March Point Landfill
Anacortes, WA

Sediment Remedial Investigation/ Feasibility Study Workplan

DRAFT

Prepared for

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List of Acronyms

COC	chain of custody
CRI	Color Rendering Index
CSL	Contaminant Screening Level
DGPS	differential Global Positioning Device
DMMP	Dredged Material Management Program
Ecology	Washington State Department of Ecology
FM	field manager
GPC	gel permeation chromatography
GPM	Government Project Manager
HASP	Health and Safety Plan
HPAH	high molecular weight polynuclear aromatic hydrocarbon
LAET	lowest apparent effects threshold
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LPAH	low molecular weight polynuclear aromatic hydrocarbon
MDL	method detection limit
MS/MSD	matrix spike/matrix spike duplicate
OC	organic carbon
PAH	polynuclear aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PLP	Potentially Liable Party
PPE	personal protective clothing
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RI/FS	Remedial Investigation/Feasibility Study
RPD	relative percent differences
SA	Selective Availability
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SEDQUAL	sediment quality (database)
SIR	Swinomish Indian Reservation
SITC	Swinomish Indian Tribal Community
SMARM	Sediment Management Annual Review Meeting
SMS	Sediment Management Standards
SOP	standard operating procedures
SQS	Sediment Quality Standard
SVOC	semi-volatile organic compound
TDL	target detection limit
TOC	total organic carbon
USEPA	U.S. Environmental Protection Agency
UV	ultraviolet

1.0 Introduction

This Sediment Remedial Investigation/Feasibility Study (RI/FS) Workplan addresses potential contamination of aquatic lands related to the former March Point Landfill (aka Whitmarsh Landfill) located in Anacortes, Washington. This Sediment RI/FS Workplan, inclusive of the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP), is being submitted to the Washington State Department of Ecology (Ecology) under contract No. C070034 between Ecology and Science Applications International Corporation (SAIC). The work described in this plan will be conducted as part of an RI/FS being conducted under Ecology's Hazardous Substances Site Investigation and Remediation for the Toxics Cleanup Program.

1.1 Regulatory Framework

The objective of work described in this plan is to complete an RI/FS per requirements in WAC 173-340-350 and WAC 173-204 (Ecology 1995). The purpose of the RI/FS is to determine the nature and extent of releases of hazardous substances from the former landfill, to characterize potential risk to ecological receptors, and to gather necessary data to support the development of a feasibility study and any subsequent sediment cleanup actions.

This work plan includes the components of an SAP and QAPP requirements per WAC 173-340-820. The plan also specifies analytical procedures in accordance with WAC 173-340-830.

1.2 Site Background

The March Point (aka Whitmarsh) Landfill, located in Anacortes, Washington, was a public dump in the 1950s, and was operated by Skagit County from 1961 until its closure in 1973. The former landfill is located adjacent to Padilla Bay, which is a National Marine Estuarine Sanctuary that supports sustenance fishing to the Swinomish Indian Tribal Community (SITC). Due to the landfill's proximity and potential impacts to Padilla Bay and Padilla Bay Lagoon, it has been identified as a high priority cleanup area under the Puget Sound Initiative.

The abandoned March Point Landfill site is approximately 14 acres located at 9663 South March Point Road in Anacortes, Washington. The site is located on former tidelands at the base of a bluff at the west end head of Padilla Bay Lagoon. The landfill is bounded by March's Point to the north and west, Padilla Bay and Padilla Bay Lagoon to the northeast, the Swinomish Indian Reservation (SIR) and Swinomish Channel to the east, and March's Point Road and Highway 20 to the south (Figure 1). The landfill is buttressed with heavy rock riprap along its saltwater edge to the northeast, which includes a railroad right-of-way. A small stream also flows along its south and southwest border (Meadows 1990). The embankment under the railroad serves as a dike separating the Padilla Bay Lagoon from the greater Padilla Bay. A small trestle in the railroad embankment allows for water exchange between the lagoon and outer bay.

The landfill was an unregulated public dump from 1950 to 1973 and was operated by Skagit County from 1961 to 1973. Skagit County used this landfill as its primary disposal area from 1969 to 1973. It is unknown the types and quantities of waste that were buried at the landfill,

which included household and commercial solid waste, and industrial waste from two refineries located nearby, as well as potentially large quantities of asbestos-containing material. Records indicate that industrial wastes were accepted from Shell and Texaco refineries. In addition, Allied Chemicals and Northwest Petrochemical may have also dumped their wastes at the landfill (Ecology 2006). A more detailed description of the landfill waste type and history, along with photo documentation of the site, is provided in the *Summary of Existing Information and Identification of Upland Data Gaps* (GeoEngineers 2007). A summary of previous sediment and aquatic investigations is provided in the *Summary of Existing Information and Identification of Data Gaps for Sediments* (SAIC 2007).

1.3 Project Scope and Work Plan Objectives

The scope of this Sediment RI/FS Workplan is limited geographically to the aquatic areas of the Padilla Bay Lagoon and nearshore areas of Padilla Bay adjacent to the former March Point Landfill. The RI/FS workplans for the upland portions of the site are being prepared under separate cover (GeoEngineers 2007b).

The purpose of this workplan is to describe the manner and methods for which a sediment characterization will be conducted in areas adjacent to the former landfill site, including Padilla Bay and Padilla Bay Lagoon. The results of the sediment characterization will be used to determine whether a cleanup action is needed, identifying remedial alternatives, and assessing the feasibility of the identified remedial actions.

The objectives of the workplan will be to conduct a tiered sediment characterization of the site designed to define the nature and extent of sediment contamination and identify any opportunities for habitat restoration. The sediment characterization is also designed to meet several data gaps identified following a review of the existing information on sediment quality at the site (SAIC 2007). The specific objectives of the RI/FS sediment characterization include the following:

- Conduct a more intensive sampling and analysis effort to characterize the overall nature and extent of sediment contamination and potential biological effects in Padilla Bay Lagoon and portions of Padilla Bay adjacent to the March Point Landfill site.

- Collect, process, and analyze representative sediment data to characterize the site in accordance with protocols, timing, and quality assurance/quality control (QA/QC) requirements outlined by Washington State SMS protocols, Puget Sound Estuary Program (PSEP) protocols, and subsequent Sediment Management Annual Review Meetings (SMARM) updates.

- Compare the sediment chemistry results to Washington State Sediment Management Standards (SMS), Sediment Quality Standards (SQS), and Cleanup Screening Levels (CSL).

- Conduct a suite of sediment toxicity tests on synoptic sediment samples that exceed the SQS chemical criteria. The suite of toxicity tests will include a larval development bioassay, an amphipod mortality bioassay, and a juvenile polychaete growth bioassay. In

addition, due to the intertidal nature of the lagoon and the presence of polycyclic aromatic hydrocarbons (PAHs), bioassays will be conducted utilizing full-spectrum lighting (Ecology 2003).

- Characterize the benthic infaunal community and habitat at the site and at an appropriate reference location.

- Provide a description of the physical characteristics of the site including potentially impacted portions and identify habitat restoration opportunities.

- Delineate impacted areas that may require remedial action, identify remedial alternatives, and assess the feasibility of implementing any remedial actions.

- Identify whether subsequent investigations are needed to further characterize the nature and extent of contamination, including but not limited to:

    - Increasing the spatial extent of the investigation,
    - Subsurface sediment quality,
    - Sediment bioaccumulation potential, and
    - Tissue residues of fish and shellfish.

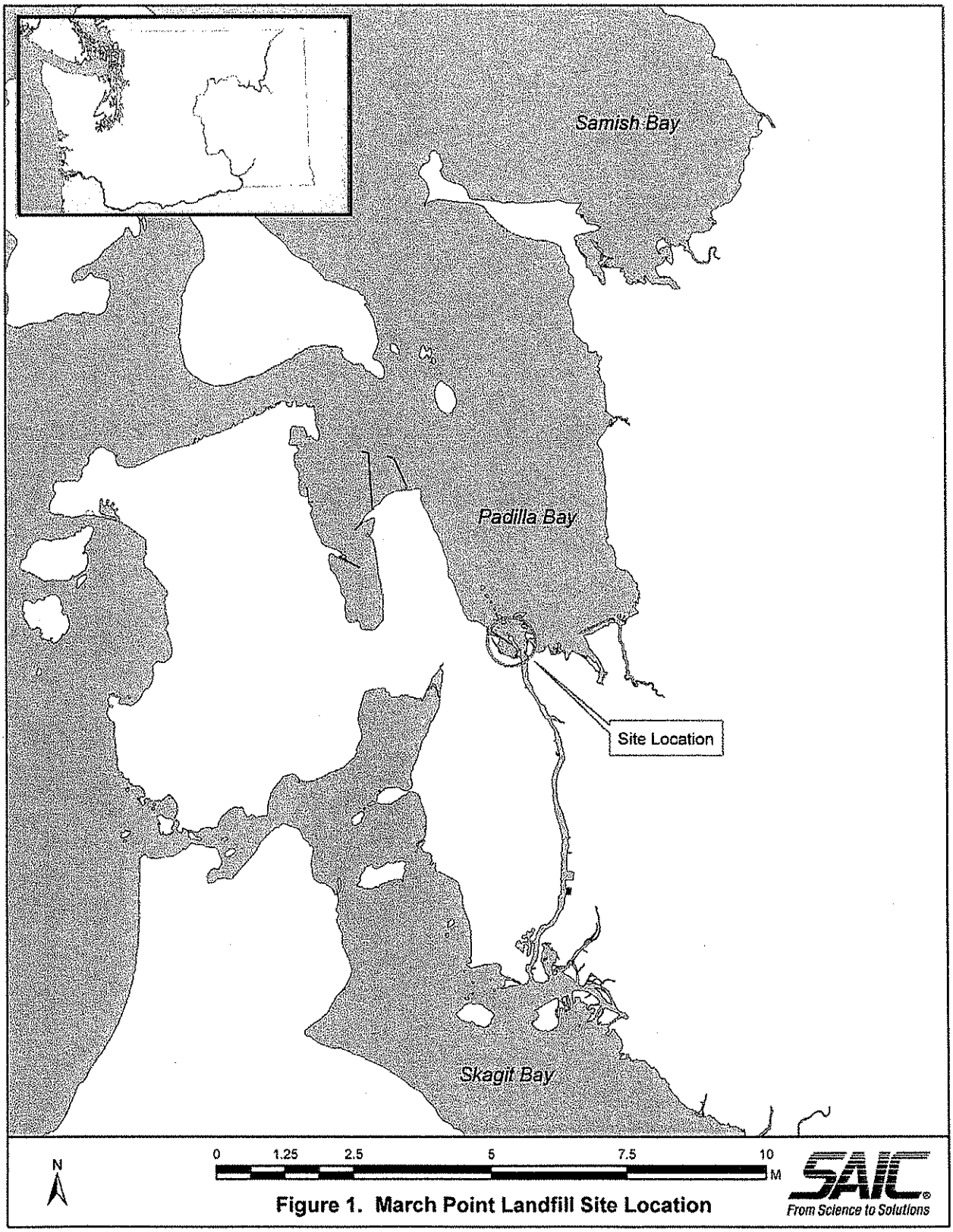

Figure 1. March Point Landfill Site Location

2.0 RI/FS Tasks

The following section describes the key tasks of the RI/FS, including a discussion of the overall Study Design, the responsibilities of the Project Team, an overview of the Data Evaluation, and the RI/FS Data Reporting.

2.1 RI Study Design

The primary component of the study design is to conduct an investigation utilizing the SMS interpretive criteria for chemistry and biological effects in conjunction with the sediment quality triad approach to characterize the nature and extent of potential contamination as a result of landfill activities at the site. The sediment quality triad uses a weight-of-evidence approach based on the combination of sediment chemistry, toxicity, and benthic community results.

The SMS provides a regulatory basis, management goal, and decision process for the characterization and cleanup of contaminated sediments (Ecology). The SMS chemical numeric criteria and biological effects interpretive criteria provide the means for evaluating the chemistry and toxicity test results. These criteria will be used to determine whether anthropogenic contaminants in sediments are a source of adverse effects to biological resources. Sediment chemistry is evaluated to determine whether further evaluation is needed due to elevated concentrations of contaminants. Toxicity testing involves the exposure of sensitive test organisms to contaminants found in the sediments. Chronic and acute toxicity endpoints are measured to determine the incidence and relative extent of adverse biological effects.

Benthic infauna communities are an integral component of marine and estuarine systems and have been widely used in ecological assessments, environmental risk assessments, pollution remediation studies, and other water quality surveys. Benthic infauna play an important role in geochemical and physical processes such as sediment reworking and flux of chemicals (Aller 1982) and, in the context of human impacts, are used as indicators of ecosystem health (Rhoads et al. 1978; Warwick 1986). Benthic communities are often ideal indicators because they tend to integrate effects of both long-term and recent exposure to environmental stresses (e.g., contaminant discharge, dredging). In addition, many benthic organisms are sessile (non-motile) and represent conditions at a specific location. Protocols for the collection and analysis of benthic samples are presented in Section 3.2.3.

Data to support the sediment quality triad approach (chemistry, toxicity, and benthic community) will be collected from a subset (five locations plus a reference location) of the sampling locations to assess the general sediment condition within the lagoon and nearshore areas of Padilla Bay. Sampling locations were placed to provide spatial coverage throughout the lagoon, in the channel running through the railroad causeway, and along the nearshore areas of Padilla Bay. Figure 2 displays the proposed sampling locations.

The remaining (i.e., not designated as sediment quality triad stations) sampling locations will be assessed using a tiered sampling and analysis approach. Surface sediment (0 to 10 cm), representing the biologically active zone, will be collected at 21 locations in sufficient quantity for chemical analysis and toxicity testing. Surface sediment chemical analysis will be conducted

at all sampling locations and the sediment collected for toxicity testing will be archived. The sediment chemistry results will be compared to the SMS numeric criteria. Samples from locations with chemistry exceeding the SQS will be submitted for toxicological testing. Locations identified as sediment quality triad locations will automatically be submitted for toxicological testing. Benthic invertebrate samples will be collected only at the sediment quality triad locations. A reference location in Padilla Bay will also be sampled in an area free of known contamination with similar physical attributes as the sediments near the landfill site. Specific details on the sampling and analysis methods are provided in Sections 3.0 and 4.0, respectively.

The results of the initial RI/FS sediment investigation will determine the nature and extent of sediment contamination and whether further investigation is warranted. Chemistry, toxicity, and sediment quality triad results will be used to determine whether additional data collection is warranted. Subsequent data needs may include subsurface sediment chemistry, additional spatial coverage, sediment bioaccumulation testing, and/or tissue sampling as deemed necessary.

Figure 2. Proposed Sampling Locations

3.0 Sampling and Analysis Methods

This section describes the methodology for positioning, sample collection, processing, identification, documentation, equipment decontamination, and waste handling for the proposed field investigation. Samples will be collected for sediment chemistry, toxicity, and benthic community analysis. The laboratory methods for chemical analysis (including specific analytes), toxicity testing, and benthic community analysis are presented in Section 4.0.

3.1 Station Positioning and Navigation

The positioning and recording of sampling locations will be accomplished using differential Global Positioning System (DGPS). The DGPS employs a receiver that tracks and times signals emitted by satellites orbiting the earth, a Coast Guard reference beacon located in the vicinity of the survey area, and a differential receiver. The receiver deployed at the Coast Guard reference beacon (horizontal control point) is used to correct for Selective Availability (SA) (satellites emit an encrypted signal designed to degrade the accuracy for non-military users by dithering the time code embedded in the signal). This receiver calculates position based on the satellite signals and compares the calculated position to the known position at the horizontal control point. A positional offset of correction factor is calculated and transmitted to the GPS receiver, which applies the correction factor to calculate the corrected position. All station coordinates will be recorded by latitude and longitude to the decimal minute and State Plane Coordinates (NAD 83).

Vertical position (i.e., water depth) will be determined using a fathometer (when feasible) or a lead-line (weighted measuring tape) or measuring stick to measure to the nearest 0.1 foot from the water surface to the mudline.

The target sample coordinates are provided in Table 2, sampling locations are displayed in Figure 2, and candidate reference locations are displayed in Figure 3.

3.2 Sediment Sample Collection

Surface sediment samples will be collected at a total of 22 sampling locations, including references. Surface sediment samples will be collected for chemical analysis, toxicity testing, and benthic community characterization. Table 2 lists the various surface sediment samples to be collected; the analytical and biological testing methods; and sample container, volume, and preservation requirements. The following sections describe the collection and processing of surface sediment samples.

3.2.1 Surface Sediment Samples

Surface sediment collected for chemical and toxicological analysis will be collected from a small boat using a stainless-steel Ekman, ponar, or similar grab sampling device. If accessible during low tide events, surface sediment samples from intertidal areas may be collected directly with stainless-steel spoons. The grab sampler will be deployed from the sampling platform using a manually triggered handle (for the Ekman in shallow water less than 5 feet deep) or using a davit and cable (grab samplers in water greater than 5 feet deep). A minimum of three grab samples will be collected and composited for each sampling location to provide sufficient volume for chemical analysis and potential toxicity testing. An additional five replicates will be collected from sediment quality triad stations for benthic community analysis. The general procedure for collecting sediment using a grab sampler is as follows:

1) Make logbook and field form entries as necessary throughout the sampling process to ensure accurate and thorough record-keeping. Field documentation is described in Section 3.5.
2) Position the sampling vessel at the targeted sampling location.
3) Secure the sampling vessel by securing a rope to the shoreline or via anchor. If deploying an anchor, use caution to prevent disturbing the sediments near the sampling location.
4) Set the spring-loaded sampler jaws in the open position, place the sampler over the edge of the boat, and lower the sampler to the bottom.
5) Trip the sampler manually if using the handle (< 5 feet deep).
6) Record the location using the DGPS; measure and record the water depth.
7) Retrieve the sampler and place it securely in the sampling vessel.
8) Examine the sample for the following sample acceptance criteria:
    - The sampler is not overfilled with sample so that the sediment surface is pressing against the top of the sampler.
    - The sample does not contain large foreign objects (i.e., trash or debris). A sample that is rock/gravel fill will be rejected in favor of depositional material (i.e., sand/silt/clay).
    - Overlying water is present indicating minimal leakage.
    - Overlying water is not excessively turbid indicating minimal sample disturbance.
    - Sediment surface is relatively flat and/or intact without any indications of disturbance or winnowing.

- A penetration depth has been achieved that allows the collection of the upper 10 cm of sediment.

If sample acceptance criteria are not achieved, the sample will be rejected and another sample collection attempt will be made.

9) Siphon off any overlying surface water.
10) Collect samples for total sulfides analysis directly from the grab sampler and place the sediment aliquots in appropriate, pre-cleaned, labeled sample containers (Table 3).
11) Measure and collect the top 10 cm with a stainless steel spoon, avoiding any sediment that is in contact with the inside surface of the grab sampler, then place the sediment into a stainless steel bowl and cover with aluminum foil.
12) Record the following observations of sediment sample characteristics on the field form (Appendix B); if more sample volume is required repeat steps 4 through 11.
    - Texture
    - Color
    - Biological organisms or structures (i.e., shells)
    - Presence of debris (i.e., natural or anthropogenic objects)
    - Presence of oily sheen or obvious contamination
    - Odor (e.g., hydrogen sulfide, petroleum)
13) Wash excess sediment back into the water away from any areas remaining to be sampled.
14) Once sufficient sediment volume has been collected, samples should be placed in the appropriate, pre-cleaned, labeled sample containers as described in Section 3.3, placed in a cooler maintained at 4°C, and prepared for shipment to the analytical or biological laboratory as described in Section 3.4.
15) Confirm all relevant documentation has been completed, entries are accurate, and paperwork has been signed.
16) Decontaminate all sampling equipment as described in Section 3.6 before proceeding to the next sampling location.

A single replicate for each required analysis will be collected from each target sampling location, with the exception of field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples to be collected randomly at the field supervisor's discretion. The sample types collected from each location are presented in Table 3.

3.2.2 Wet-sieving

The purpose for wet-sieving an aliquot of homogenized sample is to separate the coarse and fine-grained material comprising a sediment sample in order to match appropriate test and reference locations for toxicological testing. The method utilizes a 63-micron sieve to separate the silt and clay (fines), from the sand and gravel portion of the sediment sample. The grain size distribution of a given sediment sample is an important physical parameter when conducting bioassays in order to determine an appropriate reference sample (Section 4.2.3) for comparison with test sediments. The wet-sieving of surface sediment samples is conducted in the field at the time of collection, so that a reference sample(s) with similar grain size distribution (as percent fines) can be targeted for the bioassays. The procedure for wet-sieving is as follows:

1) Measure and record the exact volume of a small (100 ml) flat-topped beaker. (Note: the 100 ml gradation is generally located slightly below the rim of the beaker; hence, the actual beaker volume is greater than 100 ml).
2) Completely fill the beaker to the rim with an aliquot of homogenized sediment. Lightly tap the beaker on a hard surface to remove any air bubbles, and level the surface.
3) Rinse the entire contents of the beaker through a 63-micron (#230, 4 phi) sieve. Aggregates of material should be gently broken to facilitate sieving. Continue sieving until clear rinsewater passes through the sieve.
4) Carefully transfer the coarse-grained material from the sieve into a 250 ml graduated cylinder.
5) Divide the amount of material measured in the bottom of the graduated cylinder by the capacity of the beaker to determine the decimal percentage of coarse-grained material. Subtract the decimal percentage of coarse-grained material from 1 to determine the decimal percentage of fines (silt and clay).
6) Record the percentages of coarse and fine-grained material in the logbook containing the surface sediment field collection forms (Appendix B).

3.2.3 Benthic Sample Collection

A stainless steel grab sampler will be used to collect samples for benthic community structure. Five replicate sediment samples will be collected at each station to allow for statistical comparisons that rely on within-station variance of benthic infauna variables (PSEP 1986, Swartz 1978). Care will be taken when collecting each sample to ensure that minimal sample disturbance occurs when bringing the grab sampler on board the sampling vessel as described in Section 3.2.1.

Once a grab sample is considered acceptable, the overlying water will be carefully siphoned off and poured through a 1.0 mm sieve to retain any organisms siphoned from the sample. The sample will be visually described in the field log and penetration depth will be recorded. The sediment will then be gently sieved through a 1.0 mm sieve using site seawater to remove the sediment matrix and retain the infaunal organisms. Any organisms remaining on the screen will be carefully removed from the screen with forceps and placed in the appropriate sample jar.

In the field, the collected contents of the sample will be fixed with a 10% borax buffered formalin and seawater solution. After 10 days, samples for long-term storage will be transferred to a 70% ethyl alcohol, 25% water, and 5% glycerin solution to minimize the decalcification of molluscs and echinoderms over time. Following completion of the investigation, any archived benthos samples will be transferred to Ecology.

A total of six locations at March Point are proposed for benthic sample collection, including a reference location. The reference site will represent an area unaffected or minimally affected by anthropogenic influences and have physical characteristics similar to the study area.

3.3 Sample Identification, Containers, and Labels

Samples will be identified based on the project, sampling area, location, and sample type. All samples collected during the investigation will be labeled clearly and legibly. Each sample will be labeled with a unique alphanumeric sample identification number that identifies characteristics of the sample as follows:

Project	Sampling Area	Location Number	Sample Type
MPL-	PB-	01-	TX

Where:

Project consists of three characters describing the project (MPL=March Point Landfill).

Sampling Area consists of two characters describing the sampling area (PB=Padilla Bay; LG=lagoon, RF=reference)

Location Number consists of two characters identifying the station location number (Figures 2 and 3).

Sample Type consists of one to two characters indicating the sample type. Sample type is indicated for QA/QC samples, toxicity testing, or benthic community analysis with R=rinseate, D=duplicate, T = triplicate, RB= rinseate blank, TX=toxicity, and BC=benthic community.

Sample aliquots submitted to the analytical and biological laboratories will be placed in pre-cleaned sample containers and preserved as identified in Table 3. The procedure for sample storage and shipping is provided in Section 3.4.

Sample labels will be self-adhering, waterproof material. An indelible pen will be used to fill out each label. Each sample label will contain the project name (March Point Sediment RI/FS), sample identification, date and time of collection, analyses, preservative (as applicable), and the initials of the person preparing the sample. In addition, a unique, sequentially numbered jar tag will be placed on each sample container for tracking purposes. Jar tag numbers will be recorded in a Sample Container Logbook (Appendix B). Sample labels and jar tags will be protected by packaging tape wrapped around the entire jar to prevent loss or damage of the labels during handling and storage.

3.4 Sample Storage and Delivery

All samples will be stored in insulated coolers and preserved by cooling to a temperature of 4°C and as required by analytical method. Maximum sample holding and extraction times will be strictly adhered to by field personnel and the analytical and testing laboratories.

Preparation of bottles for shipment will be performed in the following manner:

1) Wipe or decontaminate the outside of filled, capped sample bottles to ensure there is no sample residual on the outside of the container. Secure sample lid jars with electrical tape to prevent leakage.
2) Label jars with prepared labels.
3) Each set of samples will have a unique sample ID and jar tag number.
4) Secure labels with clear packaging tape.
5) Record the samples in Sample Container Logbook (see Appendix B) and the Chain of Custody forms (Section 3.5.2).
6) Place sample containers in plastic zip-loc bubble-pack bags, or wrap in bubble pack and secure with packaging tape.
7) Prepare an empty insulated cooler by placing three to four ice packs in a garbage bag at the bottom of the cooler. Place sample containers in a garbage bag and fill with the sample bottles. Add additional bags of ice as needed to surround the bag containing the samples.
8) Seal the cooler with strapping tape and a custody seal. Samples for chemical analyses will be shipped via overnight courier to the analytical laboratory once per day or whenever a cooler is filled, and accompanied by the chain-of-custody record, which identifies the shipment contents. The chain-of-custody will be signed by the individual relinquishing samples to the onsite laboratory representative. The field personnel will be responsible for the following:
    - Packaging the samples;
    - Signing the chain-of-custody before placing inside the cooler to be sealed;
    - Applying a shipping label, an air bill, a custody seal, and strapping tape to the cooler; and
    - Shipping the samples in accordance with the maximum holding time allowed for the analyses to be performed.

Samples for toxicological testing and benthic analysis will be shipped to the appropriate biological laboratory at the completion of the sample collection effort for archiving. They will be properly labeled, packaged, and preserved with ice in a cooler as described above and temporarily stored under contractor custody. A separate chain-of-custody form will be filled out for the chemistry, toxicological, and benthic community samples. The chain-of-custody will be signed by the individuals relinquishing the samples and will be placed inside the cooler before it is sealed.

All sediment samples will be retained for a minimum of 6 months from the time they were received using standard laboratory handling procedures. They may be removed from the laboratory prior to the end of the 6-month period only at the direction of the contractor project manager in consultation with Ecology.

3.5 Field Documentation

A complete record of field activities will be maintained. Documentation necessary to meet QA objectives for this project include: field notes and field forms (Appendix B), sample container labels, and chain-of-custody forms. The field documentation will provide descriptions of all

sampling activities, sampling personnel, and weather conditions, and will record all modifications, decisions, and/or corrective actions to the study design and procedures identified in this workplan.

3.5.1 Field Notebooks

All handwritten documentation must be legible and completed in permanent waterproof ink. Corrections must be marked with a single line, dated, and initialed. All documentation, including voided entries, must be maintained within project files.

Field logbook(s) will be kept on site during field operations by the Field Manager. Daily activities will be recorded in a bound field logbook of water-resistant paper. Separate logbooks consisting of bound, paginated field forms will be kept for surface sediment grab descriptions, and an inventory of sample containers (separate from COC documentation). Examples of the various field forms to be used are presented in Appendix B. All entries will be made legibly, in indelible ink, and will be signed and dated. Information recorded will include the following:

- Date, time, place, and location of sampling;
- Onsite personnel and visitors;
- Daily safety discussion and any safety issues;
- Quality control samples (i.e., duplicate samples, field blanks, etc.);
- Calibration of field equipment (including make and model of equipment);
- Field measurements and their units;
- Observations about site, location, and samples (weather, current, odors, appearance, etc.); and
- Equipment decontamination verification.

Field logbooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occur during project field activities. Entries should be factual, detailed, and objective. Unless restricted by weather conditions, all original data recorded in field logbooks and on sample identification tags, chain-of-custody records, and field forms will be written in waterproof ink. If an error is made, the individual responsible may make corrections simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. All corrections must be initialed and dated.

3.5.2 Chain of Custody Procedures

Samples will be retained at all times in the field crew's custody until samples are delivered to the appropriate laboratory by contractor personnel. All samples will be held and transported in coolers with ice or frozen gel-packs at approximately 4°C.

Chain of custody forms will be initiated at the time of sample collection to ensure that all collected samples are properly documented and traceable through storage, transport, and analysis. When all line items on the form are completed or when the samples are relinquished,

the sample collection custodian will sign and date the form, list the time, and confirm the completeness of all descriptive information contained on the form. Each individual who subsequently assumes responsibility for the sample will sign the chain-of-custody form and provide the reason for assuming custody. The field chain-of-custody terminates when the laboratory receives the samples. The FM should retain a copy of the completed, signed, chain-of-custody form(s) for project files.

3.6 Equipment Decontamination Procedures

Sample processing equipment (i.e., spoons, bowls, and reusable containers from which samples are transferred to sample jars) will be washed with a laboratory-grade detergent (e.g., Alconox) and water solution, rinsed with deionized water, and a final distilled water rinse prior to field operations. Decontaminated equipment will be wrapped or covered with aluminum foil. Sub-sampling and processing equipment will be decontaminated before use at each station in order to prevent cross contamination of samples. Any deviations from these procedures will be documented in the field notebook.

Personal non-disposable field equipment (i.e., boots and waterproof gloves and garments) will be rinsed with water and brushed clean prior to leaving the immediate vicinity of the sample collection area. Special attention will be given to removing mud and sediments that may adhere to boot treads.

3.7 Waste Disposal

During the field investigation, field personnel will be responsible for securing appropriate waste containers, and placing wastes in labeled storage containers, performing appropriate testing, preparing wastes for disposal, and proper disposition of wastes.

Two types of waste will be generated during the activities described in this workplan:

- Excess sediment sample core not submitted to the laboratories; and
- Disposable protective clothing, sampling equipment, and packaging.

3.7.1 Sediment Sample/Sediment Core

Small quantities of excess sediment and rinseate water generated during sample processing will be returned to the site. Care will be taken to not dispose of sediment and/or rinseate at locations targeted for subsequent sampling.

3.7.2 Disposable Protective Clothing and Sampling Equipment

Used PPE, such as protective Tyvek suits or gloves, and sampling equipment, such as aluminum foil and paper towels, and any packaging material that cannot be recycled will be placed in plastic storage bags and disposed of as municipal waste.

Table 2. Target Sample Locations

Location ID	Location	Northing	Easting	Latitude	Longitude
LG-01	Lagoon	538571.04	1228874.12	48 27.8402933	122 31.7827405
LG-02	Lagoon	538406.18	1228965.50	48 27.8135173	122 31.7592505
LG-03	Lagoon	538251.62	1229015.66	48 27.7882848	122 31.7460059
LG-04	Lagoon	538289.68	1229180.92	48 27.7951423	122 31.7053565
LG-05	Lagoon	538148.08	1229352.65	48 27.7724809	122 31.6621272
LG-06	Lagoon	537889.98	1229481.70	48 27.7305091	122 31.6288168
LG-07	Lagoon	538033.79	1229646.10	48 27.7547493	122 31.5889552
LG-08	Lagoon	537848.74	1229856.02	48 27.7250826	122 31.5360495
LG-09	Lagoon	537631.88	1230126.95	48 27.6904038	122 31.4678882
LG-10	Lagoon	537354.82	1230334.08	48 27.6455945	122 31.4151743
LG-11	Lagoon	536857.58	1229997.90	48 27.5626202	122 31.4955845
LG-12	Lagoon	537047.47	1230336.20	48 27.5950662	122 31.4129805
LG-13	Lagoon	537141.05	1230695.08	48 27.6117481	122 31.3247677
LG-14	Lagoon	536640.62	1230522.84	48 27.5288410	122 31.3646323
PB-01	Padilla Bay	539477.63	1227564.28	48 27.9846058	122 32.1115438
PB-02	Padilla Bay	539278.46	1228202.77	48 27.9541781	122 31.9525880
PB-03	Padilla Bay	539055.87	1228524.95	48 27.9187468	122 31.8717160
PB-04	Padilla Bay	538839.13	1228847.12	48 27.8842777	122 31.7908777
PB-05	Padilla Bay	538311.94	1229696.49	48 27.8006678	122 31.5780079
PB-06	Padilla Bay	538288.23	1230257.94	48 27.7987993	122 31.4390695
PB-07	Padilla Bay	537711.29	1230549.26	48 27.7049853	122 31.3639109
Candidate Reference Sites[1]					
RF-01	Samish Island	581544.2	1228106	48 34.9033738	122 32.2079121
RF-02	Samish Island	577786.8	1242354	48 34.3365425	122 28.6570501
RF-03	Skagit Bay	508146.5	1223861	48 22.8193195	122 32.8545394

1. Actual reference locations will be determined in the field based on the physical characteristics of the site and the wet-sieving results.

Table 3. Sample Types to be Collected

Sample Locations	Sediment Chemistry					Sediment Toxicity	Benthic Community
Analyses	Sediment Conventionals[1]	Total Sulfides	SVOCs, PCBs	Metals	Mercury	amphipod mortality; larval development; polychaete growth	taxonomic identification and enumeration
Container(s)	16-oz glass	2-oz glass	16-oz glass	8-oz glass jar		3 32-oz glass jars	16-oz plastic
Preservative	4°C/-18°C[2]	4°C; zinc acetate	4°C/-18°C[2]	4°C/-18°C	-18°C	4°C, nitrogen purged headspace	10% formalin
Holding Time	14 days/6 months[3]	7 days	14 days/ 1 year	6 months/ 2 years	28 days	8 weeks	
LG-01	X	X	X	X		A	-
LG-02	X	X	X	X		A	-
LG-03	X	X	X	X		A	-
LG-04[4]	X	X	X	X		X	X
LG-05	X	X	X	X		A	-
LG-06	X	X	X	X		A	-
LG-07	X	X	X	X		A	-
LG-08[4]	X	X	X	X		X	X
LG-09	X	X	X	X		A	-
LG-10	X	X	X	X		A	-
LG-11	X	X	X	X		A	-
LG-12[4]	X	X	X	X		X	X
LG-13	X	X	X	X		A	-
LG-14	X	X	X	X		A	-
PB-01	X	X	X	X		A	-
PB-02	X	X	X	X		A	-
PB-03[4]	X	X	X	X		X	X
PB-04	X	X	X	X		A	-
PB-05	X	X	X	X		A	-
PB-06	X	X	X	X		A	X

Sample Locations	Sediment Chemistry				Sediment Toxicity	Benthic Community
PB-07	X	X	X	X	A	-
Reference Locations						
RF-01[4,5]	X	X	X	X	X	X
RF-02[5]	X	X	X	X	A	-
RF-03[5]	X	X	X	X	A	-
QA/QC Samples						
Duplicates[6]	2X	2X	2X	2X	-	-
Triplicates[6,7]	2X	2X	-	-	-	-
MS/MSD[6,8]	-	-	2X	2X	-	
Equipment Rinseate[6,8]	-	-	2X	2X	-	-
Rinseate Blank[8]	-	-	X	X	-	-
Sample Totals	28	28	31	31	5-24[9]	6

Notes:

X: sample to be collected and submitted for analysis/testing

A: sample to be collected and archived

-: no sample will be collected at this location

1. Sediment conventional parameters include grain size distribution, total solids, total volatile solids, total organic carbon, and ammonia.
2. Samples for grain size distribution and ammonia analysis should be stored at 4°C only.
3. Holding time for ammonia analysis is 7 days at 4°C; holding time for grain size distribution is 6 months at 4°C.
4. Sediment Quality Triad station: chemistry, toxicity testing, and benthic community analysis will be conducted at these locations
5. Three candidate reference locations have been identified for the purposes of this workplan. Actual reference locations will be determined in the field based on physical attributes of the site and the results of the wet-sieving. Up to three reference locations will be sampled for chemistry and toxicity to match grain size distribution with site sediments. One reference location will be identified as a sediment quality triad location and will include benthic community analysis.
6. Frequency of analysis is one per twenty samples (5%).
7. Triplicate analysis for sediment conventional parameters only.
8. MS/MSDs, equipment rinseate, and rinseate blanks conducted for organics and metals only.
9. The total number of samples to be tested is dependant on the sediment chemistry results. A minimum of five samples will be submitted for toxicity testing as part of the sediment quality triad.

4.0 Laboratory Methods

All of the chemical analytical and biological testing procedures used in this program will be performed in accordance with the PSEP guidelines. The laboratory analysis will be consistent with PSEP guidelines (PSEP 1997a, 1997b, 1997c, 1997d), and any recent modifications proposed during the SMARM. Each laboratory participating in this program will institute internal QA/QC plans. Analyses will be required to conform to accepted standard methods and internal QA/QC checks prior to final approval.

4.1 Chemical Analyses

Chemical analysis will be conducted by laboratories subcontracted to the Ecology contractor. The specific analyses and conventional parameters to be measured, sample preparation methods, analytical methods, target detection limits (TDLs), and SMS numeric criteria (SQS and CSL) are presented in Table 4. The TDLs listed may be subject to modification due to elevated sample concentrations, heterogeneous samples (sediment), and potential matrix interferences that may preclude obtaining the desired quantification limit. In the event the laboratory is unable to meet the TDLs, the reasons for the deviation will also be reported. SMS guidance will be used to compare chemistry data results to determine whether further biological testing is warranted.

Table 4. SMS Analytes (parameter, preparation method, analytical method, sediment method detection limit [MDL], SMS sediment quality standards [SQS], and cleanup screening levels [CSL])

Analyte	Prep Method[1]	Analytical Method[2]	Sediment MDL[3,4]	SQS	CSL
Conventional Parameters					
Total Solids (%)	---	PSEP[5]	0.1	---	---
Total Volatile Solids (%)	---	PSEP[5]	0.1	---	---
Total Organic Carbon (%)	---	PSEP[5]	0.1	---	---
Total Sulfides (mg/kg)	---	PSEP[5]	1	---	---
Ammonia (mg/kg)	---	Plumb 1981	1	---	---
Grain Size	---	Modified ASTM with Hydrometer	---	---	---
Metals			**mg/kg**	**mg/kg**	
Arsenic	PSEP/3050B	6010B/6020	19	57	93
Cadmium	PSEP/3050B	6010B/6020	1.7	5.1	6.7
Chromium	PSEP/3050B	6010B/6020	87	260	270
Copper	PSEP/3050B	6010B/6020	130	390	390
Lead	PSEP/3050B	6010B/6020	150	450	530
Mercury	---	7471A /245.5	0.14	0.41	0.59
Silver	PSEP/3050B	6010B/6020	2	6.1	6.1
Zinc	PSEP/3050B	6010B/6020	137	410	960
Low Molecular Polycyclic Aromatic Hydrocarbons (LPAH)			**µg/kg**	**mg/kg OC**	
Naphthalene	3540C/3550B	8270C/1625C	20	99	170
Acenaphthylene	3540C/3550B	8270C/1625C	20	66	66
Acenaphthene	3540C/3550B	8270C/1625C	20	16	57
Fluorene	3540C/3550B	8270C/1625C	20	23	79
Phenanthrene	3540C/3550B	8270C/1625C	20	100	480
Anthracene	3540C/3550B	8270C/1625C	20	220	1200
2-Methylnaphthalene	3540C/3550B	8270C/1625C	20	38	64
Total LPAH				370	780
High Molecular Polycyclic Aromatic Hydrocarbons (HPAH)			**µg/kg**	**mg/kg OC**	
Fluoranthene	3540C/3550B	8270C/1625C	20	160	1200
Pyrene	3540C/3550B	8270C/1625C	20	1000	1400
Benzo(a)anthracene	3540C/3550B	8270C[6]/1625C	20	110	270
Chrysene	3540C/3550B	8270C[6]/1625C	20	110	460
Benzofluoranthenes	3540C/3550B	8270C[6]/1625C	20	230	450
Benzo(a)pyrene	3540C/3550B	8270C[6]/1625C	20	99	210
Indeno(1,2,3-c,d)pyrene	3540C/3550B	8270C[6]/1625C	20	34	88
Dibenzo(a,h)anthracene	3540C/3550B	8270C[6]/1625C	20	12	33
Benzo(g,h,i)perylene	3540C/3550B	8270C/1625C	20	31	78
Total HPAH				960	5300
Chlorinated Benzenes			**µg/kg**	**mg/kg OC**	
1,2-Dichlorobenzene	3540C/3550B	8270C[6]/1625C	3.2	2.3	2.3
1,4-Dichlorobenzene	3540C/3550B	8270C[6]/1625C	3.2	3.1	9
1,2,4-Trichlorobenzene	3540C/3550B	8270C[6]/1625C	6	0.81	1.8
Hexachlorobenzene	3540C/3550B	8270C[6]/1625C	12	0.38	2.3

Analyte	Prep Method[1]	Analytical Method[2]	Sediment MDL[3,4]	SQS	CSL
Phthalate Esters			**µg/kg**	**mg/kg OC**	
Dimethyl phthalate	3540C/3550B	8270C/1625C	20	53	53
Diethyl phthalate	3540C/3550B	8270C/1625C	20	61	110
Di-n-butyl phthalate	3540C/3550B	8270C/1625C	20	220	1700
Butyl benzyl phthalate	3540C/3550B	8270C/1625C	20	4.9	64
Bis(2-ethylhexyl)phthalate	3540C/3550B	8270C/1625C	20	47	78
Di-n-octyl phthalate	3540C/3550B	8270C/1625C	20	58	4500
Ionizable Organic Compounds			**µg/kg**	**µg/kg**	
Phenol	3540C/3550B	8270C/1625C	20	420	1200
2 Methylphenol	3540C/3550B	8270C/1625C	6	63	63
4 Methylphenol	3540C/3550B	8270C/1625C	20	670	670
2,4-Dimethylphenol	3540C/3550B	8270C/1625C	6	29	29
Pentachlorophenol	3540C/3550B	8270C/1625C	61	360	690
Benzyl alcohol	3540C/3550B	8270C/1625C	6	57	73
Benzoic acid	3540C/3550B	8270C/1625C	100	650	650
Miscellaneous Compounds			**µg/kg**	**mg/kg OC**	
Dibenzofuran	3540C/3550B	8270C/1625C	20	15	58
Hexachlorobutadiene	3540C/3550B	8270C/1625C	20	3.9	6.2
N-Nitrosodiphenylamine	3540C/3550B	8270C/1625C	12	11	11
Total PCBs	3540C/3550B	8082	67	12	65

Notes:

1. Recommended sample preparation methods are: PSEP (1997a,b) and USEPA Method 3050B and 3500 series (sample preparation methods from SW-846 [USEPA 1986] and subject to changes by USEPA updates)
2. Recommended sample cleanup methods are: Sample extracts subjected to gel permeation chromatography (GPC) cleanup follow the procedures specified by USEPA SW-846 Method 3640A. Special care should be used during GPC to minimize loss of analytes. If sulfur is present in the samples (as is common in most marine sediments), cleanup procedures specified by USEPA SW-846 Method 3660B should be used. All PCB extracts should be subjected to sulfuric acid/permanganate cleanup as specified by USEPA SW-846 Method 3665A. Additional cleanup procedures may be necessary on a sample-by-sample basis. Alternative cleanup procedures are described in PSEP (1997a,b) and USEPA (1986).
3. MDL, SQS, and CSL are on a dry weight basis.
4. The recommended MDL is based on a value equal to one third of the 1988 dry weight lowest apparent effects threshold (LAET) value (Barrick et al. 1988) except for the following chemicals: 1,2-dichlorobenzene, 1,2,4-trichlorobenzene, hexachlorobenzene, hexachlorabutadiene, n-nitrosodiphenylamine, 2-methylphenol, 2,4-dimethylphenol, and benzyl alcohol, for which the recommended MDL is equal to the full value of the 1988 dry weight LAET.
5. Recommended Protocols for Measuring Metals in Puget Sound Water, Sediment and Tissue Samples, Puget Sound Estuary Program, April 1997.
6. Selected ion monitoring may improve the sensitivity of USEPA Method 8270C and is recommended in cases when detection limits must be lowered to human health criteria levels or when TOC levels elevate detection limits above ecological criteria levels. See PSEP Organics Chapter, Appendix B – Guidance for Selected Ion Monitoring (1997).

4.1.1 Analytical Laboratory Reporting

Analytical laboratory reports will be accompanied by sufficient backup data and QC results to enable independent reviewers to evaluate the quality of the data results. Analytical data will be reported in the units specified by the MDLs listed in Table 4.

The analytical laboratory deliverables will include the following:

- Case narrative (including any problems encountered, protocol modifications, and/or corrective actions taken);
- Sample analytical and QA/QC results with units;
- All protocols used during analyses;
- Any protocol deviations from the approved sampling plan;
- Surrogate recovery results;
- Matrix spike/matrix spike duplicate results;
- Laboratory duplicate/triplicate results;
- Blank results;
- Sample custody records (including original chain-of-custody forms); and
- Analytical results in SEDQUAL electronic format.

4.2 Biological Analyses

This section describes specific procedures for the suite of bioassays used for SMS biological analysis. Sediment locations designated as sediment quality triad stations will have sediments automatically submitted for biological testing. For all other locations, the decision to conduct confirmatory biological testing will be contingent on the chemistry results for a given location. To the maximum extent practicable, chemical results will be provided for bioassay decisions within 28 days of sample collection. The remaining four-week (28-day) period of the holding time will allow time for bioassay preparation as well as time for retests if necessary. Regardless of analytical results, toxicological testing will be performed on a minimum of five sediment samples selected for the sediment quality triad.

Bioassay testing requires that test sediments be matched and run with appropriate reference sediment to factor out background conditions and sediment grain-size effects on bioassay organisms. The contractor will collect the identified reference sediments at the same time that other samples are collected. Wet-sieving in the field, however, is essential in finding an adequate match. Wet sieving results should be recorded and submitted with the sample analysis results. The location of the reference sediment sampling location will be recorded to the nearest 0.1 second (NAD 83).

All sediment samples for potential bioassays will be stored at 4°C, with no headspace or under a nitrogen atmosphere (i.e., nitrogen-purged headspace) pending completion of chemical analyses and initiation of any required biological testing. All bioassays, including retests, will commence within 56 days from collection of the first grab sample in the sediment composite to be tested. The laboratory will maintain chain-of-custody procedures throughout biological testing.

Bioassay testing will be initiated as soon as possible after the first chemical results become available and the decision is made to conduct bioassays. This includes obtaining test organisms and control and reference sediments in a timely manner. This approach will support the

opportunity for any second-round (additional) biological testing within the allowable 56-day holding period, if such need arises. As initial chemistry data become available, the project manager and the bioassay laboratory representative will maintain close coordination with Ecology to expedite biological testing decisions.

Three bioassays (Table 5) including amphipod mortality, larval development, and juvenile polychaete growth will be conducted on each sample identified for biological testing. All biological testing will be in strict compliance with Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments (PSEP 1995), with appropriate modifications as specified in the annual review process. General biological testing procedures and specific procedures for each sediment bioassay are summarized in the following sections.

Table 5. Bioassay Suite for the March Point RI/FS Sediment Investigation

Bioassay Test	Test Organism
10-day Amphipod Mortality Test	*Eohaustorius estuarius;* *Rhepoxynius abronius*
48-hour Larval Development Test[1] (echinoderm or bivalve)	*Mytilus galloprovincialis;* *Dendraster excentricus*
20-day Neanthes Growth Test	*Neanthes arenaceodentata*

1. Actual test length may vary based on larval development stage.

The specific QA/QC measures employed as part of the biological analyses are discussed in detail in Section 5.0.

4.2.1 Amphipod Mortality Bioassay

This test involves exposing *Rhepoxynius abronius*, *Ampelisca abdita*, or *Eohaustorius estuarius* to test sediment for 10 days and counting the surviving animals at the end of the exposure period. Daily emergence data and the number of amphipods failing to rebury at the end of the test will be recorded as well. The control sediment has a performance standard of 10% mortality. The reference sediment has a performance standard of 25% mean mortality (Table 8).

E. estuarius is the preferred test organism for sediments with percent fines >60%. *R. abronius* is the preferred amphipod species for coarser-grained sediments (<60% fines), and if sediment clay content exceeds 20%, testing with *A. abdita* is recommended.

Ammonia and sulfides toxicity may interfere with test results for this bioassay. If elevated levels of these analytes are suspected, aeration may need to be conducted throughout the test. This action will be coordinated with Ecology. Ammonia reference toxicant tests may be conducted if elevated ammonia concentration is suspected in test sediments.

4.2.2 Larval Development Bioassay

This test monitors larval development of a suitable echinoderm or molluscan species (e.g., *Dendraster excentricus* or *Mytilus galloprovincialus*) in the presence of test sediment. *D. excentricus* is the preferred species, followed by *M. galloprovincialis*. The sediment larval bioassay has a variable endpoint (not necessarily 48 hours) that is determined by the

developmental stage of organisms in a sacrificial seawater control (PSEP 1995). At the end of the test, larvae from each test sediment exposure are examined to quantify abnormality and mortality. The seawater control has a performance standard of 70% mean normal survivorship (Table 5). Initial counts will be made for a minimum of five 10 mL aliquots. Final counts for seawater control, reference sediment, and test sediment will be made on 10 mL aliquots.

Ammonia and sulfides toxicity may interfere with test results for this bioassay. If elevated levels of these analytes are suspected, aeration may need to be conducted throughout the test. This action will be coordinated with Ecology. Ammonia reference toxicant tests may be conducted if elevated ammonia concentration is suspected in test sediments.

4.2.3 Juvenile Polychaete Growth Bioassay

This sublethal, static-renewal toxicity test can be used to determine the relative toxicity of marine sediments using the juvenile polychaete, *Neanthes arenaceodentata*. The test is conducted in accordance with the methods described by PSEP (1995) and modifications to the test approved by the DMMP agencies.

The toxicity test involves a 20-day exposure to sediments and the response of the organisms to test sediments as compared to their response in control (clean) and reference sediment. The test endpoint is mean individual growth (expressed as mg/individual/day).

The control sediment has a performance standard of 10% mortality. The reference sediment has a performance standard of 80% of the control growth. The DMMP agencies have established a target control growth performance guideline of ≥0.72 mg/individual/day. The *N. arenaceodentata* negative control performance guideline is a target growth rate of ≥0.72 mg/individual/day; the negative control performance standard is >0.38 mg/individual/day (below which the test is considered a QA/QC failure). Use of worms smaller than 0.25 mg (dry weight) at the beginning of the test will also be considered a QA/QC failure.

4.3 Full-Spectrum Lighting

Under certain conditions, when PAHs are exposed to ultraviolet (UV) radiation of sufficient quality and quantity, photo-activation may occur (Kosian 1998). Photo-activation has been demonstrated to result in increased acute and chronic toxicity (Arfsten 1996). Benthic and aquatic organisms exposed to selected PAHs and simultaneously to specific wavelengths and intensities of UV radiation may be at significantly greater risk to toxic effects than organisms exposed to the same PAHs absent the UV radiation (Ahrens 2002). When the following site conditions are encountered, bioassays should be performed in the presence of full-spectrum lighting that includes UV wavelengths of sufficient intensity to mimic conditions at the site (Ecology 2003):

1. Sediment Depth: For marine or estuarine sites, if either of
    a. >25% of the surface sediments; or
    b. ½ acre of the surface sediments

    are 4 meters/ 12 feet or less, including intertidal and subtidal zones.

2. Presence or presumed presence of any of the photo-activated PAHs listed in Table 6 (Nagpel 1993).

Table 6. Photo-activated Polycyclic Aromatic Hydrocarbons

Anthracene	Benz[c]acridine
Acridine	Benzathrone
Phenazine	Benzo[a]pyrene
Fluoranthene	Benzo[e]pyrene
1H-benzo[a]fluorine	Perylene
1H-benzo[b]fluorine	Dibenz[a,h]acridine
Pyrene	Dibenz[a,h]anthracene
Benz[a]anthracene	Dibenz[a,j]anthracene
Benz[b]anthracene	Benzo[b]chrysene
Chrysene	Dibenz[a,c]phenazine
Benzo[k]fluoranthene	Benzo[b]triphenyline
Benz[a]acridine	Benzo[g,h,i]perylene

Since these conditions are encountered in the Padilla Bay lagoon, bioassays should be conducted using full-spectrum lighting.

Standard fluorescent laboratory lighting fixtures are not full spectrum and do not produce "natural" wavelengths and intensity of light. Therefore the laboratory must use two light sources with different radiation characteristics. The full spectrum fluorescent lamp needed must include the following (Ecology 2003):

1. UV-B output (280 nm < λ < 315 nm) photo-activating wavelengths.
2. UV-A output (315 nm < λ < 400 nm), this may have an effect upon burial and feeding behavior.
3. Correct Color temperature: 'warm' red to 'cold' blue expressed in degrees Kelvin. Daylight at noon is typically estimated at 5,500°K.
4. High Color Rendering Index (CRI): Color rendering is the degree to which a light source shows the true color of objects it illuminates. This is measured on a color rendering index rated from 0–100. A normal fluorescent lamp rates 54 on the CRI scale. High quality fluorescent lamps will rate 90–98 on the same scale.

In addition to the quality of the lamp, its proximity to the animal, its output intensity, and duration of use are also critical. It is absolutely critical that nothing is placed between the envelope of the lamp tube and the recipient test organism or vessel. UV-B is greatly attenuated by glass, plastic, and ultra-fine mesh. The amount of UV-B received is also diminished with distance. It is recommended that any UV-B tubes be no further that 12 inches (30 cm) away from the organism or vessel (Ecology 2003).

The recommended lab conditions for full spectrum testing include:

- Light intensity: 50–100 foot candles;
- Light duration: 16:8 (light/dark);
- Overlying water depth: not greater than 15 cm (6 inches);
- Lamp to water surface distance: not greater than 30 cm (12 inches); and
- UV wavelength range: 3–8% UV-B (280nm < λ < 315nm), (3–5% preferred)
  20–35% UV-A (315nm < λ < 400nm).

4.4 Bioassay Interpretation

Test interpretations consist of endpoint comparisons to controls and reference on an absolute percentage basis as well as statistical comparison to reference. The SMS biological effects criteria are presented in Table 7.

Table 7. SMS Biological Effect Criteria (Ecology 2003)

Biological Test[1]	Sediment Quality Standards	Cleanup Screening Levels
Amphipod Mortality	The test sediment has a significantly higher (t-test, P≤0.05) mean mortality than the reference sediment, and the test sediment mean mortality is more than 25% greater, on an absolute basis, than the reference sediment mean mortality.	The test sediment has a significantly higher (t-test, P≤0.05) mean mortality than the reference sediment, and the test sediment mean mortality is more than 30% greater, on an absolute basis, than the reference sediment mean mortality.
Larval Development	The test sediment has a mean survivorship of normal larvae that is significantly less (t-test, P≤0.1) than the mean normal survivorship in the reference sediment, and the mean normal survivorship in the test sediment is less than 85% of the mean normal survivorship in the reference sediment.	The test sediment has a mean survivorship of normal larvae that is significantly less (t-test, P≤0.1) than the mean normal survivorship in the reference sediment, and the mean normal survivorship in the test sediment is less than 70% of the mean normal survivorship in the reference sediment.
Juvenile Polychaete Growth	The mean individual growth rate of polychaetes in the test sediment is less than 70% of the mean individual growth rate of the polychaetes in the reference sediment, and the test sediment mean individual growth rate is statistically different (t-test, P P≤0.05) from the reference sediment mean individual growth rate.	The mean individual growth rate of polychaetes in the test sediment is less than 50% of the mean individual growth rate of the polychaetes in the reference sediment, and the test sediment mean individual growth rate is statistically different (t-test, P P≤0.05) from the reference sediment mean individual growth rate.
Benthic Infauna	The test sediment has less than 50% of the reference sediment mean abundance of any one of the following major taxa: Class Crustacea, Phylum Mollusca, or Class Polychaeta, and the test sediment abundance is statistically different (t-test, P≤0.05) from the reference sediment abundance.	The test sediment has less than 50% of the reference sediment mean abundance of any two of the following major taxa: Class Crustacea, Phylum Mollusca, or Class Polychaeta, and the test sediment abundance is statistically different (t-test, P≤0.05) from the reference sediment abundance.

1. Sufficient sediment will be collected at all locations to conduct the suite of three laboratory bioassays: amphipod mortality, larval development, and juvenile polychaete growth. The benthic infauna samples will only be collected at the sediment quality triad stations. The SMS biological effects criteria will be used to assist in the interpretation of the benthic infauna data results as part of the sediment quality triad evaluation.

4.4.1 Benthic Community Analysis

Benthic infauna analysis will consist of enumeration and identification of all organisms to the lowest possible taxonomic level by qualified taxonomists. All infauna samples will be logged into the analytical laboratory before lab processing. All subsequent processing steps, as well as the time and personnel involved, will be indicated on sorter and laboratory tracking log sheets. At any step in which a sample needs to be split (for example, when vials of specimens will be sent to different taxonomists), such changes will be logged. All transfers of material outside of the laboratory will be noted on signed chain-of-custody forms. These forms indicate when any sample transfer occurs, the personnel involved, and the time the sample is returned to the laboratory.

General QA will be provided by daily audits of laboratory procedures by the laboratory supervisor. QA forms track replicates sorted, initial sorter, QC sorter, passage or failure of the sort, number of organisms found in the initial sort, and the number of organisms found in the QC sort. To assist in sorting, rose bengal stain may be added to stain preserved organisms.

Sample volume will be measured, and samples will be sorted at least twice to remove all organisms and organism fragments. Sorting will be done by placing a small amount of the sample into an appropriate dish or pan and examining the sediment under magnification (a minimum of 10X). All organisms that appear to have been alive at the time of collection will then be removed and transferred to a second dish divided into quadrants labeled for the four major taxa. These major groups will be arthropods, mollusks, annelid worms, and miscellaneous taxa (all other organisms). When full, this dish will be surveyed for misplaced animals, and those organisms transferred to their appropriate quadrant. The specimens will then be removed by taxon from each quadrant and placed into the appropriate vial for that taxon. Sediment and other remaining sample material will be saved for disposition after the project.

QC sort-checks will be conducted on each sample. The post-sorting sample will be thoroughly mixed, and a 20% aliquot of sediment will be removed. This aliquot is sorted by a sorter other than the individual who did the initial sorting. If more than 1% of the total organisms originally counted are found in the QC sort-check (indicating over 5% of the original animals had been missed), the sample will fail, and the entire sample will be re-sorted by an individual other than the original sorter.

Upon completion of the sample sorting, the vials of each major taxon will be checked to remove any missorted animals. Any animals missorted will be placed into the correct containers. After these vial checks are completed, specimens from each sample will be weighed to provide a wet-weight biomass.

The first level of taxonomy will be to sort the sample into major taxonomic groups (Annelida, Arthropoda, Mollusca, Echinodermata, and miscellaneous phyla). Identification or organisms will then be made to the lowest possible taxonomic level by qualified taxonomists. Verifying that organisms present in each sample will be accurately identified is an important component of the laboratory QA/QC procedures. Each taxonomist participating in the project will create a voucher collection. External verification and quality control will be maintained by having 5% of all samples re-identified by another equally qualified taxonomist.

4.4.2 Biological Laboratory Reporting

The biological laboratory responsible for conducting laboratory bioassays will prepare a written report documenting all the activities associated with toxicity testing. As a minimum, the following will be included in the report:

- Results of the laboratory bioassay analyses and QA/QC results for test and reference sediments; raw data will be legible or typed; illegible data may result in the need for a retest if the agencies cannot interpret the data as a result;
- Results of positive and negative control, including reference toxicant specific laboratory control limits;
- Water quality monitoring results;
- All protocols used during analyses, including explanation of any deviation from the PSEP protocols and the approved sampling plan;
- Chain-of-custody procedures, including explanation of any deviation from the identified protocols;
- Location and availability of data, laboratory notebooks, and chain-of-custody forms;
- Source of test organisms; and
- Source of control sediment and control seawater.

The biological laboratory responsible for conducting benthic community taxonomy will prepare a written report documenting all the activities associated with identification and enumeration of benthic infauna. As a minimum, the following will be included in the report:

- All protocols used during analyses, including explanation of any deviation from the PSEP protocols and the approved sampling plan;
- Number of individuals of each species;
- Total number of individuals;
- Number of individuals by major taxa;
- Total wet weight biomass;
- Wet weight biomass by major taxa;
- Each species should also be identified with an NODC code;
- Summary statistics, including indices for:
    - Richness
    - Diversity
    - Evenness
- Results of statistical evaluations such as multivariate, ANOVA, and/or cluster analyses;
- Laboratory data sheets, including:

- Sorter logs
- Taxonomic count sheets
- QA/QC sheets for resorting
- Taxonomic verification sheets

- Data will be provided in hardcopy and on magnetic media (Excel® or compatible worksheet).

5.0 Quality Assurance Project Plan

The purpose of the project QA/QC is to provide confidence in the project data results through a system of quality control performance checks with respect to data collection methods, laboratory analysis, data reporting, and appropriate corrective actions to achieve compliance with established performance and data quality criteria. This section presents the QA/QC procedures to ensure that the investigation data results are defensible and usable for their intended purpose.

5.1 Measurements of Data Quality

The tolerable limits for the data reported by the laboratory will be measured through precision, accuracy, representativeness, completeness, and comparability (PARCC).

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed conditions. Precision will be assessed by the analysis of MS/MSDs, field duplicate and triplicates, and laboratory control sample/laboratory control sample duplicates (LCS/LCSD). The calculated relative percent differences (RPDs) for field duplicates and triplicates and MS/MSD pairs will provide information on the precision of sampling and analytical procedures, and the RPDs for LCS/LCSD pairs will provide information on precision of the analytical procedures.

Accuracy is the degree to which an observed measurement agrees with an accepted reference or true value. Accuracy is a measure of the bias in the system and is expressed as the percent recoveries (%Rs) of spiked analytes in MS/MSD and LCS/LCSD samples. Accuracy objectives for the %Rs of MS/MSD and LCS/LCSD samples are listed in Table 4. Accuracy will also be evaluated through the surrogate spikes in each sample. The laboratory control limits for surrogates will be used for the project.

Representativeness expresses the degree to which data accurately and precisely represent an actual condition or characteristic at a particular sampling point. Representativeness is achieved by collecting samples representative of the matrix at the time of collection. Representativeness can be evaluated using replicate samples, additional sampling locations, and blanks.

Completeness refers to the amount of measurement data collected relative to that needed to assess the project's technical objectives. It is calculated as the number of valid data points achieved divided by the total number of data points requested by virtue of the study design. For this project, completeness objectives have been established at 95 percent.

Comparability is based on the use of established EPA-approved methods for the analysis of the selected parameters. The quantification of the analytical parameters is based on published methods, supplemented with well-documented procedures used in the laboratory to ensure reproducibility of the data.

5.2 Quality Assurance and Quality Control for Chemistry Sediment Samples

Field and laboratory QA/QC samples will be used to evaluate the data precision, accuracy, representativeness, and comparability of the analytical results. The field QA samples to be collected are described in Section 5.2.1. The laboratory QA samples are discussed in Section 5.2.2.

5.2.1 Field QA/QC for Chemistry Sediment Samples

Field QC samples will be collected during sampling to quantitatively measure and ensure the quality of the sampling effort and the analytical data. Field QC samples include field duplicates, equipment rinseate, and rinseate blanks. QC samples are to be handled in the same manner as the environmental samples collected. Brief descriptions of the field QC samples are provided below.

Field Replicates

Field duplicates are collected at the same time as the original sample using identical sampling techniques. Field duplicate sample results (triplicates for sediment conventional parameters) are used to assess the precision of the sample collection process and to help determine the representativeness of the sample. Field replicates will be collected at a 5% frequency. The replicates will be designated for the same analysis as the original samples and submitted to the laboratory blind (no indication of the contents or the associated sample). The field replicates will be collected from the same homogenate as the original sample.

Equipment Rinseate and Rinseate Blanks

The equipment rinseate blank and decontamination water (rinseate) blank provide a quality control check on the potential for cross contamination by measuring the effectiveness of the sampling and processing decontamination procedures. The equipment rinseate sample consists of de-ionized water rinsed across sample collection and processing equipment after they have been used to collect a sample and have been decontaminated for use at the next sampling location. The decontamination water blank is an unadulterated sample of the de-ionized water used to create the rinseate blank, analyzed to ensure no contaminants were present in the rinse water. Equipment blank samples will not be required when using disposable sample equipment.

5.2.2 Laboratory QA/QC for Chemical Sediment Sample

One laboratory matrix spike and matrix spike duplicate will be analyzed for every 20 samples submitted or for each analytical batch of samples (if less than 20 submitted) for the analysis of SVOCs, PCBs, metals, and total organic carbon (TOC). The combination of these spiked samples will provide information on the accuracy and precision of the chemical analysis, and to verify that the extraction and measured concentrations are acceptable. The matrix spike and matrix spike duplicates will be analyzed in accordance with EPA methods for each respective analyte.

One laboratory replicate will be analyzed for all constituents (except grain size, TOC, and total solids) for every 20 samples submitted or for each analytical batch of samples (if less than 20 submitted). Laboratory triplicates will be analyzed for grain size, TOC, and total solids. These QA/QC samples will be analyzed in accordance with the respective EPA method and will be used to evaluate the precision of the analytical method.

One laboratory method blank and LCS will be analyzed for all constituents (except grain size and total solids) for each analytical batch of twenty samples to assess potential laboratory contamination and accuracy. An LCSD will be analyzed if required by the method, or if the laboratory does not have enough sample volume to prepare an MS/MSD.

Laboratory control samples, certified reference material, and surrogate spikes will be used as defined by the analytical methods and equipment calibration requirements.

5.3 Biological Testing QA/QC for Sediment Samples

The detailed standard operating procedures (SOPs) for the bioassay tests proposed for this investigation will be provided by the selected biological laboratory upon request. This section summarizes the toxicity test QA/QC procedures to be implemented to ensure the test results are valid. Standard QA/QC procedures include the use of negative controls, positive controls, reference sediment samples, laboratory replicates, and daily water quality measurements. In addition, close contact with the biological laboratory will be maintained prior to and during the testing period to resolve any QA/QC problems or testing methodology issues in a timely manner.

5.3.1 Negative Control

The negative control consists of clean, inert material tested in parallel with the test sediments under identical test conditions. The biological testing laboratory provides this clean material, which usually consists of sediment collected from the original location from which the test organisms were harvested. The test acceptability criteria are based on the results of the negative control. A test with at least 90% survival (70% mean normal survivorship for larval development) in negative control test chambers is considered acceptable.

5.3.2 Positive Control

A positive control will be run for each bioassay. Positive controls are chemicals known to be toxic to the test organism and which provide an indication of the sensitivity of the particular organisms used in a bioassay. Cadmium chloride or other appropriate reference toxicant will be used for the amphipod mortality, larval development, and juvenile polychaete growth bioassays.

5.3.3 Reference Sediment

Reference sediments, which closely match the grain size characteristics of the test sediments, will be run with each test batch for all three bioassays. The reference sediment is used for test comparisons and interpretations. The collection area will be determined based on sample physical characteristics. Candidate reference sites for this investigation are presented in

Figure 3. All reference sediments will be analyzed for total solids, total and acid volatile solids, total organic carbon, bulk ammonia, bulk sulfides, and grain-size.

All bioassays have performance standards for reference sediments (see Section 4.2). Failure to meet these standards may result in the requirement to retest.

5.3.4 Laboratory Replication

Five laboratory replicates of each test sediment, reference sediment, negative control, and elutriate concentration will be run for each respective bioassay. The replication of tests provides multiple observations of effects to test organisms so that statistical comparisons can be made between test and reference sediments.

5.3.5 Bioassay Water Quality

Water quality monitoring will be conducted for the amphipod, larval development, and juvenile polychaete growth bioassays. This consists of daily measurements of salinity, temperature, pH, and dissolved oxygen (every third day for juvenile polychaete growth bioassay). Ammonia and sulfides will be determined at test initiation and termination and interstitial salinity will be determined prior to the test setup. Monitoring will be conducted for all test and reference sediments and negative controls (including seawater controls). Parameter measurements must be within the limits specified for each bioassay as listed in Table 8. Measurements for each treatment will be made on a separate chemistry beaker set up to be identical to the other replicates within the treatment group. In addition, interstitial ammonia measurements at test initiation and test termination will be conducted for the amphipod test.

Table 8. Water Quality Control Limits (Ecology 2003)

Test (*Test Species*)	Temperature	Salinity	Dissolved Oxygen	pH[3]
Amphipod Mortality (*E. estuarius; R. abronius*)	15 ± 1 °C	Ambient[1]	NA[2]	---
Larval Development (*Mytilus sp.*)	16 ± 1 °C	28 ± 1 ppt	> 60% saturation	---
Larval Development (*D. excentricus*)	15 ± 1 °C	28 ± 1 ppt	> 60% saturation	---
Juvenile Polychaete Growth (*N. arenaceodentata*)	20 ± 1 °C	28 ± 2 ppt	NA[2]	---

Notes:

1. Same as interstitial salinity of test sediment
2. Continuous aeration is required by the protocol, so the dissolved oxygen should not be a cause of concern

5.4 Benthic Community Analysis QA/QC Procedures

Benthic infauna data will be evaluated for quality using PSEP guidelines (PSEP, 1987) and summarized in a validation memo. The memo will include an assessment of sorting efficiency, taxonomic identification accuracy, and replicate variability. To conduct this review, the laboratory will provide sorter logs, taxonomist count sheets, QC sheets for resorting, and taxonomic verification sheets.

Quality control procedures to be followed by the laboratory include resorting 20% of each sample to determine sorting efficiency and internal verification of identification by comparison of organisms against a verified voucher collection. External verification and quality control will be maintained by having 5% of all samples re-identified by another equally qualified taxonomist. A verified voucher collection of the organisms found during the monitoring program will be created.

5.5 Data Validation

The data generated as part of this investigation will undergo an independent quality assurance review and data validation. A QA2 chemistry data review will be conducted that examines the complete analytical process from calculation of instrument and method detection limits, practical quantitation limits, final dilution volumes, sample size, and wet-to-dry ratios to quantification of calibration compounds and all analytes detected in blanks and environmental samples (PTI 1989a). A QA1 review of bioassay data will be conducted that evaluates the acceptability of test results for positive controls, negative controls, reference sediments, replicates, and experimental water quality conditions such as temperature, salinity, pH, and dissolved oxygen (PTI 1989b).

6.0 Data Analysis and Reporting

This section describes the data analysis and reporting requirements for the data collection activities described in this workplan.

6.1 Analysis of Sediment Chemistry Data

The analysis of chemistry data will include the comparison of the results to the SMS numeric criteria and as a line of evidence using the sediment quality triad index. The sediment chemistry data will be summarized and presented in tables indicating sediment locations and detected contaminants and any detection limits that exceed SQS and/or CSL numeric criteria, along with any data qualifiers assigned by the laboratory or during the data validation efforts. The locations with chemistry exceeding numeric criteria will be mapped to delineate any areas that may require cleanup or other remedial action.

6.2 Analysis of Biological Data

The analysis of biological data will include comparison to SMS biological effects criteria, providing two lines of evidence in the sediment quality triad approach, and as described in the sections below.

6.2.1 Toxicity Testing

The toxicity test data results will be summarized and presented in tables indicating sediment locations and test results that exceed SQS and/or CSL biological effects interpretive criteria, along with the results of statistical comparisons to reference sediment test results. The sampling locations with sediment toxicity exceeding the SMS criteria will be mapped to delineate any areas that may require cleanup or other remedial action.

6.2.2 Benthic Community Analysis

The Washington State Sediment Management Standards (SMS) provides criteria for evaluating changes in benthic community structure based on changes in major taxa (polychaetes, molluscs, crustaceans) abundance relative to abundance in reference areas. If any one taxa group has fewer than 50 percent of the mean number of individuals found in a reference area and is statistically different from reference, then this result is considered evidence of an adverse biological impact.

In addition, several metrics such as descriptive community indices (taxa richness, total abundance, major taxa abundance, abundance of indicator taxa), diversity indices (Shannon-Weiner diversity index [H'], Pielou's evenness [J], Swartz's Dominance Index [SDI]), and biomass may also be calculated to provide qualitative and quantitative assessments of benthic invertebrate communities. If deemed appropriate, divergent statistical methods (e.g., graphical comparisons, analysis of variance [ANOVA], multivariate techniques, cluster analysis) may also be used.

6.3 Sediment Quality Triad Index

The sediment quality triad index was developed as a weight-of-evidence approach that combines the results of the three parameters: sediment chemistry, sediment toxicity, and benthic community analysis; to classify the overall sediment quality. Only the six stations identified as sediment quality triad stations will be evaluated using the index. Four categories of sediment quality are used to define a given location as presented in Table 9 (Ecology 2004):

Table 9. Sediment Quality Triad Index

Sediment Quality Category	Results of Triad Parameters
High Quality	No degradation detected in any of three test parameters.
Intermediate/high quality	Degradation detected in one of three test parameters
Intermediate/Degraded Quality	Degradation detected in two of three test parameters
Degraded Quality	Degradation detected in all three test parameters

6.4 RI/FS Report

The contractor shall prepare a written report documenting all activities associated with collection, transportation, chemical analyses, and biological testing of sediment samples. The report will include recommendations for remedial action or further investigation based on the date results of this investigation. If no further investigations are deemed necessary and remedial actions have been identified, the report will also include the results of the FS. If further investigations are recommended, the FS will be provided as a preliminary report. The chemical, biological, and QA/QC reports will be included as appendices. As a minimum, the following will be included in the Final Report:

- Description of sampling and analysis activities;
- Protocols used during sampling and testing and an explanation of any deviations from the sampling plan protocols or the approved workplan;
- Physical descriptions of samples and site habitat;
- Methods used for station positioning, sample collection locations reported in latitude and longitude to the nearest tenth of a second (NAD 83);
- Map showing actual locations of sampling stations and results of data comparisons to SMS criteria and Sediment Quality Triad Index;
- Chain-of-custody records;
- Chemistry and biological testing results and laboratory reports;
- Comparison of data results to interpretive criteria;
- QA/QC summary; and
- Data validation reports.

7.0 References

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Appendix A

Health and Safety Plan

Location: Whitmarsh Landfill, March Point, Anacortes, WA

Site description: The Washington Department of Ecology has determined that the March Point Landfill (aka Whitmarsh landfill) site is a high priority for clean up under the Puget Sound Initiative, based on its potential impact on Padilla Bay. The abandoned March Point Landfill is approximately 14 acres. The site is on tidelands at the base of a bluff at the west end head of Padilla Bay Lagoon, at 9663 S March Point Rd in Anacortes, WA.

The landfill was an unregulated public dump from 1950 to 1973 and operated by Skagit County from 1961 to 1973. Skagit County used this landfill as its primary disposal area from 1969 to 1973. It is unknown the types and quantities of wastes that were buried at the landfill. The waste dumped at the landfill included household and commercial solid waste and industrial waste from two refineries located within two miles of the landfill. Records indicate that industrial wastes were accepted from Shell and Texaco refineries. In addition, Allied Chemical and Northwest Petrochemical may have also dumped their wastes at the landfill. Large quantities of asbestos containing material also may have been disposed of at the landfill. The off-shore sediments and sediments near inner and outer Padilla bay Lagoon have been impacted by metals, chlorinated benzenes, phthalates, phenols, petroleum related compounds, PCBs, dioxins, and furans.

Scope of work to be performed by contractor and subcontractors: A full characterization of the sediments of Padilla Bay Lagoon, as well as sediments immediately outside the break in the levee will be included as part of the RI/FS workplan. The proposed investigation will include bioassays for all stations (conducted utilizing full-spectrum lighting, due to the intertidal nature of the lagoon and the presence of PAHs). Sediment samples will be collected from areas adjacent to the site and tested for sediment conventional parameters and SMS chemicals of concern. Benthic infauna samples will also be collected and identified and enumerated. Two reference sediment samples of similar grain size to the test sediments will also be collected from an approved reference area to allow interpretation of the bioassay results.

Sediment Sample Collection
Sediment samples will be collected at 22 stations using either a grab sampler. Established deployment and recovery procedures for the sampling gear will be followed to ensure that the best possible samples are recovered and risks to personnel and equipment are minimized. A vessel subcontractor, will provide the sampling vessel. A differential global position system (DGPS) will be used to position the vessel.

For all chemical and biological testing (with the exception of volatile organic and total sulfide subsamples), composite samples will be collected. Sediments representing the top 10 cm will be placed in a decontaminated stainless steel bowl and mixed until uniform in color and texture. Only those sediments not in direct contact with the sampler walls will be obtained. In addition, sediments will be wet sieved in the field to determine approximate grain size.

Sediment for benthic samples will be rinsed through nested sieves of 1.0 and 0.5 mm. Any organisms remaining on the screens will be carefully removed from the screen with forceps and placed in the appropriate sample jar. In the field, the samples will be preserved in a solution of 10% buffered formalin in seawater, and later transferred (within 10 days) to a 70% ethanol, 5% glycerine, and 25% water solution for long-term storage. Samples that will be analyzed immediately will be transferred to a 70% ethanol and 30% water solution prior to delivery to the laboratory.

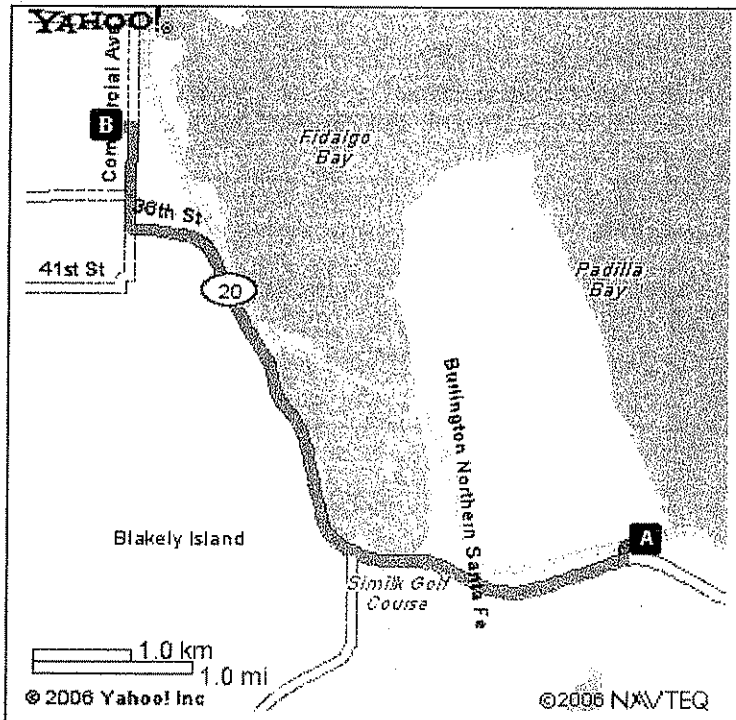
All excess sediment remaining after sampling will be washed overboard in the vicinity of the collection site. All sample handling, subsampling, judgment of sample acceptability, gear and utensil decontamination, compositing, storage, and chain-of-custody procedures will be conducted in accordance with PSEP (1986, 1987, 1997a,b,c) protocols. All utensils and mixing containers used during sample compositing will be decontaminated according to PSEP (1997c) protocols (i.e., washed with Liquinox™ and rinsed with clean site water or distilled water).

Figure 1. March Point Proposed Sediment Sampling Stations

SIGNATURES
Approval signatures: Signature below indicates review and approval of the plan and agreement that the anticipated hazards are correct and that planned hazard controls are sufficient.
Project Manager (PM) or Field Manager (FM) name and phone number: TBD
Signature and date:
CIH, CSP or designee name and phone number: TBD
Signature and date:
Commitment to implement: Signature below indicates commitment to implement this plan and to ensure that project fieldwork is conducted safely.
Field Manager/Site Safety and Health Officer name and phone number: TBD Alternate: TBD
Signature and date:
Commitment to comply: Signature below indicates that the individual has reviewed this plan, has received site-specific training (briefing), and agrees to comply with the requirements of this plan.

Name	Signature	Date

Potential Hazards and Emergency Information
Potential Hazards
Traffic accidents associated with travel to and from the site
Struck by other vessels or land structures (piers, unmarked navigation hazards)
Person overboard, drowning
Contact with powered rotating, pressurized and/or hydraulic equipment, pinching hazards (winch drum, boom, moving cables)
Contact with swinging sampling gear (sampler attached to winch cable over side of vessel)
Potential exposure to onsite contaminants (sediments)
Exposure to chemicals potentially used on site (nitric acid, methanol)
Environmental exposure (weather, rain, temperature extremes)
Physical hazards (trip/fall, cuts/contusions, etc.)
Fire or explosion
Emergency Phone Numbers
Medical: 911
Police/security: 911
Fire: 911
Coast Guard: 911 or (425) 252-5281
Emergency Medical Facility (Anacortes)
Island Hospital: Emergency/Trauma 1211 24th St Anacortes, WA 98221 General: (360) 299-1300 Emergency Services: (360) 299-1311 **Directions to Island Hospital:** 1. Head **west** on **S March Point Rd** towards **Reservation Rd** 2. Turn **left** at **Reservation Rd** 3. Turn **right** at **WA-20 W** 4. Continue on **WA-20 SPUR W** 5. Turn **right** at **Commercial Ave** 6. Turn **left** at **24th St**



Emergency Equipment Required On Site
Cellular phone (or verify immediate access to immediately available landline)
First aid kit (10 unit unitized kit or larger)
Fire extinguisher(s) rated at least 2A and 5B– Serviced annually and inspected monthly
Coast Guard approved floating devices (work vests or float coats)

Emergency Reporting

The FM will immediately report injuries or illnesses (requiring treatment other than first aid), vessel or vehicle accidents, releases (hazardous material, hazardous waste or uncharacterized waste), inspections by regulatory agencies, and any incident that could reasonably have caused a significant injury or property damage (man overboard, fire, catastrophic equipment failure, capsized vessel, etc.). The FM will contact emergency response organizations (if needed) and the PM. The PM will notify the client (as appropriate), Division Manager, Program Manager, and H&S Manager. If the PM is not available, the FM will make the other notifications. See EC&HS Procedures 4, Accident Reporting and 24, Regulatory Agency Inspections and Incident Reporting for details.

General Hazard Controls Applicable to all Work in this Program

This plan represents a good-faith effort to identify, evaluate, and prescribe controls for the hazards that will be posed by this work. Revisions to this plan will be documented. The Project Manager and CIH, CSP, or designee who originally approved the plan must approve revisions to the plan that result in decreasing or eliminating a hazard control.

This work is subject to the requirements of the contractor's Health and Safety program. The FM will insure that applicable provisions of health and safety procedures are followed and that personnel have access to these procedures.

The FM will perform and document daily safety inspections to verify that the work is performed safely, that the requirements of this plan are met, that the public is not endangered by this work, and that no environmental releases or violations occur as a result of this work. All on-site personnel and subcontractors will be responsible to report unsafe, or potentially unsafe, conditions to the FM immediately. The FM will take action to correct any work that he/she judges to be unsafe or non-compliant with this plan.

Subcontractors will be informed of the requirements of this plan and will be provided with copies or have unrestricted access to this plan and must comply with the requirements of this plan. This plan does not relieve subcontractors of the regulatory requirement to provide a safe workplace for their employees. Subcontractors are required to provide trained, experienced personnel and to operate equipment as required by the manufacturer's procedures, or the subcontractor's standard operating procedures; and are required to supplement the requirements of this plan as necessary to ensure that their employees perform their specific tasks safely.

Project training will include at least the following: The FM will have sufficient experience to understand the potential hazards. The FM will present a project kick-off safety briefing to cover this plan, physical hazards, potentially hazardous contaminants and chemicals, required hazard controls, and emergency contacts and additional safety briefings as needed (at least once per week). At least one person on site will have current first aid and cardiopulmonary resuscitation training. The FM will maintain documentation of completed training on site.

The Project Manager will be responsible for verifying that field personnel have received appropriate training or experience to safely perform their assigned tasks.

Field personnel will utilize personnel protective equipment (PPE) as directed in this plan. PPE for fieldwork will include safety glasses (goggles if splash hazards exist), steel toed rubber boots, rain gear or other waterproof protective clothing, hard hats if overhead hazards are present, and chemical resistant gloves (nitrile, PVC, or similar) if handling sediments or hazardous chemicals. The FM will evaluate PPE during routine inspections and will ensure that PPE is appropriate to the task. Respiratory protection is not required for this sampling program.

All vehicle operators must have valid drivers licenses and operate in compliance with applicable laws and regulations.

No hot work or open flame is allowed in areas where flammable substances may be present. No hot work will be initiated without expressed authorization of the FM for each hot work event. Flammable and combustible liquids will be transported and stored in containers provided by the vendors. Containers of hazardous chemicals must be labeled to indicate contents and hazard. MSDSs for hazardous chemicals must be available on-site. Formalin (10%) will be used to preserve benthic samples and will be brought in small quantities. Decontamination chemical use is not anticipated. If needed, transportation of hazardous materials will be performed per DOT or IATA requirements.

An exclusion zone is established around the back deck of the vessel when sediment sampling operations, sediment compositing and processing, use of hazardous chemicals for sample preservation or decontamination of sampling instruments) are occurring to exclude unauthorized personnel. The back deck of the vessel is not considered an exclusion zone when sediment sampling operations are not occurring and the back deck of the vessel is free of sediment and hazardous chemicals use. No food or drink will be allowed in

the exclusion zone. Personnel will wash their hands prior to eating or drinking. The FM will determine if additional personal decontamination is needed.

Excess sediments, wash water, or other site-derived materials (e.g., wood debris) will be washed overboard in the vicinity of the collection site. Containers will be labeled or indelibly marked to indicate at least; contents (including physical state), date placed in container, source, and client's name. Formalin waste disposal will be managed through a private waste firm.

Each employee is empowered and expected to stop his or her own work or the work of co-workers if any person's safety or the environment are at risk. The FM is expected to support and reinforce this expectation. Stopped work will not resume until the hazard has been controlled and a safety assessment has been performed.

Job Safety Analysis

Organization: Contractor
Work Activity: Sediment sampling from vessel using single or double stainless steel van Veen grab samplers, Gray O'Hara boxcore, or mini-soutar boxcore.

Personal Protective Equipment (PPE)	Selected	Comments
Clothing	X	Rain gear (tops and bottoms)
Safety Shoes	X	Steel toed rubber boots
Hard Hat	X	
Safety Glasses	X	As necessary
Fire Resistant Clothing		
Face Shields		
Goggles	X	As necessary for splash protection
Coast Guard approved Personal Floatation Devices (PFDs)	X	To be worn during vessel operations over the side (e.g. van Veen sampler operations)
Hearing Protection		
Air Purifying Respirator		
Supplied Air Respirator – SCBA		
Welding Hood		
Welding/Pipe Clothing		
Welding Mask/Goggles		
Gloves	X	Nitrile, PVC or similar for potentially contaminated material.
Other		
Safety Cones/Barricades		
Safety Vest		
Knee Pads		
Caution Tape		
Back Belt/Support		

Reviewers

Reviewer Name	Position	Date Approved
TBD	TBD	

Development Team

Development Team Member Name	Primary Contact	Position
TBD	Y	SSHO

Job Steps

No	Job Steps	Potential Hazard	Critical Actions
1	Mobilize to work site	Traffic accident	Valid drivers license, seat belt use, routine vehicle inspections, no cell phone use while driving
2	Sediment sampling from vessel	Being struck by sampler attached to winch cable.	The vessel subcontractor will provide a trained winch operator. The operator will keep the sampler low to the deck when deploying the sampler over the side to minimize swinging. The sampler will be deployed and retrieved when the vessel is relatively stable (e.g., wait until wakes from passing vessels have dissipated). Personnel will stand clear of areas where sampler can swing and strike personnel (e.g., between sample table and gunwale of vessel). If necessary, tag lines will be used to minimize the swing of the sampler during deployment. Safety pins

			are removed only when the gear is over the rail. When not in use, the sampler should be securely fastened to prevent movement/shifting.
		Pinching hazard from sampler	Personnel will be trained in the operation of the sampler. Personnel will keep hands and fingers clear of the jaws of the sampler when in the open position (during deployment).
		Man overboard and drowning	Personnel will wear Coast Guard approved PFDs during over the side operations. A vessel safety briefing by the vessel subcontractor will be conducted prior to the start of operations to discuss steps to be taken if a man overboard should occur. Life ring with deployable rescue line available on board.
		Slips, trips, and falls	Lines, hoses, hatch covers, and mud on the deck present tripping, slipping, and falling hazards. Every crew member should make an effort to keep the working surfaces of the deck clear and clean by coiling hoses and lines and rinsing accumulations of mud from the deck.
		Temperature stress	If temperature is above 80°F or below 40°F, administrative controls will be implemented (cooled or warmed drinks, routine breaks in heated or shaded area (vessel cabin).
		Lifting (musculoskeletal injuries)	If equipment is to be moved, an evaluation of potential pinch points and/or weight strain will be conducted. Clear area of all unnecessary equipment and slip/trip hazards. Additional help will be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lbs or has to be moved by maneuvering through awkward positioning.
		Fire	Fire extinguisher rated 2A and 5B (serviced annually and inspected monthly) in all fuel use areas.
		Potential contaminant exposure through sediments	Elevated concentrations of contaminants in the sediments are not expected based on historical sampling. However, personnel will wear nitrile gloves when handing sediments. Goggles will be worn when splash hazards exist. If incidental skin contact occurs with sediments, rinse away sediment as soon as possible. Wash hands before eating or drinking.
		Chemical exposure	Nitrile gloves and safety glasses will be worn during work with formalin and decontamination chemicals. Chemical containers will be labeled with identity and hazard. MSDSs will be on site for all chemicals in use. Site-specific training must address chemicals, hazards, and proper handling.
		Hazardous material transport	Hazardous material transport will be related to small

			quantity transport of formalin under materials of trade exception. Materials will be secured against movement and protected against damage during transport.

Job Safety Analysis		
Organization: Contractor Work Activity: Equipment decontamination		
Personal Protective Equipment (PPE)	Selected	Comments
Clothing	X	Rain gear (tops and bottoms)
Safety Shoes	X	Steel toed rubber boots
Hard Hat	X	
Safety Glasses	X	
Fire Resistant Clothing		
Face Shields		
Goggles	X	Goggles for nitric and methanol use
Coast Guard approved Personal Floatation Devices (PFDs)	X	To be worn during vessel operations over the side (e.g. van Veen sampler operations)
Hearing Protection		
Air Purifying Respirator		
Supplied Air Respirator – SCBA		
Welding Hood		
Welding/Pipe Clothing		
Welding Mask/Goggles		
Gloves	X	Nitrile, PVC or similar for potentially contaminated material and decon fluids.
Other		
Safety Cones/Barricades		
Safety Vest		
Knee Pads		
Caution Tape		
Back Belt/Support		

Reviewers		
Reviewer Name	Position	Date Approved
TBD	TBD	

Development Team		
Development Team Member Name	Primary Contact	Position
TBD	Y	SSHO

Job Steps			
No	Job Steps	Potential Hazard	Critical Actions
1	Mobilize to work site	Traffic accident	Valid drivers license, seat belt use, routine vehicle inspections, no cell phone use while driving
2	Equipment decontamination by liquinox and water rinse	Lifting (musculoskeletal injury)	If equipment is to be moved, an evaluation of potential pinch points and/or weight strain will be conducted. Clear area of all unnecessary equipment and slip/trip hazards. Additional help will be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lbs or has to be moved by maneuvering through awkward positioning.
		Temperature stress.	If temperature is above 80°F or below 40°F, administrative controls will be implemented (cooled or warmed drinks, routine breaks in heated or shaded area, provisions for emergency heating or cooling).
		Fire	Fire extinguisher rated 2A and 5B (serviced annually and inspected monthly) in all fuel/flammable liquid use areas.
		Chemical exposure	Nitrile gloves for chemical/contaminant contact. Wash hands before eating or drinking. Chemical containers labeled with identity and hazard. MSDSs on site for all chemicals in use. Site-specific training must address chemicals, hazards, and proper handling.
		IDW Control	Label or mark IDW containers to indicate container number, contents (including physical state), investigation location, date of collection, and client name. Ensure that storage area provides adequate protection against physical damage or disturbance.

MATERIAL SAFETY DATA SHEETS

FORMALIN
LIQUINOX
ZINC ACETATE

10% Buffered Formalin

ACC# 41129

Section 1 - Chemical Product and Company Identification
MSDS Name: 10% Buffered formalin
Catalog Numbers: SF99-20, SF99-4
Synonyms: None.
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
50-00-0	Formaldehyde	3.9-4.0	200-001-8
67-56-1	Methyl alcohol	2	200-659-6
127-09-3	Sodium acetate	1.2-2.0	204-823-8
7732-18-5	Water	Balance	231-791-2

Section 3 - Hazards Identification
EMERGENCY OVERVIEW
Appearance: not available liquid. Flash Point: > 194 deg F.
Warning! Contains formaldehyde which can cause cancer. Causes eye, skin, and respiratory tract irritation. May cause allergic respiratory and skin reaction. May be harmful if swallowed or absorbed through the skin. May cause central nervous system depression. This substance has caused adverse reproductive and fetal effects in animals.
Target Organs: Central nervous system, lungs, respiratory system, skin.

Potential Health Effects
Eye: Causes eye irritation.
Skin: Causes skin irritation. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material.
Ingestion: Cannot be made non-poisonous. May cause central nervous system depression, kidney damage, and liver damage. Causes gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation: Causes respiratory tract irritation. May cause allergic respiratory reaction.
Chronic: Contains formaldehyde which can cause cancer in humans. There is sufficient evidence that formaldehyde causes nasopharyngeal cancer in humans, a rare cancer in developed countries. There is limited evidence that formaldehyde causes cancer of the nasal cavity and paranasal sinuses and strong but not sufficient evidence for leukemia.

Section 4 - First Aid Measures
Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Ingestion: Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures
General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. Cool containers with flooding quantities of water until well after fire is out.
Flash Point: > 194e deg F (> 90.00 deg C)
Autoignition Temperature: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 1; Instability: 0

Section 6 - Accidental Release Measures
General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Clean up spills immediately, observing precautions in the Protective Equipment section. Provide ventilation.

Section 7 - Handling and Storage
Handling: Wash thoroughly after handling. Wash hands before eating. Remove contaminated clothing and wash before reuse. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Do not ingest or inhale. Use only with adequate ventilation.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection
Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits. See 29CFR 1910.1048 for regulatory requirements pertaining to all occupational exposures to formaldehyde, i.e., from formaldehyde gas, its solutions, and materials that release formaldehyde.
Exposure Limits Chemical Name ACGIH NIOSH OSHA - Final PELs
Formaldehyde 0.3 ppm Ceiling 0.016 ppm TWA 20 ppm IDLH 0.75 ppm TWA; 2 ppm STEL; 0.5 ppm Action Level (Irritant and potential cancer hazard - see 29 CFR 1910.1048)
Methyl alcohol 200 ppm TWA; 250 ppm STEL; Skin - potential significant contribution to overall exposure by the cutaneous route 200 ppm TWA; 260 mg/m3 TWA 6000 ppm IDLH 200 ppm TWA; 260 mg/m3 TWA
Sodium acetate none listed none listed none listed
Water none listed none listed none listed

OSHA Vacated PELs: Formaldehyde: 3 ppm TWA (unless specified in 1910.1048) Methyl alcohol: 200 ppm TWA; 260 mg/m3 TWA Sodium acetate: No OSHA Vacated PELs are listed for this chemical. Water: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear chemical splash goggles.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: not available
Odor: none reported
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point:Not available.
Decomposition Temperature:Not available.
Solubility: Soluble in water.
Specific Gravity/Density:Not available.
Molecular Formula:Mixture
Molecular Weight:Not applicable.

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Excess heat, confined spaces.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Irritating and toxic gases.
Hazardous Polymerization: Has not been reported

Section 11 - Toxicological Information

RTECS#:
CAS# 50-00-0: LP8925000
CAS# 67-56-1: PC1400000
CAS# 127-09-3: AJ4300010
CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 50-00-0:
Draize test, rabbit, eye: 750 ug/24H Severe;
Draize test, rabbit, eye: 750 ug Severe;
Draize test, rabbit, eye: 10 mg Severe;
Draize test, rabbit, eye: 37% Severe;
Draize test, rabbit, skin: 2 mg/24H Severe;
Draize test, rabbit, skin: 50 mg/24H Moderate;
Inhalation, mouse: LC50 = 454 mg/m3/4H;
Inhalation, mouse: LC50 = 505 mg/m3/2H;
Inhalation, rat: LC50 = 203 mg/m3;
Inhalation, rat: LC50 = 578 mg/m3/2H;
Inhalation, rat: LC50 = 250 ppm/2H;
Oral, mouse: LD50 = 42 mg/kg;
Oral, mouse: LD50
CAS# 67-56-1:
Draize test, rabbit, eye: 40 mg Moderate;
Draize test, rabbit, eye: 100 mg/24H Moderate;
Draize test, rabbit, skin: 20 mg/24H Moderate;
Inhalation, rabbit: LC50 = 81000 mg/m3/14H;
Inhalation, rat: LC50 = 64000 ppm/4H;
Oral, mouse: LD50 = 7300 mg/kg;
Oral, rabbit: LD50 = 14200 mg/kg;

Oral, rat: LD50 = 5600 mg/kg;
Skin, rabbit: LD50 = 15800 mg/kg;

CAS# 127-09-3:
Draize test, rabbit, eye: 10 mg Mild;
Draize test, rabbit, skin: 500 mg/24H Mild;
Inhalation, rat: LC50 = >30 gm/m3/1H;
Oral, mouse: LD50 = 6891 mg/kg;
Oral, rat: LD50 = 3530 mg/kg;
Skin, rabbit: LD50 = >10 gm/kg;

CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;

Carcinogenicity:
CAS# 50-00-0:

ACGIH: A2 - Suspected Human Carcinogen

California: carcinogen, initial date 1/1/88 (gas)

NTP: Suspect carcinogen

IARC: Group 1 carcinogen
CAS# 67-56-1: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 127-09-3: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 7732-18-5: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: In June 2004 an expert IARC group determined that there is now sufficient evidence that formaldehyde causes nasopharyngeal cancer in humans, a rare cancer in developed countries.
Teratogenicity: Formaldehyde effects on Newborn: behavioral, ihl-rat TCLo=50 ug/m3/4H; biochemical/metabolic and reduced weight gain, ihl-rat TCLo=12 ug/m3/24H. Embryo or Fetus: cytological changes, ihl-rat TCLo=1 mg/m3/24H; stunted fetus and death, ipr-mouse TDLo=240 mg/kg. Specific Developmental Abnormalities: craniofacial and musculoskeletal, ipr-mouse TDLo=240 mg/kg.
Reproductive Effects: Formaldehyde effects on Fertility: male index, itt-rat TDLo=400 mg/kg; post- implantation mortality, ims-mouse TDLo=259 mg/kg. Paternal Effects: spermatogenesis, orl-rat TDLo=200 mg/kg; testes/sperm duct/epididymis, ipr-rat TDLo=80 mg/kg.
Mutagenicity: Formaldehyde DNA Damage: human fibroblast 100 umol/L DNA Inhibition: human cell types 210 umol/L. Unscheduled DNA Synthesis: rat cell types 50 umol/L. Gene Mutation in Mammalian Cells: human lymphocyte 130 umol/L.
Neurotoxicity: No information available.
Other Studies:

Section 12 - Ecological Information
No information available.

Section 13 - Disposal Considerations
Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.

RCRA U-Series:
CAS# 50-00-0: waste number U122.
CAS# 67-56-1: waste number U154 (Ignitable waste).

Section 14 - Transport Information
US DOT Canada TDG
Shipping Name: AVIATION REGULATED LIQUID, N.O.S. AVIATION REGULATED LIQUID, N.O.S.
Hazard Class: 9 9
UN Number: UN3334 UN3334
Packing Group:

Section 15 - Regulatory Information
US FEDERAL

TSCA
CAS# 50-00-0 is listed on the TSCA inventory.
CAS# 67-56-1 is listed on the TSCA inventory.
CAS# 127-09-3 is listed on the TSCA inventory.
CAS# 7732-18-5 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
CAS# 50-00-0: 100 lb final RQ; 45.4 kg final RQ CAS# 67-56-1: 5000 lb final RQ; 2270 kg final RQ
SARA Section 302 Extremely Hazardous Substances
CAS# 50-00-0: 500 lb TPQ
SARA Codes
CAS # 50-00-0: immediate, delayed.
CAS # 67-56-1: immediate, fire.
Section 313
This material contains Formaldehyde (CAS# 50-00-0, 3.9-4.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
This material contains Methyl alcohol (CAS# 67-56-1, 2%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
CAS# 50-00-0 is listed as a hazardous air pollutant (HAP).
CAS# 67-56-1 is listed as a hazardous air pollutant (HAP).

This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 50-00-0 is listed as a Hazardous Substance under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
CAS# 50-00-0 is considered highly hazardous by OSHA.
STATE
CAS# 50-00-0 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

CAS# 67-56-1 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.
CAS# 127-09-3 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.

California Prop 65
The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:
WARNING: This product contains Formaldehyde, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 50-00-0: 40 æg/day NSRL

European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols:
T
Risk Phrases:
R 45 May cause cancer.

Safety Phrases:

WGK (Water Danger/Protection)
CAS# 50-00-0: 2
CAS# 67-56-1: 1
CAS# 127-09-3: 1
CAS# 7732-18-5: No information available.
Canada - DSL/NDSL
CAS# 50-00-0 is listed on Canada's DSL List.
CAS# 67-56-1 is listed on Canada's DSL List.
CAS# 127-09-3 is listed on Canada's DSL List.
CAS# 7732-18-5 is listed on Canada's DSL List.
Canada - WHMIS
This product has a WHMIS classification of B3, D1B, D2A.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.
Canadian Ingredient Disclosure List
CAS# 50-00-0 is listed on the Canadian Ingredient Disclosure List.
CAS# 67-56-1 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information
MSDS Creation Date: 7/12/1999
Revision #7 Date: 10/12/2005

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Liquinox Laboratory Cleaner

Section 1 – Chemical Product and Company Identification
Liquinox, Laboratory Cleaner
Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800)452-1261
CHEMTREC Emergency Phone Number: (800) 424-9300
MSDS #: 249
Revision Date: November 25, 2002

Section 2 – Composition, Information on Ingredients
Proprietary mixture manufactured by Alconox, Inc.
CAS #: None Established

Section 3 – Hazards Identification
Yellow liquid. Practically odorless.
Irritating to eyes. May be irritating to mucous membranes.

FLINN AT-A-GLANCE
Health-0
Flammability-0
Reactivity-0
Exposure-1
Storage-0
0 is low hazard, 3 is high hazard

Section 4 – First Aid Measures
Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water for 15 minutes.
Internal: Rinse out mouth, give 1 to 2 cups of water or milk, and induce vomiting. Call a physician or poison control at once.

Section 5 – Fire Fighting Measures
Non flammable, non combustible liquid.
When heated to decomposition, emits toxic fumes of CO, CO2, and SO2.
Fire Fighting Instructions: Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

NFPA CODE
None Established

Section 6 – Accidental Release Measures
Material foams profusely. Cleaner is biodegradable. Restrict unprotected personnel from area and ventilate area. Contain spill with sand or absorbent material; deposit in sealed bag or container. See Sections 8 and 13 for further information.

Section 7 – Handling and Storage
Flinn Suggested Chemical Storage Pattern: Inorganic Miscellaneous, or near washing area.

Section 8 – Exposure Controls, Personal Protection
Avoid contact with eyes, skin, and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron.

Section 9 – Physical and Chemical Properties
Yellow liquid. Practically odorless.
Liquinox is a trade name. An anionic detergent.
Solubility: Completely soluble in water.
Specific Gravity: 1.065
Boiling Point: 210 C

Section 10 – Stability and Reactivity
Avoid contact with strong oxidizing agents.
Shelf life: Good.

Section 11 – Toxicological Information
Acute effects: Irritant
Chronic effects: N.A.
Target organs: N.A.
ORL-RAT LD50: N.A.
IHL-RAT LC50: N.A.
SKN-RBT LD50: N.A.

N.A. = Not available, not all health aspects of this substance have been fully investigated.

Section 12 – Ecological Information
Data not yet available.

Section 13 – Disposal Considerations
Please consult with state and local regulations.
Flinn Suggested Disposal Method #26b is one option.

Section 14 – Transport Information
Shipping Name: Not regulated
Hazard Class: N/A
UN Number: N/A

N/A = Not applicable

Section 15 – Regulatory Information
Not listed.

Section 16 – Other Information
Consult your copy of the Flinn Scientific Catalog/Reference Manual for additional information about laboratory chemicals.
This Material Safety Data Sheet (MSDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. Flinn Scientific Inc. assumes no legal responsibility for use or reliance upon this data.

Liquinox, Laboratory Cleaner

Zinc Acetate 2.0N Solution

ACC# 89034

Section 1 - Chemical Product and Company Identification
MSDS Name: Zinc acetate 2.0N solution
Catalog Numbers: NC9744345, SLN11640
Synonyms: Acetic acid, zinc salt, in aqueous solution.
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients
CAS# Chemical Name Percent EINECS/ELINCS
7732-18-5 Water 78 231-791-2
557-34-6 Zinc acetate 22 209-170-2

Section 3 - Hazards Identification
EMERGENCY OVERVIEW
Appearance: clear, colorless liquid.
Caution! Causes eye irritation. May cause respiratory and digestive tract irritation. May cause skin irritation.
Target Organs: None.

Potential Health Effects
Eye: Causes eye irritation.
Skin: May cause skin irritation.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation: May cause respiratory tract irritation.
Chronic: No information found.

Section 4 - First Aid Measures
Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures
General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use extinguishing media most appropriate for the surrounding fire.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.

Explosion Limits, Lower:Not available.
Upper: Not available.
NFPA Rating: Not published.

Section 6 - Accidental Release Measures
General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Wash area with soap and water. Clean up spills immediately, observing precautions in the Protective Equipment section.

Section 7 - Handling and Storage
Handling: Wash thoroughly after handling. Use with adequate ventilation. Avoid contact with skin and eyes. Avoid ingestion and inhalation.
Storage: Store in a cool, dry place. Keep containers tightly closed.

Section 8 - Exposure Controls, Personal Protection
Engineering Controls: Good general ventilation should be sufficient to control airborne levels.
Exposure Limits Chemical Name ACGIH NIOSH OSHA - Final PELs
Water none listed none listed none listed
Zinc acetate none listed none listed none listed
Zinc acetate dihydrate none listed none listed none listed

OSHA Vacated PELs: Water: No OSHA Vacated PELs are listed for this chemical. Zinc acetate: No OSHA Vacated PELs are listed for this chemical. Zinc acetate dihydrate: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties
Physical State: Liquid
Appearance: clear, colorless
Odor: none reported
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate:Not available.
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point:Not available.
Decomposition Temperature:Not available.
Solubility: Soluble in water.
Specific Gravity/Density:Not available.
Molecular Formula:Mixture
Molecular Weight:Not available.

Section 10 - Stability and Reactivity
Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials.
Incompatibilities with Other Materials: Zinc salts; strong oxidizing agents.

Hazardous Decomposition Products: Carbon monoxide, carbon dioxide, toxic fumes of zinc oxide.
Hazardous Polymerization: Has not been reported

Section 11 - Toxicological Information
RTECS#:
CAS# 7732-18-5: ZC0110000
CAS# 557-34-6: AK1500000
CAS# 5970-45-6: ZG8750000
LD50/LC50:
CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;

CAS# 557-34-6:
Oral, rat: LD50 = 2510 mg/kg;

CAS# 5970-45-6:
Draize test, rabbit, eye: 20 mg/24H Moderate;
Draize test, rabbit, skin: 500 mg/24H Mild;
Oral, mouse: LD50 = 287 mg/kg;
Oral, rat: LD50 = 794 mg/kg;

Carcinogenicity:
CAS# 7732-18-5: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 557-34-6: Not listed by ACGIH, IARC, NTP, or CA Prop 65.
CAS# 5970-45-6: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No data available.
Teratogenicity: No data available.
Reproductive Effects: No data available.
Mutagenicity: Mutagenicity data exists for human lymphocyte cells at a dose of 7 mg/L.
Neurotoxicity: No data available.
Other Studies:

Section 12 - Ecological Information
No information available.

Section 13 - Disposal Considerations
Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information
US DOT Canada TDG
Shipping Name: Not regulated as a hazardous material No information available.
Hazard Class:
UN Number:
Packing Group:

Section 15 - Regulatory Information
US FEDERAL

TSCA
CAS# 7732-18-5 is listed on the TSCA inventory.
CAS# 557-34-6 is listed on the TSCA inventory.
CAS# 5970-45-6 is not on the TSCA Inventory because it is a hydrate. It is considered to be listed if the CAS number for the anhydrous form is on the inventory (40CFR720.3(u)(2)).
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
CAS# 557-34-6: 1000 lb final RQ; 454 kg final RQ
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 5970-45-6: immediate.
Section 313
This material contains Zinc acetate (listed as Zinc compounds), 22%, (CAS# 557-34-6) which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
This material contains Zinc acetate dihydrate (listed as Zinc compounds), -%, (CAS# 5970-45-6) which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
CAS# 557-34-6 is listed as a Hazardous Substance under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA. CAS# 557-34-6 is listed as a Toxic Pollutant under the Clean Water Act. CAS# 5970-45-6 is listed as a Toxic Pollutant under the Clean Water Act.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 557-34-6 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts.
CAS# 5970-45-6 can be found on the following state right to know lists: California, (listed as Zinc compounds), Pennsylvania, (listed as Zinc compounds).

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols:
XN
Risk Phrases:

R 36 Irritating to eyes.

Safety Phrases:
S 25 Avoid contact with eyes.
S 36/37/39 Wear suitable protective clothing, gloves and eye/face pr
otection.

WGK (Water Danger/Protection)
CAS# 7732-18-5: No information available.
CAS# 557-34-6: 1
CAS# 5970-45-6: No information available.
Canada - DSL/NDSL
CAS# 7732-18-5 is listed on Canada's DSL List.
CAS# 557-34-6 is listed on Canada's DSL List.
CAS# 5970-45-6 is listed on Canada's DSL List.
Canada - WHMIS
WHMIS: Not available.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.
Canadian Ingredient Disclosure List
CAS# 557-34-6 is not listed on the Canadian Ingredient Disclosure List.
CAS# 5970-45-6 is not listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information
MSDS Creation Date: 9/02/1997
Revision #3 Date: 11/19/2004

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Appendix B

Sample Forms

2007 March Point RI/FS Sediment Characterization	
Project Number:	Time Collected:
Crew:	Date:
Comments:	

Sample Container Tag Number	Sample ID	Analysis	Laboratory

Notes:

Project: March Point Landfill Sediment RI/FS **Station:**____________________
Sampling Event:____________________ **Date:**____________________

Crew:____

Grab #:	**Bottom depth:**	**Penetration Depth:**	**Time:**
Sediment type:	***Sediment color:***	***Sediment Odor:***	***Comments:***
Cobble	Drab olive	None	
Gravel	Brown	Slight	
Sand C M F	Brown surface	Moderate	
Silt/clay	Gray	Strong	
Organic matter	Black	Overwhelming	
Woody debris	Other:	H_2S	
Shell debris		Petroleum	

Grab #:	**Bottom depth:**	**Penetration Depth:**	**Time:**
Sediment type:	***Sediment color:***	***Sediment Odor:***	***Comments:***
Cobble	Drab olive	None	
Gravel	Brown	Slight	
Sand C M F	Brown surface	Moderate	
Silt/clay	Gray	Strong	
Organic matter	Black	Overwhelming	
Woody debris	Other:	H_2S	
Shell debris		Petroleum	

Grab #:	**Bottom depth:**	**Penetration Depth:**	**Time:**
Sediment type:	***Sediment color:***	***Sediment Odor:***	***Comments:***
Cobble	Drab olive	None	
Gravel	Brown	Slight	
Sand C M F	Brown surface	Moderate	
Silt/clay	Gray	Strong	
Organic matter	Black	Overwhelming	
Woody debris	Other:	H_2S	
Shell debris		Petroleum	

Grab #:	**Bottom depth:**	**Penetration Depth:**	**Time:**
Sediment type:	***Sediment color:***	***Sediment Odor:***	***Comments:***
Cobble	Drab olive	None	
Gravel	Brown	Slight	
Sand C M F	Brown surface	Moderate	
Silt/clay	Gray	Strong	
Organic matter	Black	Overwhelming	
Woody debris	Other:	H_2S	
Shell debris		Petroleum	

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CHAIN OF CUSTODY RECORD

Project No.: _____ Project Mgr: _____
Project Name: _____
Project Location: _____
Sample Collectors: _____
Client Name: _____

Sample ID	Depth	Matrix	Date	Time	# of Containers	Analyses / Tests	Comments

Shipping Information

Number of Shipping Containers:

Date Shipped:

Carrier:

Waybill No.:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature:	Signature:	Signature:	Signature:
Date/Time:	Date/Time:	Date/Time:	Date/Time:
Affiliation:	Affiliation:	Affiliation:	Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples • Canary: Lab Retains • Pink: Lab Returns to Project Manager with Final Report • Goldenrod: Retained by Sampler