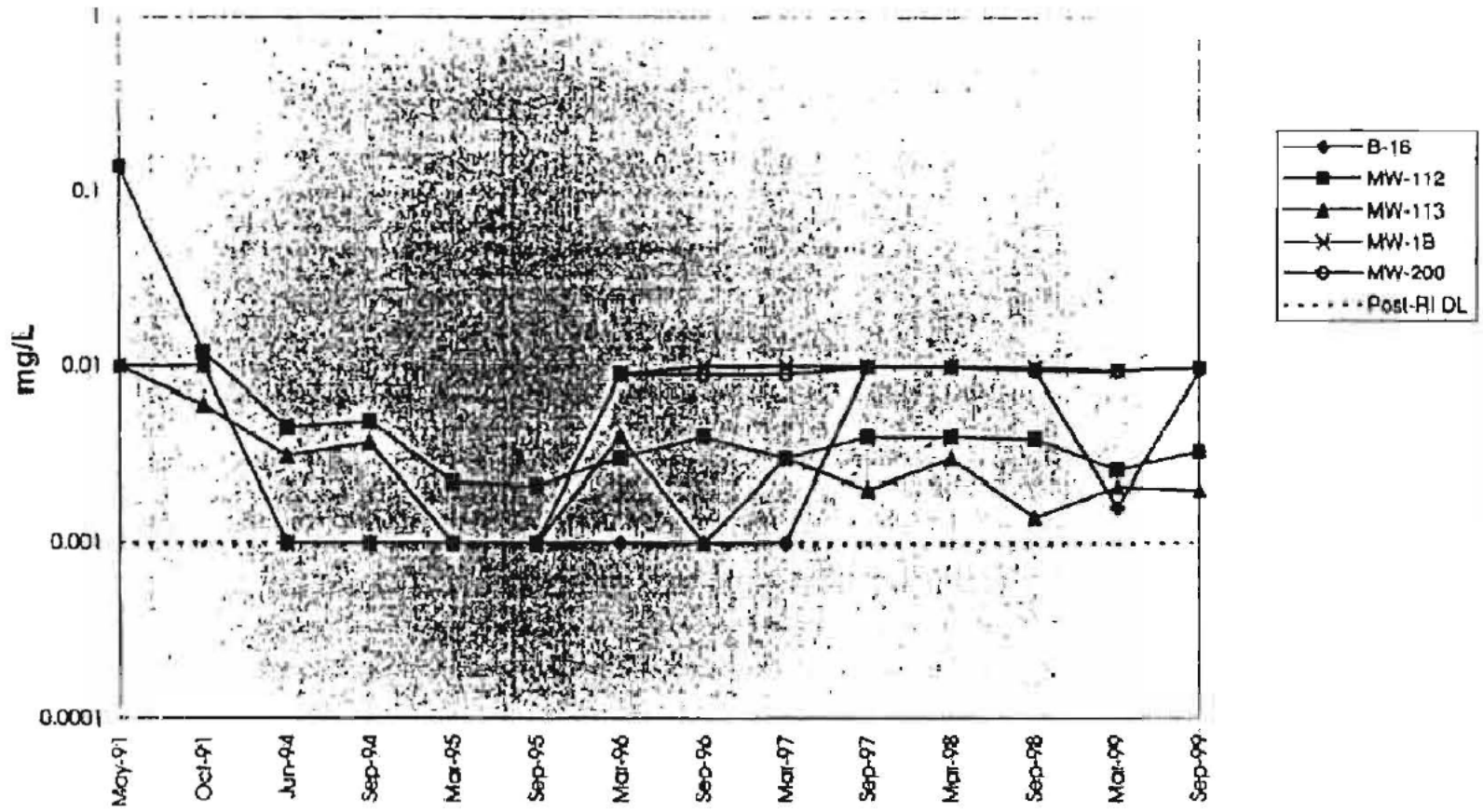
NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

Figure A-2 *1 of 3*

**N, N-Dimethylaniline Trend Plot**

Asarco Sediments/Groundwater OU 06 ROD

152679 PR 02 [illegible] Fig A-2 1of3 N-Dimethylaniline Trend Plot 8-30-00 gr




NOTE: The typical detection limit is shown. However, the detection limit was occasionally higher or lower (see Data Validation Report, Appendix D).

*Source: Hydrometrics, Inc., March 2000.*

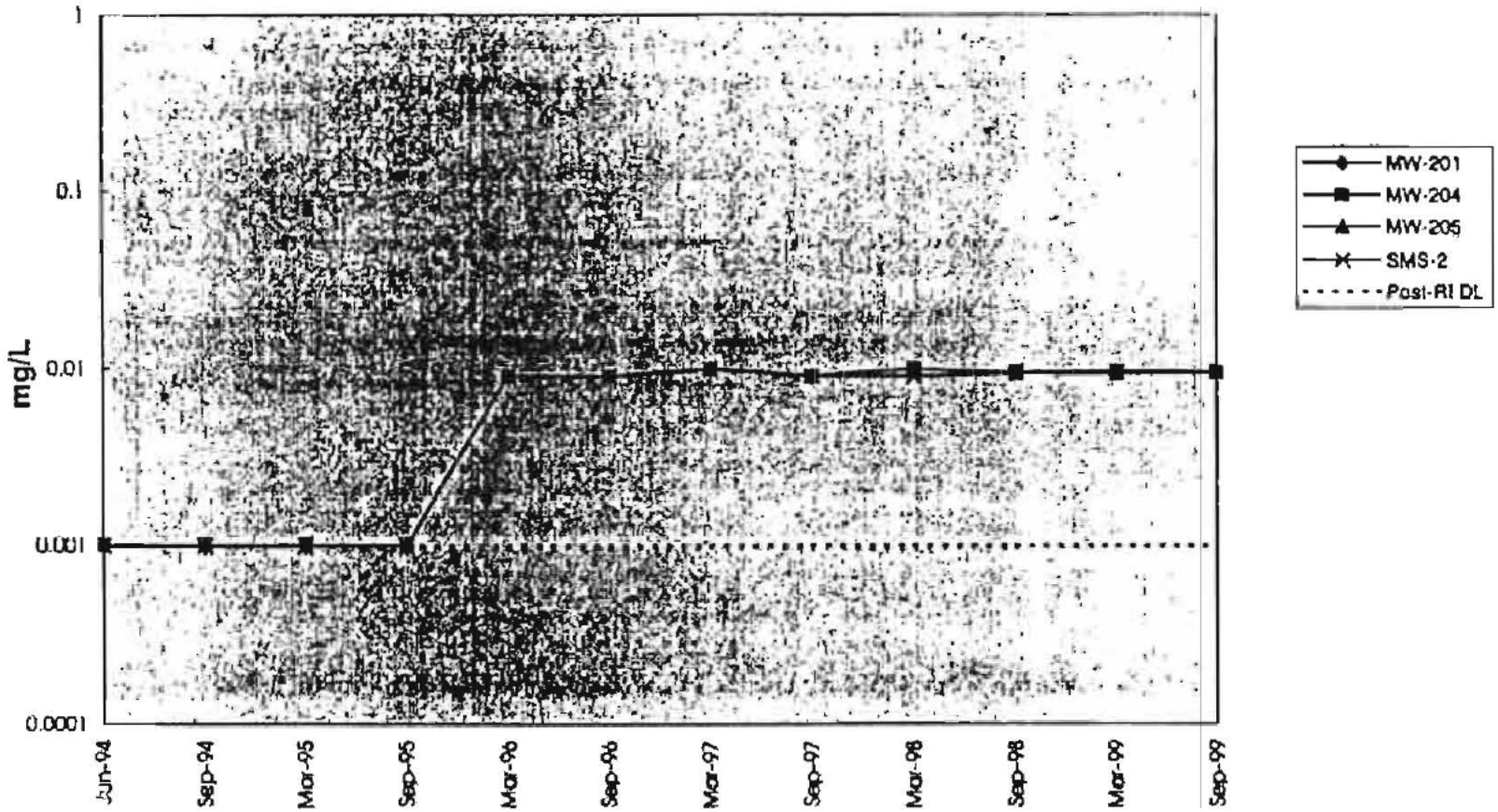
NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

Figure A-2 *2 of 3*

**N, N-Dimethylaniline Trend Plot**

Asarco Sediments/Groundwater OU 06 ROD

15/07/9 PK 02 [illegible] Fig A-2 2of3 N N-Dimethylaniline Trend Plot . 5-26-00 . gr




NOTE: The typical detection limit is shown. However, the detection limit was occasionally higher or lower (see Data Validation Report, Appendix B).

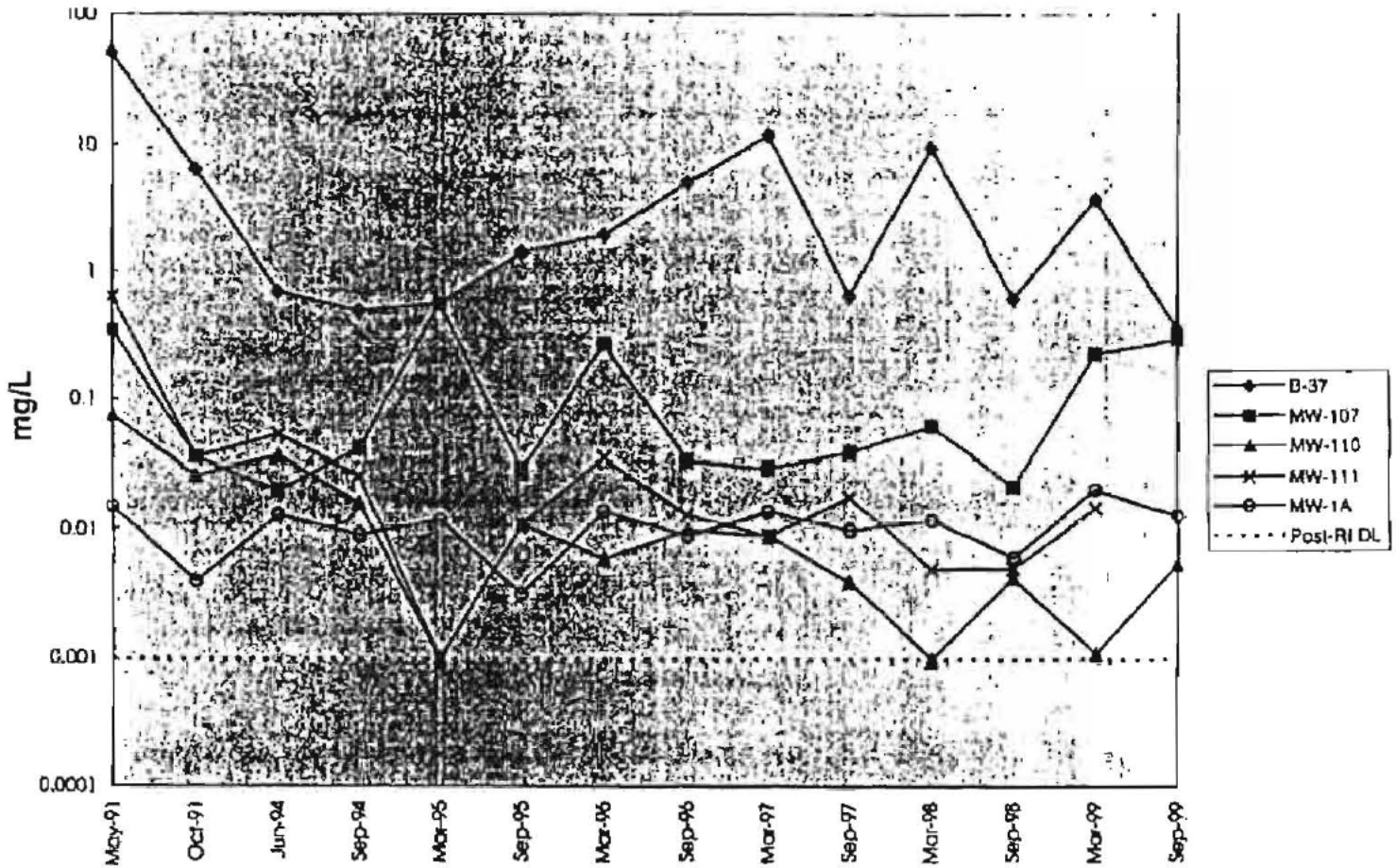
*Source: Hydrometrics, Inc., March 2000.*

NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

Figure A-2 *3 of 3*

**N, N-Dimethylaniline Trend Plot**

Asarco Sediments/Groundwater OU 06 ROD




NOTE: The typical detection limit is shown. However, the detection limit was occasionally higher or lower (see Data Validation Report, Appendix B).

*Source: Hydrometrics, Inc., March 2000.*

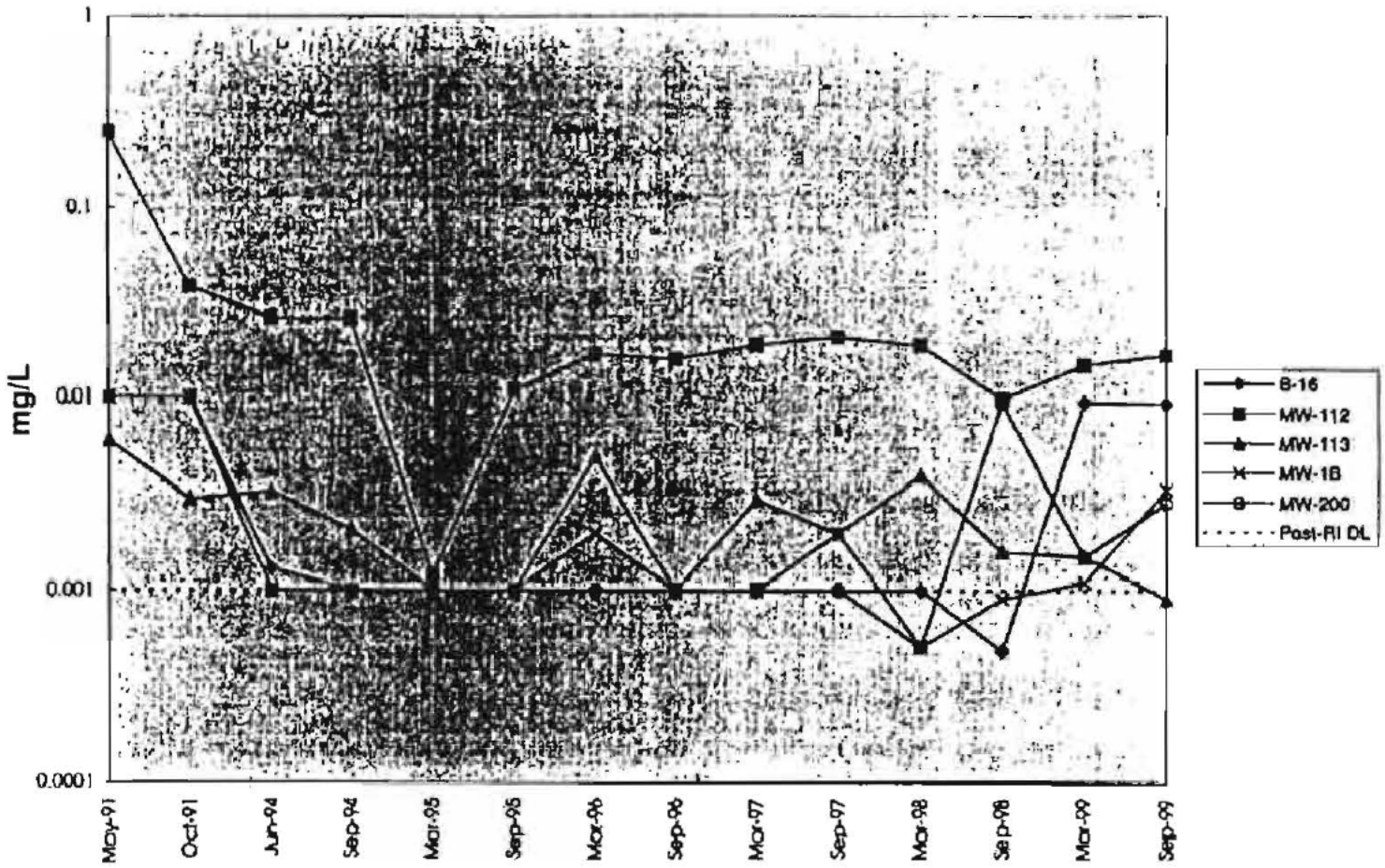
NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L.)

Figure A-3 *1 of 3*

**N-Methylaniline Trend Plot**

Asarco Sediments/Groundwater OU 06 ROD

15267B.PR 02 [illegible] Fig A-3 1of3 N-Methylaniline Trend Plot, 5-20-00 gr




NOTE: The typical detection limit is shown. However, the detection limit was occasionally higher or lower (see Data Validation Report, Appendix B).

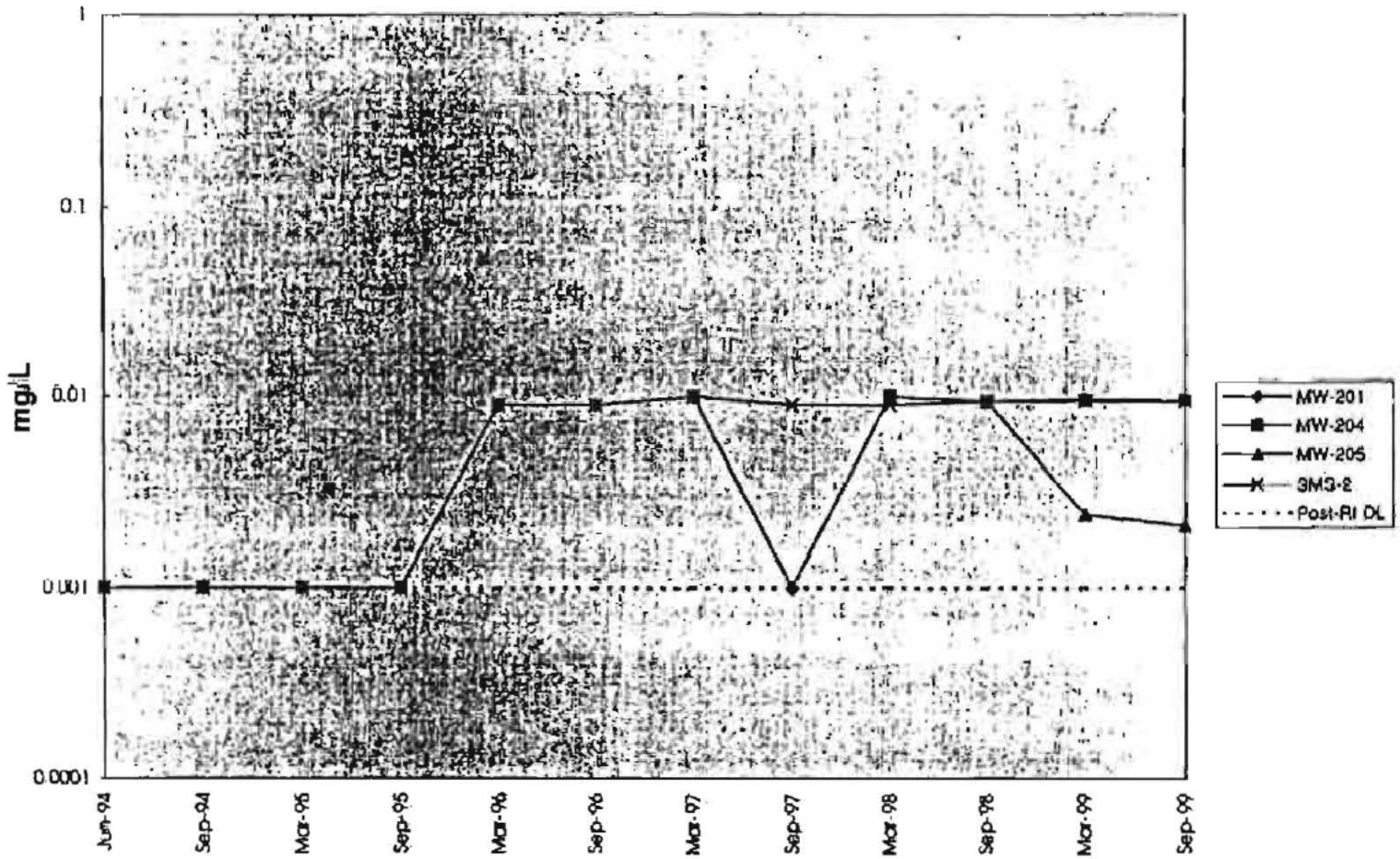
*Source: Hydrometrics, Inc., March 2000.*

NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

Figure A-3 *2 of 3*

**N-Methylaniline Trend Plot**

Asarco Sediments/Groundwater OU 06 ROD




NOTE: The typical detection limit is shown. However, the detection limit was occasionally higher or lower (see Data Validation Report, Appendix B).

*Source: Hydrometrics, Inc., March 2000.*

NOTE: Concentrations shown in this figure are expressed in mg/L (milligrams per liter). Concentrations cited in the text are expressed in µg/L (micrograms per liter). Multiply mg/L by 1,000 to convert to µg/L (e.g., 0.100 mg/L x 1,000 = 100 µg/L).

Figure A-3 *3 of 3*

**N-Methylaniline Trend Plot**

Asarco Sediments/Groundwater OU 06 ROD

APPENDIX B

# Summary of Sediment Sampling Results

| Station | Year | As | Cu | Pb | Hg | Zn |
|---|---|---|---|---|---|---|
| 1-1 | 1987[a] | 23 | 60 | 52 | ND | 118 |
| | 1988 | 19 | 50 | 33 | 0.275J | 68 |
| 2-1 | 1987[a] | 320* | 218 | 251 | ND | 850* |
| | 1988 | 30 | 120 | 65 | 0.735J* | 110 |
| 2-2 | 1987[a] | 240* | 147 | 158 | ND | 530* |
| 2-3 | 1987[a] | 70* | 50 | 72 | ND | 223 |
| 2-5 | 1988 | 27 | 23 | 35 | 0.05J | 91 |
| 2-6 | 1988 | 36J | 27J | 44J | 0.075J | 111J |
| | 1988D | 34J | 28J | 53J | 0.055J | 109J |
| 3-1 | 1987[a] | 1,620* | 1,145* | 1,805* | ND | 6,940* |
| 3-2 | 1987[a] | 555* | 381 | 830* | ND | 4,305* |
| | 1988 | 455* | 244 | 488* | 0.14 | 2,275* |
| | 1988D | 485* | 248 | 540* | 0.17 | 2,420* |
| 3-3 | 1987[a] | 170* | 290 | 477* | ND | 2,115* |
| | 1989[b] | 908* | 387 | 822* | 0.13 | 3,931* |
| 3-4 | 1988 | 2,378* | 998* | 2,600* | 0.26J | 11,250* |
| | 1989[b] | 3,117* | 1,259* | 3,094* | 0.14 | 11,250* |
| 3-5 | 1988 | 1,940* | 793* | 1,565* | 0.28J | 6,175* |
| 3-6 | 1988 | 1,130* | 468* | 845* | 0.25J | 2,725* |
| 4-0 | 1987[a] | 905* | 725* | 1,040* | ND | 4,630* |
| 4-1 | 1987[a] | 4,915* | 3,115* | 6,650* | ND | 18,000* |
| | 1988 | 7,300* | 3,500* | 7,900* | 0.2 | 19,700* |
| | 1989[b] | 7,502* | 4,080* | 7,796* | 0.11 | 25,000* |
| 4-2 | 1987[a] | 6,600* | 2,545* | 6,100* | ND | 1,625* |
| | 1988 | 7,350* | 3,025* | 6,725* | 0.17 | 17,625* |
| | 1988D | 6,825* | 2,925* | 6,200* | 0.14 | 16,825* |
| 4-3 | 1987[a] | 4,985* | 2,225* | 3,785* | ND | 11,450* |
| | 1989[b] | 6,964* | 3,200* | 4,501* | 0.15 | 23,350* |
| 4-4 | 1988 | 26 | 20 | 31 | 0.09J | 95 |
| 5-0 | 1987[a] | 100* | 615* | 191 | ND | 990* |
| | 1988 | 86* | 805* | 243 | 0.34J | 1,200* |

**See notes on Table B-1** 5 of 5.

*Source: Supplemental Feasibility Study, Commencement Bay Nearshore/Tideflats, Asarco Sediments Site, October 1993.*

Table B-1 *1 of 5*
**Summary of Inorganics Data Measured at the Asarco Sediments Site During the Asarco RI/FS**
Asarco Sediments/Groundwater OU 06 ROD

| Station | Year | As | Cu | Pb | Hg | Zn |
|---|---|---|---|---|---|---|
| 5-1 | 1987[a] | 6,450* | 3,245* | 5,400* | ND | 19,050* |
| 5-2 | 1987[a] | 8,950* | 3,450* | 6,650* | ND | 1,700* |
| | 1990 | 8,000* | 3,800* | 6,725* | 0.12 | 21,500* |
| 5-3 | 1987[a] | 1,400* | 800* | 1,355* | ND | 3,830* |
| | 1989[b] | 1,577* | 698* | 1,257* | 0.2 | 3,432* |
| 5-4 | 1989[b] | 99* | 69 | 91 | 0.24 | ND |
| 5.5-2 | 1990 | 8,050* | 3,925* | 5,025* | 0.06 | 21,100* |
| 6-0 | 1987[a] | 85* | 725* | 145 | ND | 378 |
| 6-1 | 1987[a] | 8,400 | 2,985* | 9,400* | ND | 20,850* |
| | 1988 | 9,150* | 3,375* | 9,975* | 0.16J | 21,800* |
| | 1990 | 9,025* | 3,375* | 10,300* | 0.08 | 25,250* |
| 6-2 | 1987[a] | 6,350* | 3,260* | 5,950* | ND | 16,750* |
| | 1989[b] | 7,274* | 3,736* | 6,142* | 0.2 | ND |
| | 1990 | 7,800* | 3,825* | 7,675* | 0.05 | 22,350* |
| 6-3 | 1987[a] | 1,620* | 930* | 1,630* | ND | 4,290* |
| | 1988 | 2,550* | 1,203* | 2,223* | 0.25J | 5,800* |
| | 1990 | 3,400* | 1,775* | 3,400* | 0.09 | 10,650* |
| 6-4 | 1987[a] | 100* | 49 | 85 | ND | 202 |
| | 1989[b] | 91* | 63 | 83 | 0.15 | 260 |
| 6.5-2 | 1990 | 6,825* | 3,525* | 7,675* | 0.08 | 26,011* |
| 7-1 | 1987[a] | 3,620* | 7,600* | 2,450* | ND | 5,360* |
| 7-2 | 1987[a] | 6,700* | 3,360* | 5,000* | ND | 17,900 |
| | 1990 | 6,700* | 3,575* | 5,150* | 0.05 | 20,675* |
| 7-3 | 1987[a] | 5,050* | 2,535* | 4,625* | ND | 19,000* |
| 7-4 | 1987[a] | 100* | 64 | 72 | ND | 215 |
| 7-5 | 1987[a] | 65* | 51 | 39 | ND | 117 |
| 7-6 | 1987[a] | 18 | 35 | 26 | ND | 71 |
| 7-7 | 1987[a] | 16 | 16 | 26 | ND | 54 |
| 8-1 | 1987[a] | 4,585* | 195 | 3,540* | ND | 12,100* |
| 8-2 | 1987[a] | 565* | 444* | 462* | ND | 1,285* |
| | 1989[b] | 521* | 406* | 411 | 0.62* | 1,233 |
| 8-3 | 1987[a] | 320* | 163 | 118 | ND | 394 |

**See notes on Table B-1** 5 of 5.

*Source: Supplemental Feasibility Study, Commencement Bay Nearshore/Tideflats, Asarco Sediments Site, October 1993.*

Table B-1 *2 of 5*
**Summary of Inorganics Data Measured at the Asarco Sediments Site During the Asarco RI/FS**
Asarco Sediments/Groundwater OU 06 ROD

| Station | Year | As | Cu | Pb | Hg | Zn |
|---|---|---|---|---|---|---|
| | 1989[b] | 141* | 126 | 104 | 0.26 | 329 |
| 8-4 | 1987[a] | 160* | 125 | 105 | ND | 330 |
| | 1988 | 55 | 70 | 62 | 0.19J | 143 |
| 9-1 | 1987[a] | 5,950* | 8,950* | 3,670* | ND | 5,450* |
| 9-2 | 1987[a] | 200* | 248 | 158 | ND | 355 |
| 9-3 | 1987[a] | 65* | 82 | 52 | ND | 155 |
| 9-4 | 1987[a] | 29 | 55 | 39 | ND | 92 |
| 9-5 | 1987[a] | 16 | 36 | 39 | ND | 75 |
| 9-6 | 1987[a] | 25 | 25 | 32 | ND | 75 |
| 9-7 | 1987[a] | 12 | 18 | 19 | ND | 62 |
| 9-8 | 1987[a] | 9.5 | 19 | 19 | ND | 58 |
| 10-0 | 1987[a] | 4,105* | 18,300* | 3,910 | ND | 4,080* |
| 10-1 | 1987[a] | 665* | 1,665* | 690* | ND | 1,010* |
| | 1988 | 590* | 1,873* | 860* | 1.8J* | 1,000* |
| 10-2 | 1987[a] | 170* | 243 | 118 | ND | 330 |
| | 1988 | 95* | 152 | 77 | 0.6J* | 176 |
| | 1989[b] | 144* | 223 | 113 | 0.9 | 284 |
| 10-3 | 1987[a] | 38 | 53 | 39 | ND | 100 |
| | 1989 | 77* | 103 | 65 | 0.4 | 159 |
| 10-4 | 1987[a] | 42 | 58 | 39 | ND | 109 |
| 11-1 | 1987[a] | 4,995* | 12,600* | 3,135* | ND | 2,430* |
| 11-2 | 1987[a] | 410* | 1,075* | 381 | ND | 505* |
| 11-3 | 1987[a] | 55 | 106 | 59 | ND | 100 |
| 11-4 | 1987[a] | 47 | 80 | 46 | ND | 121 |
| 11-5 | 1987[a] | 28 | 50 | 39 | ND | 104 |
| 11-6 | 1987[a] | 21 | 87 | 39 | ND | 92 |
| 11-7 | 1987[a] | 12 | 19 | 26 | ND | 58 |
| | 1988 | 13 | 21 | 28 | ND | 55 |
| 11-8 | 1987[a] | 12 | 20 | 26 | ND | 62 |
| 11-9 | 1987[a] | 7.5 | 15 | 26 | ND | 54 |

**See notes on Table B-1** 5 of 5.

*Source: Supplemental Feasibility Study, Commencement Bay Nearshore/Tideflats, Asarco Sediments Site, October 1993.*

Table B-1 *3 of 5*
**Summary of Inorganics Data Measured at the Asarco Sediments Site During the Asarco RI/FS**
Asarco Sediments/Groundwater OU 06 ROD

| Station | Year | As | Cu | Pb | Hg | Zn |
|---|---|---|---|---|---|---|
| 12-1 | 1987[a] | 5,050* | 7,650* | 4,585* | ND | 5,100* |
| | 1988 | 2,355* | 8,200* | 3,275* | 5.6J | 3,975* |
| 12-2 | 1987[a] | 190* | 497* | 138 | ND | 219 |
| | 1989 | 123* | 371 | 109 | 0.8* | 183 |
| 12-3 | 1987[a] | 60* | 200 | 72 | ND | 151 |
| | 1989 | 43 | 82 | 40 | 0.28 | 76 |
| 12-4 | 1987[a] | 35 | 60 | 39 | ND | 79 |
| 12-5 | 1987[a] | 16 | 46 | 46 | ND | 83 |
| 13-1 | 1987[a] | 2,360* | 5,400* | 2,510* | ND | 1,700* |
| 13-2 | 1987[a] | 60* | 152 | 59 | ND | 88 |
| 13-3 | 1987[a] | 65* | 130 | 59 | ND | 121 |
| 13-4 | 1987[a] | 24 | 47 | 39 | ND | 71 |
| 13-5 | 1987[a] | 15 | 23 | 26 | ND | 49 |
| 13-6 | 1987[a] | 33 | 16 | 19 | ND | 41 |
| 13-7 | 1987[a] | 12 | 17 | 32 | ND | 54 |
| 13-8 | 1987[a] | 11 | 14 | 19 | ND | 45 |
| 14-1 | 1987[a] | 11,100* | 3,850* | 3,405* | ND | 7,600* |
| | 1989[b] | 14,020* | 4,874* | 4,069* | 35* | 2,524* |
| 14-2 | 1987[a] | 160* | 306 | 105 | ND | 249 |
| | 1988 | 69* | 148 | 59 | 0.24 | 141 |
| | 1989[b] | 71* | 154 | 68 | 0.34 | 189 |
| 14-3 | 1987[a] | 35 | 179 | 65 | ND | 134 |
| | 1988 | 49 | 119 | 46 | 0.34 | 122 |
| 14-4 | 1987[a] | 60* | 46 | 39 | ND | 75 |
| 14-5 | 1987[a] | 29 | 31 | 32 | ND | 71 |
| 15-1 | 1988 | 20,225* | 4,600* | 4,430* | 2.4* | 2,825* |
| 15-2 | 1987[a] | 290* | 300 | 118 | ND | 296 |
| 15-3 | 1987[a] | 47 | 72 | 46 | ND | 79 |
| 15-4 | 1987[a] | 30 | 37 | 32 | ND | 71 |
| 15-5 | 1987[a] | 13 | 32 | 26 | ND | 58 |
| 16-1 | 1987[a] | 270* | 190 | 59 | ND | 141 |
| | 1988 | 48 | 141 | 44 | 0.22J | 81 |

**See notes on Table B-1** 5 of 5.

*Source: Supplemental Feasibility Study, Commencement Bay Nearshore/Tideflats, Asarco Sediments Site, October 1993.*

Table B-1 *4 of 5*
**Summary of Inorganics Data Measured at the Asarco Sediments Site During the Asarco RI/FS**
Asarco Sediments/Groundwater OU 06 ROD

| Station | Year | As | Cu | Pb | Hg | Zn |
|---|---|---|---|---|---|---|
| 16-2 | 1987[a] | 75* | 57 | 32 | ND | 64 |
| | 1989[b] | 41 | 58 | 31 | 0.22 | 89 |
| 16-3 | 1987[a] | 26 | 27 | 19 | ND | 46 |
| | 1989[b] | 29 | 33 | 16 | 0.12 | 68 |
| 16-4 | 1987[a] | 11 | 24 | 13 | 0.12 | 68 |
| | 1988 | 16 | 21 | 19 | ND | 50 |
| 17-1 | 1987[a] | 210* | 910* | 217 | ND | 223 |
| 17-2 | 1987[a] | 39 | 84 | 26 | ND | 46 |
| 17-3 | 1987[a] | 21 | 52 | 32 | ND | 64 |
| 17-4 | 1987[a] | 7 | 26 | 19 | ND | 46 |
| 18-1 | 1987[a] | 65* | 295 | 72 | ND | 109 |
| | 1989[b] | 57* | 249 | 71 | 0.24 | 112 |
| 18-2 | 1987[a] | 35 | 71 | 32 | ND | 64 |
| | 1988 | 33 | 65 | 35 | 0.12J | 56 |
| | 1989[b] | 20 | 61 | 23 | 0.22 | 82 |
| 18-3 | 1987[a] | 26 | 38 | 26 | ND | 46 |
| | 1989[b] | 37 | 44 | 24 | 0.18 | 69 |
| 19-1 | 1987[a] | 26 | 77 | 26 | ND | 37 |
| | 1989[b] | 15 | 56 | 20 | 0.16 | 33 |
| 19-2 | 1987[a] | 120* | 52 | 26 | ND | 41 |
| | 1989[b] | 28 | 76 | 32 | 0.24 | 52 |
| 20-1 | 1987[a] | 11 | 61 | 13 | ND | 28 |
| 20-2 | 1987[a] | 20 | 54 | 32 | ND | 41 |

**Notes:** All data are in mg/kg.

1987 data are from Arasco RI Round 1
1988 data are from Arasco RI Round 2.
1989 data are from the 1990 Supplementary Marine Sediment Survey.
1990 data are from the 1990 Supplementary Marine Sediment Survey.

ND No data are available.
D Duplicate sample
* Exceeds LAETs.
[a] All As data from the 1987 sampling event where "J" qualified.
[b] The 1989 data for As, Cu, Pb and Hg are from the "heavy metal" Word Perfect table on the 3rd disk transmitted by Parametrix through PTI (Disk 3). Data for Zn are the values from Table 1 of Parametrix's 1990 Supplemental Marine Sediment Survey. For Stations 3-4, 4-1, 10-2 and 14-2 (sampled both in 1988 and 1989), the 89 Zn values are the differences of the "means" in Table 1 multiplied by two minus the 1988 value.

*Source: Supplemental Feasibility Study, Commencement Bay Nearshore/Tideflats, Asarco Sediments Site, October 1993.*

Table B-1 *5 of 5*
**Summary of Inorganics Data Measured at the Asarco Sediments Site During the Asarco RI/FS**
Asarco Sediments/Groundwater OU 06 ROD

| Chemical | CSL* | SQS** | 2 2 | 2 3 | 2 3 Dup | 2 4 | 3 1 | 3 2 | 3 3 | 4 2 | 4 3 | 5 0 | 5 0 Dup | 5 0.25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 93 | 57 | 94 | 54 | 62 | 51 | 2,063 | 436 | 670 | 4,626 | 5,025 e | 154 e | 142 e | 5,398 |
| Cadmium | 6.7 | 5.1 | 0.3 U | 0.3 U | 0.3 U | 0.3 U | 3.0 | 0.8 | 1.4 | 6.9 | 9.3 e | 71.0 e | 1.0 e | 8.0 |
| Chromium | 270 | 260 | 34 | 33 | 39 | 149 | 68 | 36 | 42 | 100 | 161 | 28 | 38 | 290 e |
| Copper | 390 | 390 | 94 e | 47 e | 52 e | 43 e | 1,110 e | 211 e | 321 e | 1,883 e | 2,542 | 942 | 882 | 3,385 |
| Iron | | | 18,190 | 19,950 | 19,570 | 18,740 | 88,290 | 33,930 | 42,090 | 130,300 | 168,500 | 36,870 | 36,090 | 179,000 |
| Lead | 530 | 450 | 106 | 70 | 74 | 90 | 1,755 | 417 | 704 | 3,928 | 3,586 e | 1,763 e | 282 e | 4,252 |
| Manganese | | | 302 | 1,037 | 928 | 1,141 | 873 | 1,096 | 1,067 | 2,847 | 822 | 195 | 196 | 296 |
| Nickel | | | 27 | 31 | 34 | 91 | 44 | 31 | 33 | 64 | 102 | 17 | 18 | 67 e |
| Silver | 6.1 | 6.1 | 0.4 A | 0.2 U | 0.2 U | 0.2 U | 2.9 | 0.4 | 0.9 | 9.1 | 5.3 | 2.7 | 2.5 | 11 e |
| Zinc | 960 | 410 | 346 | 211 | 229 | 228 | 6,073 | 1,843 | 3,073 | 10,580 | 11,120 | 1,784 | 1,556 | 10,930 |
| Mercury | 0.59 | 0.41 | 0.095 e | 0.066 e | 0.075 e | 0.170 e | 0.200 e | 0.072 e | 0.091 e | 0.051 e | 0.03 e | 0.230 e | 0.280 e | 0.05 U |

| Chemical | CSL* | SQS** | 5 0.5 | 5 1 | 5 2 | 5 3 | 5.5 0 | 6 2 | 6.5 0 | 6.5 1 | 6.5 2 | 6.5 3 | 7 3 | 7 4.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 93 | 57 | 6,221 | 7,219 e | 8,023 e | 1,740 e | 118 e | 6,394 e | 102 e | 6649 | 7,435 | 115 e | 98 e | 27 |
| Cadmium | 6.7 | 5.1 | 5.5 | 12.0 e | 17.0 e | 5.4 e | 0.8 e | 8.3 e | 1.4 e | 8.0 | 11.0 | 0.3 Ue | 9.3 e | 0.3 Ue |
| Chromium | 270 | 260 | 338 e | 158 | 159 | 78 | 35 | 150 | 36 | 306 e | 120 | 41 | 36 | 44 |
| Copper | 390 | 390 | 4,269 | 3,047 | 3,655 | 791 | 1,041 | 2,886 | 1,358 | 4,315 | 3,308 e | 80 | 77 | 46 |
| Iron | | | 153,400 | 202,700 | 229,400 | 65,590 | 26,580 | 179,600 | 18,830 | 208,600 | 198,000 | 22,550 | 21,940 | 20,680 |
| Lead | 530 | 450 | 3,721 | 5,282 e | 6,122 e | 1,369 e | 280 e | 5,263 e | 206 e | 4,122 | 7,074 | 126 e | 276 e | 40 e |
| Manganese | | | 220 | 974 | 826 | 922 | 169 | 1,853 | 140 | 607 | 1,721 | 872 | 657 | 928 |
| Nickel | | | 107 e | 131 | 128 | 60 | 17 | 128 | 18 | 101 e | 106 | 37 | 31 | 37 |
| Silver | 6.1 | 6.1 | 9.0 | 6.6 | 8.0 | 1.8 | 2.7 | 7.1 | 2.7 | 13 | 17 | 0.2 U | 0.2 | 0.2 U |
| Zinc | 960 | 410 | 10,450 | 14,730 | 17,110 | 3,861 | 972 | 14,160 | 468 | 13,150 | 21,150 | 367 | 300 | 109 |
| Mercury | 0.59 | 0.41 | 0.05 U | 0.024 e | 0.032 e | 0.150 e | 0.290 e | 0.036 e | 0.450 e | 0.05 U | 0.055 e | 0.100 e | 0.130 e | 0.270 e |

*Source: Parametrix, Inc., April 1996*

**NOTES:**
1. Results presented in mg/kg dry weight.
2. See notes on Table B 2 *3 of 3*

Table B-2 *1 of 3*
**Metal Concentrations in Sediment (mg/kg dry weight)**
Asarco Sediments/Groundwater OU 06 ROD

| Chemical | CSL* | SQS** | 7-12 | 8-1.5 | 8-2.5 | 8-3.5 | 9-1 | 9-2 | 9-2.5 | 10-1.5 | 10-2 | 10-2.5 | 11-0 | 11-0 Dup |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 93 | 57 | 5.3 | 7,914 e | 239 | 69 | 3,341 | 121 | 88 | 143 | 93 | 45 | 3,797 | 3,914 |
| Cadmium | 6.7 | 5.1 | 0.3 U | 10.0 e | 0.3 | 0.3 U | 9.0 | 0.3 | 0.3 U | 0.5 | 0.3 U | 0.3 U | 25.0 | 26.0 |
| Chromium | 270 | 260 | 32 | 155 | 28 | 30 | 55 | 28 | 28 | 22 | 26 | 29 | 44 | 42 |
| Copper | 390 | 390 | 15 e | 3,729 | 192 | 90 | 7,261 | 206 | 117 | 421 | 193 | 95 | 9,350 | 9,228 |
| Iron | - - | - - | 14,410 | 228,600 | 24,070 | 20,140 | 101,600 | 18,670 | 18,060 | 14,400 | 16.590 | 16,230 | 37,030 | 34,780 |
| Lead | 530 | 450 | 15 | 6,312 e | 196 | 74 | 2,900 | 120 | 80 | 170 | 105 | 52 | 3,450 | 3,650 |
| Manganese | - - | - - | 619 | 1,254 | 612 | 605 | 556 | 224 | 352 | 185 | 269 | 354 | 733 | 678 |
| Nickel | - - | - - | 31 | 105 | 26 | 29 | 90 | 23 | 23 | 19 | 20 | 23 | 89.0 | 79 |
| Silver | 6.1 | 6.1 | 0.2 U | 7.6 | 0.56 A | 0.2 UA | 21 | 0.90 Ab | 0.80 Ab | 1.4 A | 1.2 C | 0.57 Ab | 50.0 | 53.0 |
| Zinc | 960 | 410 | 37 | 19,760 | 592 | 180 | 6,895 | 289 | 192 | 304 | 225 | 125 | 3,352 | 3,279 |
| Mercury | 0.59 | 0.41 | 0.050 e | 0.220 e | 0.099 | 0.110 | 1.800 | 0.340 | 0.083 | 0.350 | 0.110 | 0.140 | 1.800 | 1.890 |

| Chemical | CSL* | SQS** | 11-2 | 11-2.5 | 12-2 | 12-2.5 | 13-2 | 13-2.5 | 14-1 | 14-2 | 14-2.5 | 14-3.5 | 15-1 | 15-2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 93 | 57 | 52 | 43 | 68 | 69 | 43 | 54 | 8,677 | 96 | 63 | 54 | 26,410 | 197 |
| Cadmium | 6.7 | 5.1 | 0.3 U | 0.3 U | 0.5 | 0.3 U | 0.3 U | 0.3 U | 31.0 | 0.3 U | 0.3 U | 0.3 U | 22.0 | 0.6 |
| Chromium | 270 | 260 | 34 | 25 | 28 | 31 | 34 | 44 | 44 | 29 | 29 | 41 | 45 | 29 |
| Copper | 390 | 390 | 114 | 697 | 276 | 203 | 96.0 | 184 | 4195 | 213 | 167 | 117 | 4,365 | 383 |
| Iron | - - | - - | 14,700 | 14,730 | 15,930 | 13,390 | 15,560 | 13,950 | 79,220 | 13,730 | 13,230 | 20,330 | 94,190 | 15,150 |
| Lead | 530 | 450 | 50 | 50 | 115 | 90 | 40 | 70 | 3,510 | 118 | 58 | 59 | 4,150 | 160 |
| Manganese | - - | - - | 248 | 265 | 242 | 319 | 305 | 288 | 514 | 160 | 202 | 442 | 358 | 167 |
| Nickel | - - | - - | 24 | 21 | 27 | 23 | 21 | 29 | 45 | 20 | 20 | 33 | 54 | 23 |
| Silver | 6.1 | 6.1 | 0.70 Cb | 0.80 Ab | 1.1 Ab | 1.1 Cb | 0.40 A b | 1.1 Ab | 12 | 1.2 C | 1.2 C | 0.89 Cb | 16.0 | 2.4 A |
| Zinc | 960 | 410 | 110 | 107 | 143 | 158 | 68 | 137 | 4,480 | 270 | 100 | 120 | 2,483 | 307 |
| Mercury | 0.59 | 0.41 | 0.220 | 0.130 | 0.140 | 0.085 | 0.027 | 0.300 | 3.500 | 0.190 | 0.180 | 0.160 | 17.700 | 0.220 |

*Source: Parametrix, Inc., April 1996*

**NOTES:**
1. Results presented in mg/kg dry weight.
2. See notes on Table B 2 *3 of 3.*

Table B-2 *2 of 3*
**Metal Concentrations in Sediment (mg/kg dry weight)**
Asarco Sediments/ Groundwater OU 06 ROD

| Chemical | CSL* | SQS** | 15-2.5 | 15.5-1 | 15.5-2 | 16-0.5 | 16-1 | 16-2 | 16.5-1 | 16.5-2 | 17-1 | 17-1.5 | 17-2 | 17.5-1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 93 | 57 | 52 | 2,400 | 303 | 308 | 83 | 30 | 230 | 56 | 225 | 86 | 52 | 59 |
| Cadmium | 6.7 | 5.1 | 0.30 U | 4.0 | 0.5 | 1.5 | 0.3 | 0.3 U | 2.0 | 0.3 U | 1.5 | 0.6 | 0.3 U | 2.3 |
| Chromium | 270 | 260 | 27 | 54 | 33 | 32 | 31 | 62 | 41 | 25 | 31 | 28 | 25 | 19 |
| Copper | 390 | 390 | 97 | 2,434 | 544 | 497 | 191 | 63 | 1,066 | 178 | 601 | 296 | 149 | 320 |
| Iron | -- | -- | 13,660 | 149,100 | 18,850 | 45,750 | 12,020 | 14,550 | 17,460 | 11,486 | 14,390 | 12,310 | 12,120 | 11,799 |
| Lead | 530 | 450 | 40 | 1,340 | 146 | 330 | 77 | 31 | 317 | 65 | 165 | 84 | 73 | 125 |
| Manganese | -- | -- | 269 | 559 | 252 | 237 | 180 | 310 | 135 | 163 | 123 | 157 | 185 | 109 |
| Nickel | -- | -- | 19 | 105 | 30 | 31 | 22 | 41 | 36 | 19 | 26 | 24 | 20 | 19 |
| Silver | 6.1 | 6.1 | 0.90 Cb | 14.7 | 2.4 A | 0.93 Ac | 0.84 | 0.20 Ube | 4.35 | 0.92 ACe | 1.98 | 1.01 | 0.48 AC | 0.65 AC |
| Zinc | 960 | 410 | 84 | 1,820 | 359 | 480 | 166 | 69 | 230 | 79 | 170 | 105 | 104 | 131 |
| Mercury | 0.59 | 0.41 | 0.12 | 2.040 | 0.077 | 0.077 | 0.170 | 0.020 U | 0.170 | 0.055 | 0.092 | 0.052 | 0.085 | 0.050 |

| Chemical | CSL* | SQS** | 17.5-2 | 18-2.5 | 18-3.5 | 18.5-1 | 18.5-2 | Ref 2 | Ref 3 | Ref 4B |
|---|---|---|---|---|---|---|---|---|---|---|
| Arsenic | 93 | 57 | 26 | 19.3 | 26 | 51 | 18.3 | 6 | 55 e | 6.9 |
| Cadmium | 6.7 | 5.1 | 0.3 U | 0.3 U | 0.3 U | 0.5 | 0.3 U | 0.3 U | 0.4 | 0.3 U |
| Chromium | 270 | 260 | 23 | 22 | 39 | 36 | 35 | 27 | 47 | 20 |
| Copper | 390 | 390 | 91 | 41 | 41 | 167 | 51 | 19 | 59 | 11 e |
| Iron | -- | -- | 9,702 | 10,820 | 26,750 | 11,200 | 10,850 | 13,530 | 16,110 | 16,290 |
| Lead | 530 | 450 | 34 | 24 | 21 | 61 | 26 | 15 | 72 | 5.7 |
| Manganese | -- | -- | 152 | 199 | 414 | 120 | 236 | 138 | 373 | 154 |
| Nickel | -- | -- | 19 | 18 | 42 | 27 | 25 | 17 | 26 | 17 |
| Silver | 6.1 | 6.1 | 0.36 AC | 0.20 U | 0.020 U | 0.73 | 0.26 AC | 0.59 Ab | 0.20 U | 0.2 U |
| Zinc | 960 | 410 | 46 | 38 | 80 | 68 | 38 | 33 | 223 | 26 |
| Mercury | 0.59 | 0.41 | 0.061 | 0.020 U | 0.020 U | 0.020 | 0.027 | 0.025 | 0.020 Ue | 0.040 e |

*Washington State Cleanup Screening Levels

**Washington State Sediment Quality Standards

Value exceeds SQS

Value Exceeds CSL and SQS

U = Undetected at the reported detection limit
A = Indicates value determined by Method of Standard Addition
C = Indicates the correlation coefficient for Method of Standard Addition is less than 0.995
b = Analyte found in blank
e = Estimated

*Source: Parametrix, Inc., April 1996*

**NOTE:** Results presented in mg/kg dry weight

Table B-2 *3 of 3*
**Metal Concentrations in Sediment**
**Tab (mg/kg dry weight)**
Asarco Sediments/Groundwater OU 06 ROD

| | CSL | SQS | 3-1 | 5-0 | 5.5-0 | 8-1 | 9-1 | 11-0 | 11-1 | 12.5-1 | 14-2 | 15.5-1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Foot 0-1** | | | | | | | | | | | | |
| Arsenic | 93 | 57 | 470 | 101 | 43 | 6,737 | 1,008 | 3,560 | 127 | 6,024 | 19 | 1,933 |
| Cadmium | 6.7 | 5.1 | 1.0 | 0.50 | 0.50 | 9.5 | 3.2 | 23 | 1.0 | 28 | 0.5 U | 3.5 |
| Chromium | 270 | 260 | 36 | 52 | 54 | 186 | 82 | 99 | 121 | 33 | 39 | 80 |
| Copper | 390 | 390 | 367 | 422 | 254 | 3,514 | 2,278 | 8,488 | 443 | 23,250 | 54 | 2,128 |
| Lead | 530 | 450 | 488 | 194 | 92 | 4,755 | 986 | 3,568 | 223 | 5,278 | 31 | 1,323 |
| Nickel | - - | - - | 20 | 29 | 29 | 97 | 76 | 106 | 73 | 40 | 24 | 88 |
| Silver | 6.1 | 6.1 | 1.5 | 1.5 | 1.5 | 11 | 8.5 | 60 | 3.0 | 90 | 1.0 U | 9.5 |
| Zinc | 960 | 410 | 1,905 | 1,390 | 495 | 15,580 | 2,303 | 2,589 | 1,028 | 3,522 | 82 | 3,365 |
| Mercury | 0.59 | 0.41 | 0.31 | 0.26 | 0.29 | 0.27 | 1.7 | 4.3 | 1.3 | 1.6 | 0.094 | 8.5 |
| **Foot 1-2** | | | | | | | | | | | | |
| Arsenic | 93 | 57 | 2.5 U | 3.8 | | 7,123 | 1,373 | 3,538 | 34 | 10,020 | 10 | 1,792 |
| Cadmium | 6.7 | 5.1 | 0.5 U | 0.5. U | | 9.5 | 3.6 | 22 | 0.5 U | 70 | 0.5 U | 4.5 |
| Chromium | 270 | 260 | 45 | 45 | | 237 | 54 | 55 | 92 | 80 | 109 | 109 |
| Copper | 390 | 390 | 18 | 22 | | 3,629 | 2,671 | 8,383 | 117 | 43,840 | 32 | 2,370 |
| Lead | 530 | 450 | 13 | 25 U | | 4,821 | 1,290 | 4,315 | 51 | 22,450 | 26 | 1,086 |
| Nickel | - - | - - | 26 | 22 | | 121 | 69 | 73 | 59 | 70 | 60 | 114 |
| Silver | 6.1 | 6.1 | 1.0 U | 1.0 U | | 12 | 9.5 | 65 | 2.0 | 240 | 1.0 U | 11 |
| Zinc | 960 | 410 | 57 | 48 | | 15,730 | 3,032 | 2,458 | 123 | 10,370 | 51 | 3,366 |
| Mercury | 0.59 | 0.41 | 0.03 U | 0.051 | | 0.21 | 3.0 | 8.6 | 0.12 | 3.5 | 0.14 | 2.7 |
| **Foot 2-3** | | | | | | | | | | | | |
| Arsenic | 93 | 57 | | | | 7,898 | 925 | 3,563 | 144 | 3,832 | 2.5 U | 2,245 |
| Cadmium | 6.7 | 5.1 | | | | 10.00 | 2.6 | 19 | 1.0 | 22 | 0.5 U | 7.5 |
| Chromium | 270 | 260 | | | | 212 | 79 | 96 | 117 | 59 | 42 | 111 |
| Copper | 390 | 390 | | | | 3,537 | 1,734 | 8,427 | 403 | 24,310 | 17 | 1,946 |
| Lead | 530 | 450 | | | | 5,041 | 891 | 2,757 | 203 | 6,097 | 25 U | 2,023 |
| Nickel | - - | - - | | | | 105 | 63 | 118 | 75 | 174 | 39 | 121 |
| Silver | 6.1 | 6.1 | | | | 12 | 7.0 | 37 | 2.5 | 88 | 1.0 U | 8.0 |
| Zinc | 960 | 410 | | | | 16,740 | 2,172 | 2,417 | 365 | 4,339 | 69 | 7,021 |
| Mercury | 0.59 | 0.41 | | | | 0.042 | 1.8 | 2.6 | 0.33 | 6.2 | 0.022 | 1.1 |
| **Foot 3-4** | | | | | | | | | | | | |
| Arsenic | 93 | 57 | | | | | 691 | 2,106 | 40 | 67 | | |
| Cadmium | 6.7 | 5.1 | | | | | 2.4 | 14 | 0.5 U | 0.5 U | | |
| Chromium | 270 | 260 | | | | | 72 | 54 | 96 | 65 | | |
| Copper | 390 | 390 | | | | | 1,329 | 6,397 | 86 | 352 | | |
| Lead | 530 | 450 | | | | | 554 | 1,798 | 33 | 63 | | |
| Nickel | - - | - - | | | | | 52.0 | 74 | 50 | 75 | | |
| Silver | 6.1 | 6.1 | | | | | 4 | 25 | 1.0 U | 2.0 | | |
| Zinc | 960 | 410 | | | | | 1,296 | 1,847 | 64 | 131 | | |
| Mercury | 0.59 | 0.41 | | | | | 0.63 | 1.1 | 0.03 | 0.29 | | |
| **Foot 4-5** | | | | | | | | | | | | |
| Arsenic | 93 | 57 | | | | | 44 | 1,634 | | | | 4,543 |
| Cadmium | 6.7 | 5.1 | | | | | 0.5 U | 9 | | | | 16 |
| Chromium | 270 | 260 | | | | | 46 | 39 | | | | 106 |
| Copper | 390 | 390 | | | | | 64 | 3,467 | | | | 3,836 |
| Lead | 530 | 450 | | | | | 25 | 1,278 | | | | 5,268 |
| Nickel | - - | - - | | | | | 34 | 46 | | | | 141 |
| Silver | 6.1 | 6.1 | | | | | 1.0 U | 1 | | | | 9 |
| Zinc | 960 | 410 | | | | | 102 | 1,389 | | | | 17,400 |
| Mercury | 0.59 | 0.41 | | | | | 0.04 | 1.2 | | | | 0.1 |

Note: Recovered core sections did not contain the entire 1 foot section in some cases. Figure 3-2 indicates recoveries for each sample.

U Undetected

Indicates that the value exceeds SQS (Sediment Quality Standards).

Indicates that the value exceeds CSL (Cleanup Screening Levels).

*Source: Parametrix, Inc., December 1996.*

**NOTE** Results presented in mg/kg dry weight.

Table B-3
**Metal Concentrations in Subsurface Sediments (mg/kg dry weight)**
Asarco Sediments/Groundwater OU 06 ROD

| Chemical | CSL | SQS | 5-0 | 5.5-0 | 8-1 | 9-1 | 11-0 | 11-1 | 12.5-1 | 14-2 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Foot 0-1** | | | | | | | | | | |
| Fluorene | 79 | 23 | 7 * | 3 U | 3 U | 2 | 5 | 2 | 4 U | 9 U* |
| Phenanthracene | 480 | 100 | 83 * | 15 | 14 | 9 | 55 | 10 | 16 | 9 U* |
| Fluoranthene | 1,200 | 160 | 191 * | 51 | 40 | 27 | 100 | 11 | 146 | 9 U* |
| Butyl benzyl phthalate | 64 | 4.9 | 5 U* | 3 | 32 | 1 U | 3 U | 1 U | 4 U | 9 U* |
| Bis(2-ethylhexyl)phthalate | 78 | 47 | 29 * | 61 | 137 | 2 | 13 | 1 | 4 U | 9 U* |
| **Foot 1-2** | | | | | | | | | | |
| Fluorene | 79 | 23 | 11 U* | | 1 | 6 | 3 | 2 U | 1 | 7 U* |
| Phenanthracene | 480 | 100 | 11 U* | | 7 | 23 | 38 | 2 U | 5 | 7 U* |
| Fluoranthene | 1,200 | 160 | 11 U* | | 15 | 48 | 85 | 2 U | 43 | 7 U* |
| Butyl benzyl phthalate | 64 | 4.9 | 11 U* | | 2 | 5 | 3 U | 3 | 1 | 7 U* |
| Bis(2-ethylhexyl)phthalate | 78 | 47 | 11 U* | | 14 | 18 | 4 | 2 U | 14 | 7 U* |
| **Foot 2-3** | | | | | | | | | | |
| Fluorene | 79 | 23 | | | 5 U | 3 | 32 | 12 * | | 11 U* |
| Phenanthracene | 480 | 100 | | | 15 * | 16 | 184 | 119 * | | 11 U* |
| Fluoranthene | 1,200 | 160 | | | 27 * | 51 | 237 | 181 * | | 11 U* |
| Butyl benzyl phthalate | 64 | 4.9 | | | 5 * | 3 U | 7 U | 7 U* | | 11 U* |
| Bis(2-ethylhexyl)phthalate | 78 | 47 | | | 10 * | 11 | 20 | 7 U* | | 11 U* |
| **Foot 3-4** | | | | | | | | | | |
| Fluorene | 79 | 23 | | | | | 6 | | 2 U | |
| Phenanthracene | 480 | 100 | | | | | 43 | | 10 | |
| Fluoranthene | 1,200 | 160 | | | | | 71 | | 12 | |
| Butyl benzyl phthalate | 64 | 4.9 | | | | | 2 U | | 2 U | |
| Bis(2-ethylhexyl)phthalate | 78 | 47 | | | | | 2 | | 2 U | |
| **Foot 4-5** | | | | | | | | | | |
| Fluorene | 79 | 23 | | | | | 5 | | | |
| Phenanthracene | 480 | 100 | | | | | 52 | | | |
| Fluoranthene | 1,200 | 160 | | | | | 75 | | | |
| Butyl benzyl phthalate | 64 | 4.9 | | | | | 4 U | | | |
| Bis(2-ethylhexyl)phthalate | 78 | 47 | | | | | 5 | | | |

Note: Recovered core sections did not contain the entire 1 foot section in some cases. Figure 3-2 indicates recoveries for each sample.

U Undetected

* Organic carbon content is less than 0.5% in this sample and should not be directly compared to organic carbon normalized criteria.

Indicates that the value exceeds SQS (Sediment Quality Standards)

Indicates that the value exceeds CSL (Cleanup Screening Levels).

*Source: Parametrix, Inc., December 1996.*

**NOTE**: Results presented in mg/kg organic carbon.

Table B-4
**Organic Compound Concentrations in Subsurface Sediments (mg/kg organic carbon)**
Asarco Sediments/Groundwater OU 06 ROD

| Chemical | AET Dry Wt. | 5-0 | 5.5-0 | 8-1 | 9-1 | 11-0 | 11-1 | 12.5-1 | 14-2 |
|---|---|---|---|---|---|---|---|---|---|
| **Foot 0-1** | | | | | | | | | |
| Fluorene | 540 | 24 | N/A | N/A | N/A | N/A | N/A | N/A | 17 U |
| Phenanthracene | 1500 | 290 | N/A | N/A | N/A | N/A | N/A | N/A | 17 U |
| Fluoranthene | 1700 | 670 | N/A | N/A | N/A | N/A | N/A | N/A | 17 U |
| Butyl benzyl phthalate | 63 | 19 U | N/A | N/A | N/A | N/A | N/A | N/A | 17 U |
| Bis(2-ethylhexyl)phthalate | 1300 | 100 | N/A | N/A | N/A | N/A | N/A | N/A | 17 U |
| **Foot 1-2** | | | | | | | | | |
| Fluorene | 540 | 18 U | | N/A | N/A | N/A | N/A | N/A | 17 U |
| Phenanthracene | 1500 | 18 U | | N/A | N/A | N/A | N/A | N/A | 17 U |
| Fluoranthene | 1700 | 18 U | | N/A | N/A | N/A | N/A | N/A | 17 U |
| Butyl benzyl phthalate | 63 | 18 U | | N/A | N/A | N/A | N/A | N/A | 17 U |
| Bis(2-ethylhexyl)phthalate | 1300 | 18 U | | N/A | N/A | N/A | N/A | N/A | 17 U |
| **Foot 2-3** | | | | | | | | | |
| Fluorene | 540 | | | 18 U | N/A | N/A | 30 | | 16 U |
| Phenanthracene | 1500 | | | 54 | N/A | N/A | 310 | | 16 U |
| Fluoranthene | 1700 | | | 100 | N/A | N/A | 497 | | 16 U |
| Butyl benzyl phthalate | 63 | | | 18 | N/A | N/A | 17 U | | 16 U |
| Bis(2-ethylhexyl)phthalate | 1300 | | | 38 | N/A | N/A | 17 U | | 16 U |
| **Foot 3-4** | | | | | | | | | |
| Fluorene | 540 | | | | | N/A | | N/A | |
| Phenanthracene | 1500 | | | | | N/A | | N/A | |
| Fluoranthene | 1700 | | | | | N/A | | N/A | |
| Butyl benzyl phthalate | 63 | | | | | N/A | | N/A | |
| Bis(2-ethylhexyl)phthalate | 1300 | | | | | N/A | | N/A | |
| **Foot 4-5** | | | | | | | | | |
| Fluorene | 540 | | | | | N/A | | | |
| Phenanthracene | 1500 | | | | | N/A | | | |
| Fluoranthene | 1700 | | | | | N/A | | | |
| Butyl benzyl phthalate | 63 | | | | | N/A | | | |
| Bis(2-ethylhexyl)phthalate | 1300 | | | | | N/A | | | |

Note: Recovered core sections did not contain the entire 1 foot section in some cases. Figure 3-2 indicates recoveries for each sample.

U Undetected

N/A organic carbon content is greater than 0.5% in this sample. Value is normalized for TOC and reported in Table 3-3.

*Source: Parametrix, Inc., December 1996.*

**NOTE** Results presented in µg/kg dry weight.

Table B-5
**Organic Compound Concentrations in Subsurface Sediments (µg/kg dry weight)**
Asarco Sediments/Groundwater OU 06 ROD

| Chemical | Marine EPA Criteria Chronic | Marine EPA Criteria Acute | PW 5025 | PW 505 | PW 651 | PW 91 | PW 1020 | PW 132 |
|---|---|---|---|---|---|---|---|---|
| **Metals (µg/L)** | | | | | | | | |
| Arsenic +3 | - - | - - | 12 | 5 U | 18 | 2,205 | 30 | 18 |
| Arsenic +5 | - - | - - | 5 U | 5 U | 5 U | 23 | 5 U | 5 U |
| Total Arsenic | 36 | 69 | 28 e | 5 Ue | 36 e | 1,933 | 67 e | 25 |
| Cadmium | 9.3 | 43 | 3 UEe | 3 UEe | 3 U Ee | 3 U | 3 UEe | 3 U |
| Chromium | 50 | 1,100 | 10 Ue | 10 Ue | 10 Ue | 10 U | 10 Ue | 10 U |
| Copper | 2.9 | 2.9 | 30 | 25 U | 26 | 25 U | 25 U | 77 |
| Iron | 1,000 a | - - | 50 U | 50 U | 50 U | 867 | 50 U | 68 |
| Lead | 8.5 | 220 | 5 U | 5 U | 5 U | 5 Ue | 5 U | 5 e |
| Manganese | - - | - - | 15 U | 15 U | 65 | 512 Ee | 1,853 | 362 Ee |
| Nickel | 8 | 75 | 50 Ue | 50 Ue | 50 U | 50 U | 50 U | 50 U |
| Silver | 0.92 | 2.3 | 1 Ue | 1 Ue | 1 Ue | 1 U | 1 Ue | 1 U |
| Zinc | 86 | 95 | 50 U | 50 U | 50 U | 50 U | 50 U | 50 U |
| Mercury | 1.1 | 2.1 | 0.40 U | 0.44 | 0.44 | 0.20 e | 0.20 U | 0.37 e |
| **Organics (µg/L)** | | | | | | | | |
| LPAH | | | | | | | | |
| Acenaphthylene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Acenaphthene | 710 b | 485 b,c | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Anthracene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Fluorene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Naphthalene | 214 f | 1175 b,c | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Phenanthrene | 4.6 | 7.7 | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| 2-Methylnaphthalene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Total LPAHs | - - | - - | 21.0 | 23.1 | 23.1 | 35.0 | 39.9 | 46.9 |
| HPAH | | | | | | | | |
| Benzo(a)anthracene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Benzo(a)pyrene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Benzo(b)fluoranthene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Benzo(k)fluoranthene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Total benzofluoranthenes | - - | - - | 6.0 | 6.6 | 6.6 | 10.0 | 11.4 | 13.4 |
| Benzo(g,h,i)perylene | - - | - - | 6.1 U | 6.6 U | 6.5 U | 10.0 U | 11.0 U | 13.0 U |
| Chrysene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Dibenzo(a,h)anthracene | - - | - - | 6.1 U | 6.6 U | 6.6 U | 10.0 U | 11.0 U | 13.0 U |
| Fluoranthene | 16 b | 20 b,c | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Indeno(1,2,3,-cd)pyrene | - - | - - | 6.1 U | 6.6 U | 6.5 U | 10.0 U | 11.0 U | 13.0 U |
| Pyrene | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Total HPAHs | - - | - - | 39.3 | 42.9 | 42.6 | 65.0 | 72.9 | 85.9 |
| Total PAHs | 30 d | 150 b,c | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Phthalates | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Butyl benzyl phthalate | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Diethyl phthalate | - - | - - | 5.9 | 4.1 | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Dimethylphthalate | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Di-n-butyl phthalate | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| Di-n-octyl phthalate | - - | - - | 3.0 U | 3.3 U | 3.3 U | 5.0 U | 5.7 U | 6.7 U |
| **Conventionals** | | | | | | | | |
| Ph | - - | - - | - - | - - | - - | 7.6 | 7.8 | 7.4 |
| Ammonia (as nitrogen) (mg/L) | 0.035 | 0.230 | 0.023 | 0.056 | 0.048 | 2.200 | 1.400 | 0.700 |
| Sulfide (as hydrogen sulfide) mg/ | 0.002 | - - | 1.0 U | 1.0 U | 1.0 U | 4.0 U | 4.0 U | 4.5 |

**See notes on Table B-6 2 of 2**

*Source: Parametrix, Inc., April 1996.*

Table B-6 *1 of 2*
**Pore Water Chemical Concentrations**
Asarco Sediments/Groundwater OU 06 ROD

| Chemical | Marine EPA Criteria Chronic | Marine EPA Criteria Acute | PW 1435 | PW 1651 | PW 1651 (Dup) | PW 172 | PW 1851 | PW 1852 | PW REF 2 | PW Ref 6 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Metals (µg/L)** | | | | | | | | | | |
| Arsenic +3 | - - | - - | 19 | 13 | 11 | 44 | 10 | 21 | 5 | 17 |
| Arsenic +5 | - - | - - | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U | 5 U |
| Total Arsenic | 36 | 69 | 49 | 70 | 74 | 40 | 6 | 21 | 22 e | 42 e |
| Cadmium | 9.3 | 43 | 3 U | 3 U | 3 U | 3 U | 3 U | 3 U | 3 Ue | 3 Ue |
| Chromium | 50 | 1,100 | 10 U | 10 Ue | 10 U | 10 U | 10 U | 10 U | 10 U | 10 Ue |
| Copper | 2.9 | 2.9 | 26 | 25 U | 25 U | 30 U | 25 U | 25 U | 62 e | 25 Ue |
| Iron | 1,000 a | - - | 68 | 68 | 68 | 107 | 107 | 50 U | 50 U | 50 U |
| Lead | 8.5 | 220 | 5 Ue | 5 Ue | 5 Ue | 5 Ue | 5 Ue | 6 e | 5 U | 5 U |
| Manganese | - - | - - | 6,076 Ee | 72 Ee | 72 Ee | 971 Ee | 185 Ee | 1,428 Ee | 692 | 952 |
| Nickel | 8 | 75 | 50 U | 50 Ue | 50 U | 50 U | 50 U | 50 U | 50 U | 50 Ue |
| Silver | 0.92 | 2.3 | 1 U | 1 U | 1 U | 1 U | 1 U | 1 U | 1 Ue | 1 Ue |
| Zinc | 86 | 95 | 50 U | 50 U | 50 U | 50 U | 50 U | 67 | 50 U | 50 U |
| Mercury | 1.1 | 2.1 | 0.33 e | 0.44 e | 0.44 e | 1.00 e | 0.29 e | 0.64 e | 0.20 U | 0.20 U |
| **Organics (µg/L)** | | | | | | | | | | |
| LPAH | | | | | | | | | | |
| Acenaphthylene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Acenaphthene | 710 b | 485 b,c | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Anthracene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Fluorene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Naphthalene | 214 f | 1175 b,c | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Phenanthrene | 4.6 | 7.7 | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| 2-Methylnaphthalene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Total LPAHs | - - | - - | 33.6 | 25.9 | 25.2 | 42.7 | 29.4 | 126.0 | 30.1 | 32.9 |
| HPAH | | | | | | | | | | |
| Benzo(a)anthracene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Benzo(a)pyrene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Benzo(b)fluoranthene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Benzo(k)fluoranthene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Total benzofluoranthenes | - - | - - | 9.6 | 7.4 | 7.2 | 12.2 | 8.4 | 36.0 | 8.6 | 9.4 |
| Benzo(g,h,i)perylene | - - | - - | 9.6 U | 7.4 U | 7.2 U | 12 U | 8.3 U | 36.0 U | 8.5 U | 9.4 U |
| Chrysene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Dibenzo(a,h)anthracene | - - | - - | 9.6 U | 7.4 U | 7.2 U | 12 U | 8.3 U | 36.0 U | 8.5 U | 9.4 U |
| Fluoranthene | 16 b | 20 b,c | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Indeno(1,2,3,-cd)pyrene | - - | - - | 9.6 U | 7.4 U | 7.2 U | 12 U | 8.3 U | 36.0 U | 8.5 U | 9.4 U |
| Pyrene | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Total HPAHs | - - | - - | 62.4 | 62.4 | 46.8 | 78.7 | 54.3 | 234.0 | 55.6 | 61.1 |
| Total PAHs | 30 d | 150 b,c | 96.0 | 74.0 | 72.0 | 121.4 | 83.7 | 360.0 | 85.7 | 94.0 |
| Phthalates | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Butyl benzyl phthalate | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Diethyl phthalate | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Dimethylphthalate | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Di-n-butyl phthalate | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| Di-n-octyl phthalate | - - | - - | 4.8 U | 3.7 U | 3.6 U | 6.1 U | 4.2 U | 18.0 U | 4.3 U | 4.7 U |
| **Conventionals** | | | | | | | | | | |
| pH | - - | - - | 7.7 | 7.7 | | 7.5 | 7.3 | 7.6 | 7.8 | 7.8 |
| Ammonia (as nitrogen) (mg/L) | 0.035 | 0.230 | 2.270 | 1.900 | 2.000 | 1.300 | 0.640 | 0.810 | 1.200 | 0.700 |
| Sulfide (as hydrogen sulfide) mg/ | 0.002 | - - | 3.2 | 2.2 | 4.0 U | 1.0 U | 4.0 U | 1.0 U | 1.0 U | 4.0 U |

a Freshwater criteria.
b Unsufficient data to develop criteria. Value presented is the L.O.E.L.
c LC50 value divided by 2.
d Acute-to-chronic ratio of 10 used to develop criterion.
f Chemical specific acute-to-chronic ratio used to develop criterion.

E = Estimated.
U = Undetected at the reported detection limit.
e = Estimated.
- - = No data available.
Value exceeds chronic marine EPA criteria.
Value

*Source: Parametrix, Inc., April 1996.*

Table B-6 *2 of 2*
**Pore Water Chemical Concentrations**
Asarco Sediments/Groundwater OU 06 ROD

| Station | *Ampelisca* Sample Mortality (%)* | Echinoderm Combined Station Normality/Survivorship (%)** | *Neanthes* Mean total Biomass (mg)§ |
|---|---|---|---|
| Carr 2 | 13 | 89.6 | 97.35 |
| Carr 4 | 19 | 83.9 | 137.30 |
| REF 3 | 45 §§ | 39.1 # | 96.63 §§ |
| REF 4B | 31 §§ | 55.8 # | 89.36 |
| 2 2 | 26 | 73.3 | 67.85 |
| 2 3 | 43 | 81.4 | 74.36 |
| 2 4 | 30 | 44.9 [a,b] | 87.59 |
| 3 1*** | 46 | 41.2 [a] | 53.90 [c] |
| 3 2 | 31 | 70.8 | 84.40 |
| 3 3 | 32 | 52.5 | 91.54 |
| 4 2 | 88 [a] | 61.5 | 46.72 |
| 4 3 | 29 | 43.9 [a,b] | 82.46 |
| 5 0 | 24 | 71.3 | 137.18 |
| 5 0.25 | 94 [a] | 24.2 [a,b] | 0.00 [b] |
| 5 0.5 | 92 [a] | 31.2 [a,b] | 0.00 [b] |
| 5 1 | 48 | 61.0 | 109.55 |
| 5 2 | 33 | 61.3 | 114.82 |
| 5 3 | 32 | 73.2 | 116.14 |
| 5.5 0 | 24 | 74.8 | 145.38 |
| 6 2 | 77 [a] | 36.2 [a,b] | 81.68 |
| 6.5 0 | 72 [a,b] | 69.0 | 98.78 |
| 6.5 1 | 73 [a,b] | 3.1 [a,b] | 0.00 [b] |
| 6.5 2 | 60 | 32.1 [a,b] | 82.39 |
| 6.5 3 | 63 | 81.8 | 137.34 |
| 7 3 | 33 | 50.0 | 90.01 |
| 7 4.5 | 37 | 82.8 | 128.87 |
| 7 12 | 47 | 38.8 | 84.55 |
| 8 1.5 | 86 [a] | 0.1 [a,b] | 0.00 [b] |
| 8 2.5 | 71 [a,b] | 44.3 [a] | 50.48 |
| 8 3.5 | 24 | 87.8 [a,b] | 109.64 |
| 9 1*** | 100 [a] | 8.5 | 42.29 |
| 9 2 | 33 | 60.0 | 83.69 |
| 9 2.5 | 43 | 63.8 | 105.49 |
| 10 1.5 | 47 | 43.5 [a,b] | 84.60 |
| 10 2 | 40 | 48.8 [a,b] | 92.48 |
| 10 2.5 | 37 | 50.9 | 91.58 |
| 11 0 | 99 [a] | 0.2 [a,b] | 0.00 [B] |
| 11 2 | 17 | 58.7 | 49.06 |
| 11 2.5 | 34 | 73.8 | 98.97 |
| 12 2 | 27 | 83.0 | 109.66 |

**See note on Table B-7 *2 of 2*.**

*Source: Parametrix, Inc., April 1996.*

Table B-7 *1 of 2*
**Sediment Bioassay Results (Replicate Means) and Comparison to State Bioassay Criteria**
Asarco Sediment/Groundwater OU 06 ROD

| Station | *Ampelisca* Sample Mortality (%)* | Echinoderm Combined Station Normality/Survivorship (%)** | *Neanthes* Mean total Biomass (mg)§ |
|---|---|---|---|
| 12 2.5 | 52 | 49.1 | 94.65 |
| 13 2 | 35 | 73.9 | 98.18 |
| 13 2.5 | 49 | 54.3 | 98.74 |
| 14 1 | 99 [a] | 0.1 [a,b] | 8.24 [b] |
| 14 2 | 81 [a] | 75.2 | 78.52 |
| 14 2.5 | 78 | 78.6 | 108.52 |
| 14 3.5 | 55 | 54.0 | 56.75 |
| 15 1 | 98 [a] | 0.0 [a] | 37.22 [B] |
| 15 2 | 42 | 67.9 | 86.56 |
| 15 2.5 | 23 | 71.7 | 89.71 |
| 15.5 1 | 82 [a] | 57.6 | 62.62 |
| 15.5 2 | 63 | 46.9 [a,b] | 87.06 |
| 16 0.5 | 21 | 63.4 | 63.99 |
| 16 1 | 22 | 30.5 [a,b] | 97.83 |
| 16 2 | 36 | 46.8 [a,b] | 94.65 |
| 16.5 1*** | 29 | 53.1 | 94.12 |
| 16.5 2 | 32 | 48.6 | 100.75 |
| 17 1 | 54 | 52.4 | 79.53 |
| 17 1.5 | 20 | 32.4 [a,b] | 78.85 |
| 17 2 | 24 | 47.8 [a,b] | 93.13 |
| 17.5 1*** | 24 | 39.7 | 68.84 |
| 17.5 2 | 26 | 49.0 [a,b,c] | 79.48 |
| 18 2.5 | 39 | 30.2 [a,b] | 87.21 |
| 18 3.5 | 27 | 51.8 | 90.38 |
| 18.5 1 | 47 | 33.5 [a,b] | 85.89 |
| 18.5 2 | 26 | 35.8 [A,b] | 94.63 |

* State SQS criteria for amphipod bioassays: sediment fails if mortality is > 25% and significantly greater than reference.

** State SQS criteria for echinoderm larval bioassay: sediment fails if normal survivoship is < 85% of and significantly lower than reference.

*** Stations with greater than 20% fines that are compared to reference station Carr4.

§ State SQS criteria for polchaete bioassay: sediment fails if mean biomass < 70% of and significantly lower than reference.

§§ Does not meet reference station requirements defined by state criteria.

# Does not meet reference station requirements defined by PSDDA.

Boxed values indicate the result exceeds state SQS and CSL criteria.

[a] Not significantly different from REF 3.

[b] Not significantly different from REF4B.

[c] Not significantly different from Carr 2.

[d] Not significantly different from Carr 4.

*Source: Parametrix, Inc., April 1996.*

Table B-7 *2 of 2*

**Sediment Bioassay Results (Replicate Means) and Comparison to State Bioassay Criteria**

Asarco Sediment/Groundwater OU 06 ROD

| Station | Year | Bioassay[a] | | | Benthic Infauna[b] | | |
|---|---|---|---|---|---|---|---|
| | | Amphipod | Bivalve | Echinodem | Polychaete | Mollusca | Crustacea |
| 1-1 | | 6 | 80 | -- | -- | -- | -- |
| 2-1 | 1988 | 4 | 87* | -- | -- | -- | --* |
| 2-5** | 1988 | 19 | 60 | -- | 0.20* | 0.10* | 0.14* |
| 3-2 | 1988 | 11 | 50 | -- | -- | -- | -- |
| 3-3 | 1989 | 6 | -- | 24 | 0.55 | 0.11* | 0.44 |
| 3-4** | 1989 | 14 | 76 | -- | -- | -- | -- |
| | 1989 | 18 | -- | 49 | 0.17 | 0.14* | 0.44 |
| 3-5* | 1988 | 31* | 80 | -- | 0.41 | 0.18* | 0.46 |
| 3-6 | 1988 | 3 | 54 | --* | -- | -- | -- |
| 4-0** | 1990 | 14 | -- | 72* | 3.09 | 0.54- | 0.58 |
| 4-1 | 1989 | 95* | -- | 27 | 2.26 | 0.78 | 0.74 |
| 4-2* | 1988 | 49* | 74 | -- | 2.58 | 0.96 | 1.91 |
| 4-3** | 1989 | 32 | -- | 54* | 1.80 | 0.23 | 1.56 |
| 5-0** | 1988 | 9 | 86*/93* | -- | -- | -- | -- |
| | 1990 | 14 | -- | 56* | 0.91 | 0.18* | 0.06* |
| 5-2** | 1990 | 18 | -- | 57* | 0.62 | 0.21* | 1.72 |
| 5-3 | 1989 | 20 | -- | 16 | 0.38 | 0.13* | 0.45 |
| 5-4** | 1989 | 24 | -- | 50* | -- | -- | -- |
| 5.5-2** | 1990 | 32 | -- | 85* | 0.81 | 0.27* | 1.29 |
| 6-0 | 1990 | 17 | -- | 58 | 3.69 | 0.04* | 0.37 |
| 6-1** | 1988 | 97* | -- | -- | -- | -- | -- |
| | 1990 | 43 | -- | 41 | 0.96 | 0.29* | 1.00 |
| 6-2** | 1989 | 23 | -- | 30* | -- | -- | -- |
| | 1990 | 26 | -- | 55* | 0.85 | 0.28* | 1.27 |
| 6-3 | 1988 | 22 | 69 | -- | 0.95 | 0.72 | 1.65 |
| | 1990 | 16 | -- | 45 | 0.75 | 0.33* | 2.31 |
| 6-4 | 1989 | 12 | -- | 10 | 0.28 | 0.12* | 0.23 |
| 6.5-2** | 1990 | 38 | -- | 100* | 0.88 | 0.22 | 1.34 |
| 7-2** | 1990 | 48 | -- | 89* | 0.76 | 0.36 | 0.40 |
| 8-2 | 1989 | 13 | -- | 38* | 0.33 | 0.24 | 0.53 |

**See notes on Table B-8 2 of 2.**

*Source: Supplemental Feasibility Study, Commencement Bay Nearchore/Tideflats, Asarco Sediments Site, October 1993.*

Table B-8 *1 of 2*
**Summary of Biological Data**
Asarco Sediments/Groundwater OU 06 ROD

| Station | Year | Bioassay[a] | | | Benthic Infauna[b] | | |
|---|---|---|---|---|---|---|---|
| | | Amphipod | Bivalve | Echinoderm | Polychaete | Mollusca | Crustacea |
| 8-3** | 1989 | 17 | -- | 44* | 0.61 | 0.41 | 1.42 |
| 8-4 | 1988 | 17 | 70 | -- | 0.86 | 0.65 | 1.73 |
| 10-1** | 1988 | 14 | 99*/100* | -- | 1.46 | 0.20* | 1.54 |
| 10-2** | 1988 | 7 | 97*/91* | -- | -- | -- | -- |
| 10-3 | 1989 | 14 | -- | 45* | 1.39 | 0.54 | 1.80 |
| | 1989 | 20 | -- | 22 | 0.58 | 0.42 | 1.11 |
| 11-7** | 1988 | 4 | 70/57 | -- | 0.07* | 0.03* | 0.09* |
| 12-1** | 1988 | 62* | 99*/93* | -- | 4.88 | 0.04* | 0.43 |
| 12-2** | 1989 | 16 | -- | 45* | 1.31 | 0.23 | 0.57 |
| 12-3 | 1989 | 11 | -- | 40* | 0.77 | 0.43 | 0.83 |
| 14-1** | 1989 | 74* | -- | 99* | 0.23 | 0.20* | 0.14* |
| 14-2 | 1989 | 7 | -- | 21 | 0.47 | 0.55 | 0.39 |
| 14-3** | 1989 | 15 | -- | 63* | 0.94 | 0.39 | 1.41 |
| 16-1 | 1988 | 5 | 86*/89* | -- | 0.60 | 0.23 | 0.34 |
| 16-2 | 1989 | 19 | -- | 32* | 0.38 | 0.26 | 0.58 |
| 16-3 | 1989 | 15 | -- | 33* | 0.47 | 0.23 | 0.55 |
| 16-4** | 1988 | 17 | 98*/92* | -- | 0.36 | 0.20* | 0.21* |
| 18-1** | 1989 | 19 | -- | 40* | 0.76 | 0.22* | 2.59 |
| 18-2** | 1988 | 14 | 98*/99* | -- | -- | -- | -- |
| | 1989 | 12 | -- | 48* | 1.40 | 0.29 | 1.38 |
| 18-3** | 1989 | 37* | -- | 2 | -- | -- | -- |
| 19-1 | 1989 | 8 | -- | 22 | 0.86 | 0.58 | 2.40 |
| 19-2 | 1989 | 24 | -- | 2 | 0.85 | 0.23* | 1.33 |

[a] Bioassay results in absolute mortality (amphipod) and combined abnormality (bivalve and echinoderm). For bivalves, assays were performed twice in 1988 at certain sample locations. Data from both sets of analyses are presented; the greater response was used to characterize the sample station.

[B] Benthic infauna is ratio of station to reference (i.e., indicated value = station abundance + reference abundance).

* Exceeds problem area biological threshold value.

** Station identified as cleanup station based on at least one exceedance of MCUL biological criteria.
data not collected during indicated sampling event.

*Source: Supplemental Feasibility Study, Commencement Bay Nearchore/Tideflats, Asarco Sediments Site, October 1993.*

Table B-8 *2 of 2*
**Summary of Biological Data**
Asarco Sediments/Groundwater OU 06 ROD

| Station | Polychaets | Molluscs | Crustaceans | Miscellaneous |
|---|---|---|---|---|
| REF 2 | 365 | 144 | 128 | 40 |
| REF 3 | 491 | 92 | 57 | 267 |
| REF 4B | 235 | 64 | 23 | 20 |
| 2 2* | 373 | 57 | 93 | 122 |
| 2 3* | 235 | 39 | 81 | 70 |
| 2 4* | 164 | 35 | 44 | 36 |
| 3 1 | 452 | 31 | 47 | 58 |
| 3 2 | 255 | 53 | 51 | 245 |
| 3 3* | 423 | 43 | 79 | 86 |
| 4 2* | 598 | 49 | 60 | 325 |
| 4 3* | 382 | 46 | 92 | 556 |
| 5 0 | 519 | 134 | 19 b | 12 a |
| 5 1 | 574 | 94 | 124 | 125 |
| 5 2* | 313 | 48 | 115 | 95 |
| 5 3* | 139 | 24 | 37 | 28 |
| 5.5 0 | 1,586 | 191 | 83 | 13 a |
| 6 2 | 465 | 68 | 98 | 165 |
| 6.5 0 | 539 | 31 | 46 b | 3 a |
| 6.5 2 | 321 | 40 b | 37 b | 63 |
| 6.5 3 | 146 a | 30 | 33 b | 30 a |
| 7 12* | 139 | 22 | 40 | 16 |
| 7 3 | 200 a | 46 | 73 | 70 |
| 7 4.5 | 152 a | 45 b | 41 b | 35 a |
| 8 1.5 | 432 | 43 b | 49 b | 36 a |
| 8 2.5 | 311 | 52 | 102 | 87 |
| 8 3.5 | 194 a | 37 | 62 | 40 a |
| 9 1 | 73 | 7 | 43 | 0 |
| 9 2 | 156 a | 52 b | 40 b | 60 a |
| 9 2.5 | 338 | 54 | 86 | 82 |
| 10 1.5 | 369 | 78 | 58 | 45 a |
| 10 2 | 332 | 78 | 51 b | 59 a |
| 10 2.5 | 335 | 79 | 107 | 151 |
| 11 0 | 1 | 1 | 3 | 0 |
| 11 2 | 248 | 88 | 63 | 90 |
| 11 2.5 | 208 | 46 b | 58 | 93 |
| 12 2 | 510 | 272 | 79 | 33 a |
| 12 2.5 | 362 | 173 | 61 | 48 a |
| 13 2 | 495 | 211 | 80 | 37 a |
| 13 2.5 | 594 | 230 | 96 | 86 |
| 14 1 | 102 | 31 | 68 | 4 a |
| 14 2 | 67 | 11 | 24 b | 10 a |
| 14 2.5 | 203 | 102 | 66 | 50 a |
| 14 3.5 | 274 | 84 | 54 | 424 |
| 15 1 | 28 | 15 | 11 b | 3 a |
| 15 2 | 196 a | 32 | 62 b | 48 a |
| 15 2.5 | 124 | 54 | 41 b | 28 a |

**See note on Table B-7 *2 of 2*.**

*Source: Parametrix, Inc., April 1996.*

Table B-9 *1 of 2*
**Replicate Mean Abundances of Major Taxa Compared to Reference Stations Using Kruskal-Wallis Tests**
Asarco Sediment/Groundwater OU 06 ROD

| Station | Polychaetes | Molluscs | Crustaceans | Miscellaneous |
|---|---|---|---|---|
| 15.5-1 | 288 | 59 | 53 b | 16 a |
| 15.5-2 | 361 | 97 | 137 | 55 a |
| 16-0.5 | 658 | 127 | 138 | 47 a |
| 16-1 | 183 a | 33 | 59 b | 40 a |
| 16-2 | 96 | 25 | 19 b | 45 a |
| 16.5-1 | 393 | 91 | 352 | 29 |
| 16.5-2 | 394 | 78 | 200 | 77 |
| 17-1 | 667 | 52 b | 829 | 62 a |
| 17-1.5 | 356 | 48 b | 80 | 32 a |
| 17-2 | 289 | 31 | 114 | 67 a |
| 17.5-1 | 1,183 | 111 | 185 | 50 |
| 17.5-2 | 293 | 46 | 201 | 76 |
| 18-2.5 | 259 | 44 b | 142 | 102 |
| 18-3.5 | 313 | 63 | 91 | 36 a |
| 18.5-1 | 154 a | 19 | 69 | 9 a |
| 18.5-2 | 307 | 40 b | 201 | 82 |

Boxed values indicate mean replicate abundance that is significantly less than all appropriate reference stations.

* These stations had depths greater than 150 feet and were compared to REF4B only.

a Replicates abundance significantly less than REF3 and depth less than 150 feet.

b Replicates abundance significantly less than REF2 and depth less than 150 feet.

*Source: Parametrix, Inc., April 1996.*

Table B-9 *2 of 2*

**Replicate Mean Abundances of Major Taxa Compared to Reference Stations Using Kruskal-Wallis Tests**

Asarco Sediments/Groundwater OU 06 ROD

| Chemical | REF | 1B | 1B Dup. | 2A | 2B | 3A | 3B |
|---|---|---|---|---|---|---|---|
| **Metals (mg/kg)** | | | | | | | |
| Arsenic +3 | 0.002 U | 0.002 U | 0.002 U | 0.007 | 0.002 U | 0.002 U | 0.003 |
| Arsenic +5 | 0.017 | 0.034 | 0.180 | 0.39 | 0.081 | 0.021 | 0.030 |
| Monomethyl Arsenic | 0.005 | 0.002 | 0.007 | 0.011 | 0.002 | 0.002 | 0.003 |
| Dimethyl Arsenic | 1.5 | 4.5 | 5.3 | 7.7 | 7.0 | 2.2 | 3.3 |
| Total Arsenic | 0.40 | 0.85 | 10 | 1.9 | 1.7 | 0.92 | 0.75 |
| Cadmium | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Chromium | 0.039 | 0.16 | 0.049 | 0.066 | 0.077 | 0.067 | 0.058 |
| Copper | 4.7 | 0.72 | 6.3 | 5.6 | 6.5 | 5.5 | 5.0 |
| Mercury | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U |
| Nickel | 0.16 | 0.035 | 0..14 | 0..18 | 0.042 | 0.037 | 0.63 |
| Iron | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U |
| Lead | 0.16 | 0.035 | 0.14 | 0.18 | 0.042 | 0.037 | 0.63 |
| Silver | 0.56 | 1.3 | 3.8 | 2.0 | 1.5 | 1.2 | 0.75 |
| Zinc | 0.016 | 0.015 | 0.092 | 0.017 U | 0.018 U | 0.015 | 0.016 |
| | 14 | 12 | 24 | 14 | 16 | 14 | 14 |
| **Organics (µg/kg)** | | | | | | | |
| LPAH | | | | | | | |
| Acenaphthylene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Acenaphthene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Anthracene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Fluorene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Naphthalene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Phenanthrene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| 2-Methylnaphthalene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Total LPAHs | 231 | 231 | 231 | 231 | 224 | 224 | 224 |
| HPAH | | | | | | | |
| Benzo(a)anthracene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Benzo(a)pyrene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Benzo(b)fluoranthene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Benzo(k)fluoranthene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Benzo(g,h,i)perylene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Chrysene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Dibenzo(a,h)anthracene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Fluoranthene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Indeno(1,2,3,-cd)pyrene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Pyrene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Total HPAHs | 330 | 330 | 330 | 330 | 320 | 320 | 320 |
| Total PAHs | 561 | 561 | 561 | 561 | 544 | 544 | 544 |
| Phthalates | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 97 | 510 | 33 U | 41 | 120 | 32 U | 100 |
| Butyl benzyl phthalate | 33 U | 33 U | 170 U | 33 U | 160 U | 32 U | 69 |
| Diethyl phthalate | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Dimethyl phthalate | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Di-n-butyl phthalate | 44 | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Di-n-octyl phthalate | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| **Conventionals** | | | | | | | |
| Moisture (%) | 78 | 77 | 76 | 79 | 78 | 80 | 76 |
| Lipids (%) | 5.3 | 15 | 9.0 | 5.5 | 5.8 | 6.0 | 6.2 |

U = Undected at reported detection limit.

Boxed values are greater than Reference values for that station.

*Source: Parametrix, Inc., April 1996.*

Table B-10
**Rock Sole Whole Body Tissue Chemical Concentrations (wet weight)**
Asarco Sediments/Groundwater OU 06 ROD

| Chemical | REF | 1B | 1B Dup. | 2A | 2B | 3A | 3B |
|---|---|---|---|---|---|---|---|
| **Metals (mg/kg)** | | | | | | | |
| Arsenic +3 | 0.002 U | 0.002 U | 0.002 U | 0.007 | 0.002 U | 0.002 U | 0.003 |
| Arsenic +5 | 0.017 | 0.034 | 0.180 | 0.39 | 0.081 | 0.021 | 0.030 |
| Monomethyl Arsenic | 0.005 | 0.002 | 0.007 | 0.011 | 0.002 | 0.002 | 0.003 |
| Dimethyl Arsenic | 1.5 | 4.5 | 5.3 | 7.7 | 7.0 | 2.2 | 3.3 |
| Total Arsenic | 0.40 | 0.85 | 10 | 1.9 | 1.7 | 0.92 | 0.75 |
| Cadmium | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Chromium | 0.039 | 0.16 | 0.049 | 0.066 | 0.077 | 0.067 | 0.058 |
| Copper | 4.7 | 0.72 | 6.3 | 5.6 | 6.5 | 5.5 | 5.0 |
| Mercury | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U |
| Nickel | 0.16 | 0.035 | 0.14 | 0.18 | 0.042 | 0.037 | 0.63 |
| Iron | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U |
| Lead | 0.16 | 0.035 | 0.14 | 0.18 | 0.042 | 0.037 | 0.63 |
| Silver | 0.56 | 1.3 | 3.8 | 2.0 | 1.5 | 1.2 | 0.75 |
| Zinc | 0.016 | 0.015 | 0.092 | 0.017 U | 0.018 U | 0.018 | 0.016 |
| | 14 | 12 | 24 | 14 | 16 | 14 | 14 |
| **Organics (µg/kg)** | | | | | | | |
| LPAH | | | | | | | |
| Acenaphthylene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Acenaphthene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Anthracene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Fluorene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Naphthalene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Phenanthrene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| 2-Methylnaphthalene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Total LPAHs | 231 | 231 | 231 | 231 | 224 | 224 | 224 |
| HPAH | | | | | | | |
| Benzo(a)anthracene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Benzo(a)pyrene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Benzo(b)fluoranthene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Benzo(k)fluoranthene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Benzo(g,h,i)perylene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Chrysene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Dibenzo(a,h)anthracene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Fluoranthene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Indeno(1,2,3,-cd)pyrene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Pyrene | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Total HPAHs | 330 | 330 | 330 | 330 | 320 | 320 | 320 |
| Total PAHs | 561 | 561 | 561 | 561 | 544 | 544 | 544 |
| Phthalates | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 97 | 510 | 33 U | 41 | 120 | 32 U | 100 |
| Butyl benzyl phthalate | 33 U | 33 U | 170 U | 33 U | 160 U | 32 U | 69 |
| Diethyl phthalate | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Dimethyl phthalate | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Di-n-butyl phthalate | 44 | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| Di-n-octyl phthalate | 33 U | 33 U | 33 U | 33 U | 32 U | 32 U | 32 U |
| **Conventionals** | | | | | | | |
| Moisture (%) | 78 | 77 | 76 | 79 | 78 | 80 | 76 |
| Lipids (%) | 5.3 | 15 | 9.0 | 5.5 | 5.8 | 6.0 | 6.2 |

U = Undected at reported detection limit.

Boxed values are greater than Reference values for that station.

*Source: Parametrix, Inc., April 1996.*

Table B-11
**Rock Sole Fillet Tissue Chemical Concentrations (wet weight)**
Asarco Sediments/Groundwater OU 06 ROD

| Chemical | Species | REF *Evasterias* | 1A *Evasterias* | 1B *Evasterias* | 2A *Evasterias* | 2B *Evasterias* | 3A *Evasterias* | 3B *Evasterius* | 4A *Evasterius* | REF *Mediaster* | 2A *Mediaster* | 2B *Mediaster* | 3B *Mediaster* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metals (mg/kg)** | | | | | | | | | | | | | |
| Arsenic +3 | | 0.002 U | 0.006 U | 0.002 U | 0.015 | 0.002 | 0.002 U | 0.002 U | 0.002 | - - | 0.003 | 0.002 | 0.002 |
| Arsenic +5 | | 0.012 | 0.012 U | 0.009 | 0.485 | 0.007 | 0.019 | 0.005 | 0.008 | - - | 0.043 | 0.019 | 0.020 |
| Total Arsenic | | 0.70 | 0.96 | 0.46 | 2.0 | 0.68 | 0.56 | 0.73 | 1.10 | 3.40 | 4.10 | 4.80 | 3.70 |
| Cadmium | | 0.62 | 0.50 | 0.92 | 0.52 | .028 | 0.46 | 0.42 | 0.07 | 9.90 | 5.10 | 5.80 | 6.30 |
| Chromium | | 0.43 | 0.28 | 0.11 | 0.24 | 0.17 | 0.23 | 0.15 | 0.04 | 0.25 | 0.22 | 0.05 | 0.05 |
| Copper | | 2.8 | 13.0 | 6.8 | 6.9 | 3.2 | 2.3 | 3.3 | 8.1 | 17.0 | 20.0 | 19.0 | 18.0 |
| Mercury | | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U |
| Nickel | | 0.30 | 0.18 U | 0.15 | 0.064 | 0.05 | 0.11 | 0.14 | 0.044 | 1.50 | 0.17 | 0.20 | 0.082 |
| Lead | | 0.15 | 0.26 | 0.43 | 0.16 | 0.05 | 0.59 | 0.55 | 0.26 | 0.30 | 0.38 | 0.59 | 0.50 |
| Silver | | 0.24 | 0.13 | 0.06 | 0.14 | 0.16 | 0.16 | 0.10 | 0.11 | 0.24 | 0.18 | 0.16 | 0.13 |
| Zinc | | 15.0 | 17.0 | 15.0 | 11.0 | 13.0 | 12.0 | 8.9 | 25.0 | 13.0 | 10.0 | 12.0 | 9.7 |
| **Organics ( g/kg)** | | | | | | | | | | | | | |
| LPAH | | | | | | | | | | | | | |
| Acenaphthylene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Acenaphthene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Anthracene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Fluorene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Naphthalene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Phenanthrene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| 2-Methylnaphthalene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Total LPAHs | | 231 | 224 | 231 | 231 | 231 | 231 | 231 | 224 | 231 | 231 | 224 | 231 |
| HPAH | | | | | | | | | | | | | |
| Benzo(a)anthracene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Benzo(a)pyrene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Benzo(b)fluoranthene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Benzo(k)fluoranthene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Benzo(g,h,i)perylene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Chrysene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Dibenzo(a,h)anthracene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Fluoranthene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Indeno(1,2,3,-cd)pyrene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Pyrene | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Total HPAHs | | 330 | 320 | 330 | 330 | 330 | 330 | 330 | 320 | 330 | 330 | 320 | 330 |
| Total PAHs | | 561 | 544 | 561 | 561 | 561 | 561 | 561 | 544 | 561 | 561 | 544 | 561 |
| Phthalates | | | | | | | | | | | | | |
| Bis(2-ethylhexyl) phthalate | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 58 U | 32 U | 33 U |
| Butyl benzyl phthalate | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 110 U | 32 U | 91 U |
| Diethyl phthalate | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Dimethyl phthalate | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Di-n-butyl phthalate | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| Di-n-octyl phthalate | | 33 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | 32 U | 33 U | 33 U | 32 U | 33 U |
| **Conventionals** | | | | | | | | | | | | | |
| Moisture (%) | | 74 | 80 | 85 | 78 | 88 | 79 | 84 | 71 | 72 | 68 | 68 | 74 |
| Lipids (%) | | 3.0 | 4.1 | 9.8 | 3.6 | 4 5 | 6.2 | 4.6 | 2.4 | 2.2 | 2.9 | 3.8 | 4.4 |

*Source: Parametrix, Inc., April 1996.*

Table B-12 *1 of 2*

**Benthic Invertebrate Tissue Chemical Concentration (Wet Weight)**

Asarco Sediments/Groundwater OU 06 ROD

| Chemical | Species | REF *Stichopus* | 1A *Stichopus* | 1B *Stichopus* | 2A *Stichopus* | 2B *Stichopus* | 3A *Stichopus* | 3B *Stichopus* | 4A *Crangon* |
|---|---|---|---|---|---|---|---|---|---|
| **Metals (mg/kg)** | | | | | | | | | |
| Arsenic +3 | | 0.002 U | 0.006 U | - - | 0.002 U | 0.002 U | 0.002 U | 0.002 U | - - |
| Arsenic +5 | | 0.013 | 0.012 U | - - | 0.077 | 0.019 | 0.018 | 0.010 | - - |
| Total Arsenic | | 0.25 | 0.37 | 0.53 | 0.71 | 0.26 | 0.42 | 0.23 | 0.84 |
| Cadmium | | 0.04 | 0.08 | 0.06 | 0.13 | 0.07 | 0.01 U | 0.01 U | 0.15 |
| Chromium | | 0.05 | 0.10 | 0.05 | 0.05 | 0.13 | 0.03 | 0.11 | 0.02 |
| Copper | | 0.4 | 0.4 | 0.3 | 0.7 | 0.2 | 0.2 | 0.3 | 41.0 |
| Mercury | | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U | 0.02 U |
| Nickel | | 0.05 | 0.18 U | 0.03 | 0.03 | 0.03 | 0.05 | 0.04 | 0.19 |
| Lead | | 0.04 | 0.05 | 0.16 | 0.68 | 0.10 | 0.09 | 0.11 | 0.89 |
| Silver | | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.32 |
| Zinc | | 2.7 | 3.8 | 3.9 | 4.0 | 2.0 | 3.4 | 1.9 | 16.0 |
| **Organics (µg/kg)** | | | | | | | | | |
| LPAH | | | | | | | | | |
| Acenaphthylene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Acenaphthene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Anthracene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Fluorene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Naphthalene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Phenanthrene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| 2-Methylnaphthalene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Total LPAHs | | 217 | 224 | 231 | 231 | 231 | 231 | 231 | |
| HPAH | | | | | | | | | |
| Benzo(a)anthracene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Benzo(a)pyrene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Benzo(b)fluoranthene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Benzo(k)fluoranthene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Benzo(g,h,i)perylene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Chrysene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Dibenzo(a,h)anthracene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Fluoranthene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Indeno(1,2,3,-cd)pyrene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Pyrene | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Total HPAHs | | 310 | 320 | 330 | 330 | 330 | 330 | 330 | - - |
| Total PAHs | | 527 | 544 | 561 | 561 | 561 | 561 | 561 | - - |
| Phthalates | | | | | | | | | |
| Bis(2-ethylhexyl) phthalate | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Butyl benzyl phthalate | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Diethyl phthalate | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Dimethyl phthalate | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Di-n-butyl phthalate | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| Di-n-octyl phthalate | | 31 U | 32 U | 33 U | 33 U | 33 U | 33 U | 33 U | - - |
| **Conventionals** | | | | | | | | | |
| Moisture (%) | | 94 | 94 | 94 | 93 | 88 | 93 | 95 | 79 |
| Lipids (%) | | 2.2 | 0.97 | 1.2 | 0.1 U | 0.1 U | 2.0 | 2.7 | 1.1 |

*Source: Parametrix, Inc., April 1996.*

Table B-12 *2 of 2*

**Benthic Invertebrate Tissue Chemical Concentration (Wet Weight)**

Asarco Sediments/Groundwater OU 06 ROD

APPENDIX C

# Outcome of Preponderance of Evidence Approach for Marine Sediments

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 1a | N | N | | N/A | N/A | N/A | N/A | N/A | 1 | No identified exceedances of SQS chemical criteria; bioassay data suggest no current impacts based on lack of significant differences from reference responses. |
| 2 1a | [Y] | N | L | N/A | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As and Hg exceed CSL criteria and minimal adverse biological effects indicated by one bioassay response (bivalve larval effective mortality significantly higher than reference. |
| 2 2 | [Y] | N | | | | | N | N | 2 | Sediment concentration of As exceeded CSL criterion but current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 2 3 | N | N | | | | | N | N | 1 | No identified exceedances of SQS chemical criteria and current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 2 4 | N | N | [L] | | | | N | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by one bioassay response (echinoderm larval effective mortality) significantly higher than reference. |
| 2 5a | N | N | | [C,M,P] | N/A | N/A | N/A | N/A | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by benthic infau al abundances of three major taxonomic groups significantly depressed relative to reference. |
| 2 6a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, buy impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 3 1 | [Y] | N | [L,P] | [C,M] | | | Y | Y | 5 | Multiple exceedances of CSL criteria for sediment chemicals (As, Cu, Pb, Zn) and bioassay and benthic responses significantly different from reference, combined with dominance of pollution tolerant taxa, suggestive of moderate to severe impacts. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 2 | [Y] | N | | | | | N | N | 2 | Sediment concentrations of As and Zn exceeded CSL criteria but concern biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 3 3 | [Y] | N | | | | | N | N | 2 | Sediment concentrations of As, Pb and Zn exceeded CSL criteria but current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 3 4a | [Y] | N | [L] | M | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb and Zn exceed CSL criteria and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference and mollusc abundance significantly lower than reference. |
| 3 5a | [Y] | N | A | M | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb and Zn exceed CSL criteria and minimal adverse biological effects indicated by amphipod mortality significantly higher than reference and mollusc abundance significantly lower than reference. |
| 3 6a | [Y] | N | | N/A | N/A | N/A | N/A | N/A | 2 | Sediment concentrations of As, Cu, Pb and Zn exceed CSL criteria but current biological impacts not suggested given lack of significant differences from reference in bioassay responses. |
| 4 0a | [Y] | [Y] | [L] | | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb, Zn, and individual PAHs exceed CSL criteria and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 4 1a | [Y] | N | [A] | | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb and Zn exceed CSL criteria and minimal adverse biological effects indicated by amphipod mortality significantly higher than reference. |
| 4 2 | [Y] | N | [A] | | | J | Y | N | 4 | Sediment concentrations of As, Cd, Cu, Pb, Ag and Zn exceed CSL criteria and minimal adverse biological effects indicated by amphipod mortality siginificanlty higher than reference. |

**Table C-1—Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species-Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 4-3 | [Y] | N | [L] | -- | -- | H,J,S,SDI | N | N | 4 | Sediment concentration of As, Cd, Cu, Pb and Zn exceed CSL criteria and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference and diversity indices lower than reference. |
| 4-4a | N | [Y] | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but minimal impacts considered possible based on sediment concentrations of a phthalate ester in exceedance of the CSL criterion. |
| 5-0 | [Y] | Y | -- | -- | -- | H,J,S,SDI | Y | Y | 5 | Dominance of the benthic community by pollution-tolerant polychaetes indicative of moderate to severe benthic impacts. |
| 5-0.25 | [Y] | N | [A,L,P] | N/A | N/A | N/A | N/A | N/A | 5 | In the absence of benthic data, the multiple CSL chemical exceedances (As, Cd, Cr, Cu, Pb, Ag, and Zn), combined with multiple bioassay responses significantly different from reference, considered sufficient evidence of moderate to severe impacts. |
| 5-0.5 | [Y] | N | [A,L,P] | N/A | N/A | N/A | N/A | N/A | 5 | In the absence of benthic data, the multiple CSL chemical exceedances (As, Cr, Cu, Pb, Ag, and Zn), combined with multiple bioassay responses significantly different from reference, considered sufficient evidence of moderate to severe impacts. |
| 5-1 | [Y] | N | -- | -- | -- | N | N | N | 2 | Sediment concentrations of As, Cd, Cu, Pb, Ag, and Zn exceeded CSL criteria but current biological impacts not suggested given lack of significantly different from reference, in bioassay responses and benthic community structure. |
| 5-2 | [Y] | N | -- | -- | -- | N | N | N | 2 | Sediment concentration of As, Cd, Cu, Pb, Ag, and Zn exceeded CSL criteria but current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source : Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species-Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 5-3 | [Y] | N | -- | -- | -- | -- | N | N | 2 | Sediment concentrations of As, Cu, Pb, and Zn exceeded CSL criteria but current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 5-4a | [Y] | N/A | [L] | N/A | N/A | N/A | N/A | N/A | 4 | sediment concentration of As exceeded CSL criterion and minimal adverse biological effects indicated by one bioassay response (echinoderm larval effective mortality) significantly higher than reference. |
| 5.5-0 | [Y] | N | -- | C | -- | H.J.S.SDI | Y | Y | 5 | Dominance of the benthic community by pollution-tolerant polychaetes indicative of moderate to severe benthic impacts. |
| 5.5-2a | [Y] | N/A | [L] | M | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb, and Zn exceed CSL criteria and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference and mollusc abundance significantly lower than reference. |
| 6-0a | [Y] | N | -- | M | N/A | N/A | N/A | Y | 5 | Dominance of the benthic community by pollution-tolerant polychaetes indicative of benthic impacts. |
| 6-1a | [Y] | N | [A] | M | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb, and Zn exceed CSL criteria and minimal adverse biological effects indicated by amphipod mortality significantly higher than reference and mollusc abundance significantly lower than reference. |
| 6-2 | [Y] | N | [A,L] | -- | -- | -- | N | N | 4 | Sediment concentrations of As, Cd, Cu, Pb, Ag, and Zn exceed CSL criteria and minimal adverse biological effects indicated by amphipod mortality and echinoderm larval effective mortality significant higher than reference. |
| 6-3a | [Y] | N | -- | M | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb, and Zn exceed CSL criteria and minimal adverse biological effects indicated by significantly depressed mollusc abundance relative to reference. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source : Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species-Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 6-4a | Y | N | -- | M | N/A | N/A | N/A | N/A | 4 | Sediment concentration of As only exceeded SQS criterion but minimal adverse biological effects suggested by significantly depressed mollusc abundance relative to reference. |
| 6.5-0 | [Y] | N | [A] | M | TR | H,J,S,SDI | Y | Y | 5 | Multiple biological results, including bioassay and benthic endpoints that were significantly different from reference and dominance by pollution-tolerant species, suggestive of moderate to severe impacts. |
| 6.5-1 | [Y] | N | [A,L,P] | N/A | N/A | N/A | N/A | N/A | 5 | In the absence of benthic data, the multiple CSL chemical exceedances (As, Cd, Cr, Cu, Pb, Ag, and Zn), combined with multiple bioassay responses significantly different from reference, considered sufficient evidence of moderate to severe impacts. |
| 6.5-2 | [Y] | N/A | [L] | -- | -- | -- | N | N | 4 | Sediment concentrations of As, Cd, Cu, Pb, Ag, and Zn exceed CSL criteria and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 6.5-3 | [Y] | N | -- | M | TR,DA | -- | N | N | 4 | Sediment concentration of As exceeded CSL criterion and minimal adverse biological effects indicated by mollusc abundance and overall community abundance and dominant taxa abundance significantly lower than reference. |
| 7-1a | [Y] | N | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but minimal impacts considered and Zn in excess of CSL criteria. |
| 7-2a | [Y] | N | [L] | -- | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb, and Zn exceed CSL criteria and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 7-3 | [Y] | N | -- | -- | -- | -- | N | N | 2 | Sediment concentrations of As and Cd exceeded CSL criteria but current biological impact not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species-Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 7-4a | [Y] | N | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but minimal impacts considered possible based on sediment concentrations of As in excess of CSL criterion. |
| 7-4.5 | N | N | -- | -- | TA,DA | -- | N | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by benthic infaunal total abundance and dominant taxa abundance significantly depressed relative to reference. |
| 7-5a | Y | N | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not ava lable, but minimal impacts considered possible based on sediment concentrations of As in excess of SQS criterion. |
| 7-6a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 7-7a | N | [Y] | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but minimal impacts considered possible based on sediment concentrations of a phthalate ester in exceed of SQS criterion. |
| 7-12 | N | N | [L] | M | -- | -- | Y | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by echinoderm effective mortality significantly higher than reference and mollusc abundance significantly depressed relative to reference. |
| 8-1a | [Y] | [Y] | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but minimal impacts considered possible based on sediment concentrations of As, Pb, Zn, and a phthalate ester in excess of CSL criteria. |
| 8-1.5 | [Y] | N | [A,L,P] | -- | -- | H | Y | Y | 5 | Multiple biological results, including bioassay and benthic endpoints that were significantly different from reference and dominance by pollution-tolerant species, suggestive of moderate to severe impacts. |
| 8-2a | [Y] | N | L | -- | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Hg, and Zn exceed CSL criteria and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments (Source : Roy F. Weston, Inc., October 1996, Table 7-1).**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species-Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 8-2.5 | [Y] | N | [A,L] | -- | -- | -- | N | N | 4 | Sediment concentrations of As and Hg exceed CSL and SQS criteria, respectively, and minimal adverse biological effects indicated by amphipod mortality and echinoderm larval effective mortality significantly higher than reference. |
| 8-3a | [Y] | N | [L] | -- | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As exceeded CSL criterion and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 8-3.5 | Y | N | -- | M | -- | -- | N | N | 4 | Sediment concentration of As only exceeded SQS criterion but minimal adverse biological effects suggested by significantly depressed mollusc abundance relative to reference. |
| 8-4a | Y | N | -- | -- | N/A | N/A | N/A | N/A | 2 | Sediment concentrations As exceeded SQS criterion but current biological impacts not suggested given lack of significant difference from reference in bioassay responses and benthic abundance data. |
| 9-1 | [Y] | N | [A,L,P] | [C,M,P] | TR,DA,TR,DR | H,J,S,SDI | Y | Y | 5 | Multiple indicators of biological impacts, including significantly reduced abundance and richness values, diversity values less than reference, and bioassay responses significantly different from reference. |
| 9-2 | [Y] | N | -- | -- | -- | -- | N | N | 2 | Sediment concentrations of As exceeded CSL criterion but current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 9-2.5 | Y | N | -- | -- | -- | -- | N | N | 2 | Sediment concentrations of As exceeded SQS criterion but current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 9-3a | Y | N | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but minimal impacts considered possible based on sediment concentrations of As in excess of CSL criteria. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source : Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species-Level Data Suggestiveof Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 9-4a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 9-5a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological dat not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria |
| 9-6a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological dat not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria |
| 9-7a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological dat not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria |
| 9-8a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological dat not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria |
| 10-0a | [Y] | [Y] | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but impacts not considered possible based on sediment concentration of As, Cu, Pb, Zn, and individual PAHs in excess of CSL criteria. |
| 10-1a | [Y] | [Y] | [L] | M | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb, and Zn exceed CSL criteria and minimal adverse biological effects indicated by bivalve larval effective mortality significantly higher than reference. |
| 10-1.5 | [Y] | N | [L] | -- | -- | -- | N | N | 4 | Sediment concentrations of As and Cu exceed CSL criteria and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 10-2 | Y | N | [L] | -- | -- | -- | N | N | 4 | Sediment concentrations of As exceeded SQS criterion and minimal adverse biological effects indicted by echinoderm larval effective mortality significantly higher than reference. |
| 10-2.5 | N | N | -- | -- | -- | -- | N | N | 1 | No identified exceedances of SQS chemical criteria and current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |

**Table C-1—Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds InorganicSQS? | ExceedsOrganic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species-Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 10-3a | Y | N | -- | -- | N/A | N/A | N/A | N/A | 2 | Sediment concentration of As exceeded SQS criterion but current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic abundances. |
| 10-4a | N | N | [A] | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 11-0 | [Y] | Y | [A,L,P] | [C,M,P] | TA,DA,TR | H,SDI | Y | Y | 5 | Multiple indicators of moderate to severe biological impacts, including significantly reduced abundance and richness values, diversity values less than reference, and bioassay responses significantly different from reference. |
| 11-1a | [Y] | N | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but minimal impacts considered possible based on sediment concentrations of As, Cu, Pb, and Zn in excess of CSL criteria. |
| 11-2 | N | N | -- | -- | -- | -- | N | N | 1 | No identified exceedances of SQS chemical criteria and current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 11-2.5 | [Y] | N | -- | -- | -- | -- | N | N | 2 | Sediment concentration of Cu exceeded CSL criterion but current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic abundances. |
| 11-3a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 11-4a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 11-5a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedance of SQS criteria. |
| 11-6a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impact not predicted based on lack of sediment chemical exceedances of SQS criteria |

**Table C1—Outcome of Preponderance of Evidence Approach for Sediments**
**(Source: Roy F, Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species- Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 11-7a | N | N | -- | [C,M,P] | N/A | N/A | N/A | N/A | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by major benthic taxonomic group abundances significantly depressed relative to reference. |
| 11-8a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 11-9a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 12-1a | [Y] | [Y] | [A,L] | M | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As, Cu, Pb, Hg, and Zn exceed CSL criteria and minimal adverse biological effects indicated by bioassay mortality responses significantly higher than reference. |
| 12-2 | Y | N | -- | -- | TR,DR | H,J,SDI | N | N | 4 | Sediment concentrations of As exceeded SQS criterion and minimal adverse biological effects indicated by richness and diversity values lower than reference. |
| 12-2.5 | Y | N | -- | -- | -- | H, SDI | N | N | 4 | Sediment concentrations of As exceeded SQS criterion and minimal adverse biological effects indicated by diversity values lower than reference. |
| 12-3a | Y | N | L | -- | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As exceeded SQS criterion and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 12-4a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS driteria. |
| 12-5a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impact not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 13-1a | [Y] | [Y] | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but minimal impacts considered possible based on sediment concentrations of As, Cu, Pb, Zn, and an individual PAH in excess CSL criteria. |

**Table C1—Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedancea | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species-Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 13-2 | N | N | | | | J | N | N | 3 | No identified exceedances of SQS chemical criteria , but minimal adverse biological effects indicated by a diversity value less than reference. |
| 13-2.5 | N | N | -- | -- | -- | -- | N | N | 1 | No identified exceedances of SQS chemical criteria and current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 13-3a | Y | N | N/A | N/A | N/A | N/A | N/A | N/A | 2 | biological data not available, but minimal impacts considered possible based on sediment concentrations of As in excess of the SQS criterion. |
| 13-4a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 13-5a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS critera. |
| 13-6a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 13-7a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 13-8a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 14-1 | [Y] | N | [A,L,P] | [M,P] | TA,DA,TR | H,SDI | Y | Y | 5 | Multiple indicators of moderate to severe biological impacts, including significantly reduced abundance and richness values, diversity values less than reference, and bioassay responses significantly different from reference. |
| 14-2 | [Y] | N | [A] | [M,P] | TA,DA,TR | H | Y | Y | 5 | Multiple indicators of moderate to severe biological impacts, including significantly reduced abundance and richness values, diversity values less than reference, and bioassay responses significantly different from reference. |

**Table C1—Outcome Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depres | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species-Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 14-2.5 | Y | N | -- | -- | -- | -- | N | N | 2 | Sediment concentrations of As exceeded SQS criterion but current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic abundances. |
| 14-3a | N | N | [L] | -- | N/A | N/A | N/A | N/A | 3 | No identified exceedances of SQS chemicl criteria, but minimal adverse biological effects indicated by echinoderm larval effectively mortality response higher than reference. |
| 14-3.5 | N | N | -- | -- | -- | J | N | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by a diversity value less than reference. |
| 14-4a | Y | N | N/A | N/A | N/A | N/A | N/A | N/A | 2 | Biological data not available, but minimal impacts considered possible based on sediment concentrations of As in excess of the SQS criterion. |
| 14-5a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 15-1 | [Y] | N | [A,L,P] | [M,P] | TA,DA,TR | H,SDI | Y | Y | 5 | Multiple indicators of moderate to severe biological impacts, including significantly reduced abundance and richness values, diversity values less than reference, and bioassay responses significantly different from reference. |
| 15-2 | [Y] | N | -- | M | -- | -- | N | N | 4 | Sediment concentrations of As exceeded CSL criterion and minimal adverse biological effects indicated by mollusc abundances significantly depressed relative to reference. |
| 15-2.5 | N | N | -- | P | TA,DA | -- | N | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by overall abundance and polychaete abundance significantly depressed relative to reference. |
| 15-3a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 15-4a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 5a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 15.5 1 | [Y] | N | [A] | | | H,J,S,SDI | Y | Y | 5 | Differences in benthic community structure, combined with diversity measures lower than reference, considered sufficient evidence of moderate to severe impacts. |
| 15.5 2 | [Y] | N | [L] | | | | Y | N | 4 | Sediment concentrations of As and Cu exceeded CSL criterion and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 16 0.5 | [Y] | N | | | TR,DR | J | N | N | 4 | Sediment concentrations of As and Cu exceeded CSL criteria and minimal adverse biological effects indicated by richness values significantly depressed relative to reference and diversity indices lower than reference. |
| 16 1 | Y | N | [L] | M | | | N | N | 4 | Sediment concentrations of As exceeded SQS criterion and minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference and mollusc abundance significantly depressed relative to reference. |
| 16 2 | N | N | [L] | [M,P] | TA,DA | | N | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by benthic abundance values significantly depressed relative to reference and bioassay exceedances of reference. |
| 16 3a | N | N | L | | N/A | N/A | N/A | N/A | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 16 4a | N | N | [L] | [C,M] | N/A | N/A | N/A | N/A | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by benthic abundance values significantly depressed relative to reference and bioassay exceedances of reference. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 16.5 1 | [Y] | N | | | | J | N | N | 4 | Sediment concentrations of As and Cu exceed CSL criteria and minimal adverse biological effects indicated by diversity value lower than reference. |
| 16.5 2 | N | N | | | | | N | N | 1 | No identified exceedances of SQS chemical criteria and current biological impacts not suggested given lack of significant differences from reference in bioassay responses and benthic community structure. |
| 17 1 | [Y] | N | | | | H,J,SDI | N | N | 4 | Sediment concentrations of As and Cu exceeded CSL criteria and minimal adverse biological effects indicated by diversity values lower than reference. |
| 17 1.5 | Y | N | [L] | | | H | N | N | 4 | Sediment concentrations of As and Cu exceeded CSL criterion and minimal adverse biological effects indicated by diversity values lower than reference. |
| 17 2 | N | N | [L] | M | | | N | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by mollusc abundance significantly depressed relative to reference and echinoderm larval effective mortality significantly higher than reference. |
| 17 3a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 17 4a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 17.5 1 | Y | N | [L] | | | H,J,S,SDI | Y | N | 4 | Sediment concentrations of As and Cu exceeded CSL criterion and minimal adverse biological effects indicated by diversity values lower than reference. |
| 17.5 2 | N | N | [L] | | | | N | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source : Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 18 1a | Y | [Y] | L | M | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As and individual PAHs exceed SQS and CSL criteria, respectively, and minimal adverse biological effects indicated by bioassay and benthic abundance values significantly different from reference. |
| 18 2a | N | N | [L] | | N/A | N/A | N/A | N/A | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 18 2.5 | N | N | [L] | | | | N | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 18 3a | N | N | [A] | N/A | N/A | N/A | N/A | N/A | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by amphipod mortality significantly higher than reference. |
| 18 3.5 | N | N | | | | | Y | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by results of community structure evaluation. |
| 18.5 1 | N | N | [L] | M | TA,DA,TR | H,SDI | Y | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by community structure evaluations, benthic richness and abundance values, and bioassay results. |
| 18.5 2 | N | N | [L] | | | | N | N | 3 | No identified exceedances of SQS chemical criteria, but minimal adverse biological effects indicated by echinoderm larval effective mortality significantly higher than reference. |
| 19 1a | N | N | | | N/A | N/A | N/A | N/A | 1 | No identified exceedances of SQS chemical criteria and current biological impacts not suggested given lack of significant differences from reference in bioassay responsed and benthic community structure. |
| 19 2a | Y | N | | M | N/A | N/A | N/A | N/A | 4 | Sediment concentrations of As exceeded SQS criterion and minimal adverse biological effects indicated by mollusc abundance significantly lower than reference. |

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 1a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |
| 20 2a | N | N | N/A | N/A | N/A | N/A | N/A | N/A | 1 | Biological data not available, but impacts not predicted based on lack of sediment chemical exceedances of SQS criteria. |

Station Notes
- a: Data obtained from the SFS (WESTON, 1993)

General Response Notes
- N: No
- Y: Yes
- [ ]: Response exceeded chemical or biological CSL criteria
- N/A: Data not available.

Bioassay Response Notes
- A: Amphipod (*Rhepoxynius abronius* or *Ampelisca abdita*) bioassay
- L: Larval (*Crassostra gigas* or *Dendraster excentricus*) bioassay
- P: Polychaete (juvenile *Neanthes arenaceodentata*) bioassay

Benthic Response Notes
- C: Crustacean abundance
- M: Molluscan abundance
- P: Polychaete abundance

Abundance and Richness Notes
- TA: Total abundance
- DA: Dominant taxa abundance
- TR: Total Richness
- DR: Dominant taxa richness

**Table C-1–Outcome of Preponderance of Evidence Approach for Marine Sediments**
**(Source: Roy F. Weston, Inc., October 1996, Table 7-1)**

| Station | Exceeds Inorganic SQS? | Exceeds Organic SQS? | Bioassay SQS Exceedances | Benthic SQS Exceedances | Abundance & Richness Significant Depressions | Diversity Indices Below Reference | Community Structure Suggestive of Impacts? | Species Level Data Suggestive of Impacts? | Impact Category | Basis for Impact Category Designation |
|---|---|---|---|---|---|---|---|---|---|---|

Diversity Index Notes

- H: Shannon Weiner Diversity Index
- J: Evenness Index
- S: Simpson's Index
- SDI: Swartz's Dominance Index

Impact Categories

- 1: No current impacts; future impacts not predicted
- 2: No current impacts; future impacts possible
- 3: Current minimal impacts (cause uncertain); future impacts possible
- 4: Current minimal impacts (sediment related); future impacts possible
- 5: Current moderate to severe impacts; future impacts probable

APPENDIX D

# Comment Letters Received During the Proposed Plan Public Comment Period

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
Coastal Protection and Restoration Division
c/o EPA Region X (ECL-117)
1200 Sixth Avenue
Seattle, Washington 98101

RECEIVED
MAR 27 2000
Environmental Cleanup Office

March 27, 2000

Mr. Lee Marshall
Project Manager
U.S. EPA Region X (ECL-111)
1200 Sixth Avenue
Seattle, WA 984101

**Subject: NOAA Comments on the Proposed Plan for the Asarco / Sediments/Groundwater Operable Unit**

Dear Mr. Marshall,

The National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to comment on the proposed plan for the Asarco groundwater and sediment operable unit. Overall, we are pleased with the plan and support EPA's proposal.

General comments:

NOAA appreciates the efforts the two remedial project managers and ASARCO have made to incorporate previous NOAA technical comments and suggestions into the overall cleanup of the former ASARCO Smelter Facility. By combining parts of both operable units, it appears that the sediment remediation will be accomplished sooner than originally scheduled and the use of the upland disposal site for the Yacht Club sediments further streamlines the cleanup.

The natural resource agencies have expended considerable time and effort providing technical advice to EPA, Ecology, ASARCO, and their consultants - this Proposed Plan suggests that it was worth the effort since most of NOAA's previous concerns about the sediments have been addressed. We want to encourage EPA, Ecology, and ASARCO to continue to seamlessly integrate the sediment remediation with the shoreline stabilization. In this way, there should be no wasted efforts between the two operable units cleanups and the impacts to the natural resources will be minimized while the on-going exposures to contaminants will be curtailed sooner rather than later.

NOAA strongly supports EPA's requirement for long-term monitoring of the remedy. Our only concern with the proposed monitoring is that it does not include measuring contaminant concentrations in the waters of Commencement Bay adjacent to the facility shoreline. As explained in our section-specific comments below, we think that monitoring water quality in Commencement Bay is critical and we recommend that EPA include offshore monitoring in the final plan.

As we noted in our recent comments on the Nov. 1999 Explanation of Significant Differences (ESD) for the Commencement Bay Nearshore/Tideflats Superfund Site (2 Feb. 2000), NOAA has consistently based our evaluation of the Commencement Bay investigations and cleanup plans on five basic principles:

1. that cleanup(s) progress sooner rather than later to reduce continued exposure of trust resources to contaminants;
2. a preference for complete removal of contaminants from the aquatic environment (most contaminants originated from the uplands);
3. if the aquatic environment must continue to serve as the repository for the contaminated sediments, we prefer that contamination not be transferred from impacted waterways to otherwise clean areas for disposal;
4. where remedial actions cause adverse impacts (during cleanup or disposal), mitigation for lost natural resources or their services is required; and
5. cleanup and disposal decisions must be made under a baywide planning and evaluation effort, especially for threatened/endangered trust resources and their habitats.

This Proposed Plan appears to satisfy our principles 1,2,3, and 5. Where mitigation is required (principle 4) based on cleanup action details yet to be specified, we would strongly recommend the enhancement of the nearshore/intertidal area immediately south of the slag peninsula along Ruston Way. This could entail the removal of wood wastes from the bottom and re-contouring to allow eelgrass propagation from the existing bed further south. We look forward to reviewing a detailed Clean Water Act 404 analysis and/or mitigation plan.

Section-specific Comments:

Pg 2: Elements of the preferred Alternative, Groundwater: the first item identifies limiting groundwater "loading" *to Commencement Bay* as a remedial objective. The second item identifies monitoring of groundwater as the method to document success or failure of the remedy. However, the Groundwater-Sediments Task Force determined that two processes at the site complicate calculations of contaminant loading to Commencement Bay from discharging groundwater:

(1) tidal cycles in Commencement Bay cause significant fluctuations in the hydraulic gradient at the CB shoreline; these tidal waves intermittently enter the fractures in the slag along the shoreline and mix with discharging groundwater, altering the groundwater gradient, discharging water volumes and the concentration of conservative constituents, such as chloride (Cl); and

(2) the solubility of the metal and metalloid (e.g., arsenic) ions that are contaminants of concern at the site varies with changes in pH and/or redox conditions, both of which are altered as the groundwater mixes with saline, oxygenated seawater within the fractured slag before discharging into Commencement Bay. These processes are described at the bottom of page 7 in the Proposed Plan, also.

COMMENT: Because measurements of groundwater gradients and contaminant concentrations in upland wells are an incomplete predictor of the contaminant loading to Commencement Bay (as explained above), and the dilution from tidal mixing at the shoreline is significant but no precisely quantified; the only way to determine if the shoreline water of Commencement Bay is not contaminated by the metal and metalloid contaminants from the site is to sample the shoreline waters of Commencement Bay and analyze for these constituents.

Pg 5: State Sediment Management Standards - Sediment Cleanup Criteria:
BASIS: Numerous sediment samples at the site had extremely high concentrations of metals and metalloids, variable laboratory bioassay results, and benthic community analyses that did not show any statistically significant differences from reference. The apparent absence of the

expected response (mortality leading to benthic community alterations) at these stations may result from the physical structure of the slag that contains most of the contamination. However, very high concentrations of contaminants remain at the site, and ecological indicators of an adverse response to these contaminants were varied. The toxicity of some of these contaminants can change with changing environmental conditions, e.g. temperature or oxygen availability, and toxicity can vary by organism lifestage. Therefore, it is important that areas where high concentrations of contaminants remain in contact with ecological receptor are monitored over the long-term to demonstrate continued ecological protectiveness.

COMMENT: NOAA supports the proposal not to require active remediation of these areas on the condition that EPA require long-term monitoring to demonstrate whether this decision continues to be protective. It is recommended that this monitoring be coordinated with the long-term monitoring of benthic communities in remediation areas that are dredged and/or capped to make efficient use of equipment and labor.

Pg. 7, Sec. 3.1 Groundwater: "Groundwater at the Facility flows from the southwest to northeast and ultimately discharges to Commencement Bay."

COMMENT: Because Commencement Bay is the ultimate recipient of the contaminated groundwater, and because ecologic receptors along the Commencement Bay shoreline can be adversely affected by these contaminants, NOAA supports the preferred remedy on the condition that long-term monitoring of the site include collection of shoreline water samples for contaminant quantification.

Pg. 8, Sec. 3.1 Groundwater: "DMA-related organic compounds are also present in the shallow groundwater system. However, the DMA, arsenic, and copper in the DMA area do not appear to result in any greater exceedances of surface water criteria in the adjacent Commencement Bay than observed elsewhere at the Facility, For this reason, no special groundwater remedial action is planned for the DMA area. However, *groundwater monitoring* in the DMA area will be part of the post-remedial action monitoring program."

COMMENT: NOAA can support a decision not to take action to reduce. contaminants in groundwater at the DMA area, only if there will be long-term monitoring of the receiving water along the shoreline of Commencement Bay where NOAA trust resources are potentially affected by these contaminants, and with a commitment that if the monitoring data indicate this decision is not protective of the environment, that other remedies will be evaluated for the DMA area.

Pg. 10, Sec. 3.2, Sediment: "Some concentrations of metals and/or biological impacts (as measured with bioassays) exceeded the CSL outside of the Contaminant Effects Area in what is depicted as the "Moderate Impact Area" (Figure 5). The benthic communities in the Moderate Impact Area appear healthy. Because active cleanup might result in greater net negative impacts through destruction of existing habitats than if not remediated, long-term monitoring is proposed in these areas to verify that the overall health of the ecosystem (after the upland and offshore cleanup activities are completed) is remaining the same or improving."

COMMENT: NOAA supports the proposal not to require active rernediation of these areas on the basis that EPA will require long-term monitoring to demonstrate whether this decision continues to be protective. It is recommended that this monitoring be coordinated with the

long-term monitoring of benthic communities in rernediation areas that are dredged and/or capped to make efficient use of equipment and labor.

Pg. 13, Sec. 5.2, Ecological Risk Assessment, Groundwater: "The findings of the Task Force regarding the impact of groundwater on the sediments and waters of Commencement Bay indicate the following:

- The amount of metals currently being discharged (pre-remediation conditions) by ground-water and surface water discharges to Commencement Bay results in the exceedance of applicable water standards for certain metals (e.g., arsenic and copper) within a few feet of the shoreline. The metals load discharged to Commencement Bay by groundwater is expected to decrease after remediation because the most highly contaminated source materials will have been removed and groundwater flow to Commencement Bay will be reduced."

COMMENT: NOAA agrees with EPA's assessment and strongly supports all efforts to reduce groundwater flows through the site which would continue to transport metals into the marine environment. Early interception of the groundwater upstream of the site should be maximized the placement of an impervious cap over the site to eliminate surface water percolation downward then seaward is imperative, and co-precipitation treatment of collected runoff waters on site should be emphasized, if this technique removes significant levels of metals. However, we want to emphasize that the only means to ascertain whether the remedial actions have reduced the discharge of metals (and metalloids such as arsenic) along the shoreline of Commencement Bay to bring them into compliance with applicable water standards is to include sampling of the shoreline water of Commencement Bay in the post-rernediation monitoring. Only a well-designed sampling plan can demonstrate to all parties that the selected remedy has caused shoreline areas to achieve the applicable water quality criteria.

Pg. 15, Sec 6.1, Groundwater Cleanup Objectives:

- "Prevent discharge (to Commencement Bay) of groundwater that exceeds applicable marine surface water quality standards <u>or</u> background concentrations (if background concentrations are higher than the standards)."

AND: "The cleanup goal of 3.1 ug/L for copper is protective of human health and marine life in Commencement Bay. It is acknowledged, however, that the background concentration for copper in the vicinity of the Facility is 40 ug/L, and it may not be possible to achieve the 3.1 ug/L cleanup goal. If not, copper in groundwater will be managed to the 40 ug/L background concentration."

COMMENT: These statements are ambiguous. The information provided above documents that the (upgradient groundwater) background concentration for copper is higher than the acute and chronic ambient water quality criteria. On the basis of the wording of the Groundwater Cleanup Objective, this would indicate that for copper in groundwater the cleanup objective is 40 ug/L. However, the ecologic receptors and the applicable criterion apply to waters of Commencement Bay. It is questionable whether a remedy that does not lead to compliance with the water quality criteria is ecologically protective, and it is possible that even if the groundwater copper concentration is controlled to 40 ug/L, that the shoreline waters of Commencement Bay will not meet the water standard. There are other sources of copper (and other metals and metalloids) contamination along the shoreline such as contaminated surface water runoff and the large deposits of slag, but these sources also are affected by former actions of Asarco.

It is the position of NOAA, as the federal Natural Resource Trustee for marine organisms and habitats, that a goal of the overall remedy should be the attainment of water quality criteria for the protection of marine life in all areas of Commencement Bay affected by former site smelting, manufacturing, and/or disposal, activities.

Pg. 16, Sec 6. 1, Groundwater Cleanup Objectives:

- "Long-term monitoring"

COMMENT: NOAA recommends that this be amended to read; "Long-term monitoring of groundwater and (Commencement Bay) receiving water" in order to demonstrate that the water column used by marine organisms along the shoreline of Commencement Bay is protected by the remedy.

Pg. 21, Sec 7.1 Groundwater: "No remedial action is planned for the Slag Peninsula area (approximately 85,000 $yd^2$ or 17.5 acres) because the water depths and steep slopes make capping or dredging technically impracticable."

COMMENT: NOAA supports EPA's position of not trying to actively remediate the steep portions of the Slag Peninsula Unit located in deep water. Conventional capping techniques for not appear to be productive because of the steep slopes and water depths. NOAA prefers intertidal and shallow subtidal capping to be placed only when equivalent (or more) fill is removed so that there is no net loss of aquatic habitat; for that approach to be used on the slag peninsula it would require the removal of too much of the peninsula before reaching gentle enough slops for the capping material to repose in perpetuity. We are unaware of any other cost-effective and environmentally-sensitive remediation technology to sole these problems.

Pg. 22, Sec. 8.1 Overall Protection of Human Health and the Environment, Groundwater: There isn't any discussion of how the range of alternatives will protect the environment of Commencement Bay, which receives, the discharging groundwater. The marine habitat of Commencement Bay is composed of the waters of Commencement Bay as well as the sediments.

Pg. 23-24, Sec. 8.2 Compliance with Federal and State Environmental Standards, Groundwater: "Samples of Commencement Bay water collected at the shoreline confirm that current laws for marine water quality are not currently met at all locations and at all times. However, metals concentrations in groundwater flowing toward the shoreline are expected to decrease in future years in response to the site-wide changes (i.e., reduced groundwater discharge) affected by the cleanup. These changes are expected to allow state and federal laws to be met at the end of the remedy."

COMMENT: NOAA agrees with the preceding analysis and believes that monitoring of water quality along the shoreline, where contaminated slag will remain in place, is necessary to demonstrate that the remedy has resulted in compliance with Federal and State Environmental Standards for the waters (and habitats) of Commencement Bay. NOAA recommends that the Washington State Water Quality Criteria for protection of marine life be utiuzed as benchmarks for protection of the water column component of marine habitat.

Pg. 25, Sec. 8.3, Long-Term Effectiveness and Permanence, Sediment: NOAA agrees with the analysis in the Proposed Plan and supports the preferred approach which is to dispose dredged contaminated sediments in the upland containment facility with other contaminated

materials. The consolidation of contaminated site materials into a few engineered upland facilities is expected to make long-term operation, maintenance and monitoring of these disposal facilities more efficient and reliable than would disposal into near-shore or sub-aquatic disposal facilities.

Pg. 29, Sec. 9.2.1 *In Situ* Sediment Capping: "*In situ* capping is the Preferred Alternative for the Nearshore/Offshore area and Northshore area. Approximately 88,000 sq. yd. (18 acres) of existing contaminated sediments in the Nearshore/Offshore area will be capped with a minimum of 1 meter of clean sediment from an upland source and approximately 7,000 sq. yd. (1.5 acres) of existing contaminated sediments in the Northshore area will be capped with a minimum of 1 meter of clean sediment. The cap thickness will be designed such that it provides chemical isolation, is stable, and provides a cap surface that will allow recolonization of benthic communities."

COMMENT: While NOAA was originally pessimistic about the feasibility of capping the contaminated sediments in the remaining Nearshore and Offshore Units, the initial results of the Pilot Project supports this approach. Obviously, a fairly coarse material (sand and gravel) will be needed; such materials are often low in organic content(usually in the silt and clay fractions). However, it would be desirable if there is some way that increased organic content could be incorporated into the capping material to enhance biological repopulation. This is a challenge since the organics are usually associated with the finer components which can be swept away by the currents during emplacement. EPA should keep the goal of benthic recolonization in mind during design.

NOAA believes that nothing less than a 1-meter cap will effectively isolate contaminated sediment at the ASARCO site. One of the objectives for the sediment component of the remedy is "Restore and preserve aquatic habitats by limiting and/or preventing the exposure of environmental receptors to sediments with contaminants above Washington State Sediment Management Standards (SMS, WAC 173-204)" (See bottom of pg. 16). In order to accomplish this goal, the habitat value of the sediments must be restored. It is likely that burrowing organisms will recolonize the cap material soon after it is placed, as occurred in the pilot study cap at the site (see the monitoring reports prepared for Asarco by Pararnetrix, Inc.). One organism thought to inhabit the sediment offshore of the Asarco facility is a ghost shrimp (also called mud shrimp). This organism is known to construct burrows 2 feet deep (Garman, personal communication). Other researchers report that Rhost shrimp burrow to a depth of three feet (Ricketts and Calvin, 1962). Bases on this information, we conclude that one meter is the minimum cap thickness that would be effective. It is necessary to isolate contaminated sediment from ghost shrimp and other burrowing organisms to prevent the biota from facilitating transfer of the contaminants to the sediment surface, the water column, and to higher trophic level organisms.(G. F. Riedel et. at., 1989).

Pg. 30, See. 9.2.2 Yacht Basin: "For the dredging alternative, the material would be dewatered, and then placed in a controlled, upland location (known as Crescent Park, in the central part of the upland Facility), that will be monitored for many years. This allows for the long-term effectiveness of the remedy to be monitored. further, the mobility of the contaminants would be reduced, as the sediment would be in a location that does not have contact with water. There will also be contingency plans should the upland cap begin to fail (i.e., get cracks in it)."

COMMENT: NOAA supports the preferred alternative because it permanently removes contamination from a site area that is perturbed by marina activities and only dredging to remove the contamination will allow the marina to continue operations in the future without restrictions on dredging. In addition, isolating the contaminated materials in an upland facility with contingencies for any incipient failure of the containment structure should be easy to monitor and implement because these upland site areas also will be used for isolation of contaminated soils and/or debris.

I hope that these comments are useful to you in reaching a final decision for the cleanup of contaminated groundwater and sediments at the Asarco facility. We look forward to reviewing the design, and especially wish to review the monitoring plan. If you have any questions about NOAA's comments, you may contact me (206/553-2101) or Gayle Garman (206/526-4542).

Sincerely,

Helen E. Hillman

Helen Hillman
Coastal Resource Coordinator

cc: Alyce Fritz, NOAA/ NOS, file copy
Gayle Garman, NOAA/NOS
Robert Clark, NOAA/ NMFS/RC
Robert Taylor, NOAA/GCNR
Rachel Friedman, NOAA/NMFS/HCD
Jeff Krausmann, USFWS
Judy Lantor, USFWS
Michelle Wilcox, WA Dept. of Ecology
John Carleton, WDFW
Bill Graeber, WDNR
Bill Sullivan, Puyallup Tribe
Glen St. Amant, Muckleshoot Tribe

REFERENCES:

Garman, G., NOAA Coastal Protection and Restoration Division. 2000. Personal communication. March 24.

Ricketts, Edward F. and Jack Calvin. 1962. Between Pacific Tides: 3rd Edition revtsed by Joel W. Hedgepeth. Stanford University Press, Stanford California. pp 264-265.

Riedel, Gerhardt F., J. G. Sanders and R. W. Osman, 1989. "The role of three species of benthic invertebrates in the transport of arsenic from contaminated estuarine sediment," J. Exp. Mar. Biol. Ecol. (134) pp. 143-155.

**ASARCO**

**Thomas L. Aldrich**
Site Manager
Tacoma Plan

March 27, 2000

Mr. Lee Marshall
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, ECL-113
Seattle, WA 98401

RE: Response to EPA's Proposed Plan
Asarco Sediments/Groundwater Operable Unit
Surface Water Drainage and Control – (1103)

Dear Mr. Marshall:

In January EPA submitted a Proposed Plan for the sediments/groundwater clean up. Attached are Asarco comments. Asarco appreciates the opportunity to work with EPA and resolve any outstanding issues on the Preferred Alternative.

Please contact Dave Nation or me to further discuss these issues.

Very truly yours,
ASARCO Incorporated

Thomas L. Aldrich
Site Manager

Enclosures

cc: Bruce Cochran - Washington Dept. of Ecology
David Nation, Hydrometrics
Doug Holsten, CH2M Hill
Don Weitkamp & Jim Good, Parametrix

ASARCO Incorporated P.O. Box 1677 Tacoma, WA 98401 (253) 756-0201
INFORMATION CENTER (253) 756-5436 FAX: (253) 756-0250
email: TLAidtich@compuserve.com

**Asarco Comments on:**
**EPA's**
**Asarco Sediments and Groundwater Proposed Plan**
**(January 2000)**

## General Comments

Overall, the Proposed Plan and Preferred Alternative for sediment and groundwater looks very much like what Asarco and EPA have been working towards for a long time. However, there are several areas of the Proposed Plan that should be clarified or revised to make the Plan more easily implemented while maintaining the protectiveness of the Plan. The main areas where Asarco believes the Proposed Plan should be improved are:

1. Definition and identifications of impacted sediment areas
2. Sediment cleanup objectives
3. Sediment cap thickness
4. Sediment monitoring requirements
5. Source of sediment capping material
6. Arsenic and copper Remedial Goals and compliance point
7. Need for additional groundwater capture
8. Treatment of surface water baseflows

## Definition and Identification of Impacted Areas

As Asarco understands the Expanded RI/FS data and the Proposed Plan, all impacted areas that require remediation and can practicably be rernediated will be remediated. However, the use of the terms "moderately impacted" and "minimally impacted" in the Proposed Plan are potentially misleading and may imply that some impacted areas will not be remediated. These terms also seem to ignore the sophisticated approach that EPA and Asarco have taken to identify and characterize areas with contaminant effects. Asarco would prefer that areas simply be identified as "impacted" and "non-impacted" as determined by the preponderance of evidence approach and the extensive sediment effects data.

The approach to identification of impacted areas presented by Asarco in Phase 1 of the Expanded RI/FS was substantially more complex and complete than the approach described in the Proposed Plan. In comparison to the Phase 1 approach, it is extremely simplistic to use "...benthic results... to identify the most highly impacted areas...". Asarco prefers to base impact determinations on all of the detailed sampling and data analysis work that Asarco and EPA have conducted rather than the highly simplistic approach described in the Proposed Plan, which is only a slight modification of the Sediment Management Standards (SMS).

In Phase 1, Asarco evaluated measures of chemistry, bioassays, benthic community results and other types of sampling (e.g., pore water chemistry, pore water bioassays, tissue chemistry, sequential extraction analyses of slag) to determine those measures that appeared to be most highly correlated. The benthic results were evaluated in many ways including relatively simplistic SMS measures and much more powerful data analysis tools (e.g., proportional similarity index and principal coordinates analysis), All of these measures were

evaluated and chemistry, sediment bioassays, and numerous measures of benthic abundance and diversity were used in the final preponderance-of-evidence approach. In this approach, some benthic community measures were given greater weighting than other benthic measures, sediment bioassays, and chemistry. Bulk sediment chemistry results were given the least weight in the preponderance-of-evidence approach. Some other evidence was judged to be inappropriate for use in cleanup decisions.

The purpose of the preponderance-of-evidence approach was to define those areas exhibiting contaminant effects. To "moderate impact areas" were defined in the Phase 1 Report. The preponderance-of-evidence either "tipped the scale" into contaminant effects designation or it did not. Thus, one significantly different bioassay result or a particularly high chemistry result does not indicate a "moderately impacted" area. In such cases, the preponderance of other evidence (mainly various measures of the benthic community) indicates that this area is not impacted. Defining stations that have one significantly different bioassay and/or chemistry result as "moderately impacted" ignores all of the evidence presented in the Phase 1 and 2 Reports that clearly indicate the effects of slag may confound typical SMS interpretations of bioassay and particularly bulk sediment chemistry results. The preponderance-of-evidence approach was not designed to define "in between" or "moderately impacted" areas (see Responses to comments on Phase 1 Report). Consequently, Asarco has never agreed to the proposed definitions of moderately impacted areas.

In the Proposed Plan, the only areas that receive the designation "non-impacted" arc those that do not exceed the bulk sediment chemistry Sediment Quality Standard (SQS). Asarco has collected and reported a vast amount of information indicating that where slag particles are present, bulk sediment chemistry is often irrelevant to the actual toxicity of the sediments. Some sediment stations at the Asarco site were well above the SQS and showed no other evidence by any measure of contaminant effects, yet in Section 5.2 of the Proposed Plan these stations are defined as "minimally impacted". Because there is no evidence of contaminant effects, it is inappropriate to define these stations as impacted in anyway.

The reason described for the minimal impact designation is that the sediments "...may have impacts in the future..." However, EPA provides no scientific evidence to clarify what action or event might reasonably be expected to cause these sediments to have impacts in the future. There is no evidence available from any of the numerous studies completed to support this supposition of potential future impacts. All available information, particularly regarding slag metals availability (e.g., the sequential extraction analysis) and the present healthy state of the benthic community, do not support this supposition. Because there is no evidence that these sediments would reasonably pose future impacts, these sediments should be designated as "non-impacted".

Similarly, Asarco does not agree that stations with "minor biological CSL exceedances" should be designated as "minimally impacted". As stated in the previous comment, Asarco believes this simplistic approach ignores the preponderance of evidence for these stations (all the other benthic and/or bioassay measures) that indicate these stations are not impacted in any way. These stations should also be designated as "non-impacted".

Finally, consistent with the above comments, the remediation area should be defined simply as "impacted stations" not "severely impacted stations."

**Sediment cleanup objectives**

The Proposed Plan describes the sediment clean up objectives for remediation as the State Sediment Management Standards (SMS). Asarco agrees that the SMS may be a useful relatively simple initial measure that can be used as a guideline of the success of the rcmediation. However, it should not be the sole determination of whether the remediation is successful as defined in Section 6.2 of the Proposed Plan.

As discussed above, the SMS uses bulk sediment chemistry, bioassays, and relatively simplistic measures of benthic abundance. Both the data analysis presented in the Phase 1 Report and EPA's own methodology for determining contaminant effects areas presented in the draft Proposed Plan go beyond the simple SMS approach. It is therefore unreasonable to go back to the SMS approach when evaluating the success of remediation.

If the physical and chemical properties of the sediments (e.g., particularly slag particles) can confound the determination of cleanup areas, they can certainly confound the determination of cleanup success. To be consistent with all of the knowledge gained on Asarco sediments over the years, an achievable reasonable sediment cleanup objective must allow for these potentially confounding effects and go beyond a simple SMS type approach.

Asarco recommends that a preponderance of evidence approach as presented in the Phase 1 Report be used to determine the cleanup success. Because this approach may require extensive sampling and data analysis, cleanup success could be determined through a tiered process. The tiered process would use progressively more complex and accurate analyses to determine whether the sediments have indeed been cleaned up similar to PSDDA and the SMS itself. One possible approach would be as follows:

Tier 1. Compare bulk sediment chemistry to SQS values. If sediment chemistry is below SQS, then cleanup objective has been met. If sediment chemistry is above SQS, proceed to Tier 2.

Tier 2. Conduct bioassays (suite to be determined) and compare results to reference sediments (similar to SMS). If bioassays not significantly different (exact criteria to be determined) from reference, then the cleanup objective has been met. If bioassays are significantly different, then proceed to Tier 3.

Tier 3. Conduct benthic community analysis and analyze various measures (to be determined but similar to Phase 1 Report) of abundance and diversity. (In this case the simple SMS benthic measures might be used but some other more complex data analysis must also be included).

Immediately after cap construction, only Tiers 1 and 2 could be used, because no benthic community would be present. However, recourse to Tier 3 would be available several years after construction.

In addition, the use of the word "prevent" in the cleanup objective definition appears to be inappropriate. Asarco agrees that the exposure of receptors to contaminant effects can be "limited" or "minimized". However, cleanup success should not be measured in terms of absolute prevention of all exposure to contaminants to all potential receptors. It is possible that minor exposures might take place, but in overall terms the remediation would still be successful. The success of the remediation should be measure in terms of whether the entire cleanup meets the overall goals of protection of human health and the environment.

**Sediment cap thickness**

EPA's Proposed Plan for the Asarco Sediments/Groundwater Operable Unit provides for sediments to "be capped with a minimum of 1 meter of clean sediment from an upland source." None of the information Asarco has developed during the sediment investigations justifies the "minimum of 1 meter" thickness. Asarco is concerned that EPA has specified a considerably thicker cap than is necessary for protection of the environment of Commencement Bay and human health.

EPA proposes a minimum cap thickness rather than a nominal cap thickness as well as an increase from the 0.6 m (60 cm or 2 ft) cap proposed in the Refinement of Remedy (Parametrix, 2000) to the thicker 1 m cap. These increases represent almost twice as much cap material as originally considered by Asarco and evaluated in the pilot cap tests. Thus, the EPA proposal would be considerably more expensive than the Asarco proposal of a nominal cap thickness of 0.6 m.

No evidence has been provided by EPA that the considerably thicker cap will provide greater protection of the environment in Commencement Bay. Requiring the minimum cap thickness of 1 m requires technical or scientific justification that this increase would provide a substantial increase in protection, No such justification has been provided by EPA or any other entity in the Asarco Sediments evaluations. It appears then, that EPA's requirement for a minimum 1 meter cap is arbitrary, capricious and beyond the scope of the agency's authority given the persuasive evidence for a nominal 0.6 meter cap in the pilot study. Also, under the National Contingency Plan, selected remedies are required to be cost-effective. If a remedy is both protective of human health and the environment, and meets ARARs, it must also be cost-effective. 40 CFR § 300.430(f)(l)(ii)(D). Under the regulation, cost-effectiveness is determined by evaluating three criteria – long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness. One then compares overall effectiveness with cost to see whether the cost is proportional to effectiveness. Both a nominal 0.6 meter cap and a minimum 1 meter cap are protective of human health and the environment and meet ARARs. However, the cost increase attributable to the minimum 1 meter cap is disproportionate to its effectiveness given that the nominal 0.6 meter cap is equally effective. If the remedy is not cost-effective, EPA can't select it.

The rationale for requirement of a minimum cap thickness of 1 m appears to have its origins in the Navy Homeport deliberations of the 1980's. At that time, deepwater disposal and capping of Everett Harbor sediments dredged from the Homeport site was proposed.

Opponents to this action maintained that a minimum cap thickness of 1 m should be required to eliminate any potential that the contaminated harbor sediments would be exposed if ghost shrimp should burrow into the cap. This was based on the theory that ghost shrimp can burrow up to nearly 1 m deep, and that their burrowing would move sufficient quantities of contaminated sediments to the surface to incur a risk to the marine environment.

Asarco has searched, but been unable to find factual information that supports this concern. There appears to be a misconception that the burrowing shrimps (ghost shrimp and/or blue mud shrimp) are a demonstrated threat to a sediment cap in Puget Sound. The potential threat of these shrimp is that their burrowing activities will lead to sufficient contaminated sediment redistributed to the surface layers of the cap to raise contaminant levels above biological effects concentrations, This would require the shrimp to:

- burrow to depths that would penetrate well into the existing sediments or
- actively burrow within the contaminated sediments moving large volumes of the contaminated sediment to the surface, or
- pump large amounts of water through the contaminated sediments extracting substantial concentrations of metals.

None of these actions are probable.

It is valuable to review what is known about the local species of burrowing shrimp. There are two species of subtidal burrowing shrimp in Puget Sound, ghost shrimp *(Neolrypaea californiensis* formerly *Callianassa californiensis*) and the blue mud shrimp (*Upogebla pugettensis*). *Neotrypaea* lives primarily at middle intertidal levels, commonly decreasing in abundance at lower intertidal elevations due to predation (Posey 1985, Posey 1986, Swinbanks and Luterhauer 1987). *Upogebia* also tends to be intertidal but is found commonly at lower elevations. Both species are also found in subtidal areas. *Neotrypaea* is a deposit feeder that actively burrows in the top 10 cm of the sediments where it also constructs a single less active extension of its burrow generally about 30 cm deep, but sometimes as deep 40-50 cm (Swinbanks and Murray 1981). *Upogebia* is a filter feeder that forms a lined burrow that remains constant over time. Its burrow is Y shaped with the lower extension reaching as deep as 50-60 cm. *Upogebia* appears to actively pump water through the U shaped upper portion of its burrow to obtain food.

To our knowledge there have been no investigations demonstrating that sufficient numbers of ghost shrimp are likely to burrow to sufficient depths and move sufficient material to represent any demonstrated risk to the marine environment. We believe it is more likely that small numbers of ghost shrimp might burrow as deep as 60 cm in a cap, and that if they did the quantity of material they would move would not raise surface concentrations of metals to near the sediment quality standards. *Upogebia* does pump water through the upper portions of its burrows to provide food and oxygen. Because its burrows are lined and the active pumping is likely restricted to the upper U shaped portion of their burrows, there is little reason to expect that this water flow would extract measurable levels of contaminants even if the bottom of the burrow did extend into contaminated sediments.

Asarco has been unable to find any reports of burrowing shrimp actually changing the contaminant concentrations of sediments within a cap, or at the surface of a cap. The concern for contaminant redistribution appears to be theoretical rather than demonstrated.

Asarco also believes there is little risk in providing a 60-cm cap. Additional cap material can be added at a later date if monitoring determines there is actual evidence that ghost shrimp or other means are moving contaminants to the upper layer of the cap. The Proposed Plan (page 31) provides for the addition of material if monitoring indicates additional material is warranted.

**References**

Posey, M.H. 1985. The effects upon the macrofaunal community of a dominant burrowing deposit feeder, *Callianassa californiensis*, and the role of predation in determining its intertidal distribution. Dissertation, University of Oregon, Eugene, OR. 119 p.

Posey, M.H. 1986. Predation on a burrowing shrimp: Distribution and community consequences. Journal of Experimental Marine Biology and Ecology. 103:143-161.

Posey, M.H., B.R. Dumbauld, D.A. Armstrong. 1991. Effects of a burrowing mud shrimp, *Upogebia pugettensis* (Dana), on abundances of macro-infauna. Journal of Experimental Marine Biology and Ecology. 148:283-294.

Swinbanks, D.D., J.L. Luternauer. 1987. Burrow distribution of thalassinidean shrimp on a Fraser Delta tidal flat, British Columbia. Journal of Paleontology. 61:315-332.

Swinbanks, D.D., and J.W. Murray. 1981. Biosedimentology zonation of Boundary Bay tidal flats, Fraser River Delta, British Columbia. Sedimentology 28:201-237.

Thompson, R.K. and A.W. Pritchard. 1969. Respiratory adaptations of two burrowing crustaceans, *Callianassa californiensis* and *Upogebia pugettensis* (Decapoda, Thalassinidea), Biological Bulletin. 136:274-287.

**Sediment Monitoring**

Asarco agrees that monitoring of remediated areas is needed to verify cleanup success. However, Asarco does not believe that extensive long-term monitoring of other areas is necessary and believes the cost of this monitoring is substantial given the limited benefit of monitoring non-remediated areas. Asarco believes that EPA's proposed plan for this sampling implies that the RI/FS process was somehow incomplete and that contaminant effects area have not been adequately identified. This is not true. In fact, Asarco and EPA have come to a consistent and scientifically supported decision on areas exhibiting contaminant effects, Asarco also believes that monitoring constitutes a remedial action for

these areas and that EPA does not have authority under CERCLA to require actions for these non-impacted areas.

The Proposed Plan indicates that monitoring of areas outside remediation units will be conducted to "...confirm the assumptions and conditions..." used to make clean up decisions. The Plan further indicates that based on this monitoring, some further action may be needed. Sediment sampling to "confirm assumptions and conditions" regarding areas and volumes of sediments that may exhibit contaminant effects was conducted during the RI and FS studies consistent with Superfund Guidance. The primary purpose of the Expanded RI/FS process was to determine those areas that exhibit contaminant effects, and therefore, require remediation. Prior to conducting the Phase 1 sampling, an extensive monitoring plan was developed with the full participation of EPA and its consultants including methods for evaluating the results of that sampling. It was agreed at that time that a "preponderance-of-evidence" approach would be used to evaluate the numerous types of sampling and data analysis that were conducted. This original concept is entirely consistent with the Superfund RI process, which should define the areas and volumes of contaminated materials to be remediatcd. It has been Asarco's position since completion of the Phase 1 Report that the sampling and analysis effort provided more than sufficient information to determine areas where action such as remediation is needed (with some exceptions in the marina and north shore areas, which were addressed in subsequent sampling).

Under CERCLA Section 104, EPA can take action when a hazardous substance is released into the environment or threatened to be released. EPA can also take action if a there is a release or threat of a release of a pollutant or contaminant which may present an imminent and substantial danger to the public health or welfare. A "pollutant or contaminant" is anything that, when released into the environment and "upon exposure, ingestion, inhalation, or assimilation into any organism either directly from the environment or indirectly by ingestion through food chains will or may reasonably be anticipated to cause death, disease..." or problems with the organism or offspring. 42 USC § 9601(33).

The metals in the sediments outside the contaminant effects area have not been released (they are in the slag matrix), nor are they likely to be released. Moreover, the metals in sediments are not pollutants or contaminants because they are not causing effects. If there is neither a release nor a threatened release of hazardous substances, contaminants or pollutants, the agency cannot compel remedial or response action.

**Source of capping material**

The Proposed Plan specifies an upland source of capping material. There is no justification for specifying that the cap material be derived "from an upland source" and nothing that should preclude an aquatic source of material. Cap material from an aquatic source would be as suitable or more suitable than material from an upland source for biological colonization. There should be no difference in the effectiveness of contaminant isolation with either an upland or an aquatic source. Appropriate material may be available at a lower cost from a marine source. Asarco believes the location and selection of capping material is a Remedial Design task and that the Proposed Plan should not preclude aquatic sources of capping material.

**Dredging depth in the marina**

The Proposed Plan describes dredging to a depth of approximately 2 feet. This is an acceptable depth to use to develop a conservative estimate of dredging volume. However, it needs to be made clear that actual dredging depth will depend on the actual depth of contamination that is verified to be present during Remedial Design mid during actual dredging. There is no evidence of sediments exceeding cleanup screening levels (CSLs) below a depth of 1 ft in the marina.

As part of the Phase 2 Expanded RI/FS, subsurface sediment chemistry core samples were collected by divers at stations 5-0 and 5.5-0 in the yacht basin (Parametrix 1996). The upper layer of sediment that contains metals higher than CSLs was visually distinctive from the deeper sediments that did not exceed CSLs. Cores were observed to contain black sand in the upper 0.4 ft and gray sand from 0.4 to 1.9 ft. Core samples from the upper 1.0 ft exceeded CSLs for arsenic, copper, and zinc. Samples from 1.0 to 1.9 ft were below CSLs.

Divers collected two additional core samples from the shallow, shoreward side of the basin in 1997. Rather than dividing the cores into 1-ft segments, these cores were sectioned according to visually distinctive changes in sediment type. The core from station 5-0.9 was described as a dark olive colored sandy gravel in the upper 17 cm (0.6 ft). The 17 to 18 cm section was gravel with shell debris. Copper exceeded the CSL in the upper section and all metals tested were below CSLs in the 17 to 18 cm section. The other core sample contained olive colored fine sand in the upper 21 cm (0.7 ft). The 21 to 37.5 cm. section (0.7 to 1.2 ft) was silty sand with gravel and cobbles. The upper section exceeded CSLs for copper and mercury and the lower section was less than the CSLs for all metals analyzed.

Additional core samples will be collected in the spring of 2000 as part of the preliminary design analyses for yacht basin dredging. These analyses will help determine whether metals exceeding CSLs are limited to the upper 1 ft of sediments, or if deeper sediments exceed CSLs in any areas of the yacht basin.

**Arsenic and Copper Remedial Action Objectives, Remediation Goals, and Compliance Points**

Asarco strongly prefers that the Preferred Alternative and Proposed Plan result in attainment of Remedial Action Objectives and Remediation Goals (RGs). Asarco's primary concerns regarding the attainment of RAOs and RGs are:

1. The Remedial Action Objectives for groundwater do not match the RAOs of the Asarco Tacoma Smelter Facility Record of Decision ("Upland") ROD. Since the remedial action is being, and will continue to be, implemented as part of the Upland ROD, it appears that the remedial action must "serve two masters".
2. RAOs are overly broad and ignore site-specific information about the risk from arsenic.
3. The compliance point for attainment of RGs is not specified. Depending on location of groundwater compliance points the RGs may not be attainable.

To remedy these concerns, Asarco proposes that:

- the RAOs for groundwater in the Proposed Plan should complement the RAOs for groundwater in the Upland ROD;
- the RG for arsenic should be based on EPA's Site-specific risk assessment that indicates existing groundwater discharges to Commencement Bay do not cause unacceptable risks to human health and the environment; and
- the compliance point for groundwater discharges should be identified as the point of discharge (i.e., post-remedial action groundwater/seawater interface).

Specifically, Asarco proposes the following groundwater RAOs:

1. Prevent ingestion of potable groundwater containing concentrations above Federal MCLs and direct contact with groundwater containing contaminants in concentrations above risk-based goals.
2. Reduce discharge to Commencement Bay of groundwater that exceeds applicable marine surface water quality standards, risk-based levels protective of human health, or background concentrations (if background concentrations are higher than the standards).

Asarco proposes an arsenic remediation goal of 0.012 mg/L based on maintenance or improvement of groundwater arsenic concentration at the slag shoreline.

Asarco proposes a compliance point of surface water along the face of the post-RA slag shoreline.

Remedial Action Objectives

The Proposed Plan modifies the earlier RAOs in the Upland ROD for the Site making them overly broad and inappropriate. EPA's remedial action objectives (RAOs) for groundwater in the Proposed Plan are as follows:

1. Prevent ingestion of or direct contact with groundwater containing contaminants.
2. Prevent discharge (to Commencement Bay) of groundwater that exceeds applicable marine surface water quality standards or background concentrations (if background concentrations are higher than the standards).

For comparison, the Upland ROD RAOs are:

1. Prevent ingestion of potable (Class IIB) groundwater ... containing contaminants in concentrations above ARARs or above risk-based goals when ARARs are not protective or not available.
2. Reduce discharge to Commencement Bay of contaminated waters containing contaminants in concentrations above ARARs or risk-based goals when ARARs are not protective or not available.

As written, Proposed Plan RAO #1 is neither achievable nor necessary. EPA has substituted “groundwater” for “potable groundwater” and “groundwater containing contaminants” for groundwater ... containing concentrations above ARARs...” All groundwater, everywhere, contains “contaminants” but that is not a problem for human health or aquatic life unless concentrations are too high (i.e., above ARARs or risk-based goals). As written the RAO is

so broad that it is nearly meaningless and gives no direction to the goals that are to be achieved.

Compared to the Upland ROD RAOs, Proposed Plan RAO #2:

- substitutes "prevent discharge to Commencement, Bay of groundwater" for "reduce discharge of contaminated water"; and
- substitutes "background concentrations" for the phrase "risk-based goals when ARARs are not protective or not available".

Prevention of discharge of groundwater from the Site is not technically possible. However, the Preferred Alternative will reduce the discharge of groundwater from the Site to the extent practicable and will reduce the discharge of contaminants to levels that are clearly protective of human health and the environment.

Background concentrations are not appropriate substitutes for risk-based goals for arsenic since Site-specific risk information and protective risk-based goals are available. The Proposed Plan correctly points out that

> "*Neither the Maximum Contaminant Limits (MCLs) promulgated under the Federal Clean Water Act nor the State of Washington Model Toxics Cleanup Act (MTCA) groundwater cleanup levels are considered Applicable or Relevant and Appropriate Requirements (ARARs) for the shallow groundwater system at the Facility." page 15, Proposed Plan*

In this case, it is appropriate to use risk-based levels and EPA correctly notes that:

> *"Currently, the groundwater discharging to Commencement Bay will exceed human health risk based levels for fish consumption (0.14 µg/L for arsenic) (National Toxics Rule; CFR 40, § 131.36). However, past fish tissue sampling indicates low risk from Facility contaminants even to people consuming large quantities of fish from the Facility." page 15, Proposed Plan*

However, the RAO and RG for arsenic fail to acknowledge EPA's uncertainty in the National Toxics Rule (NTR) fish consumption limit and fails to acknowledge EPA's Site-specific data and risk assessment. The NTR does not reflect the current understanding of arsenic health risks. EPA has been reviewing the NTR arsenic criteria for several years with the intent to revise the criteria. EPA's risk assessment indicates that existing risk from fish consumption is acceptable and will be lowered further by implementation of the Preferred alternative.

CERCLA Section 121(d)(2)(B)(i) provides a standard for determining whether or not any water quality criteria under the Clean Water Act is relevant and appropriate. In making this determination, Section 121 directs that the Agency:

> "...shall consider the designated or potential use of the surface or groundwater, the environmental media affected, the purposes for which such criteria were developed, and the latest information available."

The existing human health criteria for arsenic in the NTR does not reflect the latest information available and does not consider Commencement Bay, the environmental media affected. EPA is currently in the process of revising the human health criteria for arsenic in the NTR. Recent infortnation on arsenic risks in Commencement Bay are available in EPA's risk assessment entitled "EPA Ecological Risk Assessment and Seafood Consumption Screening Risk Assessment Asarco Sediment Site – October 1996." Given the uncertainty in the NTR arsenic level and the existence of more recent Site-specific data, Asarco believes that the NTR arsenic level should not be an ARAR for the Site in accordance with CERCLA Section 121(d)(2)(B)(i). In establishing the RAO for arsenic in groundwater, EPA should consider the latest information on the environmental media affected. The latest information available is EPA's risk assessment on Comnicncement Bay. Asarco proposes that the RAO be revised to include the use of risk-based limits for arsenic.

Remediation Goal for Arsenic in Groundwater

For current arsenic risks EPA's risk assessment (EPA, October 1996) concluded:

1. The potential for adverse non-cancer health effects associated with ingestion of fish caught near the site is low (i.e. at or below the hazard quotient benchmark value of 1.0).
2. For the reasonable maximally exposed individual, inorganic cancer risk estimates are close to but not greater than the upper end of the risk management range recommended in the NCP ($1 \times 10^{-6}$ to $1 \times 10^{-4}$) at fish ingestion rates greater than approximately 150 grams per day.
3. For the average case individual, inorganic cancer risk estimates are within or below the NCP risk management range at all fish ingestion rates considered.

Or as summarized by EPA in the Proposed Plan:

> *"...past fish tissue sampling indicates low riskfrom Facility contaminants even to people consuming large quantities offish from the Facility." page 15, Proposed Plan*

In light of Site-specific data regarding the low arsenic risk from seafood ingestion, Asarco proposes that an appropriate RG for arsenic would be based on maintaining existing arsenic concentrations in groundwater discharging to Commencement Bay. Since the Preferred Alternative will result in a substantial decrease (to the extent practicable) in the amount of groundwater flow to Commencement Bay, maintaining groundwater arsenic concentrations would result in substantial decreases in the load (or mass) of arsenic discharged to Commencement Bay. Therefore, the Proposed Remedy with Asarco's proposed RG would result in further reduction to the maximum extent practicable of the already acceptable arsenic risk.

Groundwater Compliance Point

The Proposed Plan does not specify a compliance point for groundwater discharging to Commencement Bay. Asarco proposes that the compliance point for groundwater discharges should be in the surface water as close as technically possible to the point or points where ground water flows into the surface water. After remediation, the point on the Site that is "as close as technically possible to the point or points where the ground water flows into the surface water" will be surface water along the face of the stabilized and protected slag

shoreline. This compliance point of surface water along the face of the post-RA slag shoreline would protect the water resource at the point of possible human or aquatic life exposure and would comply with MTCA.

Under Washington's Model Toxics Control Act (MTCA), groundwater compliance monitoring points should be selected to be "as close as technically possible to the point or points where the ground water flows into the surface water." (WAC 173-340-720(3)(b)(v)). Furthermore, "At these sites [where the affected ground water flows into nearby surface water], the department may approve a conditional point of compliance that is located within the surface water as." (WAC 173-340-720(6)(d)). Presently, the point where groundwater flows into surface water on the Site is the face of the slag shoreline. During Upland remediation, the face of the slag shoreline will be armored to prevent erosion. After Upland remediation is completed, the point where groundwater flows into surface water on the Site will be the face of the armored shoreline. Therefore, the proposed groundwater compliance point is surface water at the face of the post-RA shoreline.

**Additional groundwater capture**

The Proposed Plan delays a final decision on the need for additional groundwater controls pending additional remedial design analysis. Asarco believes that the existing information demonstrates that additional groundwater controls are not appropriate and that ongoing evaluations during Remedial Design are unnecessary.

The hydrologic analyses of the feasibility of additional upgradient groundwater controls have been completed and draft reports have been submitted to EPA. These analyses demonstrate that additional groundwater controls would capture negligible amounts of additional groundwater and contaminants. Capture and treatment would reduce some, but not all metal concentrations in the captured groundwater and would eliminate the current reduction in arsenic concentrations provided by natural attenuation on the Site. Therefore, little or no environmental benefits would be realized by the additional groundwater capture. Costs associated with constructing an interception system and the additional treatment costs would be substantially and disproportionately expensive relative to the environmental benefit received.

**Treatment of Captured Groundwater**

The Proposed Plan presumes that treatment of groundwater will be necessary. The Proposed Plan should clearly state that treatment is not required unless treatment is necessary to meet Remediation Goals. Moreover, it is important to note that:

- Design of the stormwater treatment system is an Upland Remedial Design task.
- Design of the stormwater treatment system is based on treating stormwater, not groundwater.
- Design of the stormwater treatment system is ongoing.

Therefore, the Proposed Plan needs to be flexible regarding treatment of groundwater by the yet to be designed stormwater treatment system. One area in which the Proposed Plan may unduly constrain design of the surface water treatment system regards the treatment of groundwater during baseflow (i.e. non-stormwater flow) periods. The Proposed Plan needs to

allow the potential for bypass of captured groundwater from treatment during baseflow periods if such bypass is consistent with stormwater treatment.

## Specific Comments

**Page 3, 5th bullet.** This bullet states that Asarco will monitor the dredged area "...to ensure that it is not becoming recontaminated." Asarco is responsible for recontamination, if any that originates from the Site, but cannot ensure that the Yacht Basin will not become recontarninated from marina activities.

**Page 4, 3rd bullet.** The Refinement of the Proposed Remedy Report was revised and submitted to EPA on January 5, 1999. This document should be referenced instead of the August 1999 draft.

**Page 4, document list.** The Copper in Nearshore Marine Water Technical Memorandum submitted to EPA on June 23, 1999 should be included in the list of documents providing additional detailed information.

**Page 6, first para.** Sentence states *"The shallow aquifer system beneath the Facility is largely recharged by lateral flow of groundwater from the southwest (Ruston area) and infiltration of precipitation and surface water run-on."*

It would be more accurate to say *"The shallow aquifer system beneath the Facility is largely recharged by infiltration of precipitation and surface water run-on and to a minor extent by lateral flow of groundwater from the southwest (Ruston area)*".

**Pg. 9, 3rd full para.** This paragraph compares site tissue concentrations to reference tissue concentrations and ignored the sections of the Phase 1 Data Report that showed "...the site station tissue chemistry was found to be indistinguishable from the reference station tissue chemistry in all cases (see Table 8-3)." In other words, the differences were not statistically significant. Further, it is not appropriate to state that tissue concentrations are elevated without providing any risk context. Anyone that only gets this far reading the document may not learn that these tissue concentrations are acceptable using EPA's risk criteria, as stated later in the Proposed Plan.

**Page 9, last full para.** This paragraph seems to state that copper exceeds the marine chronic criteria (MCC) at all locations in Commencement Bay near the Site. This is not true. The best data available to Asarco and EPA indicates that copper concentrations currently exceed the MCC at about half of the sampling locations along the shoreline and only in very close proximity to the slag shoreline. At most locations, seawater a few feet away from the slag meets all aquatic life criteria for copper and all other metals.

In conjunction with the Asarco Sediment/Groundwater Task Force (ASGTF) Asarco conducted two rounds of special seawater monitoring in 1999 to determine copper concentrations in seawater near the Site. This seawater monitoring employed ultraclean sampling and analytical techniques and yielded analytical sensitivities and accuracies several

orders of magnitude better than techniques previously available. Results of this monitoring were submitted to EPA in a June 1999 Draft Technical Memorandum and in a November 16, 1999 data transmittal. The ultraclean monitoring data demonstrates that copper concentrations do not exceed criteria in all samples; only samples collected near the shoreline in some areas.

**Page 13.** The First Bullet is incorrect regarding Task Force findings related to arsenic. The Task Force found (see page 6-5 of the March 1999 ASGTF Group 5 Technical Memorandum) that groundwater discharges currently cause water column concentrations to exceed only the copper chronic aquatic life criterion. Current water column concentrations of arsenic and other metals are better than the chronic aquatic life criterion.

**Page 14, 1st para.** What does "nonminimally impacted" mean?

**Page 15, Remediation Goals.** At a minimum it would seem appropriate for EPA to acknowledge that the NTR arsenic criteria is under revision. It might also be appropriate to establish that if the arsenic RG can not be met, then the revised arsenic criteria would be considered in determining the need for additional groundwater controls/remediation.

**Page 16, 2nd para.** Deep groundwater does not presently exceed MCLs or MTCA standards for any parameters except possibly arsenic (see Summary and Interpretation of 1994, 1995, 1996, 1997 and 1998 Post-RI Long-Term Monitoring Results (Hydrometrics, 1999) and Table 4-3 in Summary and Interpretation of Production Well Abandonment Action-Specific Monitoring Results (Hydrometrics, June 1997).

**Page 20, Table 7-3.** The note for alternative S-2D states: "As a contingency, if all the contaminated material cannot be removed from the Yacht Basin, dredging in the Basin followed by placement of clean material may occur." EPA should acknowledge that slag will remain in the Yacht Basin following dredging and that this material, though it may exceed CSLs, has been shown to not exhibit contaminant effects at other areas of the Site. It would not be possible to remove all the slag exceeding CSLs from the basin without removing the entire breakwater peninsula, and dredging at the base of the peninsula will need to be designed so that it does not destabilize steep slopes. Placement of clean material over the slag will not be necessary because the metals in slag are bound in a rock-like form and are not necessarily available to the benthic community.

**Page 23, last para.** The Plan states *"Modeling performed by the Task Force indicates that state and federal laws applicable to protection of marine water quality may not be currently achieved within a few feet of the shoreline for all metals."* Although model results did indicate some metal concentrations above marine chronic criteria, the Task Force placed more emphasis on empirical data rather than model predictions in concluding impacts from groundwater. The Task Force concluded that with the sole exception of copper, groundwater discharge currently does not cause metal concentrations to be higher than marine chronic criteria (see page 6-5 of the March 1999 ASGTF Group 5 Technical Memorandum).

**Page 25, 2nd para.** States *"The in situ treatment and seawater injection treatment alternatives would promote chemical precipitation (i.e., "settling out") of arsenic from groundwater, thereby reducing the arsenic load reaching Commencement Bay."* Based on the Asarco Sediment/Groundwater Task Force evaluations, the effectiveness of in situ treatment is uncertain given that seawater already oxidizes and removes arsenic to the extent practical, with the exception of the Southeast Plant area.

**Page 28, bottom of page**. It states *"Additional groundwater interception is being considered at the Facility, and may also be considered by EPA at a later date. The need for additional groundwater interception would be based on the results of ongoing groundwater sampling."* Earlier in the Proposed Plan (3rd paragraph, pg. 27) it is stated that additional diversions are disproportionately expensive and would only be considered if cleanup goals could not be met. Asarco agrees that additional interception is disproportionately expensive and believes that additional interception should only be considered if cleanup goals are not met.

**Page 29, 3rd para.** It states *"At a minimum, monitoring wells at the downgradient perimeter of the Facility (along the shoreline) will be monitored, including wells near source areas."* Rather than *"wells near source areas"*, it would be better to say, "wells near source areas if, and to the extent compatible with, protection and maintenance of the cap."

It further states *"In addition, should the groundwater indicate high concentrations of metals, contingency actions, such as additional groundwater diversions, may be considered"* What is meant by high metal concentrations? Above cleanup goals? Where? It is expected that concentrations will remain above cleanup goals in and near source areas but this occurrence alone should not trigger additional diversions. Given EPA's broad authority under the five year review provisions of the Upland ROD, this last sentence is unnecessary and should be deleted. If the sentence is retained, then EPA should specify the trigger criteria of "high concentrations of metals". Asarco believes appropriate trigger criteria would be remedial action objectives and remediation goals (including Asarco's proposed changes) at a compliance point located in surface water along the armored slag shoreline.

RECEIVED
MAR 29 2000
Environmental Cleanup Office

WASHINGTON STATE DEPARTMENT OF
**Natural Resources**

JENNIFER M. BELCHER
Commissioner of Public Lands

March 27, 2000

Mr. Lee Marshall, Project Manager
Office of Environmental Cleanup
US EPA Region 10
1200 Sixth Avenue, MS ECL-111
Seattle, WA 98101

Subject: Comments on the Proposed Plan, *Asarco-Sediments/Groundwater Operable Unit, Ruston and Tacoma, Washington*, January 2000

Dear Mr. Marshall,

Enclosed please find comments regarding the Asarco Sediments and Groundwater Proposed Plan. The comments are provided on behalf of the Washington State Department of Natural Resources (DNR) and are based on a summary review of the Proposed Plan document. We appreciate the opportunity to provide input and would like to thank the Environmental Protection Agency (EPA) for extending the comment deadline in response to our letter dated February 4, 2000. It is our understanding that the comments will be considered by EPA in the determination of a cleanup plan for the site.

As trustee and land manager for public aquatic lands at the site, we rely on clear standards for use of public aquatic lands - standards that are defined in state laws and the state Constitution, in long-standing policies and strategies for implementing these laws, and in guidance developed to ensure we effectively and permanently solve current contamination and avoid future contamination.

Based on the information provided in the Proposed Plan, we believe that additional evaluation is necessary to ensure that we can meet the management standards for public aquatic lands at this site and in the bay. Specifically, we are concerned about restoration and sustainability of natural resources at the site as a component of the overall function and productivity of Commencement Bay. We are also concerned about appropriate short-and long-term land use, source control, and risk and responsibility management. The following discussion identifies a number of issues that we request receive further consideration.

1111 WASHINGTON ST SE P.O. BOX 47000 OLYMPIA, WA 98504-7000
*FAX: (360) 902-1775 TTY: (360) 902-1125 TEL: (360) 902-1000*
Equal Opportunity/Affirmative Action Emoloyer

Endangered Species Act (ESA)

We anticipated that the extension to the comment period would provide the opportunity to review the Proposed Plan in the context of the Commencement Bay Biological Assessment (BA). We view the BA as critical to decision-making at all scales in the bay, including site-specific cleanup actions. Without consideration of the BA, we do not believe that our common goal of achieving cleanup in a broader ecosystem management context can be ensured. We also cannot evaluate the adequacy of the proposed site-specific remedial action in achieving ESA compliance without review by and discussion with EPA and National Marine Fisheries Service of the BA and the biological opinion. Until this information and analysis is available, we remain concerned that the effects of the proposed remedial action on critical habitats for chinook salmon are not resolved at either a site or baywide scale.

For example, we are concerned with the lack of information and guidance on the functional linkages between deep water (>-10 MLLW) epibenthic habitats and the foodweb for young-of-year and immature resident chinook salmon. Recent studies of the polychlorinated biphenyls body burdens for Puget Sound chinook and herring stocks indicate an exposure pathway link between the benthic community and the pelagic foodwebs of these species. This information argues for a very conservative approach to remediating chemicals of concern for bioaccumulation, such as arsenic and mercury.

We are also concerned that the proposal does not restore the healthy nearshore habitats, both as salmonid migration corridors and as intertidal feeding areas, that once existed at the site. In addition, we believe that decisions regarding cleanup objectives are based on incomplete information. We encourage incorporation of the latest information from the federal services - particularly results of current NMFS efforts - on cleanup standards that are protective of trust resources.

Available information suggests that numerous individuals from the White River chinook stock are expected to rear nearshore at the Asarco site for extended periods. The proposed plan does not provide sufficient information to determine the degree to which chinook salmon will be restored and protected. We encourage EPA to more actively integrate the numerous cleanup decisions necessary throughout Commencement Bay within the context of the Commencement Bay BA and biological opinion. We are interested in working with EPA on a management plan for the entire bay that defines both site-specific and baywide implementation actions, with net gain in habitat area and function being one of the primary plan objectives.

Land Use

The current proposal includes the permanent capping of contaminated sediments in place. Siting such permanent caps within the City of Tacoma Harbor Area - as the proposal currently does - is problematic in that the caps may be inconsistent with constitutional, statutory and regulatory directives. The main issues are:

- Capping as a mechanism for contaminated sediment storage is a non waterdependent use. Non water-dependent uses in harbor areas are considered interim uses and can only be allowed if defined criteria are met (e.g., compatibility and exceptional circumstance analyses and other factors, Washington Administrative Code (WAC) 332-30-137);

- Institutional controls (i.e., Regulated Navigation Area) likely necessary to maintain the integrity of the capped areas will limit commerce and navigation in a Harbor Area. However, Harbor Areas are reserved for conimerce and navigation in the Washington State Constitution; and

- Caps displace navigation and increase present navigational hazards.

In addition, some of the proposed cap appears to extend beyond the outer harbor line. This is especially problematic because Article XV Section 1 of the Washington State Constitution establishes that "the state shall never give, sell, or lease to any private person, corporation, or association any rights wbatever in the waters beyond such harbor lines."

If the proposed caps are authorized, the City of Tacoma's Harbor Area will have to be adjusted, a time-consuming process subject to rules detailed in WAC 332-30-116. A Harbor Area relocation should maintain or enhance the type and amount of harbor area needed to meet long-term needs of water dependent commerce. The relocation should also maintain adequate space for navigation beyond the outer harbor line. After these findings are made, there are other issues to be considered (see WAC 332-30-116(2)).

We have identified to EPA the value of the Asarco area as an important functional component to the overall Harbor Area in Commencement Bay. We continue to encourage EPA to define a plan that recognizes this important land use role and that allows a balance between commerce/navigation and habitat functional needs. The cleanup plan should not impact the existing deep draft capability at the site or lessen the current and future capacity for structures associated with navigation and commerce.

Permanence of Proposed Remedy

The proposed plan does not define the design life for the remedy. It is uncertain how long monitoring will occur, under what conditions monitoring will be enhanced or curtailed, and what will trigger contingency actions now and in the future. These and other concerns lead to uncertainty regarding the permanence of the remedy and to questions regarding how exhaustively more permanent solutions were explored.

For example, the proposal to cap the north nearshore unit is not supported by the information and analysis. The costs shown demonstrate that dredging and upland disposal, a more permanent remedy, is less expensive. Costs associated with mitigation for habitat impacts due to cap design, as well as a number of additional costs - including potential compensation for use of public aquatic lands - not included in the existing analysis, will increase the costs associated with the capping alternative. We therefore do not support capping of this unit.

We also believe that permanent solutions such as treatment are viable. Vendors are providing treatment rates of around $29 per cubic yard. We encourage EPA to further evaluate treatment as part of the decision-making process.

For public aquatic lands, the state laws, the state Constitution, and the existing policies, strategies, and guidance for implementing these laws do not support the use of public aquatic lands for permanent storage of contaminated material. If contamination is to be temporarily stored on public aquatic lands, the worst of the contamination must be removed for treatment or upland disposal, and the remaining storage site must be designed to allow future removal for treatment or upland disposal once technology makes it feasible to do so. Neither the alternatives analysis nor the resulting proposal to cap recognizes or incorporates these standards for use of public aquatic lands.

Source Control

The proposal for the sediments unit does not adequately provide for long-term isolation of materials. For example, the porous slag slopes and incomplete armoring will result in continued release of fine-grained slag particulates to the nearshore sediments. More innovative alternatives to reduce the slopes to allow more effective armoring or to isolate the peninsula in some other way need to be more thoroughly analyzed. The benefits and total costs (including on-going source control, long-term operation and maintenance, and contingency actions) associated with all potential alternatives need to be fully evaluated in order to make well-informed decisions.

We strongly support alternatives to actively remove and treat contaminated groundwater, and we encourage a commitment to long-term, intensive monitoring to determine effectiveness of the remedy. We also encourage removal of any leaking, unused and/or abandoned pipes and any other debris or unnecessary structures along the shoreline. Finally, we would like to discuss the potential reuse of the treated groundwater as a resource for restoration of a stream delta estuary. Such a delta existed on-site prior to development. The value of these small estuaries as nodes of productivity is becoming more widely recognized. Salmonid species such as chinook, chum, and cutthroat have been documented to preferentially target these areas in their utilization of nearshore corridors. The potential for creation of a stream delta estuary appears to exist on the southeast portion of the site. Integration of planning for such a project with the remedial and damage assessment actions may provide opportunities for an improved, less expensive, more comprehensive project.

Natural Resource Damages

The facility's operations have filled and/or degraded a substantial acreage of aquatic lands. The values of the public aquatic lands for a broad range of functions and services are damaged. The proposed remedy does not restore those values, and Asarco has not proposed to compensate the State of Washington as a natural resource trustee for past and on-going losses. We will seek natural resource damages for functions and services that are not restored in order to compensate the citizens' natural resource trust values.

The extent of damages will be highly-dependent on the degree to which the functions of aquatic lands have been and will continue to be injured by slag deposition/deposits, groundwater, runoff, point discharges, and other releases of injurious contaminants. We encourage the resolution of natural resource damages claims in conjunction with the remedial action processes at the site.

Text-Specific Comments

- (Section 5.2) It is unclear how healthy biological communities are being defined. How was this determined? Diversity, abundance, both?
- (Section 6. 1) What happens in the future if and when background concentrations and laboratory detection limits drop? Will cleanup goals track these drops, if they occur, until it reaches the National Toxics Rule standard of 0. 14 µg/l for arsenic. Likewise for copper.
- (Section 7) What is the term of the OMMP?

- (Table 7.2 and 7.3) Alternative S-1E: Dredge and Upland Disposal has a present worth cost of $26.2 million for 88,000 cy. This is $298/cy. Alternative S-2D: Dredging and Upland Disposal has a present worth cost of $3.6 million for 55,000 cy of Yacht Basin sediment. This is $65/cy. Why is one over 4.5 times more than the other?
- (Section 8.1) Do you understand why fish tissue remained below risk thresholds even though groundwater exceeds human health risk based levels for fish consumption? If not, how can you be sure that the environmental conditions which allow this to happen will remain constant?
- (Section 8.1) Were the full range of potential organisms considered when determining the thickness of cap necessary to prevent recontamination due to bioturbation?
- (Section 9.2) The plan should require that institutional controls, maintenance and monitoring results be shared and coordinated with DNR.
- (Section 8.6) Since the following sentence claims that pump and treat is reliable and available, by "difficult" do you mean costly?
- (Section 8.7) The sentence "For all sediment areas, upland disposal is less costly than nearshore confinement" is not consistent with Table 7.2.
- (Section 9.1.1) What will be the final quality of treated groundwater?
- (Section 9.2.1) The likely static and dynamic slope stability risks indicate the need for a more permanent solution.
- (Section 9.2.4) What is the contingency for heavy erosion of the cap?

We appreciate the opportunity to provide input to EPA. We also appreciate EPA's effort to address issues. In particular, we applaud the recent discussions with local citizens about their concerns, many of which we share. We look forward to active involvement with the interested parties to resolve issues as the process moves forward. If you have any questions or concerns, please feel free to contact me at 360-902-1148, **chuck,turley@wadnr.gov** or Amy Kurtenbach at 360-902-1029, **amy.kurtenbach@wadnr.gov.**

Sincerely,

Tamara Allen for

Charles W. Turley
Assistant Division Manager
Aquatic Resources Division

c: Maria Victoria Peeler, Division Manager, DNR Aquatics
Mark Mauren, ADM, DNR Aquatics
Amy Kurtenbach, DNR Aquatics
Tammy Allen, DNR Aquatics
Kathy Marshall, DNR SPS Region
Bill Graeber, DNR Aquatics
Lee Stilson, DNR Aquatics
Tim Goodman, DNR Aquatics
Michelle Wilcox, Ecology, TCP

CITIZENS FOR A HEALTHY BAY

RECEIVED
MAR 29 2000
Environmental Cleanup Office

917 Pacific Avenue
Suite 406
Tacoma, WA 98402
Phone (253) 383 2429
Fax (253) 383 2446
chb@wa.net

March 27, 2000

Mr Lee Marshall, Project Manager
US EPA Region 10
1200 Sixth Avenue
MS/ECL-111
Seattle, WA 98101

marshall.lee@epamail.epa.gov

Re: Former Asarco Smelter Facility
Sediment and Groundwater Remediation
Ruston/North Tacoma, Washington

*Board of Directors*
Mary Brown
Jeff Daniel
Scott Hansen
Kristi Lynett
Lee Roussel
Robert Stivers
Sheri Tonn
Allen Zulauf

Dear Mr. Marshall:

On behalf of Citizens for a Healthy Bay (CHB), an organization representing 850 members of the Tacoma and Greater Commencement Bay community, thank you for the opportunity to comment on the proposed remedial plan for Asarco Smelter site groundwater and sediments. Except as discussed below, CHB generally agrees with the remedial actions proposed for site sediments and groundwater.

Of greatest concern is that EPA defer to and enforce all Washington State cleanup standards for groundwater and sediments. As was recently proved in the findings for Asarco at the Asarco Everett facility, failure to enforce Washington State standards on one site can have adverse impacts to another site cleanup. As Asarco is a PRP for another Commencement Bay Superfund sediment cleanup action in the Hylebos Waterway, it is imperative that uniform cleanup standards be employed throughout the entire Commencement Bay cleanup area.

**5.1 Human Health Screening Risk Assessment**

**Sediments:** In determining human health risks associated with eating fish caught within the site, the low end range (1 gram per day of fish) was selected to represent the consumption of an infrequent sports fisherperson who might eat fish from the waters off the facility a few times each year. The greater Commencement Bay area hosts a number of ethnic communities who routinely fish for subsistence. Because of easy access, the waters along Ruston Way/Asarco/Point Defiance are a popular fishing spot for members of these communities. We believe that the assumption of 1 gram per day of fish does not consider the subsistence harvest practiced by members of these communities and needs to be increased accordingly.

A tax exempt nonprofit organization with 501(c)(3) status

**5.2 Ecological Risk Assessment**

**Sediment:**

*Non Impacted/Minimally Impacted Stations*

Stations that have chemical concentrations greater than the state standards must be cleaned up to meet Washington State standards, Additionally, those areas with minor biological CSL exceedances must be remediated as well.

*Moderately Impacted Stations*

Stations falling within this category need to be remediated to meet Washington State cleanup standards.

**6.1 Groundwater Cleanup Objectives**

Background contamination levels for copper in the remedial area are held to be 40 ug/L and a question is raised as to whether groundwater cleanup levels of 3.1 ug/L can be met. However, no mention is made as to what the background levels for copper in groundwater are for the Commencement Bay area outside of the Asarco site, Presumably, the higher copper background contaminant level is directly attributable to past smelter operations, and therefore subject to remedial action to correct the problem.

**6.2 Sediment Cleanup Objectives**

EPA's stated cleanup objective for sediments is to restore and preserve aquatic habitats by limiting or preventing the exposure of environmental receptors to sediments with contaminant above Washington State Sediment Management Standards.,

**7.1 Groundwater**

We agree with the stated preferred alternative GW-B involving intercepting and treating site groundwater prior to discharging into Commencement Bay. We are concerned that the remedy be scaled to handle large magnitude storm events and associated increases to groundwater.

Also, use of an on-site cap to limit infiltration of precipitation into the soil will increase the amount of stormwater runoff and contaminants commonly associated with stormwater runoff.

How will recontamination of the sediments by toxins such as PAHs, BEPs, fertilizers, herbicides, insecticides, etc. be avoided? We do not wish to see one set of problems exchanged for another.

**7.2 Sediment**

In addition to the remedial alternatives presented in the proposed cleanup plan, additional actions are required in the *Non Impacted/Minimally Impacted Stations* and *Moderately Impacted Stations* to ensure that these stations are remediated to meet all State of Washington Criteria. (see 5.2 above)

**9.2.4 Long-term Monitoring**

Components of the long-term remedial monitoring plan must include action plans for earthquakes, high-intensity storm events, severe tide/wind storms, etc.

Citizens for a Healthy Bay urges you to consider that private citizens, aquatic communities and the improved health of Commencement Bay are the largest stakeholders in the cleanup and disposal of contaminated sediments and groundwater at the former Asarco Smelter site. As a citizen-based representative of that community, Citizens for a Healthy Bay is concerned about the decisions EPA will make regarding remediation at the Asarco site. We urge the Environmental Protection Agency to make decisions that will positively affect the primary stakeholders in the cleanup of Asarco sediments and groundwater.

We appreciate your attention to our concerns regarding this document.

Sincerely:

Leslie Ann Rose
Senior Policy Analyst
Citizens for a Healthy Bay

Lee Marshall
EPA Project Manager
1200 Sixth Avenue
MS/FCL- 111
Seattle, WA. 98101

February 17, 2000

Dear Mr. Marshall:

As a long-time resident of North Tacoma, I would like to take this opportunity to comment on the EPA cleanup of the Asarco smelter. I would like to voice my concerns about the long-term effectiveness of the proposed disposal alternatives. I can not see how capping contaminated sediments on-site with 1 meter of clean material represents a safe and reliable solution. Humans have been burying garbage for thousands of years, surely we can do better than this by now? I would like to encourage the EPA to support the development and use of improved treatment methods. I believe the government has an obligation to the future health and well being of humans and the environment to forward progressive solutions. In addition, I am concerned about the storage of contaminated sediments so near the water. Earthquakes and slides could yield potentially disastrous results. Furthermore, there is the corrosive, erosive capacity of the salt air and water to consider. Hopefully, the EPA will continue to re-evaluate conditions at the site and apply improved treatment measures as they become available. Thank you for your thoughtful consideration.

Sincerely,

(b) (6)

Tacoma, WA. 98407

FORMAL COMMENT PERIOD
JANUARY 26 THROUGH FEBRUARY 24, 2000
FOR
Asarco Sediments and Groundwater Proposed Plan

COMMENTS BY (b) (6) LONG RANGE PLANNING COMMITTEE – TACOMA YACHT CLUB

1. TACOMA YACHT CLUB SHOULD BE FORMALLY DESIGNATED AS A STAKE HOLDER IN THE DESIGN AND IMPLEMENTATION OF THE REMEDIATION PLAN FOR THE YACHT BASIN. THE CLUB WILL FORMALLY DESIGNATE A COMMITTEE TO LAISON WITH E.P.A., ASARCO AND OTHER ACTIVE PARTIES

2. EPA + ASARCO SHOULD CONSIDER DEEPER DREDGING BETWEEN THE ROAD AND A DOCK TO REMOVE CONTAMINANTS AND TO FACILITATE PASSAGE OF DEEPER DRAUGHT BOATS – CONTAMINATED SEDIMENTS HAVE ACCUMULATED FROM ASARCO PROPERTY TO FILL THIS AREA IN TO A DISADVANTAGEOUS DEGREE.

PLEASE: - Fold the page in half so that EPA's address is showing
-Tape or Staple closed
-Put on a 33 cent stamp
-Drop in the mail!

OR - Leave with us tonight

3. MAKE SURE ANY DREDGING PLAN FOR THE YACHT BASIN INCLUDES INDEMNIFICATION FOR DAMAGE TO BOATS + HOUSES AND DOCKAGE. MAKE SURE PROVISION FOR TEMPORARY MOORAGE FOR DISPLACED BOATS IS MADE AVAILABLE.

Lee Marshall, EPA Project Manager
1200 Sixth Ave, M.S/ECL-111
Seattle, Wa. 98101

RECEIVED
FEB 04 2000
Environmental Cleanup C

Going through the Fact Sheet on the former Asarco Smelter Cleanup from Jan. 2000, I wish to enter the following written comments on the clean up.

I am a boater and live and have lived in the Yacht Basin for the last 15 yrs. from just before the Smelter shut down. I have seen the Basin so dead and hot you could almost power a light bulb, to today, where electrolysis is almost gone and sea life has come back. Years back we never had much growth on boat bottoms, now we have barnacles and mussels and growth of seaweed. What you are doing, I have faith it is a good job and see nothing to change, I only want to push 2 points that relate to me.

Re: Yacht Basin Area The bottom is deep mud gunk. In spite of the returned sea life, this life cannot be safe do to the bottom it lives over.

And in some cases on and in.
I wish to strongly push for the dredging of the Basin to at least 2 ft. Absolutely no less and possibly more. I know what this stuff looks like and is.
My only other concern is the slow speed that all of the cleanup is going at. Please no more extentions. Lets just get it done!
Thank you for reading this and for your consideration.

(b) (6)
[redacted]
Tacoma, Wa. 98407
(b) (6)
[redacted]

(b) (6)

Lakewood, WA 98498-6040
(b) (6)

Thu; 09.Mar.2000

EPA Project Manager
1200-Sixth Avenue
Seattle, WA 98101

ATTN: Lee Marshall

I recently saw an item in the Tacoma News Tribune concerning the cleanup of the old ASARCO site in Ruston. I would like to add written comments toward the process of cleaning up the wastes.

My standpoint, you must understand, comes from a metallurgical engineer who had an opportunity to tour the ASARCO smelter while a young college student. It is fortunate to the community and the area as a whole that so much toxic substances were released into the environment in the name of progress and the almighty dollar. It should also be remembered that the plant offered employment to numerous workers during its lifetime. It was a monument to the ingenuity of metallurgists while now becoming a bane to those of us in the profession. It is demoralizing to think that the metals industry has had to cope with changes that sometimes make my training obselete.

Just as a passing thought; there are plans to remove and store in a landfill, the contaminated soils around the Ruston plant. And the Seattle-Tacoma airport is looking for fill for their third proposed runaway. Abra-cadabra! Why not use this soil for their fill and kill two birds with one stone? I had heard some statistics about the amount of fill needed for the SEA-TAC airport and the time needed to complete their plans, much to the consternation of the local residents.

Another thought; why not sell, for refining, the waste products from the ASARCO plant? It used to be that tailings piles from older mines would be reprocessed again and again to remove the smallest traces of valuable metals. Arsenic still has used in rodenticides. Lead is used in storage batteries. Cadmium is used in low-melting point alloys. What other treasures could be gleaned from all the waste?

The EPA plan to cover the site with non-permeable material does not take into account one thing; water seeping UP through the covering layer. This is something that must be considered in our wet Washington Weather.

Men have torn down mountains to get to precious metals for a long time. If the material at Ruston is offending, why not dig out a big hole and put it back into those torn-down mountains?

These are my thoughts and suggestions concerning the treatment of the wastesite at ASARCO's Ruston plant. I hope they are doing a better job of not polluting in their new location in the southwestern USA. It was a kick in the butt to see them leave town. That was one less place I could have sought gainful employment from.

Thank you for the opportunity to comment on your proposals.

Sincerely,
(b) (6)

former President; Metalchemy, Inc.
"The Metalchemist"

# Appendix C

# (Statement of Work or SOW)

# 1. INTRODUCTION

1.1.1 The Washington State Department of Natural Resources (DNR) shall monitor and maintain the remedy in accordance with the Record of Decision (ROD), this Statement of Work (SOW), the Performance Standards, and all deliverables created under this SOW and approved by the U.S. Environmental Protection Agency (EPA).

1.1.2 The Performance Standards include all Applicable or Relevant and Appropriate Requirements (ARARs), cleanup goals, cleanup levels, cleanup standards, specifications and all measures for the performance of treatment processes, engineering controls and other controls set forth in the ROD, the SOW and any deliverable created and approved under the Consent Decree (CD) and the SOW.

1.1.3 The Scope of the Work is set out in Appendix A of this document.

1.1.4 Periodic Meetings. The EPA and the DNR will meet at least once prior to each monitoring event to coordinate monitoring and other Operations and Maintenance (O&M) activities.

1.1.5 The DNR shall notify EPA of any upcoming events that could significantly impact the sediment remedy.

1.1.6 Inspections.

.1 The EPA shall conduct periodic inspections of (or have an on-Site presence during) any Work. At the EPA's request, the DNR or other designee shall accompany EPA during inspections.

.2 Upon notification by the EPA of any deficiencies in the Remedial Action (RA) construction, the DNR, or parties directed by the DNR, shall take all necessary steps to correct the deficiencies and/or bring the RA construction into compliance with the approved Final Remedial Design (RD), any approved design changes, and/or the approved RA Work Plan. If applicable, the DNR shall comply with any practicable schedule provided by the EPA in its' notice of deficiency.

1.1.7 Progress Reports. Commencing with the first month following entry of the CD, the DNR shall submit progress reports to the EPA every 6 months for the first two years and thereafter every two years, or more frequently as needed, to report any significant developments that could affect remedial performance. The reports must be submitted in hard copy and electronic form. The reports must cover all activities that took place during the prior reporting period, including:

.1 The actions that have been taken toward achieving compliance with the CD;

.2 A summary of all results of sampling and tests and all other data received or generated by the DNR;

.3 A description of all plans, reports, and other deliverables that were submitted;

.4 A description of all activities relating to any Work scheduled for the next reporting period;

.5 A description of any modifications to the work plans or other schedules that the DNR has proposed or that have been approved by the EPA; and

.6 A description of all activities undertaken in support of this SOW during the reporting period and those to be undertaken in the next reporting period.

1.1.8 Notice of Progress Report Schedule Changes. If the schedule for any activity described in the Progress Reports changes, the DNR shall notify the EPA of such change at least seven days before performance of the activity.

1.1.9 Emergency Reporting.

.1 Upon the occurrence of any event during performance of the Work that the DNR is required to report pursuant to Section 103 of CERCLA, 42 U.S.C. § 9603, or Section 304 of the Emergency Planning and Community Right-to-know Act (EPCRA), 42 U.S.C. § 11004, the DNR shall, within 24 hours of the onset of such event, orally notify the EPA Project Coordinator or the Alternate EPA Project Coordinator (in the event of the unavailability of the EPA Project Coordinator), or, in the event that neither the EPA Project Coordinator nor Alternate EPA Project Coordinator is available, the Emergency Response Section, Region 10 U.S. EPA. These reporting requirements are in addition to the reporting required by CERCLA Section 103 or EPCRA Section 304.

.2 Within 20 days after the onset of such an event, the DNR shall furnish to the EPA a written report, signed by the DNR's Project Coordinator, setting forth the events that occurred and the measures taken, and to be taken, in response thereto. Within 30 days after the conclusion of such an event, the DNR shall submit a report setting forth all actions taken in response thereto.

## 2. DELIVERABLES

### 2.1 Applicability

2.1.1 Paragraphs 2.2 and 2.3 apply to any deliverable that is required to be submitted for EPA approval.

### 2.2 General Requirements

2.2.1 All communications specified in this SOW, including approvals, consents, deliverables, modifications, notices, notifications, objections, proposals, and/or requests, must be in writing unless otherwise specified.

2.2.2 All deliverables must be submitted by the deadlines in the Schedule.

2.2.3 Technical Specifications for Deliverables. Sampling and monitoring data contained in any deliverables must be submitted in Electronic Data Deliverable (EDD) format compatible with Ecology's electronic data base format (e.g. EIM).

**2.3** Approval of Plans, Reports or Other Deliverables

2.3.1 Initial Submissions.

.1 After review of any plan, report, or other deliverable that is required to be submitted for EPA approval under the CD or the SOW, the EPA shall: (i) approve, in whole or in part, the submission; (ii) approve the submission upon specified conditions; (iii) disapprove, in whole or in part, the submission; or (iv) any combination of the above options.

.2 The EPA also may modify the initial submission to cure deficiencies in the submission if: (i) the EPA determines that disapproving the submission and awaiting a resubmission would cause substantial disruption to the Work; or (ii) previous submission(s) have been disapproved due to material defects and the deficiencies in the initial submission under consideration indicate a bad faith lack of effort to submit an acceptable plan, report, or deliverable.

2.3.2 Resubmissions. Upon receipt of a notice of disapproval under ¶ 2.3.1 (Initial Submissions) or if required by a notice of approval upon specified conditions under ¶ 2.3.1, the DNR shall, within 30 calendar days or such longer time as specified by the EPA in such notice, correct the deficiencies and resubmit the plan, report, or other deliverable for approval. After review of the resubmitted plan, report, or other deliverable, the EPA may: (a) approve, in whole or in part, the resubmission; (b) approve the resubmission upon specified conditions; (c) modify the resubmission; (d) disapprove, in whole or in part, the resubmission, requiring the DNR to correct the deficiencies; or (e) any combination of the above options.

2.3.3 Implementation. Upon approval, approval upon conditions, or modification by the EPA under ¶ 2.3.1 (Initial Submissions) or ¶ 2.3.2 (Resubmissions), of any plan, report, or other deliverable, or any portion thereof: (a) such plan, report, or other deliverable, or portion thereof, will be incorporated into and will be enforceable under the CD; and (b) the DNR shall take any action required by such plan, report, or other deliverable, or portion thereof. The implementation of any non-deficient portion of a plan, report, or other deliverable submitted or resubmitted under ¶¶ 2.3.1 or 2.3.2 will not relieve the DNR of any liability for stipulated penalties under the CD.

**2.4** Deliverables

2.4.1 The DNR shall submit each of the following supporting deliverables for EPA approval. The deliverables must be submitted, for the first time, by the deadlines in the Schedule or

any other EPA-approved schedule, as applicable. The DNR shall develop the deliverables in accordance with all applicable regulations, guidance and policies. The DNR shall update each of these supporting deliverables as necessary or appropriate during the course of the Work, and/or as requested by the EPA.

2.4.2 Emergency Response Plan. The Emergency Response Plan (ERP) must describe procedures to be used in the event of an accident or emergency at the Site (e.g. , power outages, water impoundment failure, treatment plant failure, slope failure, etc.) that might arise from monitoring, maintenance, and remedial corrective actions associated with Operable Unit 6. The ERP must include:

.1 Name of the person or entity responsible for responding in the event of an emergency incident;

.2 Plan and date(s) for meeting(s) with the local community, including local, State and Federal agencies involved in the cleanup, as well as local emergency squads and hospitals;

.3 Spill Prevention, Control, and Countermeasures (SPCC) Plan describing measures to prevent, and contingency plans for, potential spills and discharges from materials handling and transportation;

.4 Notification activities in the event of a release of hazardous substances requiring reporting under Section 103 of CERCLA, 42 U.S.C. § 9603, or Section 304 of the Emergency Planning and Community Right-To-Know Act (EPCRA), 42 U.S.C. § 11004; and

.5 A description of all necessary actions to ensure compliance with the Emergency Response section of the CD in the event of an occurrence during the performance of the Work that causes or threatens a release of Waste Material from the Site that constitutes an emergency or may present an immediate threat to public health or welfare or the environment.

2.4.3 Field Sampling Plan. The Field Sampling Plan (FSP) supplements the Quality Assurance Project Plan (QAPP) and addresses all sample collection activities. The FSP must be written so that a field sampling team unfamiliar with the project would be able to gather any samples and field information required. The DNR shall develop the FSP in accordance with *Guidance for Conducting Remedial Investigations and Feasibility Studies*, EPA/540/G-89/004 (Oct. 1988).

2.4.4 Health and Safety Plan. The Health and Safety Plan (HASP) describes all activities to be performed to protect on-site personnel and area residents from physical, chemical and all other hazards posed by the Work. The DNR shall develop the HASP in accordance with the EPA's Emergency Responder Health and Safety and Occupational Safety and Health Administration ( OSHA) requirements under 29 C.F.R. §§ 1910 and 1926. The HASP

also must address monitoring and control measures to protect the community during the Work.

2.4.5 Institutional Controls Implementation and Assurance Plan. The Institutional Controls Implementation and Assurance Plan (ICIAP) describes plans to implement, maintain and enforce the Institutional Controls (ICs) at the Site. The DNR shall develop the ICIAP in accordance with *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites*, OSWER 9355.0-89, EPA/540/R-09/001 (Dec. 2012), and *Institutional Controls: A Guide to Preparing Institutional Controls Implementation and Assurance Plans at Contaminated Sites*, OSWER 9200.0-77, EPA/540/R-09/02 (Dec. 2012). The ICIAP must include the following additional requirements:

.1 Locations of recorded real property interests (e.g., easements, liens) and resource interests in the property that may affect ICs (e.g., surface, mineral, and water rights) including accurate mapping and geographic information system (GIS) coordinates of such interests;

.2 A contingency plan if any ICs cannot be implemented, are ineffective or are not sufficient to prevent exposure;

.3 All legal descriptions and survey maps must be prepared according to current American Land Title Association (ALTA) [for Texas sites: "Texas Land Title Association (TLTA)"] Survey guidelines and certified by a licensed surveyor; and

.4 All GIS coordinates must be formatted into an Environmental Systems Research Institute, Inc. (ESRI) polygon shape file and the Universal Transverse Mercator (UTM) zone must be identified. The shape file must be projected into the UTM, North American Datum (NAD) 83 projection system. Each shape file must include an attribute name for each polygon submitted (e.g., "site boundary," "residential use prohibited," "landfill cap," and "groundwater use prohibited").

2.4.6 O&M Plan. The O&M Plan describes all sampling and monitoring, as well as operation and maintenance of the sediment cap, the shoreline armoring, and the uncapped state-owned DNR-managed, properties. The DNR shall develop the O&M Plan in accordance with *Operation and Maintenance in the Superfund Program*, OSWER 9200.1 37FS, EPA/540/F-01/004 (May 2001). The O&M Plan must provide for the implementation of the Field Sampling Plan. The O&M Plan must include the following additional requirements:

.1 Description of sampling and monitoring requirements;

.2 Sample checklists and periodic reports;

.3 Description of verification sampling procedures, if performance standards are no longer being met;

.4 Description of corrective actions to be implemented in the event that performance standards are not met; (In the event that performance standards are not met for the sediment cap, the shoreline armoring, and/or the uncapped state-owned DNR-managed properties, a work plan for additional actions will be required. This additional work plan will propose for EPA approval the actions required for the area to again meet performance standards, as well as the documents to be prepared, and schedule required to again meet performance standards) ;

.5 Description of records and reports that will be generated during O&M.

2.4.7 Quality Assurance Project Plan.

.1 The Quality Assurance Project Plan (QAPP) addresses all project data acquisition and handling associated with the Work.

.2 The QAPP must include a detailed explanation of the DNR's quality assurance, quality control, and chain of custody procedures for all treatability, design, compliance, and monitoring samples.

.3 The DNR shall develop the QAPP in accordance with *EPA Requirements for Quality Assurance Project Plans*, QA/R-5, EPA/240/B-01/003 (March 2001, reissued May 2006), *Guidance for Quality Assurance Project Plans*., QA/G-5, EPA/240/R 02/009 (Dec. 2002), and *Uniform Federal Policy for Quality Assurance Project Plans*, Parts 1-3, EPA/505/B-04/900A though 900C (March 2005).

.4 The QAPP also must include procedures:

.4.1 To ensure that the EPA [and the State] and its [their] authorized representative(s) have reasonable access to laboratories used by the DNR in implementing the Consent Decree ("DNR Labs");

.4.2 To ensure that DNR Labs analyze all samples submitted by the EPA pursuant to the QAPP for quality assurance monitoring;

.4.3 To ensure that the DNR Labs perform all analyses using EPA-accepted methods (i.e., the methods documented in USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis, ILM05.4 (Dec. 2006), USEPA Contract Laboratory Program Statement of Work for Organic Analysis, SOM01.2 (amended April 2007), and USEPA Contract Laboratory Program Statement of Work for Inorganic Superfund Methods (Multi-Media, Multi-Concentration), ISM01.2 (January 2010)) or other methods acceptable to the EPA;

.4.4 To ensure that the DNR Labs participate in an EPA-accepted QA/QC program or other QA/QC program acceptable to the EPA;

.4.5 To ensure the DNR provides the EPA with notice at least 28 days prior to any sample or other data collection activity;

.4.6 For the DNR to provide split sediment samples and/or duplicate samples to the EPA upon request;

.4.7 For the EPA to take any additional samples that it deems necessary;

.4.8 For the EPA to provide to the DNR, upon request, split samples and/or duplicate samples in connection with EPA's oversight sampling; and

.4.9 For the DNR to submit to the EPA all field sampling and testing results and any other data in connection with the implementation of the Consent Decree.

**2.5** Applicability and Revisions

2.5.1 All deliverables and tasks required under this SOW must be submitted or completed by the deadlines or within the time durations listed in the RD and RA Schedules. The initial RD and RA Schedules are set forth below. Upon the EPA's request, the DNR shall submit proposed revised RD Schedules or RA Schedules for EPA approval.

**2.6** Schedule

| | Deliverable | Days from Entry of CD | Additional Requirements | |
|---|---|---|---|---|
| 1 | Sampling and Analysis Plan (SAP) and associated documents | 120 days | SAP may be modified in subsequent years to cover project requirements | |
| 2 | Baseline Sampling (first sampling event under this SOW) | 1 year | | |
| 3 | Data Report | | 120 days from data receipt | |
| 4 | Sampling Events | | Per required schedule 2/5/10 years following baseline sampling. | |
| 5 | Data Report | | 120 days from data receipt | |
| 6 | Site Completion Sampling | | Within 1 year of the of submittal of the Point Ruston Remedial Action Completion Report | |
| 7 | Data Report | | 120 days from data receipt | |
| 8 | Long Term Monitoring | | As scheduled. | |
| 9 | Data Report | | 120 days from data receipt | |

## 3. REFERENCES

The following regulations and guidance documents, among others, apply to the Work. A more complete list may be found on the following EPA Web pages:

Laws, Policy, and Guidance http://www.epa.gov/superfund/policy/index.htm

Test Methods Collections http://www.epa.gov/fem/methcollectns.htm

For any regulation or guidance referenced in the CD or SOW, the reference will be read to include any subsequent modification, amendment or replacement of such regulation or guidance. Such modifications, amendments or replacements apply to the Work only after the DNR receives notification from the EPA of the modification, amendment or replacement.

.1 A Compendium of Superfund Field Operations Methods, OSWER 9355.0-14, EPA/540/P-87/001a (August 1987).

.2 CERCLA Compliance with Other Laws Manual, Part I: Interim Final, OSWER 9234.1-01, EPA/540/G-89/006 (August 1988).

.3 Guidance for Conducting Remedial Investigations and Feasibility Studies, OSWER 9355.3-01, EPA/540/G-89/004 (October 1988).

.4 CERCLA Compliance with Other Laws Manual, Part II, OSWER 9234.1-02, EPA/540/G-89/009 (August 1989).

.5 Guidance on EPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties, OSWER 9355.5-01, EPA/540/G-90/001 (April 1990).

.6 Guidance on Expediting Remedial Design and Remedial Actions, OSWER 9355.5-02, EPA/540/G-90/006 (August 1990).

.7 Guide to Management of Investigation-Derived Wastes, OSWER 9345.3-03FS (January 1992).

.8 Permits and Permit Equivalency Processes for CERCLA On-Site Response Actions, OSWER 9355.7-03 (February 1992).

.9 Guidance for Conducting Treatability Studies under CERCLA, OSWER 9380.3-10, EPA/540/R-92/071A (November 1992).

.10 National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule, 40 C.F.R. Part 300 (October 1994).

.11 Guidance for Scoping the Remedial Design, OSWER 9355.0-43, EPA/540/R-95/025 (March 1995).

.12 Remedial Design/Remedial Action Handbook, OSWER 9355.0-04B, EPA/540/R-95/059 (June 1995).

.13 EPA Guidance for Data Quality Assessment, Practical Methods for Data Analysis, QA/G-9, EPA/600/R-96/084 (July 2000).

.14 Operation and Maintenance in the Superfund Program, OSWER 9200.1-37FS, EPA/540/F-01/004 (May 2001).

.15 Comprehensive Five-year Review Guidance, OSWER 9355.7-03B-P, 540-R-01-007 (June 2001).

.16 Guidance for Quality Assurance Project Plans, QA/G-5, EPA/240/R-02/009 (December 2002).

.17 Quality Systems for Environmental Data and Technology Programs -- Requirements with Guidance for Use, ANSI/ASQ E4-2004 (2004).

.18 Uniform Federal Policy for Quality Assurance Project Plans, Parts 1-3, EPA/505/B-04/900A though 900C (March 2005).

.19 Superfund Community Involvement Handbook, EPA/540/K-05/003 (April 2005).

.20 EPA Guidance on Systematic Planning Using the Data Quality Objectives Process, QA/G-4, EPA/240/B-06/001 (February 2006).

.21 EPA Requirements for Quality Assurance Project Plans, QA/R-5, EPA/240/B-01/003 (March 2001, reissued May 2006).

.22 EPA Requirements for Quality Management Plans, QA/R-2, EPA/240/B-01/002 (March 2001, reissued May 2006).

.23 USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis, ILM05.4 (Dec. 2006).

.24 USEPA Contract Laboratory Program Statement of Work for Organic Analysis, SOM01.2 (amended April 2007).

.25 Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration, OSWER 9283.1-33 (June 2009).

.26 Principles for Greener Cleanups (August 2009), http://www.epa.gov/oswer/greenercleanups/.

.27 Providing Communities with Opportunities for Independent Technical Assistance in Superfund Settlements, Interim (September 2009).

.28 USEPA Contract Laboratory Program Statement of Work for Inorganic Superfund Methods (Multi-Media, Multi-Concentration), ISM01.2 (January 2010).

.29 Close Out Procedures for National Priorities List Sites, OSWER 9320.2-22 (May 2011).

.30 Groundwater Road Map Recommended Process for Restoring Contaminated Groundwater at Superfund Sites, OSWER 9283.1-34 (July 2011).

.31 Construction Specifications Institute's MasterFormat 2012, available from the Construction Specifications Institute, www.csinet.org/masterformat.

.32 Recommended Evaluation of Institutional Controls: Supplement to the "Comprehensive Five-Year Review Guidance," OSWER 9355.7-18 (September 2011).

.33 Updated Superfund Response and Settlement Approach for Sites Using the Superfund Alternative Approach (SAA Guidance), OSWER 9200.2-125 (September 2012).

.34 Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites, OSWER 9355.0-89, EPA/540/R-09/001 (December 2012).

.35 Institutional Controls: A Guide to Preparing Institutional Controls Implementation and Assurance Plans at Contaminated Sites, OSWER 9200.0-77, EPA/540/R-09/02 (December 2012).

.36 EPA's Emergency Responder Health and Safety Manual, OSWER Directive 9285.3-12 (July 2005 and updates). http://www.epaosc.org/_HealthSafetyManual/manual-index.htm

Appendix A

**MONITORING AND REPAIR REQUIREMENTS FOR THE SEDIMENT CAP, SHORELINE ARMORING, AND STATE-OWNED DNR-MANAGED UNCAPPED PROPERTIES**

The following, in the EPA's best professional judgment, are the long-term monitoring and maintenance requirements for the offshore sediments including the sediment cap, shoreline armoring, and state-owned, DNR-managed uncapped properties. These requirements may change as sampling plans are prepared and as results of monitoring are evaluated.

Remediation has been conducted on state-owned, DNR-managed property under two Record of Decisions (RODs):

Marine Sediments and Groundwater ROD:

- Sand/silt capping on "flat" areas of offshore sediments (conducted by Point Ruston).
- Riprap and sand gravel capping of nearshore steep areas (conducted by Point Ruston).

Asarco Tacoma Smelter Facility ROD:

- Shoreline Armoring (conducted by Asarco and Point Ruston).

In addition, the DNR demolished the docks at the Asarco Smelter site, and placed some capping material over the dock footprints.

**Short term and long term management of State-owned, DNR-managed properties**

The phrase "long-term monitoring and maintenance" consists of short term management and long term management. Short term management refers to the period of 15 or more years following baseline sampling during which data trends are developed. Long term management refers to the period when sampling frequency occurs every 15 years. Long term management will begin if three consecutive sampling events separated by a minimum of 5 years show acceptable performance (e.g. years 5, 10 and 15). Sampling frequency begins with the baseline event which will take place following the entry of the Consent Decree. Thus, the 2 year sampling event occurs 2 years following baseline.

Long term management covers the period following short term management and continues in perpetuity.

## 1. Sediment Cap Monitoring: Physical Parameters

Visual and bathymetric inspections of the cap will be performed to ensure that the cap continues to meet physical stability performance standards. Additional discretionary visual inspections of the cap may be required after a significant storm or earthquake event, barge grounding, etc. if the EPA or the DNR has reason to believe that the cap may no longer be meeting performance standards. At its discretion, the EPA may perform cap inspections as well.

### 1.1. Physical Cap Inspection Requirements.

Physical monitoring will consist of visual and bathymetric monitoring, and may also include core sampling and grain size analysis. The cap will be visually inspected by divers or underwater camera to determine whether or not the cap remains in place and remains stable, especially on sloped areas. A representative number of core samples will be taken on the sand/silt cap areas to demonstrate the depth of the cap, and observe the interface between the original surface and the cap. The number of core samples will be determined in the sampling plan. Bathymetric studies will also be required. The bathymetry must allow comparison with the pre and post construction bathymetry. Grain size analyses may be required.
An extreme low tide visual survey of the full length of the armored/riprap slope will be conducted to check for slumping, undercutting, and the presence of fine-grained material.

### 1.2. Monitoring Frequency.

Physical monitoring will be performed at years 2, 5, and 10. Post-construction bathymetry was performed when the remedy was completed, and so will not be repeated until year 5. The results of physical monitoring will be used to re-evaluate the locations of samples for the next chemical sampling events. The other exception to this frequency is that visual inspection of the shoreline armoring will occur every 2 years per Section 5, regardless of the frequency for other monitoring unless DNR requests and EPA approves a change in frequency during long term management.

After year 10, physical monitoring will be required every 10 years (the need for the 10 year bathymetry will be evaluated based on the timing of the bathymetry conducted at Point Ruston completion. Monitoring may be reduced to once every 15 years if three sequential monitoring events separated by a minimum of 5 years indicate a trend of reliability of remedial performance (see Section 4.0 Sediment Cap Long Term Management: Monitoring and Repair.) The other exception to this frequency is that visual inspection of the shoreline armoring will occur every 2 years per Section 5, regardless of the frequency for other monitoring unless DNR requests and EPA approves a change in frequency during long term management.

## 2. Sediment Monitoring: Chemical Parameters

The primary objectives of cap chemical monitoring are to determine whether or not cap recontamination has occurred, and whether the cap stays in place and continues to isolate underlying contaminants. This will be determined by sampling for conventional parameters including total organic carbon (TOC) and grain size, and the metals previously identified in underlying contaminated sediments. In addition, as a significant number of pilings were removed during the sediment action, monitoring for PAHs will also be conducted.

The first sampling event under this SOW, baseline sampling, will be considered the baseline to which subsequent samples will be compared. Should this sampling event indicate that chemical performance standards are not being met (by comparison to SQS) additional sampling (e.g. bioassays) or placement of additional clean sediments may be required.

A statistical method for determining recontamination will be proposed by Point Ruston or the DNR and must be approved by the EPA.

### 2.1. General Strategy for Sediment Monitoring.

The following strategy outlines the anticipated sediment sampling needs for the offshore sediments. These guidelines will be developed by the DNR into a sampling plan.

#### 2.1.1. General Sampling Requirements.

Samples of cap surface material (0-10 cm) will be collected. On a case by case basis, grain size or substrate type may be confirmed, and based on this, a sample may be relocated.

#### 2.1.2. Monitoring Frequency.

Baseline chemistry will be conducted within 12 months of entry of the CD. Short term monitoring for chemistry will then occur at years 2, 5, and 10 following baseline sampling.

Sampling will then continue every 5 years, until three sequential monitoring events demonstrate cap reliability if three sequential monitoring events demonstrate cap reliability, long term sediment cap monitoring for chemistry will be conducted once every fifteen years (see 4.0 Sediment Cap Long Term Monitoring and Repair.)

### 2.2. Sample Placement.

Using Figures 7-1 and 9-1 from the 2000 ROD, and knowing the location and nature of the active remediation that occurred on site, four main areas are identified requiring sediment characterization/monitoring:

- Moderate Impact Areas – These offshore areas were not actively remediated, but were acknowledged to require long term monitoring. In contrast to the remediated areas, SQS exceedances may be anticipated in early monitoring. If the exceedances are similar to those found previously, bioassays will not be required. However, with sources contained, and sediment accumulation over time, it is anticipated that sediment quality will improve in moderate impact areas. If this pattern is not observed by year 10, bioassays may be required. Level of effort: 10 grab samples and analyses for site-specific COCs in years baseline, 2, 5, and 10.

- Capped Areas – These offshore areas were actively remediated and should remain in relatively clean condition, i.e., it is anticipated that all samples will meet the SQS for site-specific COC's. Should any COC exceed SQS, bioassays may be required by EPA. The nature of the materials used to armor the cap will preclude sediment sampling in some areas, so locations may have to be fine-tuned in the field using the grab sampler along the margins of the riprap cap cover. Level of effort: 10 grab samples and analyses for site-specific COCs in years baseline, 2, 5, and 10. Should the nature of the surface material preclude grab sampling, the number of capped area stations may be reduced in early years of monitoring.

- Low-tide, Armor Toe Sediment Depositional Areas – These samples will be taken at extreme low tide and consist of composited, hand-sampled grabs taken from sediment depositional areas along transects parallel to shore. Four transects will be sampled for four analyses representing:

  1. Non-capped armored shoreline at either end of the capped area (e.g. Figure 9-1 between transects 16-16.5, and between transects 6.5-7),
  2. Capped armored shoreline adjacent to the old ore dock (e.g. Figure 9-1 transects 13-14), and
  3. Capped armored shoreline adjacent to the old Copper dock (e.g. Figure 9-1 transects 10-11).

Level of effort: 4 total composited grab samples and analyses for site-specific COCs in years baseline, 2, 5, and 10.

Discretionary Areas – These are discretionary samples that will target specific locations of interest. Potential areas of interest include: city outfall, north outfall, south outfall, areas directly adjacent to the mounded area, and the footprints of the former copper dock and ore dock. Level of effort: 6-9 grab samples and analyses in years baseline, 2, 5, and 10. Analytes may include the full suite of SMS COC's depending on the station and interest.

The total above level of effort includes 30 to 33 0-10 cm samples.

A number of issues will need to be resolved in the first version of the SAP. These include:

- Whether to remove noticeable slag in samples – i.e., agreement on a protocol for recording slag presence and removing it in the lab.

- Length of low-tide armor toe transects and protocol for sampling.
- How to redefine sample numbers and reassign sample areas if sediments are not available to sample.

2.3. Failure to Meet Performance Standards.

Cap repair may be required if physical monitoring reveals that the cap is no longer meeting physical performance standards (i.e., maintaining 3 foot of cover over underlying contaminated sediments and slag).

If chemical monitoring reveals the surface of the cap is recontaminated, the EPA may require preparation and implementation of an additional sampling plan to determine source/extent and expected rate of recontamination. The EPA may also require cap repair in order to achieve chemical performance standards.

3. Requirements at Completion of Point Ruston Remedial Action[1]

At the completion of the Point Ruston Remedial Action, Point Ruston must demonstrate that the sediment cap meets performance standards. If it does not, then EPA may withdraw its Certification(s) of Completion for the cap until either (i) Point Ruston demonstrates that its actions were not responsible for the cap no longer meeting Performance Standards, or (ii) Point Ruston takes those actions necessary to again meet Performance Standards.

Sediment chemistry and a visual and bathymetric inspection is required prior to the EPA's certification of completion of the Point Ruston Remedial Action, if data is not available from sampling and inspections done within 12 months of Point Ruston's submittal of the Remedial Action Completion Report. Chemical parameters may be modified by EPA to ensure that the cap is clean at the time that EPA certifies the Point Ruston Remedial Action completion. At its technical discretion, the EPA may require an additional sampling event even if data is available from a sampling event and inspection done within 12 months of submittal.

Cap repair will be required if, at the completion of the Remedial Action, the cap is shown to no longer meet physical and/or chemical performance standards.

1

This information is found in Section 2.8.3 Long-Term Maintenance (O&M) of the Final Statement Of Work For Remedial Design And Remedial Action Commencement Bay Nearshore/Tideflats Superfund Site Operable Unit 02 – Asarco Tacoma Smelter Facility And Slag Peninsula And Operable Unit 06 – Marine Sediments And Groundwater Ruston And Tacoma, Washington (2006).

## 4. Sediment Cap Long Term Management: Monitoring and Repair

Long term management occurs when site conditions (physical and chemical) allow for a 15 year sampling frequency.

### 4.1. Sampling

Monitoring frequency will be reduced to every 15 years if three consecutive sampling events show acceptable performance. The EPA may determine that a different frequency (longer or shorter) is acceptable or required given chemical and/or physical monitoring results and project performance.

Additional discretionary visual inspections of the cap may be required after a significant storm or earthquake event, barge grounding, etc. if the EPA or the DNR has reason to believe that the cap may no longer be meeting performance standards.

### 4.2. Repair

Cap repair will be required if long term monitoring, including EPA inspections, determine the cap no longer meets physical or chemical performance standards.

## 5. Shoreline Armoring: Monitoring and Repair

### 5.1. Monitoring

Shoreline armoring will be visually inspected at least every 2 years following baseline unless DNR requests and EPA approves a change in frequency during long term management.

Inspection shall also occur after extreme events, such as earthquakes or storm events exceeding design parameters, for damage and wear, to ensure the armor protection is well maintained and continues to meet performance standards.

### 5.2. Repair

Repairs of shoreline armoring will be required if, based on the above inspections, the EPA determines that shoreline armoring has been damaged, shoreline armoring has shifted/or moved, or shoreline armoring is no longer meeting performance standards.

| | **Activity** | | | | | | |
|---|---|---|---|---|---|---|---|
| | Physical Monitoring | | | Chemical Monitoring<br>Estimated number of samples required | | | |
| **Year** | Bathymetry | Low Tide Cap Inspection | Shoreline Armoring Inspection | Moderately Impacted Areas[1,3] | Capped Areas[1,3] | Toe Depositional Areas[1,3] | Discretionary Areas[2] |
| Baseline | Not required | Required | Required | 10 | 10 | 4 | 6-9 |
| 2 | Not required | Required | Required | 10 | 10 | 4 | 6-9 |
| Every 2 years | Not required | Not required | Required | Not required | Not required | Not required | Not required |
| 5 | Required | Required | Required | 10 | 10 | 4 | 6-9 |
| 10 | Required | Required | Required | 10 | 10 | 4 | 6-9 |
| Site completion | May be required | Required | Required | Not required | 10 | 4<br>Capped areas only | 6-9<br>Capped areas only |
| **Long Term Monitoring** | | | | | | | |
| Every 15 years | Required | Required | Required | 10 | 10 | 4 | 6-9 |
| Every 2 years[4] | Not required | Not required | Required | | | | |

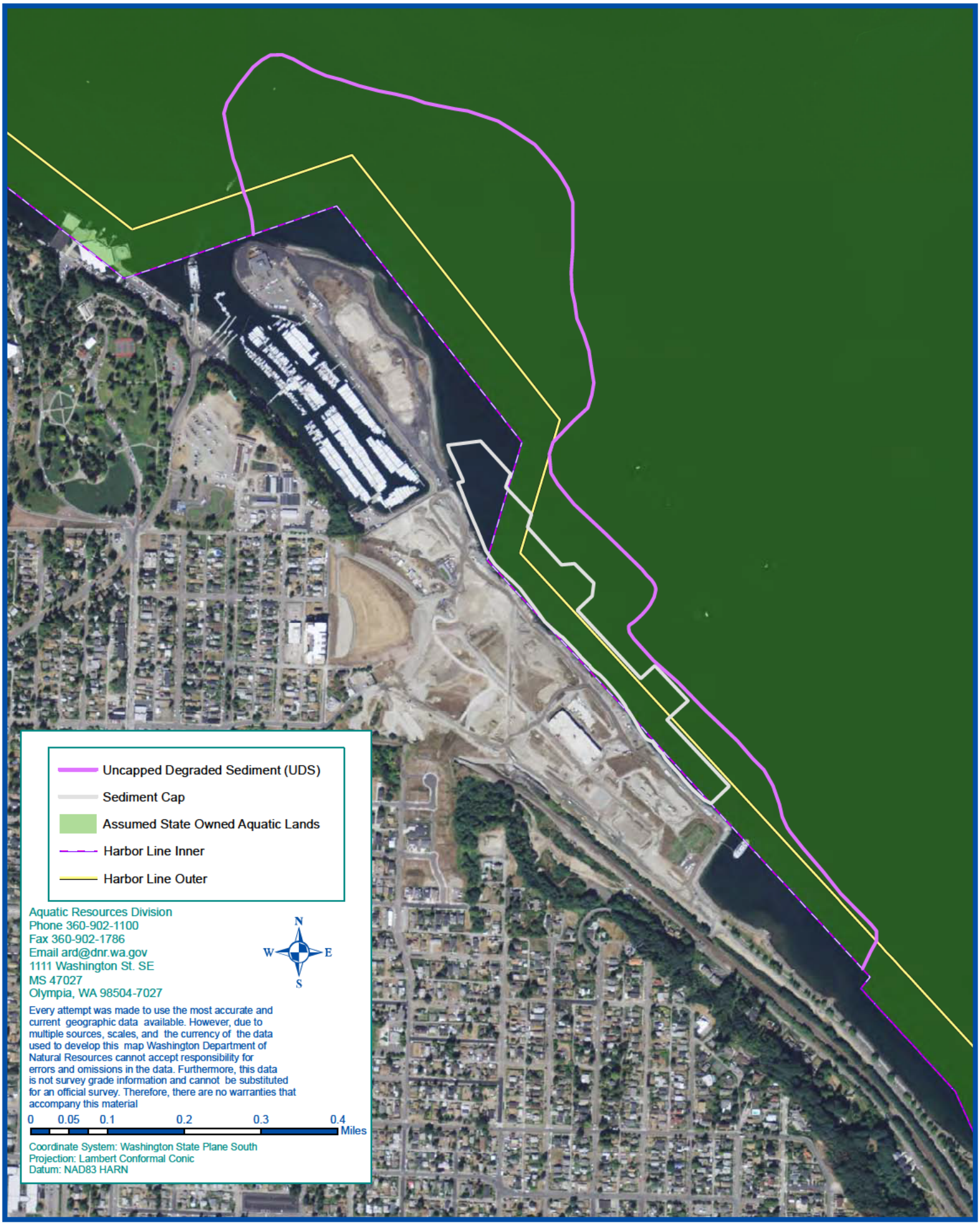
**Notes:**
1 – site COCs
2 - SMS COCs
3 – bioassays/surveys if determined by results
4 – DNR may request and EPA may approve a change in frequency of shoreline monitoring during the long term management period..

# Appendix D

# (Description and/or Map of the Site)

# Asarco Aquatic Land Ownership and Action Areas

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands




Aquatic Resources Division
Phone 360-902-1100
Fax 360-902-1786
Email ard@dnr.wa.gov
1111 Washington St. SE
MS 47027
Olympia, WA 98504-7027

Every attempt was made to use the most accurate and current geographic data available. However, due to multiple sources, scales, and the currency of the data used to develop this map Washington Department of Natural Resources cannot accept responsibility for errors and omissions in the data. Furthermore, this data is not survey grade information and cannot be substituted for an official survey. Therefore, there are no warranties that accompany this material

Coordinate System: Washington State Plane South
Projection: Lambert Conformal Conic
Datum: NAD83 HARN

# Appendix E

# (Land Use Controls Document)

**DNR Land Use Controls for Asarco Superfund Site, OUs 2 and 6**

DNR will exercise its proprietary authority to restrict activities that have the potential to degrade the functional integrity of the remedial action measures or may reduce the quality of benthic layer sediment through disturbance of capped or recovering contaminated sediment. All future uses that are both within Operable Units 2 and 6 and on State-owned aquatic land (SOAL), over which DNR has proprietary control, will require review and written approval from DNR and EPA. Any use determined by DNR or EPA to be incompatible with the remedial goals, notwithstanding the following detailing of specific items, will not be permitted. DNR will require applicants to demonstrate compatibility of the proposed use with the remedy.

Following is a partial list of typical uses for which DNR may receive applications with recommendations by DNR and EPA sediment experts on the compatibility of the proposed use with remedial goals:

1. Installation of Piling:
    a. Capped Area: The effects of driving pile through an engineered sediment cap will depend on site conditions, but in general, are not well studied or easy to predict. This activity is unlikely to be approved by DNR and EPA unless it is on a small scale and a sound scientific rationale is provided for why the integrity of the cap would not be degraded. In all cases, DNR will require the applicant to monitor for and repair any degradation of sediment, the cap, or rip-rap on SOAL.
    b. Uncapped Degraded Sediment (UDS) Area: Pile driving is likely to re-suspend contaminated sediment, potentially re-contaminating the capped areas. The applicant must demonstrate to a high degree of scientific certainty that their methods will not degrade the cap. DNR will require the applicant to perform before and after sediment sampling and repair any degradation of sediment or the cap. The UDS Area is depicted on “Appendix D” to the Consent Decree.
2. Dredging, trenching (e.g. for buried cables, pipes, or other structures): This activity has a high likelihood of causing recontamination of clean surface sediment and will not be authorized as long as the cap must function.
3. Surface Linear Uses: Cables, pipes and similar linear uses that will be laid on the surface will only be authorized in the UDS area due to their potential to interfere with operation, maintenance and monitoring activities of the cap. The applicant must demonstrate to a high degree of scientific certainty that their methods will not degrade adjacent areas of the cap. DNR will require the applicant to perform before and after sediment sampling and repair any degradation of sediment or the cap. At year 15 DNR and EPA will use all monitoring results to evaluate the need to continue this moratorium.
4. Anchoring, Spuds or similar devices: DNR will not authorize uses that involve or promote these activities in all capped or degraded areas of OU6. DNR is not authorized or obligated to actively prevent or control anchoring activities. DNR will cooperate should EPA decide to seek to

establish and post a no-anchor zone, as provided under § 12.2 of the ASARCO Sediments/Groundwater Operable Unit 6 ROD.

5. Buoys:
    a. Capped Area: Buoy anchoring systems that penetrate the cap will not be authorized by DNR or EPA. Weighted buoy systems will be considered by DNR and EPA on a case by case basis.
    b. UDS Area: Buoys in the UDS area may be authorized by DNR if approved by EPA. The applicant must demonstrate that the anchoring system will not disturb or re-suspend contaminated sediment to the degree that recontamination of nearby clean sediment might occur.
6. Marinas: Marinas will not be authorized by DNR or approved by EPA on SOAL in any part of OU6 for a minimum of 15 years from the time of cap placement. A marina may interfere with monitoring, maintenance and potential contingency actions. Similarly, at year 15 DNR and EPA will use all monitoring results to evaluate the need to continue the moratorium on marinas.
7. Piling Removal
    a. Capped Area: Piling removal by full extraction will not be authorized by DNR in the capped area. Alternate methods, such as cutting below the sediment surface will be considered by DNR and EPA on a case by case basis. In all cases, DNR will require the applicant to monitor for and repair any degradation of sediment, the cap, or rip-rap on SOAL..
    b. UDS Area: Full extraction will be discouraged and only considered for small projects where a net benefit is demonstrated by the applicant. Cutting below the sediment surface will be considered on a case by case basis. Sediment monitoring and repair is required.
8. Aquaculture (e.g. Shellfish, Net Pens): These types of activities will not be authorized within OU6 by DNR or EPA for at least fifteen years. An evaluation of this moratorium by DNR and EPA may occur (assuming an application has been received) based on at least 15 years of monitoring. Given the proximity and configuration of sediment contaminants known to be hazardous to human health and the environment, aquaculture may introduce an inappropriate level of health risk.
9. Launch Ramps and Lifts: These activities may be authorized by DNR and EPA on a limited case by case basis. The applicant will be required to show that navigational impacts to sediment (see paragraph below on navigation) have been factored into the design. For example, vessel size may need to be limited and the area armored against induced current or grounding.

Following is a list of other types of uses that DNR does not authorize, but are pertinent to management of SOAL within a CERCLA site:

1. Derelict Vessels: Qualifying derelict vessels will be managed by the DNR Derelict Vessel Removal Program (DVRP). DNR will coordinate the management of non-qualifying derelict vessels with the appropriate agency.

2. Fishing: DNR does not have the authority and is not obligated to actively prevent fishing activities. DNR will cooperate if EPA choses to seek to establish and post a no fishing zone.
3. Diving: DNR does not have the authority and is not obligated to actively prevent diving activities. DNR will cooperate if EPA choses to seek to establish and post a no diving zone.
4. Navigation: Wake and prop induced current from vessel traffic is an important factor in cap design. There is a demonstrable limit to vessel characteristics beyond which it is mathematically predicted to erode the cap or to re-suspend degraded sediment. It is the responsibility of the cap designer/installer or the applicant to specify this limit, not DNR. DNR does not have the authority and is not obligated to actively prevent all or certain navigation activities. DNR will cooperate if EPA choses to seek to establish and post limits to vessel speed or characteristics (e.g. power, draft). Vessel restrictions must be considered in development plans for docks, marinas, buoys, or similar facilities.

Additional permits and restrictions enforced by other federal, state, and local agencies will be required for certain uses.