

**Document Summaries
And Areas for Further Investigation
Maury Island Gravel Mining Impact Studies
Department of Ecology**

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**Document Summaries and Areas for Further Investigation
Maury Island Gravel Mining Impact Studies**

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Introduction

The primary objective of this report is to identify “data gaps”—areas that need additional investigation—for the Maury Island Gravel Mining Impact Studies. The report emphasizes reasons why additional data are required and recommends approaches for collecting and analyzing them. A secondary objective is to identify existing documents that describe either site conditions and/or probable impacts of the mine and to briefly summarize their contributions.

Although off-site studies were reviewed, only documents that pertain to site-related mining studies or impact assessments are addressed herein. We reviewed regional studies to assess conditions in areas surrounding the mine and to identify the types of data collected for these studies (e.g., Ritzi (1981), Booth (1991), Carr/Associates (1983), Vashon-Maury Groundwater Management Committee (1998)). These regional studies will be used to develop the site conceptual model under Task 3 and will provide background information for off-site characterization under Tasks 4, 5, and 8 of our scope. However, because these studies were not intended to evaluate the potential impacts of the mine or conditions at the mine site directly, their content is not discussed herein.

This report is divided in two main sections. Section 1 lists and briefly summarizes perti-

nent site documents. The second section discusses areas that require further investigation to assess mining impacts and addresses supporting information that would benefit documents summarized in Section 1. Section 2 is divided into Ecology’s four areas of concern for mining impacts: groundwater, surface water, near-shore environment, and contaminated soils. Each topic is evaluated using specific *Questions Guiding the Study Effort* as presented in Ecology’s initial request for proposal (ECY RFP 9913). Our comments focus on what additional information is needed to complete the impact studies and reference proposed project tasks where appropriate.

This work was performed, and this report prepared, in accordance with hydro-geologic practices generally accepted at this time in this area, for the exclusive use of the Department of Ecology and their consultants, for specific application to the project site. No other warranty, express or implied, is made.

Section 1 - Review Existing Project Documents

The following documents were prepared specifically for the Lone Star-Maury Island mine project and are important for building a conceptual understanding of environ-

mental conditions at the site. They are listed in chronological order.

Document 1: *Potential Water Quality Impacts and Mitigations, Maury Island Pit, King County, Washington.* Unpublished consulting report, dated April 3, 1998, prepared by Associated Earth Sciences, Inc. (1998a).

This report was prepared by Lone Star Northwest's hydrogeologic consultant. It contains a semi-quantitative analysis of why no impacts would occur to water quality at the Maury Island mine site. Potential for water quality impacts to the groundwater systems and to Puget Sound are discussed in the context of a centralized retention/infiltration pond with the assumed stockpiling of topsoil containing elevated arsenic concentrations. The study assumed that all water collected on the site enters the *Principal Aquifer*, which then flows east and discharges to Puget Sound.

Potential contamination issues considered include turbidity, arsenic, temperature, and petroleum spills. The report concludes that each issue poses a minimal threat to water quality providing that suggested mitigation measures are followed. These measures include the following:

- Providing at least 15 feet of separation between the mine floor and the water table

- Designing retention/infiltration ponds so that they do not contact the water table using King County guidelines
- Stockpiling and covering arsenic-contaminated topsoil
- Strictly managing the on-site use and handling of petroleum products

Document 2: *Existing Conditions, Impacts, and Mitigations for Marine Fisheries, Maury Island Pit Barge Loading Facility, King County, Washington.* Unpublished consulting report, dated April 16, 1998, prepared by Associated Earth Sciences, Inc. (1998b).

This report was completed by Lone Star's fisheries consultant in support of an expanded environmental checklist. It describes the marine habitat near the Lone Star dock area and includes a review of site literature. It also describes the results of a reconnaissance survey of marine habitat near the Lone Star dock area as well as a brief description of potential impacts to the marine environment that may result from the project. The following potential impacts were reported in the marine fisheries report:

- Shading from the near-continuous presence of barges at the site
- Accidental spillage of sand and gravel during loading
- Petroleum spills from increased marine equipment activity

- Impacts to water quality from mining and barge traffic activities

The report concluded that none of these potential impacts is expected to be significant in marine environments around the Pit Barge Loading facility. Eelgrass habitats, which would be affected by shading, were found in shallow areas but not seaward of the pilings where barge activities are proposed. Spills of gravel and sand would be mitigated by a spill tray under the conveyor belt; past operations at the barge dock would be reviewed to guide operations, providing information to mitigate spillage. Accidental spills of petroleum products are not expected because of the slow vessel speeds and the nature of the material transported. Barge traffic would not occur in nearshore sensitive habitats and the displacement of fish is expected to be limited to relatively small areas. No runoff from the site would contribute to surface water features or directly to Puget Sound.

Document 3: *Soils, Geology, Geologic Hazards and Groundwater Report, Existing Conditions, Impacts and Mitigation, Maury Island Pit, King County, Washington.* Unpublished consulting report, with a revised date of April 27, 1998, prepared by Associated Earth Sciences, Inc. (1998c).

This report, completed by Lone Star's hydrogeologic consultant, describes their initial understanding of subsurface conditions at

the site. Work included reviewing available literature and collecting data to characterize on-site soils, geology, and groundwater. It also involved excavating 15 pits to explore shallow soil and interflow conditions and drilling four borings that ranged from 16.5 to 340 feet deep. Two observation wells (OBW-1 and OBW-2) were installed, providing preliminary information about groundwater flow directions in the *Principal Aquifer*. Limited soil testing for arsenic, mercury and lead was also conducted

The report concludes that no impacts to the groundwater or surface water systems will occur if mitigation measures are followed except for the loss of the on-site interflow network. The mitigative measures include providing appropriate setbacks and separation from surface water and groundwater. The study suggests that additional testing and exploration should be conducted to support a design for the detention/infiltration pond. It further recommends that groundwater flow modeling be conducted to assess mounding effects and associated infiltration rate changes due to stormwater system operation. The study also recommends additional soil-quality testing and procedures for handling topsoil to protect water quality.

Document 4: *Hydrogeological Review of Maury Island Pit, prepared for Gold Beach Water Company*, May 1998. Unpublished consulting report prepared by Rongey/Associates, Hydrology (1998).

This report presents an independent interpretation of the hydrogeology for the Gold Beach area and adjacent parts of the Lone Star mine site. It provides a qualitative assessment of the potential impact of the proposed mining activities on wells supplying the Gold Beach water system, located northeast of the pit. The report was prepared based on a review of AESI's earlier work (Document 3) and an evaluation of well data and water system operating information from the Gold Beach system. Limited sampling and analysis for selected wells, springs, and streams were also conducted for this report.

The report concludes that the Gold Beach wells and Lone Star pit area have a common recharge source—the *Principal Aquifer*. It also concludes that the proposed mine expansion will not impact the Gold Beach wells if a 15-foot separation remains between the water table and pit floor. The report concludes that groundwater interflow likely occurs in the shallow subsurface but is not a significant source of recharge to the Gold Beach wells. The report also concludes that increased seasonal fluctuations in the water table caused by mine expansion are not expected to change hydraulic gradients or directions of groundwater move-

ment near Gold Beach wells significantly. However, the report recommends monitoring water level for Gold Beach wells quarterly to evaluate changes in groundwater elevation.

Document 5: *Addendum Geology and Ground Water Report, Maury Island Pit, King County, Washington*. Unpublished consulting report, revised date of March 3, 1999, prepared by Associated Earth Sciences, Inc. (1999a).

This report is the second hydrogeologic report prepared by Lone Star's consultant. It provides a more detailed understanding of the subsurface conditions at the site than AESI (1998c). The primary objective of the study was to characterize hydrogeologic conditions on the site, including groundwater occurrence, flow directions, quality, and temporal water level trends. The study was conducted partly in preparation for site impact and mitigation assessment under the Environmental Impact Statement (EIS) process. Work was therefore coordinated with Terra Associates, the project's EIS hydrogeologic consultant and included:

- Drilling and logging seven exploratory borings
- Installing five additional monitoring wells
- Conducting geophysical logging in three wells
- Excavating 19 test pits for till mapping

- Installing five interflow piezometers
- Testing water quality
- Monitoring water levels in selected on-site wells
- Installing dedicated equipment for monitoring in three wells (OBW-6, -7, and -9)

The report includes geologic cross sections, a geologic map based on test pit results, water level data and short-term hydrographs for the *Principal Aquifer*, a summary of background water quality, geophysical logs, and exploration logs. A groundwater flow map of the site is *not* presented in the report. The report concludes that groundwater interflow at the site is not significant in terms of the local and off-site flow systems. It further states that no adverse impacts to off-site interflow, to the *Primary Aquifer*, or to other aquifers in the project area are expected when on-site interflow is disrupted during mine expansion. Geophysical data indicate that relatively thin zones of perched groundwater exist at the site but have limited aerial distribution.

The authors conclude that the potential hydrogeologic impacts from mine expansion and reclamation are small and can be mitigated. They suggest maintaining 15 feet between the mine floor and the underlying aquifer system and recommend monitoring groundwater quality and water levels in the *Principal Aquifer* during mine operation.

Document 6: *Letter to Ron Summers of Lone Star Northwest, Inc. from Jill Wheeler of AESI, regarding monthly groundwater monitoring summary*, letter correspondence dated of May 3, 1999, prepared by Associated Earth Sciences, Inc. (1999b).

This letter presents updated monthly groundwater level data and surveyed well-head elevations for seven monitoring wells completed by AESI for Lone Star at the Maury Island site. It describes how well-head and water level elevations were established for previous reports and acknowledges that some topographic data were flawed. Consequently, some water level elevations reported on flow maps and hydrographs were incorrect. Although the letter does not include a flow map, it concludes that previous water level data in the northwest property corner are not representative and that groundwater flow is to the southeast beneath the site. The letter underscores the importance of accurate survey data for meaningful water level surveys.

Document 7: *Draft Environmental Impact Statement for Maury Island Lone Star Gravel Mine*, Jones & Stokes Assoc., Inc., Terra Associates, Inc., and M.R. Stearns Planning and Design, July 1999. King County Dept. of Development and Environmental Services (1999).

The Draft Environmental Impact Statement (DEIS) presents a compilation and assessment of all project data available to date and evaluates potential impacts and mitigative measures associated with the preferred mining alternative. Appendices to the DEIS present additional supporting data and interpretation by technical specialists on the EIS team. Topic areas (and source chapters) of the DEIS requiring evaluation by the Pacific Groundwater Group Team include the following:

- **Geology and Hydrogeology** (Chapter 4; Appendices A and E)
- **Marine Habitat and Fisheries** (Chapter 6)
- **Contaminated Soil and Sediment** (Chapter 10; Appendices B and C)

Brief summaries of major site-related impacts for these topic areas are presented below. The seven topic areas of the DEIS not included in this list are not discussed herein because they are outside of our scope.

Geology and Hydrogeology

The *Geology and Hydrogeology* chapter of the DEIS is based on a *Groundwater Discipline Report* prepared by Terra Associates (Terra) as presented in Appendix A of the DEIS. Most data in Terra's report was collected and interpreted by AESI and

discussed in documents described above. No new field data were collected as part of Terra's work for the DEIS. Although Terra's report presents an independent interpretation of the site data, its description of the groundwater system differs only slightly from interpretations in previous reports. Terra provided a new water budget for the site under existing and completed mine conditions. Its water budget indicates that increased groundwater recharge will occur in the mine area because of the proposed removal of vegetation, and till soils, which will result in increased runoff (assumed to ultimately reach the underlying aquifer).

Groundwater monitoring results from AESI, including up to 6 months of water level measurements and two quarters of water quality data, are presented as Appendix E of the DEIS. These data provide an initial baseline for on-site groundwater conditions against which mine impacts can be measured. The appendix states that future water quality sampling will occur quarterly in three wells and that groundwater levels will be measured monthly in all seven on-site wells. The data presented in Appendix E was considered in the site characterization presented by Terra in Appendix A and Chapter 4 of the DEIS.

The DEIS states that proposed mining activities would not impact the availability of local drinking water (the *Principal Aquifer*) because:

- Appropriate drainage and recharge designs will be implemented
- The site does not contribute to lateral, off-site interflow
- On a regional scale, the site is considered to be located in a groundwater discharge area rather than a recharge area
- The amount of water reaching the aquifer would not be reduced, but rather would increase because of vegetation removal

Although the DEIS could be correct in these statements, additional data should be collected to better understand changes in groundwater flow conditions caused by mine expansion.

Based on the DEIS, mining impacts to groundwater quality are not expected to be significant if the recommended mitigations are followed. Such mitigations include instituting good management practices in on-site fueling areas and maintaining a 15-foot separation between the mine floor and the underlying groundwater system. Special handling measures and containment of arsenic-contaminated topsoil, as discussed below, are proposed to protect groundwater quality from low-concentration leaching that could otherwise occur during routine handling of surface soils.

Aquifer breach is not considered to be a significant concern at the site because no shallow aquifers have been identified above the regional water table within the proposed excavation zone. Based on these findings, the DEIS states that aquifer breach cannot occur if the proposed 15-foot separation is maintained between the mine floor elevation and the top of the *Principal Aquifer*.

The DEIS suggests that a number of drainage modifications are being considered to provide better distribute infiltration and to minimize runoff at the site during active mining periods. These measures include using reverse terrace slopes and constructing a series of temporary collection ponds on cut benches within the mine area. Temporary water-collection ponds on the uppermost cut benches are recommended to supplement a single detention/infiltration pond in the bottom of the mine. Localized infiltration at cell-specific detention/infiltration ponds is also recommended during the site reclamation.

Unavoidable impacts to groundwater because of mine operation include greater seasonal fluctuations in recharge rates. These fluctuations would occur as unsaturated soils are removed. Removing vegetation from the site would further increase groundwater recharge at the site until reclamation occurs. The magnitude of such changes was not assessed in the DEIS nor was groundwater mounding that may occur beneath the site during the peak recharge

events. Numerical modeling of the ground-water system is necessary to quantify these impact and to assess possible shifts in groundwater flow directions near the site.

Marine Habitat and Fisheries

The Marine Habitat and Fisheries chapter of the DEIS is based on the Existing Conditions document prepared by AESI (1998b) and other existing literature and information. No new data were collected in the marine environment within the study area. The DEIS reported that an eelgrass survey would be conducted during periods of maximum eelgrass coverage in the study area; results would be presented in the Final EIS. Until these data are available, it was assumed that the maximum depth of eelgrass would be -22 feet MLLW, the reported limit from other Puget Sound studies. The DEIS summarized physical conditions in the intertidal and subtidal zones of the marine environment. It also summarized biological resources for economically important or sensitive species. Biological resources were summarized for eelgrass and kelp, geoducks, sea cucumbers, herring, surf smelt, sand lance, and salmon.

The DEIS also evaluated the potential impacts of barge shading, spillage of sand and gravel during barge loading, turbidity caused by barge prop wash, noise and vibration from pile driving and barge loading, dock modifications, and partial bluff removal. It also evaluated the potential effects of project activities on geoduck harvests by the Puyallup Tribe, along with the increased

potential for petroleum spills. Several mitigation measures were proposed, including:

- Modifying the dock in accordance with requirements for new dock construction
- Installing a spill tray under the conveyor belt
- Installing an automatic power interrupt switch on the belt
- Developing spill response and containment plans for petroleum spills and mining activities
- Initiating a marine monitoring plan

The DEIS reported that if the proposed mitigation measures are implemented, no significant adverse impacts on the marine environment are expected from the Proposed Action or other alternatives. The technical justifications for this conclusion are summarized below:

- Barge shading is not expected to impact eelgrass because none is present and habitat where shading would occur is not suitable for eelgrass. The barge loading area is deeper than -22 ft MLLW, the limiting depth for eelgrass growth in Puget Sound.
- Shading may alter invertebrate populations or other marine life but the impact would be minor since the alteration would occur over a relatively small area and only common species would be affected.
- Tugboats would typically be aligned so that prop wash would be oriented par-

allel to or away from the shore. Any decrease in light associated with turbulence would be directed parallel to shore at a depth where eelgrass does not grow.

- Effective mitigation would reduce gravel spillage.
- Minor spillage is expected where the conveyor belt would dump material onto the barge. This area does not contain eelgrass or kelp.
- No vessel refueling would take place at the project site, reducing the risk of petroleum spills. Barges would haul sand and gravel, not petroleum products.
- Surface water from mining operations would infiltrate to the underlying aquifer via the proposed retention/infiltration pond; therefore, sediments generated by mining activities would not reach Puget Sound.
- Tugs would be operated in deeper waters where prop wash would dissipate before it could disturb the bottom.
- Sensitive habitats lie close to the shoreline and farther from the proposed tug traffic.
- Currents continuously flush the southeast side of Maury Island and would prevent disturbed sediment from causing a decrease in dissolved oxygen.
- The 200-foot vegetated buffer would protect against erosion, roughly main-

taining the existing sediment input from the bluff to the beach.

- All shoreline areas in Puget Sound are potential juvenile salmon rearing and migration habitat. This site is not unique or large in terms of habitat for salmon. Other studies have shown the effects of pile driving on juvenile salmon to be relatively minor.
- The most likely effect of the project on marine mammals would be the avoidance of the area by harbor seals.
- The dock would be modified over a period of 2 to 4 weeks, which is not long enough to alter the survival rate of eelgrass in the area. Sediment disturbance during this time would be intermittent, occurring only during pile driving.
- Geoduck divers from the Puyallup Tribe should be able to harvest within the study area during breaks in loading.

Contaminated Soil and Sediment

The nature and extent of soil contamination on the proposed mine sites is summarized in Chapter 10 and Appendices B and C of the DEIS. Appendix B is a Technical Memorandum, *Environmental Soil Sampling*, by Terra Associates, Inc. which summarizes sampling done by Terra, as well as by Landau Associates (1999) with AGRA split samples, AESI (1998c), and University of

Washington's *Ruston/Vashon Arsenic Exposure Pathways Study* (1987).

The DEIS summarizes the soil data, mostly total arsenic, cadmium, and lead analyses with one leach test sample analyzed by two methods. It also addresses impacts of dust by proposing to prepare a dust control plan. The DEIS proposes to mitigate impacts of mining runoff to surface water contamination and any possible soil leaching of arsenic by containing contaminated soils. Appendix C of the DEIS is *Mitigation Report for Contaminated Soils* (Foster Wheeler Environmental, 1999). This mitigation proposes to contain contaminated soils in a lined and covered containment cell located on the north side of the property.

Section 2 - Identify Areas for Further Investigation

Four topic areas were considered in evaluating areas in the studies described above that require additional investigation. The topics Ecology considers critical for assessing impacts associated with the proposed mine expansion include groundwater, surface water, nearshore environment, and contaminated soil. This section presents general questions we considered while reviewing the documents described in Section 1 and discusses areas where additional studies are required.

Ground Water

The general questions we used to assess whether additional groundwater information was required for the studies discussed in Section 1 were as follows:

- Do the existing data for Maury Island accurately characterize the hydrogeology in the vicinity of the Northwest Aggregates Company mine site?
- What areas, if any, in the available hydrogeologic characterization of the study area require additional investigation?
- How do you propose to address areas requiring additional hydrogeologic investigations in order to accurately and completely answer these questions?
- What are the hydraulic relationships between aquifers in the study area, including recharge relationships between shallow and deeper aquifer zones and ground water/surface water interrelationships?
- What are the impacts of the proposed mine expansion on local aquifers, including aquifer recharge effects?
- What are the impacts of the proposed mine expansion on ground water quality and quantity?

In general, the hydrogeology of the mine site appears to be adequately characterized by existing data. Significant work has already been completed both on and near the site to define the hydrogeologic setting. However, further investigation is needed to define the relationship between site-scale groundwater flow conditions and regional-scale flow for adjacent parts of Maury Island. These investigations would lead to a better understanding of groundwater recharge from the site. Specific tasks could include the following:

- Assessing on-site vertical gradients using data from new wells
- Conducting a regional well inventory and water level survey to provide data for characterizing regional flow patterns and locating groundwater flow divides
- Refining the site conceptual model developed by previous investigators

Areas requiring additional hydrogeologic investigation will be addressed in three initial tasks outlined by the Pacific Groundwater Group Team in *Proposal and Statement of Qualifications for Maury Island Gravel Mining Impact Studies*, dated August 6, 1999. Specific tasks proposed to satisfy the need for further investigations include:

- **Task 3** Conceptual Model Development

- **Task 4** Aquifer Exploration and Analysis
- **Task 5** Well Inventory and Water Level Survey

Relationships between shallow aquifers in the study area have been described by previous investigators. However, the high costs of deep explorations have justifiably limited deep aquifer characterization on Maury Island. Another reason deep exploration has been limited is that adequate quantities of water have always been available in the shallow (*Principal*) aquifer. As a result, deep wells have generally not been necessary for obtaining water supplies.

The focus of groundwater investigations for the mine project has been, and should continue to be, the *Principal Aquifer*. However, available information will be reviewed to assess recharge relationships between the *Principal Aquifer* and deeper aquifers. Relationships between groundwater and surface water will also be assessed using a numerical groundwater flow model under Task 8 of the proposed work scope. Springs will be assessed under Task 6.

Impacts of proposed mine expansion on local aquifers, including aquifer recharge effects, were addressed qualitatively in the DEIS and supporting documents. These documents do not, however, predict the magnitude of impacts, making it difficult to estimate water levels beneath the proposed

mine floor and surrounding areas of the *Principal Aquifer*. Further work is necessary to better quantify changes in recharge rates that may result from mine expansion. It is also necessary to predict the magnitude of groundwater mounding that may occur when recharge in the pit area increases and to evaluate changes in groundwater flow direction, changes that could occur during mine operation or reclamation.

A spreadsheet-based, infiltration model will be used along with an unsaturated flow model (or direct observation of hydrograph time lags) to estimate recharge to the *Principal Aquifer* under current and proposed mine conditions. Recharge evaluations are described under Task 8.1 of the proposed work scope. A simplified numerical model of groundwater flow will be developed to predict changes associated with increased recharge. These changes may affect water levels, groundwater flow patterns, and flow rates in bluff-face springs. Modeling evaluations are described under Task 8.2 of the proposed work scope. The model will be based on the site conceptual model updated in Tasks 2 through 6.

Current data and site documents suggest that groundwater quantity and quality will not be adversely impacted by proposed mine expansion. However, they will be addressed further under the Task 6 modeling effort. The quantity assessment will consider predicted changes to aquifer recharge rates (likely to increase locally) and regional wa-

ter levels (likely to rise locally) as a result of mine expansion. The quality assessment will consider the results of existing soil leaching tests and the design of soil-containment systems proposed for arsenic-contaminated topsoil (see below).

Surface Water

The questions we used to assess whether additional surface water information was required for the studies discussed in Section 1 were as follows:

- What are the impacts of the proposed mine expansion on water quality in local springs and streams?
- What are the impacts of the proposed mine expansion on flow in local springs and streams?

Existing documents provide information about the location, estimated flow rate, and water quality of springs that exist along the eastern bluff face of the mine site (although water quality data are limited). The DEIS and supporting documents report that there is no surface water on the mine site. These conditions will be verified and the water quality of on-site springs will be evaluated as specified under Tasks 3.2 and 6.1 of the proposed work scope. These data, in combination with contaminated soil information (see below) will provide a baseline understanding of local spring quality.

These data can also be used to help us estimate the impacts of mine expansion on springs, an issue that was not specifically addressed in the DEIS or supporting site documents. Potential changes in spring flow rates will be assessed using the numerical groundwater flow model developed under Task 8.2 of the proposed work scope. Spring flows during mine expansion will be simulated by assigning springs as discharge cells in the model grid.

Nearshore Environment

The questions we used to assess whether additional information about the nearshore environment was required for the studies discussed in Section 1 were as follows:

- What are the critical criteria of the nearshore marine ecology in the study area that may be affected in terms of habitat and marine life?
- What gaps exist in the available data on the nearshore environment and ecology, especially with regard to critical factors associated with the Endangered Species Act?
- How would you propose to fill gaps in nearshore ecology data in order to accurately and completely answer these questions?
- What are the impacts of the proposed mine on the nearshore environment?

Each of these questions is discussed below.

Critical Criteria of the Nearshore Marine Ecology

The project team will search the literature to find information about the nearshore area below the mine. This search will target information about the physical oceanography and patterns of sediment transport near the site, sediment grain size and chemistry, and benthic habitat types. It will also target information about the use of the nearshore area by fish species that are listed or are candidates for listing as threatened or endangered. Areas that require additional study will be addressed through interviews with fisheries biologists from the Washington Department of Fisheries and Wildlife (WDFW), as well as through focused field work.

Critical Factors Associated with the Endangered Species Act

More information than exists in the DEIS is needed to assess the current status of ecological resources of the nearshore area. Our review has identified the following critical resources that require detailed characterization:

- *Fisheries habitat for threatened or endangered species and commercially important species.* The DEIS provided little information about the use of the study area by juvenile Puget Sound chinook salmon, a species recently listed as threatened. Similarly, lit-

tle information was provided regarding habitat use by several candidate species for the Endangered Species List. These habitats include eelgrass, used by spawning herring; near-surface waters offshore, used by pre-spawning herring; underwater structures, used by brown and other rockfish species; and the nearshore, used by juvenile Pacific cod and walleye pollock. Little information was presented on the geoduck populations that are commercially harvested by Puyallup tribal members.

- *Benthic habitat types and sediment quality.* Little baseline information about the types, condition, and extent of benthic habitats, including eelgrass beds, was provided in the DEIS.
- *Nearshore sediment quality.* Little information was provided in the DEIS about the existing conditions of sediments in the nearshore area, including grain size, kinetic regime, and chemistry.

Additional Studies Required to Characterize Nearshore Ecology

Fish, epifaunal invertebrates, and marine mammals occurring in the nearshore environments of the study area will be identified by evaluating fisheries surveys conducted on Maury and Vashon Islands and in central and south Puget Sound. The scientific literature and key references on habitat requirements, life histories, trophic relationships, and behavior of key fish, invertebrate, and marine mammal species will be

reviewed to identify the species most vulnerable to proposed pier reconstruction and barge operations.

As part of the endangered species evaluations for the Puget Sound chinook salmon, which is listed as threatened, the project team will:

- Evaluate salmon stock assessment and catch statistics by the WDFW for catch reporting areas in Central and South Puget Sound. This is required to identify the chinook salmon runs in the area and run sizes over time.
- Evaluate available data on the movements of adult and juvenile fish of local stocks that may use the study area (for example, Puyallup River stock).
- Review the scientific literature to assess habitat preferences of juvenile salmonids in Puget Sound, and evaluate the habitat of the Vashon/ Maury Island nearshore for its potential to support juvenile salmonids.
- Review the scientific literature on avoidance behavior caused by ship traffic, noise, vibrations, and propeller wash.
- Evaluate the degree to which barge traffic could affect juvenile salmonids.

As part of the endangered species evaluations for the Pacific herring, which is a candidate for listing, the project team will:

- Interview herring biologists from then WDFW who are responsible for

spawning surveys of the Quartermaster Harbor herring stock. These interviews will be used to assess the extent of spawning in the study area. Historical data indicate that the study area lies on the edge of spawning grounds.

- Evaluate the stock status reports from the WDFW that describe the spawning biomass of discrete herring stocks over time to assess population trends of the Quartermaster Harbor stock.
- Identify the spatial position of pre-spawning holding areas in relation to barge traffic to and from the study area.
- Review the scientific literature on avoidance behavior caused by ship traffic, noise, vibrations, and propeller wash. Evaluate and present vessel management programs to protect herring fisheries in other areas.
- Evaluate the potential effects of barge traffic on larval, spawning adult, and pre-spawning adult herring in and near the study area.

Along with Pacific herring, several other Puget Sound fish species were listed as ESA candidates, including Pacific cod, Pacific hake, walleye pollock, and brown, copper, and quillback rockfish. EVS will also evaluate the habitat requirements and occurrence of these species in the study area.

The baseline benthic habitat and sediment quality characterization will be developed using a combination of traditional grab sam-

pling and acoustic and optical reconnaissance survey technologies: high-resolution (500 kHz) side-scan sonar and bathymetry along with sediment profile imaging (SPI) technology. The side-scan sonar survey will be used to characterize the sediment grain size, map sediment surface features, and identify the location and lateral extent of any eelgrass patches. The side-scan sonar and bathymetric survey will provide detailed, continuous coverage of the nearshore area that was surveyed to a limited extent by divers, and it will update the accuracy of that preliminary information. The SPI camera will then be deployed to obtain photographic documentation of existing bottom conditions and to accurately identify sediment grain size (to ground-truth the side-scan record) and document benthic infaunal successional stage.

Sediment grab samples will be collected from six stations in the nearshore area to provide baseline information on existing sediment chemical concentrations prior to mining operations. The analytes will include the trace metals arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc; total organic carbon; grain size; total solids (percent moisture), PAHs, PCBs, and chlorinated pesticides. The six station locations will include 3 stations inshore from the reconstructed pier and 3 stations offshore the pier at locations with the greatest potential for project impacts. The six stations will fall on the SPI and sonar mapping tracks, to provide for data comparison and confirmation.

Impacts on the Nearshore Environment

The following potential impacts to the near-shore environment will be characterized:

- Noise from construction activities or operations
- Turbidity
- Loss of habitat due to piling installation
- Spills or leaks of petroleum hydrocarbons
- Propeller wash
- Shading by barges
- Accidental spills of sand and gravel
- Piling installation effects on longshore sediment transport

Based on the literature review and interviews with fisheries specialists, the marine species of concern known or expected to use the project area will be identified, along with their sensitivities to potential project impacts. Potential impacts to the communities or populations of these species will be assessed.

Contaminated Soil

The questions we used to assess whether additional information about contaminated soils was required for the studies discussed in Section 1 were as follows:

- What is the nature and extent of soil contamination on the proposed mine sites?

- What is the potential for marine sediment contamination due to the proposed mine expansion?
- What are the impacts of removal and storage of contaminated soil on site?
- What are the long-term impacts of capped on site storage of contaminated soil on ground water quality?

The nature and extent of soil contamination at the site has been studied previously. In the next year, further characterization will occur with the *Vashon/Maury Island Soils Study* (Phase I) by the Seattle-King County Health Department under the Site Hazard Assessment Grant.

The existing data show a fairly consistent pattern of contamination in the upper 18 inches of soil, which will be removed and contained on site. The deeper soil will be mined and taken off site for its intended use. For this study, the existing soil and soil leaching data will be summarized. No further investigation is planned.

Existing sediment quality in nearshore marine areas near the site has not been described. The sediment investigation proposed in the Nearshore Environment section of this report is designed to provide data on the pre-mining sediment quality to compare to future monitoring efforts.

The impacts of removing contaminated soil and storing it on site include:

- Direct contact with airborne dust during excavation and transport of dust off site
- Limited surface runoff during excavation rain events
- Temporary leaching of soils until capping occurs at the on-site containment cell

According to the DEIS, Lone Star plans to address concerns airborne dust by developing a dust control plan in consultation with the Puget Sound Air Pollution Control Agency. In addition, mitigation measures include covering exposed soil and limiting soil clearing to 2-acre parcels. These measures will also assist in minimizing surface runoff of contaminated soil during excavation. Based on site data and on mitigation measures presented in the DEIS, no further investigation is warranted under this study beyond the spring investigation proposed in Task 6.1.

The impacts of removing contaminated soil and storing it on site are partly due to leaching and runoff of surface particles. Soil leaching would not differ substantially before and after excavation. Appendix B of the DEIS presents results of Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leach Procedure (SPLP) tests conducted on a single composite soil sample. This sample was created from the three on-site soil samples with highest arsenic concentrations. It was ana-

lyzed by two leaching methods, yielding two sets of analytical results. The results indicate that leachate concentrations are at least an order of magnitude below Maximum Contaminant Levels for protection of drinking water. Although the data set is extremely small, in-situ leaching of site soils has occurred naturally over the entire site for the last 15 to 100 years. According to the DEIS, sampling results from on-site monitoring wells indicate that groundwater quality does not appear to be impacted by the existing topsoil contamination and leaching conditions at the site. Soil particulate runoff during excavation is not directly addressed by the DEIS. Other than on-site surface water sampling to establish baseline spring water quality, this study does not propose additional investigation of the impacts of removal and storage of contaminated soils.

The DEIS does not address the long-term impacts of storing capped, contaminated soils on groundwater quality. The proposed containment cell features a leachate collection system. This study proposes that the proposed design of the soil containment cells be reviewed in Task 7.2 (Engineering Analysis of Soil Containment Systems); however this review does not include a study of seismic impacts on the cell's integrity.