Terrestrial Ecological Evaluation
Ellisport Creek Greenspace Project Site
Vashon Island, Washington

November 27, 2007

Prepared For:

King County Solid Waste Division
King Street Center
201 South Jackson Street, Suite 701
Seattle, Washington 98104-3855

Prepared By:

A
11811 NE 1st Street, Suite 201
Bellevue, Washington 98005

CDM Project No. 19897.57600

A Report Prepared For :

King County Solid Waste Division
King Street Center
201 South Jackson Street, Suite 701
Seattle, Washington 98104-3855

TERRESTRIAL ECOLOGICAL EVALUATION
ELLISPORT CREEK GREENSPACE PROJECT SITE
VASHON ISLAND, WASHINGTON

November 27, 2007

Lance Peterson, LHG
Senior Hydrogeologist

Tony Gendusa, Ph.D.
Ecological Risk Assessor / Ecotoxicologist

A
11811 N.E. 1st Street, Suite 201
Bellevue, Washington 98005
425 / 453-8383

CDM Project No. 19897.57600

Contents

Tables

Abbreviations and Acronyms

As	Arsenic
AET	Apparent Effects Threshold
AST	Aboveground Storage Tank
BCF	Bioconcentration Factor
CDM	Camp Dresser & McKee Inc.
COC	Chemical of Concern
COPC	Chemicals of Potential Concern
Ecology	Washington State Department of Ecology
EPC	Exposure Point Concentration
ESA	Environmental Site Assessment
ESL	Ecological Screening Level
HQ	Hazard Quotient
LCV	Lowest Chronic Value
LOEC	Low Effect Concentration
mg	Milligram
MTCA	Model Toxics Control Act
NOEC	No Effect Concentration
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated Biphenyls
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
SCEM	Site Conceptual Exposure Model
TEE	Terrestrial Ecological Evaluation
TOC	Total Organic Carbon
TV	Toxicity Value
µg/L	Micrograms per liter

Executive Summary

This report presents a site-specific Terrestrial Ecological Evaluation (TEE) performed by Camp Dresser & McKee, Inc. on behalf of King County at the Ellisport Creek Greenspace Project site on Vashon Island, Washington. Site assessment work has identified elevated concentrations of Bunker C-range petroleum hydrocarbons from former industrial use of the property. The Model Toxics Control Act (MTCA) specifies that sites located in an area where management or land use plans will maintain or restore native or semi-native vegetation (e.g., greenbelts and protected wetlands) require a site-specific TEE under WAC 173-340-7493. The goal of this site-specific TEE is protection of plants and animals from exposure to environmental contamination at levels likely to cause significant adverse or toxic effects. Because the contamination includes Bunker C oil, for which ecotoxicity data are not available, site-specific toxicity testing in the form of biological assays (bioassays) was selected in consultation with the Washington State Department of Ecology (Ecology) as most effective means of determining risks to selected ecological receptors.

The primary components of the TEE are Problem Formulation, Toxicity Assessment, and Risk Characterization (which integrates exposure and toxicity information). The Problem Formulation portion of the TEE compared detected chemicals in surface water, freshwater and marine sediment, and soil to ecological screening levels (ESLs) established for those chemicals. The ESLs, along with the bioassay results, are used to assess potential toxicity. ESLs represent the threshold exposure to a chemical beyond which adverse effects are likely; chemicals exceeding established ESLs are identified as chemicals of potential concern (COPCs). A hazard quotient is then established for each COPC by dividing the maximum detected concentration of each contaminant by its ESL, and those chemicals with a resulting hazard quotient greater than 1.0 are identified as COPCs warranting further evaluation in the TEE. Final COPCs included Pyrene in surface water and arsenic, lead, Bunker C and several Polycyclic Aromatic Hydrocarbon (PAH) compounds in soil. A site conceptual exposure model (SCEM) was developed as the primary output of the Problem Formulation. The SCEM identifies the major relevant exposure scenarios, or ways in which indigenous plants and animals come into contact with the contaminants identified at the site. The SCEM also determines the assessment end points, or ecological values, to be protected (for this TEE, the establishment and maintenance of healthy and diverse terrestrial, aquatic and semi-aquatic/wetland ecosystems within the project area); and the measurement end points, which establish the amounts of contamination that can remain resident at the site and still permit attainment of the assessment endpoint.

The Toxicity Assessment identified the concentrations of Bunker C oil and other contaminants that represent a potential for significant adverse impact to plants and animals at the site. This TEE determined that all COPCs were linked to soil exposure, making terrestrial plants and terrestrial invertebrates (represented by earthworms) the two groups at most risk from the soil contamination caused by Bunker C oil and other COPCs. Soil toxicity values and the potential effects linked to such values were obtained from existing studies for all identified COPCs except Bunker C oil and used

with the hazard quotient approach previously described. Of all COPCs identified, only arsenic, lead and naphthalene produced hazard quotients over 1.0, and none of those three were considered indicative of significant site-related risk because they either are not highly bioavailable in soil or were found at a depth beyond the likely area of significant ecological exposure.

For Bunker C, the absence of ecotoxicity data led to the use of bioassay testing to determine potential impacts to ecological receptors. Earthworms and lettuce were used to represent indigenous soil invertebrates and terrestrial plants in laboratory bioassay tests that measured toxic effects from exposure to samples of contaminated soil collected at the site. In those tests, exposure of lettuce to even the highest concentrations of Bunker C contamination produced some reduction of biomass in surviving seedlings, but no demonstrable toxicity. Earthworm exposure to soil samples containing the highest concentrations of Bunker C (18,000 mg / kg) produced a mean survival rate of 26.7%, but exposures at all other test levels produced survival rates of 80% or higher, and no significant effect at exposures of 6,700 mg / kg or less. After consulting with Ecology it was agreed that the soil cleanup value for Bunker C be based on protection of apparently more sensitive soil invertebrates (represented by earthworm) instead of protection of terrestrial plants. The no effect level of 6,700 mg Bunker C / kg soil is a conservative threshold at which adverse effects may begin to be observed in resident soil invertebrates and, as such, would be adequately protective of soil organisms at the site.

The recommended soil cleanup value for Bunker C is 6,700 mg / kg, based on the results of the soil toxicity tests with earthworms.

Section 1
Introduction

This report presents a Terrestrial Ecological Evaluation (TEE) performed by Camp Dresser & McKee Inc. (CDM) on behalf of King County (the County) at the Ellisport Creek Greenspace Project site (the site) located on Vashon Island, Washington.

The Model Toxics Control Act (MTCA) specifies that sites located in an area where management or land use plans will maintain or restore native or semi-native vegetation (e.g., greenbelts and protected wetlands) require a site-specific TEE under WAC 173-340-7493. The scope of a site-specific TEE requires consultation with the Washington State Department of Ecology (Ecology). The goal of the TEE process is the protection of terrestrial ecological receptors (plants and animals) from exposure to contaminated soil with the potential to cause significant adverse effects.

CDM initiated a site-specific TEE for the site in 2006 under Work Order No. 20 to Contract No. E23023E. The scope of the TEE consisted of conducting a literature survey and evaluation of available site data. TEEs typically do not go beyond the literature review phase if the level of contamination is unlikely to cause measurable adverse ecological effects, therefore, a more intensive TEE was not proposed initially. A more detailed TEE could include site-specific toxicity testing through bioassays, collection of additional chemical and possibly biological data, and more intensive site surveys. The preliminary site-specific TEE used information obtained from relevant literature sources and from information gathered during data evaluation tasks to begin to determine site-specific concentrations of contaminants in soil that would be protective of the ecological resources within or associated with the site. For the purposes of the TEE, ecological resources are defined as the habitats and plant and animal communities and populations occurring onsite or utilizing the site.

After consultation with Ecology and drafting of the literature review, it became apparent that a soil cleanup level for Bunker C oil would need to be supported by either a detailed site survey or bioassay study. A site visit with representative of Ecology was conducted on January 4, 2007. During the site visit guidance was received from Ecology indicating bioassay testing as the recommended course of action since a site survey would be expensive and time consuming. Bioassay is shorthand commonly used for biological assay and involves use of a biological organism to test for chemical toxicity. Bioassays replicate the impact of a substance (in this case Bunker C) on organisms through implementation of a laboratory experiment. For the Ellisport Creek TEE, Ecology recommended earthworms be used to replicate the impact on soil-dwelling organisms and lettuce be used to replicate the impact on plants. The bioassay study and finalization of the site-specific TEE were performed in accordance CDM's January 22, 2007 proposal, Work Order No. 1, Contract No. E00025E and the Ecology-approved Quality Assurance Project Plan (QAPP) dated May 7, 2007.

Since the site contains habitat characteristic of wetlands, the TEE scope also included evaluation of identified aquatic issues such as habitat impairment and potential effects on aquatic and other water-dependent receptors such as amphibians.

The primary components of the TEE are Problem Formulation (Section 2, which includes contaminant exposure information), Toxicity Assessment (Section 3), Risk Characterization (Section 4), and References (Section 5).

1.1 Background

CDM conducted a Phase II environmental site assessment (ESA) at the site in September 2005 that included collecting soil samples from the near surface and from test pits for analytical testing. In addition, one sediment sample was analyzed. The investigation is presented in a report titled *Phase II Site Assessment, Ellisport Creek Greenspace Project Site, Vashon Island, Washington* dated December 23, 2005.

The results of the investigation indicate Bunker C-range petroleum hydrocarbons are present in soil at concentrations exceeding human health-based cleanup levels (MTCA Method A and Method B). Assessment results suggest that the residual Bunker C is not an immediate threat to the environment although no site specific TEE or comprehensive sediment studies were performed. Based on proposed future site use, the receptor category for the residual Bunker C is sediment / aquatic life. Contaminant pathways include surface water to sediment and groundwater to sediment, with the potential for both sediment and surface water exposures to human and ecological receptors. The report concluded that a site-specific TEE would likely be required to define risk to the environment from the site.

After consultation with Ecology and stakeholders, a scope for a Supplemental Phase II ESA was developed that included sediment sampling within Ellisport Creek as well as in the intertidal zone near the Ellisport Creek discharge point to Tramp Harbor (Puget Sound), additional soil sampling, and surface water and groundwater sampling. It was also agreed that a site specific TEE would assist in determining an appropriate Bunker C cleanup level for the upland portion of the site. The supplemental investigation was performed in July 2006 and is presented in a report *titled Supplemental Phase II Environmental Site Assessment, Ellisport Creek Greenspace Project Site, Vashon Island, Washington* dated December 21, 2006. The supplemental investigation results confirm earlier estimates concerning the distribution of Bunker C contamination in soil at the site. The investigation results also indicate that marine sediments in Puget Sound adjacent to the upland portion of the site and freshwater sediments in Ellisport Creek are not adversely impacted by the Bunker C release.

1.2 Project Area Description

The site is mostly naturally restored wetland, and consists of four privately owned contiguous parcels totaling 8.66 acres of which 5.65 acres are tide land at the northwest head of Tramp Harbor on the east coast of Vashon Island. The remaining 3.01 acres are mostly wetland bisected by Ellisport Creek. A paved road, Chautauqua

Beach Road SW, crosses the lower end of the upland property at just above the beach. Ellisport Creek currently flows under Chautauqua Beach Road through a pair of culverts approximately 3 foot in diameter.

In the past (between 1920 and 1940) the site housed a lumber mill, a millpond, and a vegetable greenhouse. Three aboveground storage tanks (ASTs) were on the property, as were concrete blocks and foundations for the ASTs. The ASTs were removed in the 1960s.

Also important from a soil contamination viewpoint, ASARCO operated a smelter at Ruston, directly south of Vashon Island, from 1887 to 1985. This was the only tidewater smelter in the United States and the last to close in Washington. Originally a lead smelter, the plant was enlarged to handle copper in 1903 and by 1910 lead smelting had ceased. ASARCO handled ores from Washington, Montana, Oregon, Alaska, and the Coeur d'Alene mining district in Idaho, as well as from multiple locations in Latin America and Asia. High silica flux was brought in to aid in the smelting process. These fluxes were ores of gold, silver, and copper and contained small amounts of pyrite, calcium-magnesium carbonates, and wall rock such as feldspars, clays, and micas. In 1902 slag pots were used to remove slag from the lead/copper furnaces and used to create a synthetic bedrock peninsula around the site. Later slags were then poured molten over the older slag. Some of the slag has been exposed to groundwater, saltwater, and oxygen for more than a century. The site is now undergoing cleanup and closure. It is likely that past emissions from this facility contribute to elevated concentrations of metals in soil on Vashon Island.

1.3 Data Collection

The data set used in this TEE to characterize current site conditions include surface water, freshwater sediment, marine sediment, and a variety of soil samples collected during the 2005 and 2006 investigations. These samples were analyzed for a variety of chemical constituents, with the list of analytes differing somewhat with the media sampled and the specific data collection objective. Media quality data collected and analyzed in 2005 included samples from soil test pits, surface soil, and sediment (CDM, 2005). The portions of these data relevant to the TEE are summarized in this document. CDM also collected additional media quality data from the site in summer 2006 (CDM, 2006). These samples included those taken from surface water, freshwater sediment, marine sediment, surface soil, soil cores, and groundwater. With the exception of groundwater, these data are summarized and used in this TEE. Soil utilized for bioassay testing was collected from the site in June 2007 in accordance with the project QAPP. The bioassays were performed by Nautilus Environmental, LLC of Tacoma, Washington with the test results delivered to CDM in mid-August 2007.

Section 2
Problem Formulation

The Problem Formulation section of the TEE provides the basis for the evaluation, and can be viewed as the planning and/or descriptive phase of the process. Exposure-related information, such as contaminant concentrations in various media, is also presented in the Problem Formulation section. Therefore, this section identifies contaminants or chemicals of concern, ecological resources potentially at risk, and exposure pathways that may be important. An important outcome of Problem Formulation is the site conceptual exposure model (SCEM), which describes potential exposure scenarios or pathways, including contaminant sources, transport mechanisms, exposure media, exposure routes, and receptors. The SCEM provides descriptions of the relationships between contaminants and ecological receptors, and further describes how receptors may come into contact with chemical contaminants.

2.1 Chemicals of Potential Concern

Surface water, freshwater sediment, marine sediment, and soil samples were collected in 2005 and 2006 and analyzed for a wide variety of chemical constituents. Chemicals detected in these media are further evaluated for additional assessment by comparing maximum detected concentrations to conservative ecological screening levels (ESLs). Potentially toxic chemicals for which maximum detected concentrations exceed ESLs are identified as chemicals of potential concern (COPCs). COPCs warrant full evaluation in the TEE and are critical components used to derive risk estimates for ecological resources.

The TEE is used to determine concentrations of major COPCs which would be protective of ecological resources. More specifically, if these concentrations are not exceeded then key ecological receptors would be unlikely to suffer adverse effects related to survival, growth, or reproduction.

2.1.1 Chemicals Detected in Surface Water

A single surface water sample (denoted SW-1) was collected onsite in July 2006. This wetland water sample was analyzed for polycyclic aromatic hydrocarbons (PAHs) and Oil as Bunker C, the primary COPCs associated with the source area soils. Of these, eight individual PAHs and Bunker C were measured at concentrations exceeding the laboratory detection limits. These detected chemicals are considered COPCs warranting further evaluation.

2.1.2 Chemicals Detected in Freshwater Sediment

Freshwater sediment samples (denoted FWS-1 and FWS-5) were collected from two locations onsite in July 2006. These samples were analyzed for total metals, PAHs, ten miscellaneous organic chemicals (including phthalates), tributyl tin, organochlorine pesticides, polychlorinated biphenyls (PCBs), conventionals (sulfide and total solids), and total organic carbon (TOC). Of these, five metals, 13 individual PAHs,

dibenzofuran, and sulfides were measured at concentrations exceeding the laboratory detection limits. These detected chemicals are considered COPCs warranting further evaluation.

2.1.3 Chemicals Detected in Marine Sediment

Marine sediments were collected in July 2006 and analyzed for a variety of chemicals. Data from this sampling event was used to characterize the chemical constituents in marine sediments. Marine sediment samples were collected from three locations onsite (denoted MS-1, MS-2, and MS-3). These samples were analyzed for total metals, PAHs, 14 miscellaneous organic chemicals (including phthalates), total PCB, and TOC. Of these, three metals and six individual PAHs were measured at concentrations exceeding the laboratory detection limits. These detected chemicals are considered COPCs warranting further evaluation.

2.1.4 Chemicals Detected in Soil

Two soil cores were obtained in July 2006 and analyzed for Bunker C, PAHs, and TOC. These samples could also be considered sediment as they are intended to help characterize material that could erode into Puget Sound under a "worst case" condition after installation of a proposed box culvert to replace the existing culverts below Chautauqua Beach Drive S.W. Eight individual PAHs and Bunker C were measured above detection limits. These detected chemicals are considered COPCs warranting further evaluation.

Surface soil samples were collected in September 2005 and July 2006. Both sets of samples were analyzed for a wide variety of inorganic and organic chemicals. The results of the September 2005 surface soil analyses resulted in Bunker C, 16 PAHs, 1-methylnaphthalene and 2-methylnaphthalene being present at concentrations exceeding detection limits. These detected chemicals are considered COPCs warranting further evaluation. In 2006, analytes included numerous organochlorine and organophosphorus pesticides, Bunker C, and arsenic, cadmium, and lead. The analyses of the three surface soil samples (S19, S20, and S21) in the July 2006 investigation revealed that lead was detected in all three samples and arsenic and cadmium were also detected in one of the three samples. These detected chemicals are considered COPCs warranting further evaluation. No pesticides were detected and none are COPCs warranting further evaluation.

2.1.5 COPC Screening

All chemicals measured at concentrations exceeding laboratory detection limits are subjected to a screening based on comparisons of detected concentrations to conservative ESLs. ESLs are described below, by media.

2.1.5.1 Surface Water ESLs

Two ESLs are used for surface water. These are listed in order of preference:

- Lowest of the Lowest Chronic Value (LCV) for fish, daphnids, and aquatic plants (Suter and Tsao, 1996)
- Interim Guideline, Canadian Water Quality Guideline for the Protection of Aquatic Life (CCME, 2002)

2.1.5.2 Freshwater Sediment ESLs

The single source of freshwater sediment ESLs is Table 3-3, Apparent Effects Threshold (AET) produced by Avocet Consulting (2003) and recommended for use by Ecology.

2.1.5.3 Marine Sediment ESLs

The single source of freshwater sediment ESLs is Table 1, WAC Chapter 173-204, Sediment Management Standards, as recommended by Ecology.

2.1.5.4 Soil ESLs

Three ESLs are used for soil, listed in order of preference:

- Table 749-3, MTCA, Chapter 173-340-WAC
- EPA Region 5 ESL, RCRA Program
  - This source is preferred over other EPA regional sources because the database for soil contaminants is much more extensive than other EPA sources.
- Soil Cleanup Criterion for Oil and Grease for Decommissioning Industrial Sites in Ontario, Canada (Richardson, 1987 in USFWS, 1990)
  - This source is used because toxicity-based data are lacking for Bunker C and related petroleum mixtures for soil

Tables 1 through **Table 3** present the maximum detected concentrations of contaminants, the selected ESLs, and the resulting screening level hazard quotients or HQs. As used in this TEE, HQs are the maximum detected exposure concentrations of a contaminant divided by the selected chemical-specific ecological screening concentration or ESL.

Hazard Quotient (HQ) = exposure concentration / screening level concentration

These data are used to derive a list of COPCs that warrant further evaluation, based on chemicals detected at concentrations resulting in screening level HQs greater than 1.0.

Tables 1 through **Table 3** present the results of the screening of the chemicals detected in surface water (**Table 1**), marine sediment (**Tables 2a** and **2b**), freshwater sediment (**Table 2c**), soil cores (**Table 3a**), surface soil (2006, **Table 3b**; 2005, **Table 3c**).

Table 1. Surface Water Contaminants

(Sample SW-1 collected on 7/26/06)

Surface Water Analyte [a]	Max Det µg/L	ESL µg/L	ESL Source	HQ max/ESL	ECO COC?
Oil as Bunker C	5,600	NV	NA	NA	Unknown
Benzo(a)anthracene	0.11	0.65	1	0.17	NO
Benzo(a)pyrene	0.16	0.30	1	0.53	NO
Benzo(b) fluoranthene	0.054	NV	NA	NA	Unknown
Benzo(g,h,i)perylene	0.13	NV	NA	NA	Unknown
Chrysene	0.17	NV	NA	NA	Unknown
Dibenz(a,h)anthracene	0.02	NV	NA	NA	Unknown
Indeno(1,2,3-cd)pyrene	0.036	NV	NA	NA	Unknown
Pyrene	0.4	0.025	2	**16.0**	**YES**

Notes:

a) All other analytes (PAHs) measured at less than detection limit (0.094 µg/L).

ESL - Ecological Screening Level.

HQ - Hazard Quotient (max det / ESL), HQ>1 indicates risk.

NV - No Value (no value available from any source consulted (e.g., EPA, WA DOE, CCME, ORNL, etc.).

µg/L – Micrograms per liter.

ESL Source:

1) Lowest of lowest chronic value (LCV) for fish, daphnids, and aquatic plants (Suter and Tsao 1996).

2) Interim guideline, Canadian Water Quality Guideline for Protection of Aquatic Life (CCME 2002).

Table 2a. Marine Sediment Contaminants (2006)

(Samples MS-1 through MS-3 collected on 7/25/06)

Marine Sediment Analyte [a]	Max Det mg/kg dw	Fraction TOC [b]	Max Det mg/kg OC	ESL [c] mg/kg dw	HQ max/ESL	ECO COC?
Chromium	26	NA	NA	260	0.10	NO
Copper	8.9	NA	NA	390	0.023	NO
Zinc	27	NA	NA	410	0.066	NO
	Max Det mg/kg dw	**Fraction TOC [b]**	**Max Det mg/kg OC**	**ESL [c] mg/kg OC**	**HQ max/ESL**	**ECO COC?**
Benzo(a)anthracene	0.0086	0.00982	0.88	110	0.000078	NO
Benzo(a)pyrene	0.010	0.00982	1.02	99	0.00010	NO
Chrysene	0.022	0.00982	2.24	110	0.00020	NO
Fluoranthene	0.031	0.00982	3.16	160	0.00019	NO
Pyrene	0.025	0.00982	2.55	1000	0.000025	NO
Total Benzofluoranthenes	0.021	0.00982	2.14	230	0.000091	NO
Total HPAH	0.118	0.00982	12.02	960	0.00012	NO

Notes:

a) All other analytes measured at less than detection limit.

b) Fraction TOC = mg/kg/106 (value associated with location of max. detect).

c) From WAC Chapter 173-204, Sediment Management Standards, Table 1.

ESL – Ecological Screening Level.

HQ – Hazard Quotient (max. cet. / ESL), HQ>1 indicates risk.

mg/kg – Milligrams per kilogram.

Table 2b. Sediment Contaminants (2005)

(Sample EC-SS collected on 9/21/06)

Marine Sediment Analyte [a]	Max Det mg/kg dw	Fraction TOC [b]	Max Det mg/kg OC	ESL [c] mg/kg OC	HQ max/ESL	ECO COC?
Acenaphthylene	0.058	0.145	0.40	66	0.0061	NO
Anthracene	0.053	0.145	0.37	220	0.0017	NO
Benzo(a)anthracene	0.70	0.145	4.83	110	0.044	NO
Benzo(a)pyrene	2.8	0.145	19.31	99	0.20	NO
Benzo(b) fluoranthene	0.76	0.145	5.24	230	0.023	NO
Benzo(g,h,i)perylene	3.1	0.145	21.38	31	0.69	NO
Benzo(k)fluoranthene	0.079	0.145	0.54	230	0.0024	NO
Chrysene	1.3	0.145	8.97	110	0.082	NO
Dibenz(a,h)anthracene	0.56	0.145	3.86	12	0.32	NO
Fluoranthene	0.098	0.145	0.68	160	0.0042	NO
Indeno(1,2,3-cd)pyrene	0.8	0.145	5.52	34	0.16	NO
Phenanthrene	0.048	0.145	0.33	100	0.0033	NO
Pyrene	1.3	0.145	8.97	1000	0.0090	NO
Total LPAH	0.159	0.145	1.10	370	0.0030	NO
Total HPAH	11.5	0.145	79.31	960	0.083	NO

Notes:

a) All other analytes measured at less than detection limit.

b) Fraction TOC = mg/kg / 106 (value associated with location of max detect).

c) From WAC Chapter 173-204, Sediment Management Standards, Table 1 (ESL for benzo(b,k)fluoranthene based on total benzofluoranthenes).

ESL - Ecological Screening Level.

HQ - Hazard Quotient (max det / ESL), HQ>1 indicates risk.

mg/kg - Milligrams per kilogram.

Table 2c. Freshwater Sediment Contaminants (2006)

(Samples FWS-1 and FWS-2 collected on 7/25/06)

Freshwater Sediment Analyte [a]	Max Det mg/kg dw	Fraction TOC [b]	Max Det mg/kg OC	ESL [c] mg/kg dw	HQ max/ESL	ECO COC?
Chromium	31	NA	NA	95	0.326	NO
Copper	14	NA	NA	619	0.023	NO
Lead	11	NA	NA	335	0.033	NO
Nickel	33	NA	NA	53.1	0.621	NO
Zinc	45	NA	NA	683	0.066	NO
Acenaphthene	0.150	0.00458	32.75	1.06	0.142	NO
Anthracene	0.110	0.00458	24.02	0.47	0.234	NO
Benzo(a)anthracene	0.180	0.00458	39.30	4.26	0.042	NO
Benzo(a)pyrene	0.043	0.00458	9.39	3.3	0.013	NO
Benzo(b)fluoranthene	0.096	0.00458	20.96	11	0.009	NO
Benzo(g,h,i)perylene	0.013	0.00458	2.84	4.02	0.003	NO
Benzo(k)fluoranthene	0.026	0.00458	5.68	11	0.002	NO
Chrysene	0.150	0.00458	32.75	5.94	0.025	NO
Dibenzofuran	0.120	0.00458	26.20	0.399	0.301	NO
Fluoranthene	1.2	0.00458	262.01	11.1	0.108	NO
Fluorene	0.240	0.00458	52.40	1.07	0.224	NO
Indeno(1,2,3-cd)pyrene	0.013	0.00458	2.84	4.12	0.003	NO
Phenanthrene	1.0	0.00458	218.34	6.1	0.164	NO
Pyrene	0.64	0.00458	139.74	8.79	0.073	NO
Sulfide	3.29	0.00753	436.92	702	0.0047	NO
Total HPAH	2.361	0.00458	515.50	NA	NA	NA
Total LPAH	1.5	0.00458	327.51	NA	NA	NA

Notes:

a) All other analytes measured at less than detection limit.

b) Fraction TOC = mg/kg / 106 (value associated with location of max detect).

c) From Avocet Consulting, 2003 (Table 3-3, Apparent Effects Threshold).

ESL - Ecological Screening Level.

HQ - Hazard Quotient (max detect / ESL), HQ>1 indicates risk.

mg/kg - Milligrams per kilogram.

Table 3a. Soil Contaminants (Soil Core Data)

(Samples FWS-3 and FWS-4 collected on 7/25/06)

Soil Core Analyte [a]	Max Det mg/kg dw	Lowest ESL mg/kg dw	ESL Source	HQ max/ESL	ECO COC?
Oil as Bunker C	580	10,000	3	0.058	NO
Benzo(a)anthracene	0.023	5.21	2	0.0044	NO
Benzo(a)pyrene	0.13	12	1	0.011	NO
Benzo(b)fluoranthene	0.038	59.8	2	0.00064	NO
Benzo(g,h,i)perylene	0.22	119	2	0.0018	NO
Chrysene	0.049	4.73	2	0.010	NO
Dibenz(a,h)anthracene	0.022	18.4	2	0.0012	NO
Indeno(1,2,3-cd)pyrene	0.051	109	2	0.00047	NO
Pyrene	0.052	78.5	2	0.00066	NO
Total HPAH	0.563	NA	NA	NA	NA

Notes:

a) All other analytes measured at less than detection limit.

ESL - Ecological Screening Level.

HQ - Hazard Quotient (max det / ESL), HQ>1 indicates risk.

mg/kg - milligrams per kilogram.

ESL Source:

1. Lowest of Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants, Soil Biota, or Wildlife (Table 749-3, Chapter 173-340WAC).

2. EPA Region 5 ESL, RCRA program, August 2003.

3. Soil cleanup criterion for oil and grease for decommissioning industrial sites in Ontario, Canada (Richardson 1987 in USFWS 1990).

3b. Soil Contaminants (Surface Soil 2006)

(Samples S14 through S21 collected on 7/26/06)

Surface Soil Analyte [a]	Max Det mg/kg dw	Lowest ESL mg/kg dw	ESL Source	HQ max/ESL	ECO COC?
Arsenic	22	7	1	**3.1**	**YES**
Cadmium	0.73	4	1	0.18	NO
Lead	120	50	1	**2.4**	**YES**
Oil as Bunker C	830	10,000	3	0.083	NO

Notes:

a) All other analytes measured at less than detection limit.

ESL - Ecological Screening Level.

HQ - Hazard Quotient (max det / ESL), HQ>1 indicates risk.

mg/kg - Milligrams per kilogram.

ESL Source:

1. Lowest of Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants, Soil Biota, or Wildlife (Table 749-3, Chapter 173-340WAC). ESL for As based on As III per guidance.
2. EPA Region 5 ESL, RCRA program, August 2003.
3. Soil cleanup criterion for oil and grease for decommissioning industrial sites in Ontario, Canada (Richardson 1987 in USFWS 1990).

3c. Soil Contaminants (Surface Soil 2005)

(Samples EC-S1 through EC-S13 and TP-7 through TP-14 collected on 9/21/05 and 9/22/05)

Surface Soil [a] Analyte [b]	Max Det mg/kg dw	Lowest ESL mg/kg dw	ESL Source	HQ max/ESL	ECO COC?
Oil as Bunker C	44,000	10,000	3	**4.4**	**YES**
1-Methylnaphthalene	40	3.24*	2	**12.3**	**YES**
2-Methylnaphthalene	60	3.24	2	**18.5**	**YES**
Acenaphthylene	1.1	682	2	0.0016	NO
Acenaphthene	6.4	20	1	0.32	NO
Anthracene	13.0	1,480	2	0.0088	NO
Benzo(a)anthracene	11	5.21	2	**2.1**	**YES**
Benzo(a)pyrene	7.0	12	1	0.58	NO
Benzo(b)fluoranthene	2.8	59.8	2	0.047	NO
Benzo(g,h,i)perylene	4.6	119	2	0.039	NO
Benzo(k)fluoranthene	0.025	148	2	0.00017	NO
Chrysene	15	4.73	2	**3.2**	**YES**
Dibenz(a,h)anthracene	0.027	18.4	2	0.0015	NO
Fluoranthene	6.2	122	2	0.051	NO
Fluorene	12	30	1	0.40	NO
Indeno(1,2,3-cd)pyrene	1.3	109	2	0.012	NO
Naphthalene	7.4	0.0994	2	**74.4**	**YES**
Phenanthrene	63	45.7	2	**1.4**	**YES**
Pyrene	50	78.5	2	0.64	NO

Notes:

a) Includes surface samples and test pit samples (0-6 feet bgs). Deeper test pit data (>6 feet bgs) not included (limited ecological exposure potential).

b) All other analytes measured at less than detection limit.

ESL - Ecological Screening Level.

HQ - Hazard Quotient (max det / ESL), HQ>1 indicates risk.

ESL Source:

1. Lowest of Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants, Soil Biota, or Wildlife (Table 749-3, Chapter 173-340WAC).

2. EPA Region 5 ESL, RCRA program, August 2003. ESL for 1-methylnaphthalene based on ESL for 2-methylnaphthalene.

3. Soil cleanup criterion for oil and grease for decommissioning industrial sites in Ontario, Canada (Richardson 1987 in USFWS 1990).

2.1.5.5 Final COPCs

The final COPCs that warrant further evaluation in this TEE are presented below, by media type.

Final COPCs		
Surface Water	**Freshwater / Marine Sediment**	**Soil**
Pyrene	(none)	Arsenic, lead, Bunker C, 1-methylnapthalene, 2-methylnapthalene, benzo(a)anthracene, chrysene, naphthalene, phenanthrene

2.1.5.6 Bioaccumulation Potential of Final COPCs

Risks to upper trophic level receptors (e.g., birds or mammals) are considered indirect, because the primary exposure is via ingestion of contaminated prey (and, to a lesser degree, ingestion of contaminated surface water and solid media). The risks associated with dietary exposure are discussed below, based on evaluation of bioaccumulation potential of contaminants. Quantitative food web modeling was not warranted in this TEE.

None of the organic COPCs identified above are expected to accumulate in upper trophic level animals because the bioaccumulation potential of all is low. PAHs are not accumulated in many types of animals and microorganisms because PAHs are often metabolized to degradation products. Most studied vertebrates and crustaceans have the enzymes necessary for metabolic activation (Statham et al., 1976; Varansi et al., 1980; Fabacher and Baumann, 1985; all in Eisler, 1987). In addition, the bioaccumulation potential of PAHs that are not well-studied, such as 1- and 2-methylnaphthalene, is predicted to be low, based on log Kow (Kow is known as the octanol / water partition coefficient). The log Kow of both of these methylnaphthalenes is 3.72 (ECOSAR, 2006) and the equation of Veith and Kosian (1982) predicts bioconcentration factor or BCF from log Kow, as follows:

Log BCF = 0.79 log Kow – 0.40 (Veith and Kosian, 1982)
Log BCF – 0.79 (3.72) – 0.40 = 2.54
BCF = 346

EPA (1991) generally considers BCFs less than 1,000 to be low and bioaccumulation in aquatic biota is not expected. Although aquatic BCFs cannot be used to estimate bioaccumulation in soil biota (both methylnaphthalenes are soil COPCs only), they can be used to generally describe the potential for chemicals to be accumulated by biota. There is no evidence that methylnaphthalenes are accumulated to any significant degree by upper trophic level biota.

Arsenic and lead, both soil COPCs, can accumulate in plants, soil invertebrates, and to some degree in upper trophic level biota. Both arsenic and lead are not highly bioavailable in soil, and therefore neither is expected to accumulate to a significant

degree in most biota. More specifically for this TEE, both arsenic and lead have been detected at concentrations in soil that are similar to background concentrations. Although soils in the western U.S. often contain elevated As concentrations relative to the eastern U.S., it may be more important that ASARCO once operated a smelter just south of Vashon Island and this historical condition probably contributes to the relatively higher As and Pb (and possibly other metals) concentrations in soil samples (Public Health – Seattle & King County, 2000). Finally, it is expected that remediation of the primary source area soils for Bunker C will result in remediation of the relatively more minor soil COPCs (e.g., methylnaphthalenes). For these reasons, this TEE does not further evaluate risks related to bioaccumulation of COPCs and instead focuses on the potential effects of direct contact exposures for terrestrial plants, soil invertebrates, and aquatic biota that may be exposed to contaminants transported from the source area.

2.2 Site Conceptual Exposure Model (SCEM)

The site conceptual exposure model (SCEM) is the primary output of the Problem Formulation. The SCEM presents the major exposure scenarios relevant to ecological receptors for this site. The SCEM (shown on the following page) focuses on the complete and significant exposure scenarios relevant to this TEE (shown with bold type), and these are used to help develop a series of testable null hypotheses for the site. Null hypotheses are used to test assumptions regarding relationships between contaminants and receptors. The null hypotheses for this site are presented below.

1. The levels of site-related contaminants in onsite surface soils are not sufficient to adversely affect the survival, growth, or reproduction of *terrestrial plants* within the site boundaries

2. The levels of site-related contaminants in onsite surface soils are not sufficient to adversely affect the survival, growth, or reproduction of *terrestrial invertebrates* within the site boundaries

3. The levels of site-related contaminants in onsite surface waters and / or sediments are not sufficient to adversely affect the survival, growth, or reproduction of *aquatic invertebrates*

4. The levels of site-related contaminants in onsite surface waters and / or sediments are not sufficient to adversely affect the survival, growth, or reproduction of *fish*

Site Conceptual Exposure Model (SCEM)

Primary Source	Primary Release Mechanism	Secondary Source	Secondary Release Mechanism	Exposure Medium	Exposure Route	Potential Receptor
Contaminants in Soil	Wind Erosion	Dust	Fugitive Dust Generation	Particulates in Air	Inhalation	Terrestrial Animals
	Direct Release / Spills	**Soil**	**-**	**Soil**	**Direct Contact / Ingestion**	**Terrestrial Plants, Soil-associated Animals**
	Infiltration / Leaching	**Groundwater**	**Seepage / Recharge / Discharge**	**Surface Water / Sediment**	**Direct Contact / Ingestion**	**Benthic and Water Column Invertebrates,** Larval Amphibians**, Fish**
	Surface Runoff / Erosion	**Surface Water / Sediment**	**-**	**Surface Water / Sediment**	**Direct Contact / Ingestion**	**Benthic and Water Column Invertebrates,** Larval Amphibians**, Fish**
	Biotic Uptake	**Biota**	**Uptake by Plants / Animals**	**Plants, Prey**	**Ingestion**	**Herbivorous, Insectivorous, Piscivorous, and Carnivorous Birds and Mammals**

Significant and complete pathways and components shown in bold type
Receptors shown in bold type indicate adequate data exist for assessment

The SCEM presents the most important terrestrial and aquatic exposure pathways for representative ecological receptors exposed to site-related COPCs. These pathways indicate how the ecological resources can co-occur or come in contact with COPCs, and include contaminant sources, fate and transport processes, and exposure routes. Some exposure pathways considered relatively minor (e.g., inhalation) are not evaluated in this TEE, but are shown in recognition of the completeness of this pathway.

This TEE is focused primarily on assessing community- and population-level risks in representative receptors associated with site-related contamination in the following media:

- Surface soil (terrestrial biota, especially plants and soil invertebrates),
- Sediment (bottom-dwelling aquatic biota, especially benthic invertebrates), and
- Surface water (aquatic biota, especially water-column biota such as salmonid fish).

The risks associated with these exposure media (i.e., soil, sediment, and surface water) can be direct or indirect. Direct risks include those based on exposures to contaminated abiotic media. Direct risks can include, for example, direct contact with and uptake of soil contaminants by terrestrial plants; direct contact with and ingestion of soil or sediment or pore water contaminants by terrestrial or aquatic invertebrates; and direct contact and ingestion of surface water by fish.

2.2.1 Complete and Significant Exposure Pathways

Complete and significant exposure pathways warranting assessment in this TEE are identified below:

- Risks to terrestrial plants due to direct contact with and uptake of soil COPCs
- Risks to terrestrial soil-dwelling invertebrates, represented by earthworms, due to direct contact with and ingestion of soil COPCs
- Risks to benthic aquatic biota, represented by benthic macroinvertebrates, due to direct contact with and ingestion of sediment COPCs
- Risks to water-column animals, represented by fish, due to direct contact with and ingestion of surface water COPCs

2.3 Assessment and Measurement Endpoints

This section introduces, defines, and discusses appropriate assessment and measurement endpoints for evaluating potential ecological effects associated with exposures to identified COPCs.

2.3.1 Assessment Endpoints

Assessment endpoints identify the ecological values to be protected (e.g., abundance and diversity of soil-dwelling invertebrates in onsite surface soils). Assessment endpoints are directly related to remedial action goals and objectives determined for the site. Appropriate assessment endpoints are developed by risk assessors and often consider guidance from relevant regulatory agencies.

TEE-related remedial action goals and objectives for the site that have been generally determined by Ecology include:

- The establishment and maintenance of a healthy and diverse terrestrial ecosystem within the project area.
- The establishment and maintenance of a healthy and diverse aquatic and semi-aquatic / wetland ecosystem within the project area.

The TEE is designed to support decisions related to these preliminarily identified general remedial action goals and objectives. This support consists of selecting appropriate assessment endpoints and evaluating risks related to these endpoints. Assessment endpoints are described as explicit expressions of the environmental variable(s) that are to be protected. For the purpose of expressing assessment

endpoints, "onsite" refers to the area within the site boundaries. Also of concern, but considered "offsite" are areas adjacent to the site that may be impacted by site-related activities or conditions. The characteristics of the COPCs, toxic mechanisms, exposure pathways, and relevant receptors were used to select the following *assessment endpoints*:

- Sufficient rates of survival, growth, and reproduction to sustain populations of native *terrestrial plants* with the potential to occur onsite
- Sufficient rates of survival, growth, and reproduction to sustain populations of *soil-dwelling invertebrates* with the potential to occur onsite
- Sufficient rates of survival, growth, and reproduction to sustain populations of *aquatic macroinvertebrates* in the surface waters onsite
- Sufficient rates of survival, growth, and reproduction to sustain populations of *fish* in the surface waters onsite

It is assumed that the protection of the aforementioned receptors would be associated with the protection of other sensitive organisms or receptors for which toxicity data are lacking. For example, terrestrial plants are assumed to be among the most important receptors for this site because they provide important cover and in some cases foraging for a wide variety of wildlife not assessed directly in this TEE. The selected receptors or receptor groups include those that are components of all the major routes of exposure relative to this assessment.

2.3.2 Measurement Endpoints

Assessment endpoints are often difficult to measure or evaluate directly. For example, we cannot predict with certainty the critical concentration of lead in site surface soil that allows survival and successful reproduction of earthworms and wildlife that consume earthworms. Such critical concentrations are site-specific and depend on innumerable factors. Some of these factors include soil chemical and physical characteristics (which affects bioavailability), foraging behavior and dietary requirements of both prey species and consumer species, and chemical interactions (i.e., synergistic, antagonistic, or additive).

Measurement endpoints are quantitative expressions of observed or measured biological responses to stressors relevant to selected assessment endpoints. For example, earthworm survival, growth, and reproduction (assessment endpoints) can be evaluated using toxicity data based on appropriate measurement endpoints, such as the concentration of lead in surface soil that reduced earthworm survival, growth, or reproduction in laboratory toxicity tests. In this example, concentrations of lead in site surface soil would serve as the measurement endpoint.

This example expresses the relationship between a relevant measurement endpoint (concentration of lead in surface soil) that is directly related to the assessment endpoints of earthworm survival, growth, and reproduction. Measurement endpoints selected for this TEE are based on information from appropriate literature sources

and, where data allow, site-specific abiotic and biological data. Toxicity data that serve as measurement endpoints in this TEE are described in Section 3, Toxicity Assessment. Toxicity information for Bunker C is presented in Section 4.

Ecologically significant effects are defined here as those affecting survival, growth, or reproduction of important receptors. Other endpoints such as effects on behavior or histopathological effects are not considered as useful because these cannot be easily or confidently linked to ecologically significant endpoints that can impair populations or communities. Protection of populations and communities is a major goal of the TEE, while protection of individual organisms is warranted for species of special concern (e.g., threatened or endangered species).

Section 3
Toxicity Assessment

This section identifies contaminant concentrations that may cause significant adverse impacts in the receptors of concern that may result from exposure to Bunker C and other COPCs. The assessment is based on a review of State and Federal soil and sediment regulatory levels, including applicable standards, criteria, and benchmark concentrations. In addition, the assessment considers a review of contaminant concentrations associated with toxic effects in terrestrial plants and soil-dwelling animals.

Finally, it is noted that relevant ecotoxicity data for some of the primary COPCs identified for this site, especially Bunker C, are non-existent or sparse. The potential adverse effects of Bunker C on ecological receptors are addressed using site-specific toxicity data. Some degree of qualitative assessment is necessary for Bunker C and other similar contaminant mixtures due to the scarcity of ecotoxicity data.

3.1 Toxicity Profiles

Toxicity profiles are derived for the final COPCs, based on media type and selected receptor group applicable to this TEE. For surface water, the single COPC is pyrene, and the selected receptor group for this exposure scenario is freshwater fish. Little aquatic toxicity data are available for pyrene, so the single toxicity value presented is based on the predicted 30 day chronic value, derived by EPA ECOSAR software which uses chemical structure and other characteristics to estimate toxicity. The chronic value is generally defined as the geometric mean of the No Effect and Low Effect levels. As such, the chronic value represents a chemical concentration that is greater than that associated with no observed adverse effect but less than one associated with an observed effect.

All other COPCs are linked to soil exposures; therefore, terrestrial plants and earthworms are the receptor groups of choice. Earthworms represent soil dwelling invertebrates, and phytotoxicity data for terrestrial plants are commonly based on laboratory studies using crop species.

Where available, the preferred soil toxicity values are from earthworm and plant studies resulting in chronic toxicity endpoints. Endpoints include those associated with survival and growth or growth-related endpoints such as seed emergence. **Table 4** presents the available toxicity data for the identified COPCs for this TEE.

These toxicity values or effects concentrations are used in the Risk Characterization section of the TEE to derive quantitative risk estimates, where applicable. An important exception to this approach is Bunker C. No suitable ecotoxicity data are available for Bunker C, and therefore quantitative risk estimates are not derived for Bunker C. An alternative approach is used to estimate the impacts of exposure to

Bunker C in soil by terrestrial plants and soil dwelling invertebrates. This alternative approach is discussed in Section 4, Risk Characterization that follows.

Table 4. Media-Specific Toxicity Data for Final COPCs

Medium	COPC	Toxicity Data	Source	Comment
Surface Water	Pyrene	55 µg/L	EPA ECOSAR	Predicted 30-d chronic value, fish
Soil	Arsenic	60 mg/kg	Efroymson, Will, and Suter 1997	Soil benchmark for earthworm toxicity, from multiple studies
		10 mg/kg	Efroymson, Will, Suter, and Wooten 1997	Soil benchmark for phytotoxicity, from multiple studies
	Lead	500 mg/kg	Efroymson, Will, and Suter 1997	Soil benchmark for earthworm toxicity, from multiple studies
		50 mg/kg	Efroymson, Will, Suter, and Wooten 1997	Soil benchmark for phytotoxicity, from multiple studies
	Oil as Bunker C	-	-	No terrestrial ecotoxicity data
	1-methylnaphthalene	258 mg/kg	EPA ECOSAR	Predicted 14-d LC50, earthworm
		-	Eisler 1987 (summary of multiple studies)	No Data on Phytotoxicity (PAH-induced phytotoxic effects are rare)
	2-methylnaphthalene	258 mg/kg	EPA ECOSAR	Predicted 14-d LC50, earthworm
		-	Eisler 1987 (summary of multiple studies)	No Data on Phytotoxicity (PAH-induced phytotoxic effects are rare)
	Benzo(a)anthracene	116 mg/kg	EPA ECOSAR	Predicted 14-d LC50, earthworm
		-	Eisler 1987 (summary of multiple studies)	No Data on Phytotoxicity (PAH-induced phytotoxic effects are rare)
	Chrysene	116 mg/kg	EPA ECOSAR	Predicted 14-d LC50, earthworm
		-	Eisler 1987 (summary of multiple studies)	No Data on Phytotoxicity (PAH-induced phytotoxic effects are rare)
	Naphthalene	54 mg/kg	Environment Canada 1995 in CCME 2002	LC25, earthworm
		3 mg/kg	Environment Canada 1995 in CCME 2002	25% reduction in seedling emergence, lettuce
	Phenanthrene	207 mg/kg	EPA ECOSAR	Predicted 14-d LC50, earthworm
		-	Eisler 1987 (summary of multiple studies)	No Data on Phytotoxicity (PAH-induced phytotoxic effects are rare)

Section 4
Risk Characterization

Risk characterization integrates exposure and toxicity or effects information to estimate risks to representative ecological receptors. Several approaches can be used to integrate exposure and effects data, with selected approaches often dependent on the availability of specific types of data. For example, because ecotoxicity data are lacking for Bunker C in soil, the results of site-specific surveys or bioassays were determined to be useful for evaluating the potential impacts of exposure to Bunker C. For all other COPCs, the primary method of risk estimation used in this TEE is based on the hazard quotient approach, which is described below.

4.1 Risks Based on Direct Exposure

Risks based on direct exposure (direct contact and ingestion) to COPC-contaminated media are assessed using the hazard quotient (HQ) approach. This method of assessing risks is based on the ratio of an exposure concentration to an effects or toxicity-based concentration. The general equation follows:

$$HQ = \frac{\textit{Exposure Concentration of COC}}{\textit{Effects Concentration of COC}}$$

For example, the maximum concentration of a COPC detected in surface soil (EPC) is compared to a COPC concentration in soil that is associated with low but significant likelihood of adverse effects (represented by a selected toxicity value, from **Table 4**). The latter is most appropriately a threshold concentration at which adverse effects begin to be observed, but also may be a higher concentration at which adverse effects are usually or always observed in more sensitive life stages.

HQs greater than 1.0 (i.e., where the exposure concentration exceeds the effects concentration) indicate significant potential for adverse effects. HQs less than 1.0 are considered insignificant and adverse effects are unexpected. Higher HQs are not necessarily indicative of more severe effects. Instead, where confidence in toxicity values is equal, higher HQs suggest a greater likelihood of adverse effects.

HQs are presented for all COPCs except Bunker C on **Table 5**. An alternative approach based on laboratory toxicity testing with a representative soil invertebrate (earthworm) and a representative terrestrial plant (lettuce) is used to assess the potential ecological impacts of exposure to Bunker C. A summary of the design and results of these tests, which were conducted in accordance with the project QAPP, is presented in Section 4.2. **Appendix A** (Soil Toxicity Evaluation) presents the detailed laboratory data and results associated with these tests.

Table 5. Hazard Quotients for Media-Specific COPCs (Excluding Bunker C)

Medium	COPC	EPC	Receptor	TV	HQ
SW	Pyrene	0.4	Fish	55	0.0073
SOIL	Arsenic	22	Earthworm	60	0.37
			Plant	10	**2.2**
	Lead	120	Earthworm	500	0.24
			Plant	50	**2.4**
	1-Methylnaphthalene	40	Earthworm	258	0.16
	2-Methylnaphthalene	60	Earthworm	259	0.23
	Benzo(a)anthracene	11	Earthworm	116	0.095
	Chrysene	15	Earthworm	116	0.13
	Naphthalene	7.4	Earthworm	54	0.14
			Plant	3	**2.5**
	Phenanthrene	63	Earthworm	207	0.30

Notes:
EPC - exposure point concentration (max detect), µg/L SW, mg/kg soil.
Receptor - only those for which TVs are available are shown.
TV - toxicity value (from Table 4, µg/L SW, mg/kg soil).
HQ - hazard quotient (EPC/TV).

As shown on **Table 5**, ecological risks due to exposure to pyrene (the single surface water COPC) in surface water are insignificant, with the HQ being much lower than the 1.0 threshold (HQ=0.0073).

For soil COPCs other than Bunker C, HQs range from less than 1.0 (8 scenarios) to 2.5 (3 scenarios). The three scenarios associated with HQs greater than 1.0 are

- Terrestrial plants exposed to arsenic in soil (HQ=2.2)
- Terrestrial plants exposed to lead in soil (HQ=2.4)
- Terrestrial plants exposed to naphthalene in soil (HQ=2.5)

None of these HQs are considered indicative of significant site-related risks based on the following:

- The historical ASARCO smelter that operated at Ruston south of Vashon Island probably contributed to elevated concentrations of arsenic and lead in soil throughout the area. It is unlikely that the slightly elevated concentrations observed onsite are limited to the project area.
- As discussed previously, both arsenic and lead are not highly bioavailable in soil. The risk estimates calculated here are based on (1) toxicity data from laboratory (not natural or field) studies and, (2) maximum detected concentrations. It is likely that risk estimates based on site-wide average concentrations of arsenic and lead in soil would be much lower.
- The risk estimate for naphthalene in soil is based on the maximum detected concentration of naphthalene. Average concentrations would result in lower risk

estimates. Also, the soil sample from which this maximum detected concentration was measured (TP-7) was collected within the concentrated Bunker C area, at six feet below the ground surface. This depth is beyond the likely area of significant ecological exposure, and remediation of the concentrated Bunker C area would likely result in substantial reductions of associated COPCs above the six foot depth interval.

In summary, none of the conservative (based on maximum detected concentrations) risk estimates (HQs) for surface water or soil COPCs are expected to pose significant hazards to potentially exposed ecological receptors. This is not the case for Bunker C, where ecologically significant adverse effects can be expected where this mixture of contaminants is concentrated. Because ecotoxicity data are lacking for Bunker C, an alternative approach to the HQ method is required. The selected alternative approach is discussed below.

4.2 Risks Associated with Bunker C—Laboratory Tests

The approach used to evaluate potential impacts to ecological receptors from exposure to Bunker C in soil is based on laboratory toxicity tests in which earthworms (a representative soil invertebrate) and lettuce (a representative terrestrial plant) are exposed to various mixtures of contaminated and non-contaminated (background) soils collected from the site.

The purpose of these tests is to determine the toxicity of soils contaminated with Bunker C to soil-associated organisms, primarily soil invertebrates and terrestrial plants. The earthworm *Eisenia fetida* and lettuce (*Lactuca sativa*) are standard laboratory test species used for this purpose. **Appendix A** provides the details of the methods, results, and quality assurance (QA)/quality control (QC) data associated with these tests. A summary of the test methods and results follows.

4.2.1 Summary of Test Methods

Soil samples were collected from a highly contaminated (source) area of the site (Bunker C concentration 51,000 mg/kg) and from a background, non-contaminated area of the site. Exposure concentrations used in the tests included background soil (undiluted) along with dilutions of source area (contaminated) soil mixed with background soil. The diluted soils resulted in measured Bunker C concentrations of 18,000, 6,700, 2,800, 1,700, and 930 mg/kg. In addition, exposures included laboratory control soil.

Exposure duration was 14 days for both species, and test endpoints for the earthworm tests included 14 day survival. For lettuce, 14 day test endpoints included mean percent survival (based on seed germination and seedling survival) and mean biomass (mg) per surviving seedling. No effect concentrations (NOEC), low effect concentrations (LOEC), and median lethal concentrations to 50 percent of test organisms (LC50) were derived for earthworm survival and lettuce survival. NOEC,

LOEC, and inhibitory concentration to 50 percent of test organisms (IC50) were derived for the lettuce biomass endpoint.

In all cases, the results of the tests at various Bunker C concentrations are compared directly to those of background (uncontaminated site) soil. Results are not compared directly to control soil results, but control soil results are instead used to confirm that the test organisms are healthy and suitable for testing. Reference toxicity tests were also conducted to confirm the health of test organisms and their responses to known concentrations of previously tested toxic chemicals.

4.2.2 Summary of Test Results

4.2.2.1 Earthworm

Statistically significant results, based on comparisons to tests with exposures to background soils, were found only for earthworm survival at the highest exposure concentration of Bunker C (18,000 mg/kg). Mean percent survival at this exposure concentration was 26.7, while all other exposures resulted in mean percent survival values of 80.0 to 93.3. Laboratory control survival was 100 percent.

The highest exposure concentration associated with no significant effects was 6,700 mg/kg Bunker C, and this values serves as the NOEC. The lowest exposure concentration associated with significant adverse effects was 18,000 mg/kg Bunker C, and this value serves as the LOEC. From these results the LC50 (median lethal concentration to 50% of test organisms) was estimated to be 13,700 mg/kg. Worms appeared to be avoiding the soils at 6,700 and 18,000 mg/kg exposures, but the degree and ecological significance of these observations was not determined.

4.2.2.2 Lettuce

Based on seed germination and seedling survival endpoints, no toxicity was observed in lettuce tests during the 14 test duration. Mean percent survival ranged from 80.0 in the background soil to 98.3 in the 930 mg/kg Bunker C exposure. The NOEC was set at the highest test concentration, 18,000 mg/kg. The LOEC and estimated LC50 were both greater than 18,000 mg/kg Bunker C.

Mean biomass in surviving seedlings (based on weight, mg) was significantly reduced in exposure concentrations of 1,700 mg/kg Bunker C and higher. However, in all cases the mean biomass was within 20 percent of the biomass associated with background exposures. Mean biomass (mg) was 1.78 in the laboratory control exposure, 1.11 in the background soil exposure, and ranged from 0.87 to 0.96 in the test exposures with Bunker C. No clear pattern was observed between test concentration of Bunker C and mean biomass—the two highest biomass values for exposures with Bunker C were the 930 mg/kg and the 6,700 mg/kg exposures. Similar, but slightly lower biomass was associated with Bunker C exposures of 1,700, 2,800, and 18,000 mg/kg Bunker C.

4.3 Conclusions and Recommendations

The data summarized above and presented in detail in **Appendix A** indicate the following:

- Bunker C in soil is toxic to earthworms (based on survival endpoints) at 18,000 mg/kg (LOEC) but not at 6,700 mg/kg (NOEC)
- The estimated LC50 for earthworm survival in soil is estimated at 13,700 mg/kg

  These data suggest that an appropriate soil cleanup value for Bunker C would be higher than 6,700 mg/kg but lower than 13,700 mg/kg. This conclusion is based on the assumption that 50 percent mortality is unacceptable (based on the earthworm LC50 of 13,700 mg/kg). Available data do not provide sufficient information to compute a clear threshold Bunker C concentration that would be associated with sublethal or chronic effects.

  Ecology reviewed the toxicity testing results and requested calculation of LC05 and LC10 concentrations for both earthworms and lettuce. These calculations are presented in **Appendix B**.

Toxicity test results for lettuce reveal the following:

- At the highest Bunker C concentrations tested, seed germination and seedling survival were not affected.
- Mean seedling biomass was slightly reduced at all test concentrations (930 to 18,000 mg/kg), but in all cases the reduction in biomass was small (less than 20 percent) relative to the background soil tests.
- No clear pattern is noted between percent reduction in biomass and Bunker C concentration, suggesting that other confounding factors may be present.

These data suggest that exposures of terrestrial plants (with sensitivities similar to lettuce) to Bunker C concentrations of up to 18,000 mg/kg are unlikely to result in ecologically significant effects to terrestrial plants.

After consulting with Ecology it was agreed that the soil cleanup value for Bunker C be based on protection of apparently more sensitive soil invertebrates (represented by earthworm) instead of protection of terrestrial plants and the earthworm NOEC value of 6,700 mg/kg would be protective of soil organisms at the site.

The recommended soil cleanup value for Bunker C is 6,700 mg/kg, based on the results of the soil toxicity tests with earthworms.

Section 5
References

Avocet Consulting. 2003. *Development of Freshwater Sediment Quality Values for Use in Washington State. Phase II Report: Development and Recommendation of SQVs for Freshwater Sediments in Washington State*. Publication Number 03-09-088. September 2003.

CCME (Canadian Council of Ministers of the Environment). 2002. *Canadian Environmental Quality Criteria for Contaminated Sites.* Environmental Quality Guidelines Division. Water Quality Branch. Environment Canada. Ottawa, Canada.

CDM. 2005. *Phase II Site Assessment, Ellisport Creek Greenspace Project Site, Vashon Island, Washington*. December 23, 2005.

CDM. 2006. *Supplemental Phase II Environmental Site Assessment, Ellisport Creek Greenspace Project Site, Vashon Island, Washington.* December 21, 2006.

Washington State Department of Ecology. 1995. *Sediment Management Standards, Chapter 173-204 WAC.* Olympia, Washington. Amended December 1995.

Ecology. 2001a. *Model Toxics Control Act Cleanup Regulation, Chapter 173-340 WAC* Washington State Department of Ecology Toxics Cleanup Program. Publication No. 94-06. Amended February 12, 2001.

ECOSAR (Ecological Structure Activity Relationships). 2006. U.S. EPA online program. Office of Pollution Prevention and Toxics (OPPT).

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision*. Oak Ridge National Laboratory. Oak Ridge, Tennessee.

Eisler, R. 1987. “Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a synoptic review.” U.S. Fish Wildl. Serv. Biol. Rep. 85(1.11). 81 pp.

EPA (U.S. Environmental Protection Agency). 1991c. *Assessment and Control of Bioconcentratable Contaminants in Surface Waters.* Draft Document. EPA-600-XX-XX-XXX. Office of Water Enforcement and Permits. Washington, D.C. 20460.

EPA (U.S. Environmental Protection Agency). 2003. Region 5 Ecological Screening Levels, RCRA. August 22.

Fabacher, D.L. and P.C. Baumann. 1985. *Enlarged livers and hepatic microsomal mixed-function oxidase components in tumor-bearing brown bullheads from a chemically contaminated river*. Environ. Toxicol. Chem. 4:703-710.

Public Health – Seattle & King County, Environmental Health Division and Gregory L. Glass. 2000. *Vashon/Maury Island Soil Study, 1999-2000, Final Report*. July 2000.

Richardson, G.M. 1987. "Inventory of cleanup criteria and methods to select criteria." Unpublished report, Committee on Industrial Site Decommissioning, Industrial Programs Branch, Environment Canada, Ottawa, Ontario K1A 1G2. 46pp.

Stathham, C.N., M.J. Melancon, Jr., and J.J. Lech. 1976. "Bioconcentration of xenobiotics in trout bile: a proposed monitoring aid for some waterborne chemicals." Science 193:680-681.

Suter, G.W. II and C.L. Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*. Oak Ridge, Tennessee: Oak Ridge National Laboratory.

USFWS (U.S. Fish and Wildlife Service). 1990. "Evaluating Soil Contamination." Biological Report 90(2). July.

Varanasi, U., and D.J. Gmur. 1980. *Metabolic activation and covalent binding of benzo(a)pyrene to deoxyribonucleic acid catalyzed by liver enzymes of marine fish.* Biochem. Pharmacol. 29:753-762.

Veith, G.D. and P. Kosian. 1982. *Estimating Bioconcentration Potential from Octonal/Water Partition Coefficients.* In: Physical Behavior of PCBs in the Great Lakes (MacKay, Paterson, Eisenreich, and Simmons, eds.). Ann Arbor, Michigan: Ann Arbor Science.

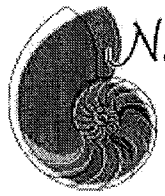
Distribution

4 Copies	King County Solid Waste Division Department of Natural Resources and Parks King Street Center 201 South Jackson Street, Suite 701 Seattle, Washington 98104-3855 Attention: Mr. James Neely
1 Copy	Department of Ecology Toxics Cleanup Program Policy and Technical Assistance Unit PO Box 47600 Olympia, Washington 98504-7600 Attention: Mr. Dave Sternberg
1 Copy	Department of Ecology Northwest Regional Office Toxics Cleanup Program 3190 160th Avenue SE Bellevue, Washington 98008-5452 Attention: Ms. Jing Liu
1 Copy	ECOSS 8201 10th Avenue South Seattle, Washington 98108-4449 Attention: Ms. Emery Bayley

Appendix A
Soil Toxicity Evaluation

Appendix B
Additional Statistical Evaluation of Terrestrial Toxicity Tests

Appendix A
Soil Toxicity Evaluation



Nautilus Environmental, LLC

Soil Toxicity Evaluation

King County Ellisport Creek Greenspace Project Site, Vashon Island, WA

Final Report: September 6, 2007

Submitted to:

CDM
Bellevue, WA

Washington Laboratory
5009 Pacific Hwy East
Suite 2
Tacoma, WA 98424

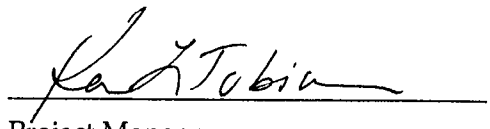
TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF APPENDICES

SIGNATURE PAGE



Project Manager

This report has been prepared based on data and or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party.

1.0 INTRODUCTION

Laboratory toxicity testing was conducted on a soil sample collected from a site on Vashon Island, Washington as part of a site-specific terrestrial ecological evaluation (TEE) under The Model Toxics Control Act (MTCA). The specific contaminant of concern for the bioassay component of the TEE was Bunker C oil. A soil sample was collected from an area with concentrated Bunker C and diluted with background soil in the laboratory to obtain a dilution series of Bunker C. Two soil toxicity tests were conducted: a 14-day earthworm survival test with the lumbricid earthworm *Eisenia fetida* and a 14-day early seedling growth test using the butter crunch lettuce seed *Lactuca sativa*. Testing was conducted between June 27 and July 11, 2007 at the Washington Laboratory of Nautilus Environmental located in Tacoma, Washington. Test procedures followed methods published by Washington State Department of Ecology for the Toxics Cleanup Program

2.0 METHODS

2.1 Samples

Soil sampling was conducted by CDM personnel on June 19, 2007. Samples were collected into 5-gallon buckets, labeled, packed in ice chests containing cubed ice, and delivered to the laboratory the day of collection.

Upon receipt at the Nautilus laboratory, the containers were opened and the contents verified against information provided on the chain-of-custody forms (COC). Sample temperatures were measured and recorded on the COC. Samples were stored at 4 ±1°C in the dark during holding time.

2.2 Soil preparation

In order to confirm the concentration of Bunker C in the source soil, a subsample was collected from the sample container and sent to OnSite Environmental for analysis. The sample was thoroughly homogenized prior to subsampling. The results are provided in Appendix D (Analytical Results).

The plant and earthworm bioassays were conducted using a dilution series of contaminated soil mixed with background soil. The dilution series was based on analytical results of 51,000 mg/kg of Bunker C in the source soil. Soil dilutions were prepared by serially diluting the source soil with background soil following a 0.5x dilution series and consisted of 50, 25, 12.5, 6.25, and 3.13% source soil. A subsample of each concentration was collected and sent to On-Site Environmental for analysis of Bunker C. Analytical results are provided in Appendix D.

2.3 Earthworm (*Eisenai fetida*) 14-day survival test

Eisenia fetida (earthworms) were exposed to test soils for 14 days to determine the effects of site soil on survival. The tests were conducted according to methods presented in Washington State Department of Ecology (WDOE) Publication No. 96-327 (1996), and are summarized in Table 1.

E. fetida were obtained from BRR Worm Farm (Yelm, Washington). The organisms were transported in a box containing a plastic container with the earthworms in a mesh bag containing soil as substrate. Upon arrival at the laboratory, observations of animal condition were made. Upon receipt, the worms were placed in 30-L glass aquaria and kept moist. The tanks were held at 22±2°C and monitored daily.

Test chambers consisted of one-liter glass jars with perforated lids to allow air exchange. The test chambers were randomized and placed in an environmental chamber maintained at 22 ±2°C under constant light. Three replicates were included per site with one additional replicate used for soil quality parameter measurements at points during the test period.

Each test chamber received 200 g dry weight of soil. The percent moisture of each test soil was calculated and used to determine the wet weight of sample to add to provide 200 g dry weight per test chamber. Sufficient volumes of DI water were added to hydrate the soils to an appropriate moisture level. Due to the differences in soil composition (texture, structure, and organic content), hydrating soils to a standard level can be problematic. One soil may appear very wet and even have standing water on the surface, while another may appear considerably drier after both being hydrated to the recommended hydration level of 35 to 45 percent of its dry weight. To address such differences, an alternative method is to use the artificial control soil hydrated to 45 percent of its dry weight as a standard. All sites were then hydrated to a level approximating the texture and visual appearance of the hydrated artificial soil control. A summary of hydration levels achieved in the test soils is provided in Appendix B with the laborataory bench sheets.

Soils were allowed to equilibrate for 24 hours prior to addition of the test organisms. Ten worms were randomly added to each test chamber after confirmation that the correct number of test organisms was segregated and in healthy condition. The worms were not fed during the test period.

The temperature of the test chambers was monitored daily. Abnormal conditions or unusual animal behavior, if observed, were also noted at this time. At test termination, each replicate was emptied into a glass dish and gently sorted. Surviving worms were counted and recorded on a data sheet.

A soil control (negative control) and a 2-chloroacetamide reference toxicant test (positive control) were conducted in conjunction with the test soils to ensure that organisms were not impacted by stresses other than contamination in the test material.

Table 1. Summary of test conditions for the 14-day *Eisenia fetida* test.

Test start date	6/27/2007
Test end date	7/11/2007
Test organism	*Eisenia fetida*
Test organism source	BRR Worm Farm, Yelm, WA
Organism age at test initiation	>2 months, fully clitillated
Feeding	No feeding during test
Test chamber	1 liter glass jar
Soil volume	200 g dry weight
Water source for soiil hydration	Deionized water (DI)
Target soil moisture content	35 to 45%
Control soil	70% sand, 20% Kaolin clay, 10% peat, 0.4%$CaCO_3$ mixed 1:1 with clean garden soil
Number of organisms/replicate	10
Number of replicates/concentration	3
Test temperature	22 ± 2°C
Illumination	Continuous
Test acceptability criterion for laboratory control (negative control)	≥90% survival organisms
Reference toxicant (positive control)	2-Chloroacetamide

2.4 Early seedling *(Lactuca sativa)* 14-day survival and growth test

Butter crunch lettuce seeds (*Lactuca sativa*) were used to determine plant viability in the test soils. The seedling germination and growth test was conducted in accordance with WDOE Publication No. 96-324 (1996). A summary of test conditions is outlined in Table 2.

L. sativa seeds were obtained from Territorial Seed Company (Cottage Grove, Oregon). The seeds were sorted by size and stored in a dry container at 4 ±1°C until used for testing. Tests were conducted in an environmental chamber maintained at 22± 2°C under a 16 hour light/8 hour dark lighting schedule. Samples were prepared as described in Section 2.2 above.

Test chambers consisted of 36-cell (6x6) seedling starter trays with drainage holes. Each individual pot in the tray was 9 centimeters (cm) by 2.5 cm wide and 6 cm deep. Clear plastic dome lids were used to cover the trays during the duration of the test to maintain adequate soil moisture and at least 50 percent relative humidity. Five replicates were included for each concentration with one additional replicate used for soil quality parameter measurements at points ruing the test period. Each replicate was randomized within a block so that replicates were evenly spaced throughout the trays under the light banks.

Each concentration of test soil was homogenized and 300 g was distributed to each test chamber according to the randomization scheme. Initial measurements of soil pH and conductivity were measured by mixing a subsample of the soils with an equal amount of DI, shaken thoroughly, and allowed to sit for 30 minutes. The pH and conductivity was then measured in the overlying water after the soil had settled. Twelve seeds were distributed into each test chamber and covered with a light layer of the soil. The seeds were then gently watered to field capacity using DI water in a spray bottle.

Air temperature and plant observations were recorded daily and light intensity was measured at the beginning, middle and end of the test. Soils were watered daily to maintain constant moisture. No nutrient amendments were added t the soils. Test chambers were rotatied during the test to ensure that all portions of each tray received similar amounts of light.

The test was terminated on day 14, by first counting the number of seedlings germinated in each test chamber. The above-ground portion of the seedlings from each replicate were then collected using a sharp blade and placed in tared weigh boats. Wet weights were recorded for

each replicate before placing the pans in an oven for drying at 70°C for 24 hours. After 24 hours, the dried plants were placed in a desiccator, allowed to cool, and then weighed.

A soil control (negative control) and a boric acid reference toxicant test (positive control) were conducted in conjunction with the test soils to ensure that *L. sativa* was not impacted by stresses other than contamination in the test material.

Table 2. Summary of test conditions for the 14-day germination test with *Lactuca sativa*

Test start date	6/27/2007
Test end date	7/11/2007
Test organism	*Lactuca sativa* (butter crunch lettuce)
Test organism source	Territorial Seed Company, Cottage Grove, OR
Test chamber	36-cell seedling trays with domed cover
Test soil weight	200 g dry weight
Water source for hydration	Deionized water (DI)
Control soil	70% sand, 20% Kaolin clay, 10% peat, 0.4% $CaCO_3$ mixed 1:1 with clean garden soil
Number of organisms per chamber	12
Number of replicates/site	5
Test temperature	20 to 30°C
Illumination	16 hourslight/8 hours dark
Test acceptability criterion for laboratory control (negative control)	Mean control germination ≥ 75%
Reference toxicant (positive control)	Boric acid

3.0 RESULTS

3.1 Eisenia fetida

Results of the toxicity test conducted using *E. fetida* are provided in Table 3. The table shows mean percent survival as well as results of the statistical analyses comparing response in the background soil and the concentrations of diluted source soil. Detailed results of the soil toxicity test, soil quality measurements recorded during the test, and the reference toxicant test results are provided in Appendices A, B, and C, respectively. Copies of the chain-of-custody form are in Appendix E.

Mean survival in 50 percent source soil, measuring 18,000 mg/kg Bunker C, was 26.7 percent and was the only concentration exhibiting toxicity relative to background soil results. The concentration of Bunker C estimated to be lethal to 50 percent of the organisms was 13,700 mg/kg Bunker C.

Observations during the test indicated that the earthworms were avoiding the soil at concentrations of 6700 and 18,000 mg/kg Bunker C.

Table 3. Survival data for the *Eisenia fetida* test

Concentration of Source Soil (%)	Measured concentration of Bunker C (mg/kg)	Mean Percent Survival	Standard Deviation	NOEC	LOEC	LC50
				(mg/kg Bunker C)		
0 (Laboratory Soil)	810[1]	100	0.0	6700	18,000	13,700
0 (Background Soil)	ND	93.3	10.0			
3.13	930	90.0	11.5			
6.25	1700	80.0	17.3			
12.5	2800	86.7	15.3			
25	6700	80.0	17.3			
50	18,000	26.7	28.9			

[1] See the QA/QC section for a discussion of the investigation on the detectable level of Bunker C in the laboratory control soil.

3.2 *Lactuca sativa*

No toxicity was observed to germination and survival of *L. sativa* seedlings by any of the test soil concentrations during the 14-day exposure period. Results are shown in Table 4 and are also provided in Appendix A.

Results for growth are provided in Table 5 and show that biomass was reduced in all site soil concentrations compared to laboratory control data. The background soil used to dilute the source soil was high in gravel, and although not hindering germination it may not have provided as much nutrition for the growing seedlings as the laboratory control soil. The background soil was, therefore used for statistical comparisons. Biomass was significantly reduced (with 95% confidence) in concentrations of Bunker C at 1700 mg/kg and above. Biomass for all concentrations, however, was within 20 percent of biomass for the background

soil and the concentration estimated to inhibit growth in 50 percent of the organisms (IC50) was greater than the highest concentration tested.

Table 4. Survival data for the *Lactuca sativa* test

Concentration of Source Soil (%)	Measured concentration of Bunker C (mg/kg)	Mean Percent Survival	Standard Deviation	NOEC	LOEC	LC50
				(mg/kg Bunker C)		
0 (Laboratory Soil)	810[1]	98.3	3.7	18,000	>18,000	>18,000
0 (Background Soil)	ND	80.0	19.2			
3.13	930	98.3	3.7			
6.25	1700	93.3	3.7			
12.5	2800	88.3	12.6			
25	6700	90.0	10.9			
50	18,000	88.3	12.6			

[1] See the QA/QC section for a discussion of the investigation on the detectable level of Bunker C in the laboratory control soil.

Table 5. Biomass data for the *Lactuca sativa* test

Concentration of Source Soil (%)	Measured concentration of Bunker C (mg/kg)	Mean Biomass per Surviving Seedling (mg)	Standard Deviation	NOEC	LOEC	IC50
				(mg/kg Bunker C)		
0 (Laboratory Soil)	810[1]	1.78	0.11	930	1700	>18,000
0 (Background Soil)	ND	1.11	0.07			
3.13	930	0.96	0.13			
6.25	1700	0.89	0.14			
12.5	2800	0.88	0.11			
25	6700	0.90	0.10			
50	18,000	0.87	0.09			

[1] See the QA/QC section for a discussion of the investigation on the detectable level of Bunker C in the laboratory control soil.

4.0 QA/QC

The *E. fetida* and *L. sativa* tests met acceptability criterion for control performance with greater than 90 percent mean control survival in both tests. The temperature in the lettuce seed test was below the established range of 20 to 30 °C for the method. The temperature, however, was within one degree of the required range and because all test chambers experienced the same temperatures it is unlikely that the test results were impacted by this deviation. A temperature chart for continuous monitoring of air temperature inside the test chamber is included in Appendix B with the laboratory bench sheets for the test. All other soil quality parameters remained within the specified ranges throughout the test period.

Analytical results for Bunker C in subsamples from the test soils submitted to OnSite Environmental reported 810 mg/kg Bunker C in the laboratory control soil. This value is higher than expected and an investigation was conducted. The laboratory control soil was comprised of a 50:50 mixture of artificial soil (70% sand, 20% Kaolin clay, 10% peat, 0.4% Calcium Carbonate) and garden soil purchased from a local garden store (Earthgro, packaged by Hyponex Corporation; regionally formulated from compost, forest products, and manure). Subsamples of the artificial soil and garden soil were sent to OnSite Environmental for analysis. Results (provided in Appendix D) indicated no Bunker C was detected in the artificial soil. However, 2200 mg/kg Bunker C was reported in the subsample of garden soil, which is clearly the source of contamination. Interpretation of the test results were not affected by the detectable levels of Bunker C in the garden soil because survival in the laboratory control was good and the background soil results were used for all statistical comparisons.

Results of reference toxicant tests conducted with the test organisms are provided in Table 6. Results for the tests conducted with *Eisenia fetida* fell within the acceptable range of mean ± two standard deviations for historical data generated by this laboratory. Thus, these data indicate that the test organisms appeared to have been of an appropriate degree of sensitivity. Historical data is not available for the lettuce seed reference toxicant test.

Table 6. Reference toxicant test results.

Species	Date Initiated	Endpoint	Toxicant	EC50	95% Confidence Interval	Historical range (mean ± 2 SD)
E. fetida	6/27/2007	14d Survival	2-chloroacetamide	28.0 mg/kg	24.8 - 31.6	21.0 - 39.4
L. sativa	6/27/2007	14d Survial	Boric acid	>2000 mg/L	NA	NA
L. sativa	6/27/2007	14d Growth	Boric acid	>2000 mg/L	NA	NA

5.0 REFERENCES

American Society of Testing and Materials (ASTM). 1999. Standard guide for conducting terrestrial plant toxicity tests. ASTM designation E1963-98.

American Society of Testing and Materials (ASTM). 1997. Standard guide for conducting laboratory soil toxicity or bioaccumulation tests with the lumbricid earthworm *Eisenia* fetida. ASTM designation E1676-97.

American Society of Testing and Materials (ASTM). 1994. Standard practice for conducting early seedling growth tests. ASTM designation E1598-94.

Tidepool Scientific Software. 2000-2003. CETIS Comprehensive Environmental Toxicity Information System Software, Version 1.6.3revE.

Washington State Department of Ecology (WDOE). 1996. Earthworm bioassay protocol for soil toxicity screening. WDOE Environmental Investigations and Laboratory Services Program Publication No. 96-327.

Washington State Department of Ecology (WDOE). 1996. Early seedling growth protocol for soil toxicity screening. WDOE Environmental Investigations and Laboratory Services Program Publication No. 96-324.

APPENDIX A - Summary of Results

Appendix Table A-1. *Eisenia. fetida* 14-Day Survival
King County Ellisport Creek Project
Test Initiated June 27, 2007

Site	Rep	# Alive	% Survival	Mean % Survival	St. Dev.
Laboratory Control	1	10	100	100	0.0
	2	10	100		
	3	10	100		
Background Soil	1	9	90	90.0	10.0
	2	8	80		
	3	10	100		
3.13% - 930 mg/kb Bunker C	1	8	80	93.3	11.5
	2	10	100		
	3	10	100		
6.25% - 1700 mg/kg Bunker C	1	10	100	80.0	17.3
	2	7	70		
	3	7	70		
12.5% - 2800 mg/kg bunker C	1	7	70	86.7	15.3
	2	10	100		
	3	9	90		
25% - 6700 mg/kg Bunker C	1	7	70	80.0	17.3
	2	7	70		
	3	10	100		
50% - 18,000 mg/kg Bunker C	1	6	60	26.7	28.9
	2	1	10		
	3	1	10		

Appendix Table A-2: *Lactuca sativa* 14-day Survival and Growth
King County Ellisport Creek Project
Test Initiated June 27, 2007

		Survival				Growth					
Concentration	Rep	# Alive	% Survival	Mean % Survival	St. Dev.	Tare Weight (mg)	Total Weight (mg)	Total Seedling Weight (mg)	Growth per Seedling (mg)	Mean Growth per Org (mg)	St. Dev.
Laboratory Control	1	12	100	98.3	3.7	1599.06	1620.95	21.89	1.82	1.78	0.11
	2	11	91.7			1642.72	1663.35	20.63	1.88		
	3	12	100.0			1525.30	1547.84	22.54	1.88		
	4	12	100.0			1588.83	1608.97	20.14	1.68		
	5	12	100.0			1603.87	1623.56	19.69	1.64		
Background Soil	1	9	75.0	80.0	19.2	1653.39	1663.40	10.01	1.11	1.11	0.07
	2	8	66.7			1708.42	1717.10	8.68	1.08		
	3	12	100.0			1559.79	1574.51	14.72	1.23		
	4	12	100.0			1588.23	1601.40	13.17	1.10		
	5	7	58.3			1614.29	1621.61	7.32	1.05		
3.13% - 930 mg/kg Bunker C	1	12	100.0	98.3	3.7	1621.52	1631.75	10.23	0.85	0.96	0.12
	2	12	100.0			1645.88	1656.41	10.53	0.88		
	3	12	100.0			1573.89	1587.32	13.43	1.12		
	4	12	100.0			1687.83	1700.77	12.94	1.08		
	5	11	91.7			1680.18	1690.01	9.83	0.89		
6.25% - 1700 mg/kg Bunker C	1	12	100.0	93.3	3.7	1603.32	1612.36	9.04	0.75	0.89	0.14
	2	11	91.7			1717.31	1729.38	12.07	1.10		
	3	11	91.7			1620.72	1629.05	8.33	0.76		
	4	11	91.7			1666.79	1676.90	10.11	0.92		
	5	11	91.7			1661.96	1672.00	10.04	0.91		
12.5% - 2800 mg/kg bunker C	1	12	100.0	88.3	12.6	1719.95	1730.72	10.77	0.90	0.88	0.11
	2	9	75.0			1577.11	1584.20	7.09	0.79		
	3	12	100.0			1580.67	1589.46	8.79	0.73		
	4	11	91.7			1579.63	1590.53	10.90	0.99		
	5	9	75.0			1590.21	1598.93	8.72	0.97		
25% - 6700 mg/kg Bunker C	1	11	91.7	90.0	10.9	1600.90	1609.60	8.70	0.79	0.90	0.10
	2	12	100.0			1650.24	1660.49	10.25	0.85		
	3	10	83.3			1674.28	1684.19	9.91	0.99		
	4	9	75.0			1612.99	1620.55	7.56	0.84		
	5	12	100.0			1671.06	1683.33	12.27	1.02		
50% - 18000 mg/kg Bunker C	1	11	91.7	88.3	12.6	1644.95	1655.16	10.21	0.93	0.87	0.09
	2	12	100.0			1698.47	1708.55	10.08	0.84		
	3	11	91.7			1779.34	1790.11	10.77	0.98		
	4	11	91.7			1686.23	1695.53	9.30	0.85		
	5	8	66.7			1792.58	1798.53	5.95	0.74		

APPENDIX B - Statistical Analyses and Laboratory Bench Sheets

Eisenia fetida (earthworm)

CETIS Summary Report

Link/Link Code: 16-1514-2211/070T-T076

Eisenia 14-d Survival Soil Test — Nautilus Environmental WA

Test Run No:	07-5416-1662	Test Type:	Survival	Analyst:	Karen Tobiason
Start Date:	27 Jun-07 16:00	Protocol:	WDOE 96-327	Diluent:	
Ending Date:	11 Jul-07 13:00	Species:	Eisenia fetida	Brine:	
Duration:	13d 21h	Source:		Age:	

Sample No:	04-2064-9698	Code:	420649698	Client:	Camper Dresser McKee
Sample Date:	19 Jun-07 10:30	Material:	Bunker C	Project:	King County Ellisport Creek
Receive Date:	19 Jun-07 15:15	Source:	CDM		
Sample Age:	8d 5h	Station:			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
18-5532-2275	Survival Rate	6700	18000	11000	44.9%	Dunnett's Multiple Comparison Test

Point Estimate Summary

Analysis No	Endpoint	Effect-%	Conc-mg/k	95% LCL	95% UCL	Method
08-0090-7657	Survival Rate	25	9620	3740	12700	Linear Regression (MLE)
		50	13700	8960	18100	

Survival Rate Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	3	0.9	0.863	0.937	0.8	1	0.0183	0.1	11.1%	0.0%
930		3	0.933	0.89	0.976	0.8	1	0.0211	0.115	12.4%	-3.7%
1700		3	0.8	0.735	0.865	0.7	1	0.0316	0.173	21.7%	11.1%
2800		3	0.867	0.81	0.924	0.7	1	0.0279	0.153	17.6%	3.7%
6700		3	0.8	0.735	0.865	0.7	1	0.0316	0.173	21.7%	11.1%
18000		3	0.267	0.159	0.374	0.1	0.6	0.0527	0.289	108.0%	70.4%

Survival Rate Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3
0	Backgtround S	0.9	0.8	1
930		0.8	1	1
1700		1	0.7	0.7
2800		0.7	1	0.9
6700		0.7	0.7	1
18000		0.6	0.1	0.1

CETIS Analytical Report

Eisenia 14-d Survival Soil Test — Nautilus Environmental WA

Analysis No:	18-5532-2275	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 16:01	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)		C > T	Not Run	6700	18000	11000	0.0149	44.9%

Dunnett's Multiple Comparison Test

Control	vs	Conc-mg/kg	Test Stat	Critical	MSD	P-Value	Decision(5%)
Backgtround Soil		930	-0.287	2.5	0.474	0.9030	Non-Significant Effect
		1700	0.657	2.5	0.474	0.5790	Non-Significant Effect
		2800	0.204	2.5	0.474	0.7670	Non-Significant Effect
		6700	0.657	2.5	0.474	0.5790	Non-Significant Effect
		18000*	3.94	2.5	0.474	0.0040	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	1.297011	0.2594023	5	4.81	0.0121	Significant Effect
Error	0.6470451	0.0539204	12			
Total	1.944057	0.3133227	17			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	1.2	15.1	0.9450	Equal Variances
Distribution	Shapiro-Wilk Normality	0.886		0.0332	Normal Distribution

Survival Rate Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	3	0.9	0.862	0.938	0.8	1	0.0186	0.1	11.1%	0.0%
930		3	0.933	0.889	0.977	0.8	1	0.0214	0.115	12.4%	-3.7%
1700		3	0.8	0.734	0.866	0.7	1	0.0322	0.173	21.7%	11.1%
2800		3	0.867	0.809	0.925	0.7	1	0.0284	0.153	17.6%	3.7%
6700		3	0.8	0.734	0.866	0.7	1	0.0322	0.173	21.7%	11.1%
18000		3	0.267	0.157	0.376	0.1	0.6	0.0536	0.289	108.0%	70.4%

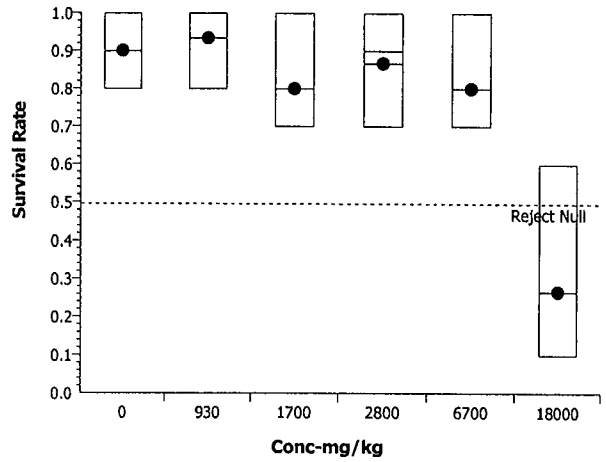
Angular (Corrected) Transformed Summary

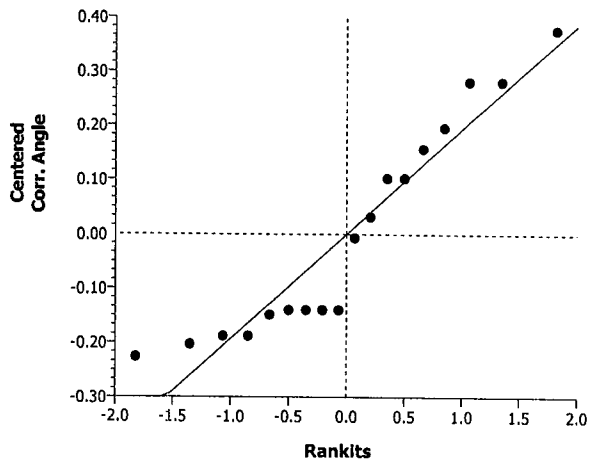
Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	3	1.26	1.2	1.31	1.11	1.41	0.0283	0.153	12.1%	0.0%
930		3	1.31	1.24	1.38	1.11	1.41	0.0327	0.176	13.4%	-4.32%
1700		3	1.13	1.04	1.22	0.991	1.41	0.0451	0.243	21.5%	9.92%
2800		3	1.22	1.14	1.3	0.991	1.41	0.0394	0.212	17.4%	3.08%
6700		3	1.13	1.04	1.22	0.991	1.41	0.0451	0.243	21.5%	9.92%
18000		3	0.51	0.386	0.634	0.322	0.886	0.0605	0.326	63.9%	59.4%

Eisenia 14-d Survival Soil Test — **Nautilus Environmental WA**

Analysis No:	18-5532-2275	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 16:01	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Eisenia 14-d Survival Soil Test — **Nautilus Environmental WA**

Analysis No:	08-0090-7657	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 16:01	**Analysis:**	Linear Regression (MLE)	**Official Results:**	Yes

Linear Regression Options

Model Function	Threshold Option	Threshold	Optimized	Pooled	Het Corr	Weighted
Log-Normal [NED=A+B*log(X)]	Control Threshold	0.1	Yes	No	No	Yes

Regression Summary

Iters	LL	AICc	Mu	Sigma	G Stat	Chi-Sq	Critical	P-Value	Decision(5%)
10	-32.7	70.4	-2.99	0.23	0.42	19	22.4	0.1220	Non-Significant Heterogeneity

Point Estimates

Effect-%	Conc-mg/k	95% LCL	95% UCL
25	9620	3740	12700
50	13700	8960	18100

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(5%)
Threshold	0.125	0.0305	0.0647	0.184	4.08	0.0013	Significant Parameter
Slope	4.35	1.44	1.53	7.18	3.03	0.0097	Significant Parameter
Intercept	-13	6.01	-24.8	-1.25	-2.17	0.0493	Significant Parameter

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(5%)
Variances	Bartlett Equality of Variance	0.716	9.49	0.9490	Equal Variances
Distribution	Shapiro-Wilk Normality	0.883		0.0521	Normal Distribution

Survival Rate Summary

			Calculated Variate(A/B)								
Conc-mg/k	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%	A	B
0	Backgtround Soil	3	0.9	0.8	1	0.0183	0.1	11.1%	0.0%	27	30
930		3	0.933	0.8	1	0.0211	0.115	12.4%	-3.7%	28	30
1700		3	0.8	0.7	1	0.0316	0.173	21.7%	11.1%	24	30
2800		3	0.867	0.7	1	0.0279	0.153	17.6%	3.7%	26	30
6700		3	0.8	0.7	1	0.0316	0.173	21.7%	11.1%	24	30
18000		3	0.267	0.1	0.6	0.0527	0.289	108.0%	70.4%	8	30

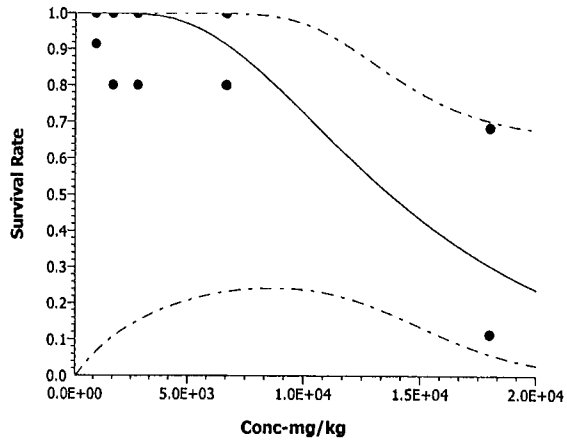
Survival Rate Detail

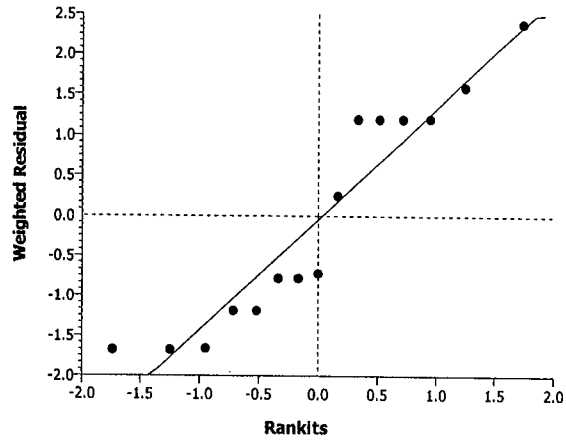
Conc-mg/k	Control Type	Rep 1	Rep 2	Rep 3
0	Backgtround Soil	0.9	0.8	1
930		0.8	1	1
1700		1	0.7	0.7
2800		0.7	1	0.9
6700		0.7	0.7	1
18000		0.6	0.1	0.1

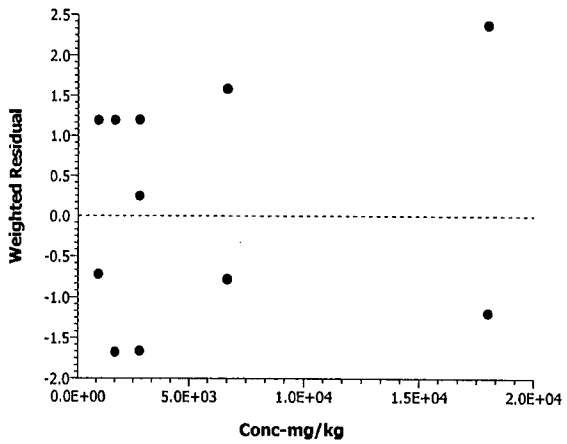
Eisenia 14-d Survival Soil Test — **Nautilus Environmental WA**

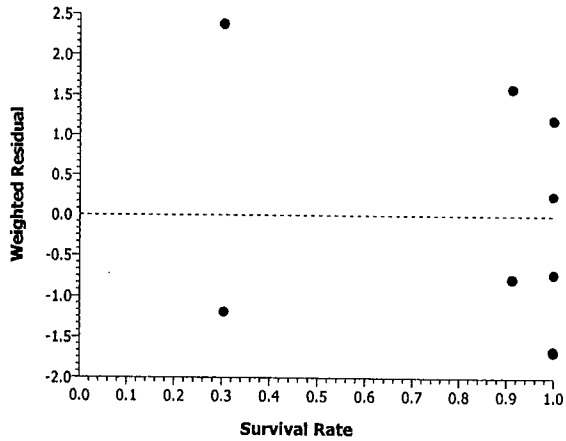
Analysis No:	08-0090-7657	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 16:01	**Analysis:**	Linear Regression (MLE)	**Official Results:**	Yes

Graphics









Environmental Quality Results - 14-Day Soil
Nautilus Environmental

Client/ Project ID: CDM
Site ID: Source soil
Test #: 0706-T076

Organism Tested: Eisenia fetida
Start Date/Time: 6-27-07 1600
End Date/Time: 6th 7/11/07 1300

Test Day	Temp (°C)	Tech Initials
0	20.6	mc
1	*19.5	mc
2	*19.5	MM
3	*19.6	ef
4	*19.3	ef
5	*19.1	les
6	*19.5	les
7	*19.2	ef
8	*19.2	les
9	20.4	les
10	20.6	les
11	20.4	MM
12	20.1	les
13	20.0	les
14	20.7	mc

Conc. ~~mg/kg~~ %	Rep.	Container	% Moisture initial	% Moisture final	pH (units) initial	pH (units) final	Conductivity (uhom-cm initial	Conductivity (uhom-cm final	Survival initial	Survival final
CON-L	1	18							10	10
	2	19							10	10
	3	10							10	10
CON-R	1	15							10	9
	2	5							10	8
	3	16							10	10
3.13	1	8							10	8
	2	4							10	10
	3	3							10	10
6.25	1	1							10	10
	2	2							10	7
	3	7							10	7
12.5	1	9							10	MU 7
	2	17							10	10
	3	20							10	9

Washington Laboratory - 5009 Pacific Hwy. E., Suite 2. Tacoma, WA 98424.

QA Review/Date: KJ
Final Review/Date: KJ

* Temperature too low - see corrective action #07-012

Environmental Quality Results - 14-Day Soil
Nautilus Environmental

Client/ Project ID: CDM
Site ID: Source Soil
Test #: 0706-T076

Organism Tested: Eisenia fetida
Start Date/Time: 6-27-07 1600
End Date/Time: 7/11/07 1300

Test Day	Temp (°C)	Tech Initials
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

surface

Conc. mg/kg	Rep.	Container	% Moisture initial	% Moisture final	pH (units) initial	pH (units) final	Conductivity (uhom-cm initial	Conductivity (uhom-cm final	Survival initial	Survival final
25	1	14							10	7
	2	11							10	7
	3	6							10	10
50	1	12							10	6
	2	13							10	1
	3	21							10	1
	1								10	
	2								10	
	3								10	
	1								10	
	2								10	
	3								10	
	1								10	
	2								10	
	3								10	

Slight avoidance

Washington Laboratory - 5009 Pacific Hwy. E., Suite 2. Tacoma, WA 98424.

QA Review/Date: KJ
Final Review/Date: KT

*worms are avoiding 50% soil, climbing up on sides of jars Day 7

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Soil Data
14-Day Soil Toxicity Test

Client: CDM
Sample ID. Source Soil
Test No: 0706-T076
Log-In#:

Start Date & Time: 6-27-07 1600
Stop Date & Time: 7/11/07 1300
Test Species: Eisenia fetida

Final

Soil Weights

Site	Pan weight	Initial (wet)	Final (dry)	MF
Control-L	1.61509	26.10300	~~16.256~~ *	66.2
Con-R	1.64600	26.95047	24.62969	10.1
3.13	1.62885	27.27804	~~24.79911~~ **	10.7
6.25	1.56073	26.37226	24.37080	8.8
12.5	1.56631	26.64721	23.70238	13.3
25	1.59514	26.06972	22.84595	15.2
50	1.61614	27.60060	24.74877	12.3
Tech Initials:	mc	mc		

* 16.351255
** 24.80341

MF= (I-F)/[A-(I-F)]*100

MF= Moisture fraction of bulk soil (in %)
I= Initial wet weight of sample + crucible (in grams)
F=Final dry weight of sample + crucible (in grams)
A= Initial aliquot weight (in grams)

pH/ Conductivity

Site	pH (5 min)	Cond (5min)	pH (30 min)	Cond (30 min)
Control-L	7.22	371	7.10	399
Control-R	6.25	168	6.28	180
3.13	6.39	101	6.32	106
6.25	6.54	77	6.52	80
12.5	6.30	127	6.23	133
25	6.17	50	6.19	150
50	5.99	39	5.97	132
Tech Initials:		mc		

To measure pH/Conductivity make a slurry of soil and DI in a 1:1 ratio. Put on stir plate for 5 minutes and record reading. Allow slurry to settle for 30 minutes and record reading

Nautilus Environmental
Soil Hydration Calculation

6/27/07 Day 0

CDM Test # 0706-T076

Soil Weights

%	Pan wt.	Initial (wet)	Initial minus Pan wt	Final (dry)	Final minus Pan wt.	% Hydration
Con-R bkg	0		25	0	21.6	15.74074074
3.13	0		25	0	23.0	8.695652174
6.25	0		25	0	22.2	12.61261261
12.5	0		25	0	22	13.63636364
25	0		25	0	21.5	16.27906977
50	0		25	0	21.6	15.74074074
~~7~~	0		0	0	0	0
~~8~~	0		0	0	0	0
~~9~~	0		0	0	0	0
~~10~~	0		0	0	0	0

Control soil hydration = 35%

① adjust soils to 25-45 % Hydration

bkg - add 230 g to each jar
3.13 - add 216 g
6.25 add 224 g
12.5 add 226 g
25 add 232 g
50 add 230 g

Cannot bring soils above the % hydration they are already at. Soils are at their water holding capacity already.

Nautilus Environmental
Soil Hydration Calculation

CDM Final % moisture

Soil Weights

%	Pan wt.	Initial (wet)	Initial minus Pan wt	Final (dry)	Final minus Pan wt.	% Hydration
con-L	1.61509	26.103	24.48791	16.35125	14.73616	66.17565227
con-R	1.646	26.95047	25.30447	24.62969	22.98369	10.09750828
3.13	1.62885	27.27804	25.64919	24.80341	23.17456	10.67821784
6.25	1.56073	26.37226	24.81153	24.3708	22.81007	8.774457948
12.5	1.56631	26.64721	25.0809	23.70238	22.13607	13.30330994
25	1.59514	26.06972	24.47458	22.84595	21.25081	15.1701041
50	1.61614	27.6006	25.98446	24.74877	23.13263	12.32817021
0	0		0	0	0	0
0	0		0	0	0	0
0	0		0	0	0	0

14-Day Soil Observations
Nautilus Environmental

Client: CDM
Project ID: King County Fill, Spot C/C
Test Date: 6/27/07
Test Org: *Eisenia fetida*

Date	Cont. #	Observations	Tech.
07/02/07	Sur con-L	counted 10 animals	MH
07/02/07	Sur con R	counted 8 animals	MH
07/02/07	Sur 12.5	counted 7 animals	MH
07/02/07	Sur 50	counted 8 animals - 5 possibly dead.	MH
07/02/07		Con-L soils all looked very dry - watered w/ D.I. Client soils very wet - not watered	MH
		No worms climbing out - most at bottom of containers.	
7/3/07	9,14	dead worm, decomposing (might be more than one, can't tell) on side of container	LES
↓	11,12,7	dead + decomposing worm visible through bottom of container	LES
	13,21	several dead + decomposing worms visible through bottom + sides of container	LES
7/6/07	8, Sur 50	dead + decomposing worm visible through side of jar	LES
7/7/07	8	live worm on surface of substrate	LES
↓	11	several dead + decomposing worms visible through bottom + sides	LES
7/10/07	9,14	several dead + decomposing worms visible through sides	LES
	CONR, 20	Dead worm visible through bottom	

QA: [illegible]

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Soil Data
14-Day Soil Toxicity Test

Client: CDM
Sample ID. ~~SP~~ Source Soil
Test No: 0706-T076
Log-In#:

Start Date & Time: 6-27-07 1600
Stop Date & Time: 7/11/07 1300
Test Species: Eisenia Fetida

Initial

Soil Weights
(g)

Site	Pan weight	Initial (wet)	Final (dry)	MF
CON-L		25	~~21.6~~	35%
CON-R		25	~~23.0~~ 21.6	15.7 %
3.13		25	~~22.2~~ 23.0	8.69 %
6.25		25	~~23.2~~ 22.2	12.61 %
12.5		25	~~21.5~~ 22.0	13.63 %
25		25	21.5	16.28 %
50		25	21.6	15.74 %
Tech Initials:		ML		

MF= (I-F)/[A-(I-F)]*100

MF= Moisture fraction of bulk soil (in %)
I= Initial wet weight of sample + crucible (in grams)
F=Final dry weight of sample + crucible (in grams)
A= Initial aliquot weight (in grams)

pH/ Conductivity

Site	pH (5 min)	Cond (5min)	pH (30 min)	Cond (30 min)
CON-L	6.98	~~0~~ 504	6.94	585
CON-R	6.95	34.8	7.09	73.3
3.13	7.28	20.9	7.06	42.8
6.25	7.11	19.2	6.97	33.6
12.5	7.12	23.5	6.91	25.7
25	6.92	18.6	6.91	19.1
50	6.61	56.2	6.55	54.1
Tech Initials:		CP		

To measure pH/Conductivity make a slurry of soil and DI in a 1:1 ratio. Put on stir plate for 5 minutes and record reading. Allow slurry to settle for 30 minutes and record reading

Lactuca sativa (butter crunch lettuce)

CETIS Summary Report

Early Seedling Growth — **Nautilus Environmental WA**

Test Run No:	09-1073-7649	**Test Type:**	Survival-Growth	**Analyst:**	Karen Tobiason
Start Date:	27 Jun-07 16:45	**Protocol:**	WDOE 96-324	**Diluent:**	
Ending Date:	11 Jul-07 16:45	**Species:**	Lactuca sativa	**Brine:**	
Duration:	14d 0h	**Source:**	Carolina Biological Supply	**Age:**	

Sample No:	04-2064-9698	**Code:**	420649698	**Client:**	Camper Dresser McKee
Sample Date:	19 Jun-07 10:30	**Material:**	Bunker C	**Project:**	King County Ellisport Creek
Receive Date:	19 Jun-07 15:15	**Source:**	CDM		
Sample Age:	8d 6h	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
04-7612-5129	Mean Dry Biomass-mg	18000	> 18000	N/A	27.5%	Dunnett's Multiple Comparison Test
10-5129-2786	Mean Dry Weight-mg	930	1700	1260	14.6%	Dunnett's Multiple Comparison Test
12-0231-8126	Survival Rate	18000	> 18000	N/A	24.4%	Dunnett's Multiple Comparison Test

Point Estimate Summary

Analysis No	Endpoint	Effect-%	Conc-mg/k	95% LCL	95% UCL	Method
17-6844-1402	Mean Dry Weight-mg	25	> 18000	N/A	N/A	Linear Interpolation (ICPIN)
		50	> 18000	N/A	N/A	

Mean Dry Biomass-mg Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	5	0.898	0.802	0.995	0.61	1.23	0.047	0.258	28.7%	0.0%
930		5	0.949	0.898	1	0.819	1.12	0.0253	0.139	14.6%	-5.68%
1700		5	0.827	0.783	0.87	0.694	1.01	0.0215	0.118	14.2%	8.0%
2800		5	0.771	0.721	0.821	0.591	0.908	0.0243	0.133	17.2%	14.2%
6700		5	0.811	0.756	0.867	0.63	1.02	0.0269	0.147	18.2%	9.67%
18000		5	0.772	0.712	0.832	0.496	0.898	0.0293	0.16	20.8%	14.1%

Mean Dry Weight-mg Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	5	1.11	1.09	1.14	1.05	1.23	0.0124	0.068	6.1%	0.0%
930		5	0.964	0.918	1.01	0.852	1.12	0.0227	0.125	12.9%	13.4%
1700		5	0.888	0.835	0.941	0.753	1.1	0.0259	0.142	16.0%	20.3%
2800		5	0.876	0.833	0.918	0.732	0.991	0.0205	0.113	12.9%	21.4%
6700		5	0.9	0.862	0.937	0.791	1.02	0.0185	0.101	11.2%	19.2%
18000		5	0.867	0.834	0.901	0.744	0.979	0.0165	0.0904	10.4%	22.1%

Survival Rate Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	5	0.8	0.728	0.872	0.583	1	0.035	0.192	24.0%	0.0%
930		5	0.983	0.969	0.997	0.917	1	0.0068	0.0373	3.79%	-22.9%
1700		5	0.933	0.919	0.947	0.917	1	0.0068	0.0373	3.99%	-16.7%
2800		5	0.883	0.836	0.931	0.75	1	0.0231	0.126	14.3%	-10.4%
6700		5	0.9	0.859	0.941	0.75	1	0.0198	0.109	12.1%	-12.5%
18000		5	0.883	0.836	0.931	0.667	1	0.0231	0.126	14.3%	-10.4%

Early Seedling Growth — **Nautilus Environmental WA**

Mean Dry Biomass-mg Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Backgtround S	0.834	0.723	1.23	1.1	0.61
930		0.852	0.878	1.12	1.08	0.819
1700		0.753	1.01	0.694	0.842	0.837
2800		0.898	0.591	0.732	0.908	0.727
6700		0.725	0.854	0.826	0.63	1.02
18000		0.851	0.84	0.898	0.775	0.496

Mean Dry Weight-mg Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Backgtround S	1.11	1.08	1.23	1.1	1.05
930		0.852	0.878	1.12	1.08	0.894
1700		0.753	1.1	0.757	0.919	0.913
2800		0.898	0.788	0.732	0.991	0.969
6700		0.791	0.854	0.991	0.84	1.02
18000		0.928	0.84	0.979	0.845	0.744

Survival Rate Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Backgtround S	0.75	0.667	1	1	0.583
930		1	1	1	1	0.917
1700		1	0.917	0.917	0.917	0.917
2800		1	0.75	1	0.917	0.75
6700		0.917	1	0.833	0.75	1
18000		0.917	1	0.917	0.917	0.667

CETIS Analytical Report

Early Seedling Growth — **Nautilus Environmental WA**

Analysis No:	10-5129-2786	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 15:52	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	930	1700	1260	0.108	14.6%

Dunnett's Multiple Comparison Test

Control	vs	Conc-mg/kg	Test Stat	Critical	MSD	P-Value	Decision(5%)
Backgtround Soil		930	2.16	2.36	0.163	0.0735	Non-Significant Effect
		1700*	3.27	2.36	0.163	0.0069	Significant Effect
		2800*	3.45	2.36	0.163	0.0045	Significant Effect
		6700*	3.1	2.36	0.163	0.0102	Significant Effect
		18000*	3.57	2.36	0.163	0.0034	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.221339	0.0442678	5	3.72	0.0123	Significant Effect
Error	0.2853279	0.0118887	24			
Total	0.5066668	0.0561565	29			

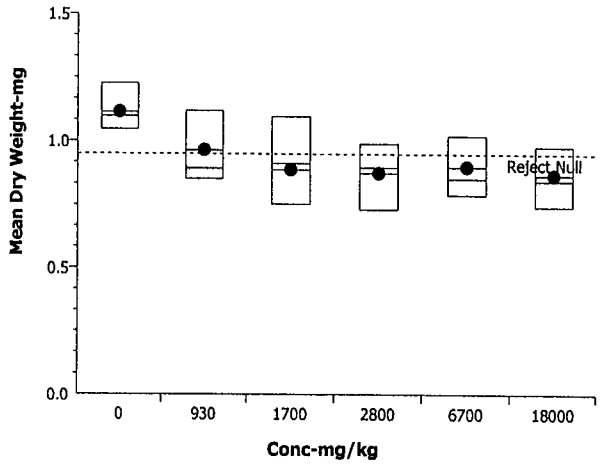
ANOVA Assumptions

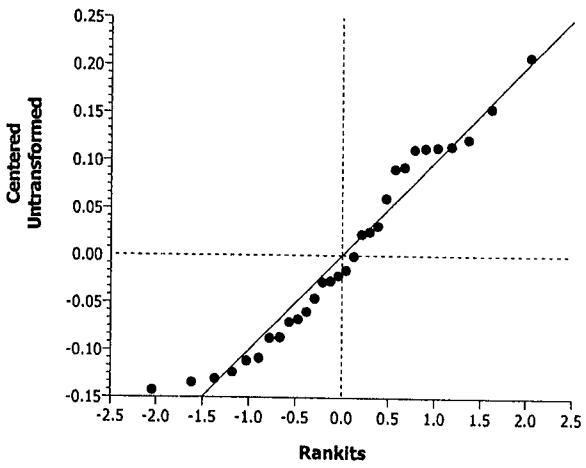
Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	2.24	15.1	0.8150	Equal Variances
Distribution	Shapiro-Wilk Normality	0.946		0.1350	Normal Distribution

Mean Dry Weight-mg Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	5	1.11	1.09	1.14	1.05	1.23	0.0126	0.068	6.1%	0.0%
930		5	0.964	0.917	1.01	0.852	1.12	0.0231	0.125	12.9%	13.4%
1700		5	0.888	0.834	0.942	0.753	1.1	0.0264	0.142	16.0%	20.3%
2800		5	0.876	0.833	0.918	0.732	0.991	0.0209	0.113	12.9%	21.4%
6700		5	0.9	0.861	0.938	0.791	1.02	0.0188	0.101	11.2%	19.2%
18000		5	0.867	0.833	0.902	0.744	0.979	0.0168	0.0904	10.4%	22.1%

Graphics





Early Seedling Growth — **Nautilus Environmental WA**

Analysis No:	04-7612-5129	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 15:52	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	18000	>18000	N/A	0.00556	27.5%

Dunnett's Multiple Comparison Test

Control	vs	Conc-mg/kg	Test Stat	Critical	MSD	P-Value	Decision(5%)
Backgtround Soil		930	-0.487	2.36	0.247	0.9380	Non-Significant Effect
		1700	0.686	2.36	0.247	0.5640	Non-Significant Effect
		2800	1.21	2.36	0.247	0.3290	Non-Significant Effect
		6700	0.829	2.36	0.247	0.4980	Non-Significant Effect
		18000	1.21	2.36	0.247	0.3310	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.1285672	0.0257134	5	0.937	0.4750	Non-Significant Effect
Error	0.6583027	0.0274293	24			
Total	0.7868699	0.0531427	29			

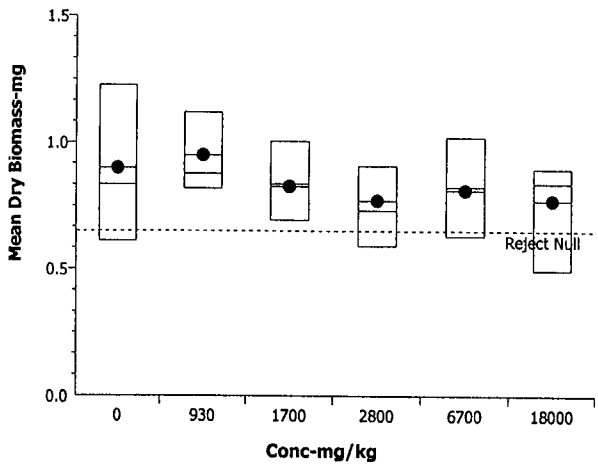
ANOVA Assumptions

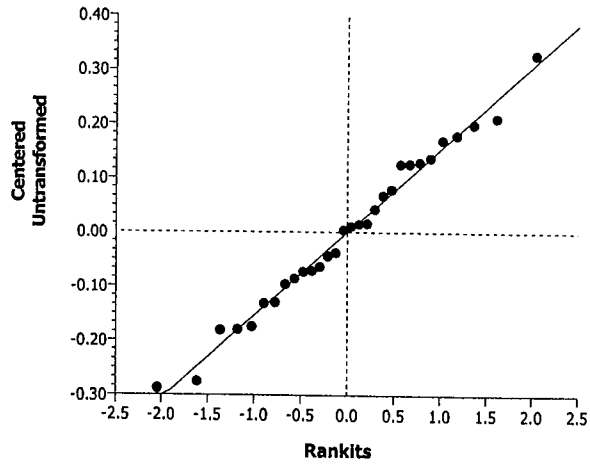
Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	3.25	15.1	0.6620	Equal Variances
Distribution	Shapiro-Wilk Normality	0.984		0.9210	Normal Distribution

Mean Dry Biomass-mg Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	5	0.898	0.8	0.996	0.61	1.23	0.0478	0.258	28.7%	0.0%
930		5	0.949	0.897	1	0.819	1.12	0.0258	0.139	14.6%	-5.68%
1700		5	0.827	0.782	0.871	0.694	1.01	0.0219	0.118	14.2%	8.0%
2800		5	0.771	0.721	0.822	0.591	0.908	0.0247	0.133	17.2%	14.2%
6700		5	0.811	0.755	0.868	0.63	1.02	0.0274	0.147	18.2%	9.67%
18000		5	0.772	0.711	0.833	0.496	0.898	0.0298	0.16	20.8%	14.1%

Graphics





Early Seedling Growth — Nautilus Environmental WA

Analysis No: 12-0231-8126 Endpoint: Survival Rate CETIS Version: CETISv1.6.3
Analyzed: 14 Aug-07 15:18 Analysis: Parametric-Control vs Treatments Official Results: Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)		C > T	Not Run	18000	>18000	N/A	0.00556	24.4%

Dunnett's Multiple Comparison Test

Control	vs	Conc-mg/kg	Test Stat	Critical	MSD	P-Value	Decision(5%)
Backgtround Soil		930	-2.34	2.36	0.254	1.0000	Non-Significant Effect
		1700	-1.52	2.36	0.254	0.9960	Non-Significant Effect
		2800	-0.933	2.36	0.254	0.9800	Non-Significant Effect
		6700	-1.12	2.36	0.254	0.9880	Non-Significant Effect
		18000	-0.916	2.36	0.254	0.9790	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	0.1719985	0.0343997	5	1.19	0.3420	Non-Significant Effect
Error	0.6918734	0.0288281	24			
Total	0.8638719	0.0632278	29			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	9.62	15.1	0.0866	Equal Variances
Distribution	Shapiro-Wilk Normality	0.959		0.2840	Normal Distribution

Survival Rate Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	5	0.8	0.727	0.873	0.583	1	0.0356	0.192	24.0%	0.0%
930		5	0.983	0.969	0.998	0.917	1	0.00692	0.0373	3.79%	-22.9%
1700		5	0.933	0.919	0.948	0.917	1	0.00692	0.0373	3.99%	-16.7%
2800		5	0.883	0.835	0.931	0.75	1	0.0235	0.126	14.3%	-10.4%
6700		5	0.9	0.859	0.941	0.75	1	0.0202	0.109	12.1%	-12.5%
18000		5	0.883	0.835	0.931	0.667	1	0.0235	0.126	14.3%	-10.4%

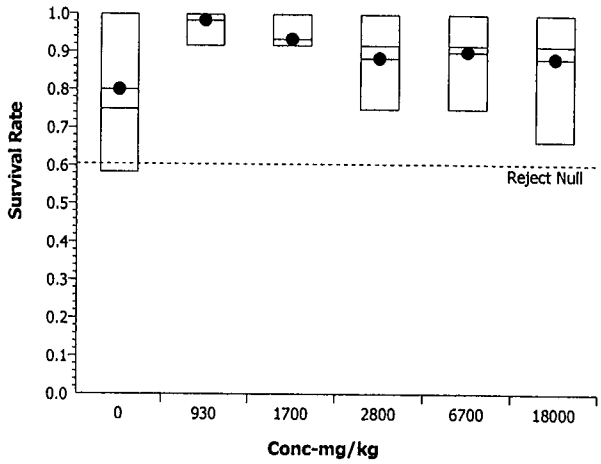
Angular (Corrected) Transformed Summary

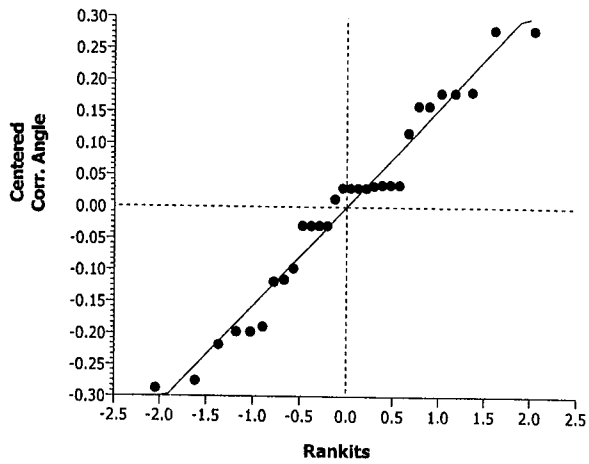
Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	5	1.14	1.04	1.25	0.869	1.43	0.0491	0.264	23.1%	0.0%
930		5	1.4	1.37	1.42	1.28	1.43	0.0123	0.0662	4.74%	-22.0%
1700		5	1.31	1.28	1.33	1.28	1.43	0.0123	0.0662	5.06%	-14.2%
2800		5	1.24	1.17	1.32	1.05	1.43	0.0353	0.19	15.3%	-8.75%
6700		5	1.27	1.2	1.33	1.05	1.43	0.0312	0.168	13.3%	-10.5%
18000		5	1.24	1.18	1.31	0.955	1.43	0.0321	0.173	13.9%	-8.59%

Early Seedling Growth — **Nautilus Environmental WA**

Analysis No:	12-0231-8126	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 15:18	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Graphics





CETIS Analytical Report

Early Seedling Growth — Nautilus Environmental WA

Analysis No:	17-6844-1402	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 15:52	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Linear	Linear	5795186	280	Yes	Two-Point Interpolation

Point Estimates

Effect-%	Conc-mg/k	95% LCL	95% UCL
25	> 18000	N/A	N/A
50	> 18000	N/A	N/A

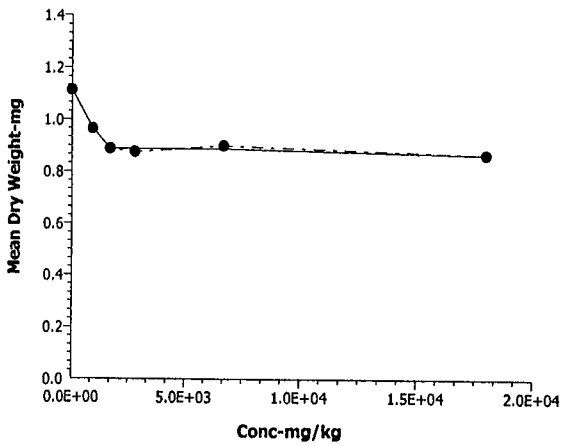
Mean Dry Weight-mg Summary

			Calculated Variate						
Conc-mg/k	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround Soil	5	1.11	1.05	1.23	0.0124	0.068	6.1%	0.0%
930		5	0.964	0.852	1.12	0.0227	0.125	12.9%	13.4%
1700		5	0.888	0.753	1.1	0.0259	0.142	16.0%	20.3%
2800		5	0.876	0.732	0.991	0.0205	0.113	12.9%	21.4%
6700		5	0.9	0.791	1.02	0.0185	0.101	11.2%	19.2%
18000		5	0.867	0.744	0.979	0.0165	0.0904	10.4%	22.1%

Mean Dry Weight-mg Detail

Conc-mg/k	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Backgtround Soil	1.11	1.08	1.23	1.1	1.05
930		0.852	0.878	1.12	1.08	0.894
1700		0.753	1.1	0.757	0.919	0.913
2800		0.898	0.788	0.732	0.991	0.969
6700		0.791	0.854	0.991	0.84	1.02
18000		0.928	0.84	0.979	0.845	0.744

Graphics



Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Shoot and Root Weight Data
14-Day Soil Toxicity Test

Client: CDM
Sample ID. Source Soil
Test No: 0706-T075
Log-In#: N1

Start Date & Time: 6-27-07 1645
Stop Date & Time: 7-11-07 1600
Test Species: *Lactuca sativa* (Butter Crunch Lettuce)

Conc.	Cont.	Rep.	No. Seedlings Emerged	Shoot Pan Tare Wt. (g)	Pan + Wet Shoot Wt. (g)	Pan + Dry Shoot Wt. (g)	
Con-lab	23	1	12	1.59906	2.15330	1.68332095	SB
	16	2	11	1.64272	2.11330	1.66335	
	17	3	12	1.52530	2.02217	1.54784	
	31	4	12	1.58883	2.10744	1.60897	
	26	5	12	1.60387	2.09885	1.62356	
Con-ref	21	1	9	1.65339	1.92217	1.66340	
	12	2	8	1.70842	~~1.79376~~ ②	1.71710	
	8	3	12	1.55979	1.79376	1.57451	
	18	4	12	1.58823	1.85985	1.60140	
	24	5	7	1.61429	1.78073	1.62161	
3.13	34	1	12	1.62152	1.80510	~~1.62865~~	1.63175 KT
	11	2	12①	1.64588	1.84752	1.65641	
	33	3	12	1.57389	1.68561	1.58732	
	30	4	12	1.68783	1.94659	1.70077	
	20	5	11	1.68018	1.83292	1.69001	
6.25	5	1	12	1.60332	1.74930	1.61236	
	32	2	11	1.71731	1.84846	1.72938	
	35	3	11	~~1.65090~~*	1.67712	1.62905	
	14	4	11	1.66679	1.86160	1.67690	
	13	5	~~10~~ 11	1.66196	1.84837	1.67200	
12.5	15	1	12	1.71995	1.90263	1.73072	
	6	2	9	1.57711	1.75338	~~1.58622~~	1.584.20 KT
	25	3	12	1.58067	1.74374	1.58946	
	2	4	11	1.57963	1.77803	1.59053	
	9	5	9	1.59021	1.77832	1.59893	
25	3	1	11	1.60090	1.78192	1.60960	
	10	2	12	1.65024	1.80907	1.66049	
	27	3	10	1.67428	1.88315	1.68419	
	7	4	9	1.61299	1.76617	1.62055	
	1	5	12	1.67106	1.91845	1.68333	
Tech Initials:			CE	MM	CC ② 1.88850	SB	

Comments: Initial number of seeds added to each replicate = 12
* 1.62075
① See note on daily germination counts

Date/Time in: 7-11-07 1730
Oven Temp (°C): 60
Date/Time out: 7/13/07 1200
Oven Temp (°C): 60

QC Check: KT

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Shoot and Root Weight Data
14-Day Soil Toxicity Test

Client: CDM
Sample ID. Source Soil
Test No: 0706-T075
Log-In#: NA

Start Date & Time: 6-27-07 1645
Stop Date & Time: 7/11/07 1600
Test Species: *Latuca sativa* (Butter Crunch Lettuce)

Conc.	Cont.	Rep.	No. Seedlings Emerged	Shoot Pan Tare Wt. (g)	Pan + Wet Shoot Wt. (g)	Pan + Dry Shoot Wt. (g)
50	19	1	11	1.64495	1.82140	1.65516
	28	2	12	1.69847	1.90010	1.70855
	22	3	11	~~1.61~~ 1.77934	1.99052	1.79011
	29	4	11	1.68623	1.87221	1.69553
	4	5	8	1.79258	1.91030	1.79853
		1				
		2				
		3				
		4				
		5				
		1				
		2				
		3				
		4				
		5				
		1				
		2				
		3				
		4				
		5				
		1				
		2				
		3				
		4				
		5				
		1				
		2				
		3				
		4				
		5				
Tech Initials:			ce	mc	ce	SB

Comments: Initial number of seeds added to each replicate = 12

See page 1

Date/Time in:
Oven Temp (°C):
Date/Time out:
Oven Temp (°C):

See page 1

QC Check: KT

PLANTING MAP (Client)

	1	2	3	4	5	6	7
surrogate	SUR CON-L	SUR CON-R	SUR 3.13	SUR 6.25	SUR 12.5	SUR 25	SUR 50
A	1 25	6 12.5	11 3.13	16 CON-L	21 CON-R	26 CON-L	31 CON-L
B	2 12.5	7 25	12 CON-R	17 CON-L	22 50	27 25	32 6.25
C	3 25	8 CON-R	13 6.25	18 CON-R	23 CON-L	28 50	33 3.13
D	4 50	9 12.5	14 6.25	19 50	24 CON-R	29 50	34 3.13
E	5 6.25	10 25	15 12.5	20 3.13	25 12.5	30 3.13	35 6.25

Soil Toxicity Test — **Lettuce Seed Daily Germination Counts**

Client/Project ID: CDM **Test No:** 0706-T075 **Start Date/Time:** 6/27/07 1645

Tray #: **Test Species:** Lactuca sativa **End Date/Time:** 7/11/07 1600

Day 3	Row	Column 1	2	3	4	5	6	Σ
Surrogate		0	0	8	0	0	0	0
	A	10	8	2	4	4	3	6
	B	9	3	6	6	9	8	10
	C	6	9	8	11	8	6	9
	D	5	6	9	5	2	6	11
	E	11	8	9	9	8	11	11
Analyst	QA							

Day 7 (6/28)	Row	Column 1	2	3	4	5	6	Σ
Surrogate		–	–	12	–	–	–	–
	A	12	9	2	11	9	12	12
	B	11	9	8	12	11	10	11
	C	11	11	11	12	12	12	12
	D	8	9	11	11	6	11	12
	E	12	12	12	11	12	12	11
Analyst	LES							

Day 11	Row	Column 1	2	3	4	5	6	Σ
Surrogate		—	—	11	—	—	—	—
	A	12	9	2	11	9	12	12
	B	11	9	7	12	10	10	11
	C	11	9	11	11	12	12	12
	D	8	9	11	11	5	11	12
	E	12	12	12	11	12	12	11
Analyst	QA							

Day 4	Row	Column 1	2	3	4	5	6	Σ
Surrogate		0	0	11	0	0	0	0
	A	12	9	3	11	9	12	9
	B	11	7	7	12	10	10	10
	C	10	9	10	11	11	12	12
	D	7	9	10	10	7	10	12
	E	12	12	~~9~~ 10 12	11	12	12	11
Analyst	QA							

Day 8 (6/29)	Row	Column 1	2	3	4	5	6	Σ
Surrogate		–	–	12	–	–	–	–
	A	12	9	2	11	9	12	12
	B	12	9	8	12	11	10	11
	C	11	11	11	12	12	12	12
	D	8	9	11	11	7	11	12
	E	12	12	12	11	12	12	11
Analyst	LES							

Day 12	Row	Column 1	2	3	4	5	6	Σ
Surrogate		—	—	12	–	–	–	–
	A	12	9	~~8~~ 12	11	9	12①	12②
	B	12	9	8	12	11	10	11
	C	11*	11	11*	12	12	12	12
	D	8	9	11	11	7	11	12
	E	12	12	12	11	12	12	11
Analyst	LES							

① Almost of stem wilted + is now hair-like in Cotyledons gone, just stem left on one seedling

Day 5	Row	Column 1	2	3	4	5	6	Σ
Surrogate		—	—	11	–	–	–	–
	A	12	9	2	11	9	12	12
	B	11	9	7	12	10	10	10
	C	10	9	11	11	12	12	12
	D	7	9	11	11	5	10	12
	E	12	~~13~~ 12	12	11	12	12	11
Analyst	LES							

Day 9 (6/30)	Row	Column 1	2	3	4	5	6	Σ
Surrogate		–	–	12	–	–	–	–
	A	12	9	3	11	9	12	12
	B	12	9	8	12	11	10	11
	C	11	11	11	12	12	12	12
	D	8	~~10~~ 9	11	11	7	11	12
	E	12	12	12	11	12	12	11
Analyst	LES							

Day 13	Row	Column 1	2	3	4	5	6	Σ
Surrogate		–	–	12	–	–	–	–
	A	12	9	3	~~4~~ 11	~~12~~ 9	12	12
	B	12	~~12~~ 9	8	12	~~11~~ 10	10	11
	C	11	12	11	12	12	12	12
	D	8	9	11	~~7~~ 11	~~11~~ 7	11	12
	E	12	12	12	~~12~~ 11	12	12	11
Analyst	LES							

Day 6	Row	Column 1	2	3	4	5	6	Σ
Surrogate		—	—	11	–	–	–	–
	A	12	9	2	11	9	~~10~~ 12	12
	B	11	9	7	12	10	10	11
	C	11	9	11	11	12	12	12
	D	8	9	11	11	5	11	12
	E	12	12	12	11	12	12	11
Analyst	LES							

Day 10 (7/1)	Row	Column 1	2	3	4	5	6	Σ
Surrogate		–	–	12	–	–	–	–
	A	12	9	3	11	9	12	12
	B	12	9	8	12	11	10	11
	C	11	11	11	12	12	12	12
	D	8	~~10~~ 9	11	11	7	11	12
	E	12	12	12	11	12	12	11
Analyst	LES							

Day 14	Row	Column 1	2	3	4	5	6	Σ
Surrogate				12				
	A	12	9	3	11	9	12	12
	B	11	9	8	12	11	10	11
	C	11	12	~~10~~ 11	12	12	12	12
	D	8	9	11	11	7	11	12
	E	12	12	12	11	12	12	11
Analyst	CL							

Day 11 (7/2)	Row	Column 1	2	3	4	5	6	Σ
Surrogate		–	–	12	–	–	–	–
	A	12	9	3	11	9	12	12
	B	12	9	8	12	11	10	11
	C	11	11	11	12	12	12	12
	D	8	9	11	11	7	11	12
	E	12	12	12	11	12	12	11
Analyst	MM							

Comments: E-7 all seedlings fell over (Day 8) ② Day 12 - Column 7 Seedling's cotyledons caught under dome - plant injured

QC Check: KJ

Surrogate in column 3 planted with seeds instead of Row A column 3 both are 3.13%. When Test is ended use surrogate

Final Review:

Nautilus Environmental 5009 Pacific Hwy. E., Suite 2. Tacoma, WA 98424.

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Sublethal Data
14-Day Soil Toxicity Test

Client: COM
Sample ID. Source Soil
Test No: 0706-T025
Log-In#: NA

Start Date & Time: 6/27/07 1645
Stop Date & Time: 7/11/07 1600
Test Species: *Lactuca sativa* (Butter Crunch Lett

Conc.	Cont.	Rep.	Comments
6.25	5	1	~~4 tea~~
	32	2	1 very small w/ brown leaves - all with small leaves
	35	3	all thin w/ small leaves
	14	4	1 small + curly, 1 brown spot
	13	5	1 with hair-thin stem
12.5	15	1	1 smaller
	6	2	
	25	3	1w brown hair-like stem
	2	4	
	9	5	
25	3	1	1 stem just hair-thin brown ~~stem~~
	10	2	1 w/ small leaves, 1 whilted
	27	3	
	7	4	1 w/ small, dark leaves
	1	5	

Tech Initials: ce

QC Check: [illegible]

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Sublethal Data
14-Day Soil Toxicity Test

Client: CDM
Sample ID. Source Soil
Test No: 0706-T075
Log-In#: NA

Start Date & Time: 6-27-07 1645
Stop Date & Time: 7/11/07 1600
Test Species: *Lactuca sativa* (Butter Crunch Lett

Conc.	Cont.	Rep.	Comments
CON lab	23	1	
	16	2	
	17	3	1 smaller than the rest
	31	4	
	26	5	1 lost its leaves
CON Ref	21	1	
	12	2	1 significantly smaller
	8	3	2 small + whilted, 1 thin, hair-like stem
	18	4	
	24	5	
3.13	34	1	all ~~small~~ thin w/ small leaves
	11	2	1 sig. smaller than others
	33	3	all very small, 2 (leaves) without leaves
	30	4	
	20	5	1 smaller

Tech Initials: CC

QC Check: KT

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Sublethal Data
14-Day Soil Toxicity Test

Client: COM
Sample ID. Source Soil
Test No: 0706-T075
Log-In#: NA

Start Date & Time: 6/27/07 1645
Stop Date & Time: KT 6/X 7/11/07 1600
Test Species: *Latuca sativa* (Butter Crunch Lett

Conc.	Cont.	Rep.	Comments
50	19	1	
	28	2	
	22	3	some leaves misformed 2. 1 very small w/ brown leaves
	29	4	1 small w/ brown curly leaves
	4	5	1 smaller leaves. 1 much shorter w/ no leaves
		1	
		2	
		3	
		4	
		5	
		1	
		2	
		3	
		4	
		5	

Tech Initials: cc

QC Check: KT

Soil Toxicity Test

Soil Quality Measurments

Client: CDM

Sample ID: Source Soil

Test #: 0706-T075

Test Species: *Lactuca sativa* (butter crunch lettuce)

Start Date/Time: 6/27/07 1645

End Date/Time: 7/11/07 1600

Test Day	Temperature (°C)	Were Plants Watered? (Y/N)	Light Intensity (lux)	Tech Initials
0	22.2	✓	2950	les
1	*19.4	✓		mm
2	*19.3	✓		MM
3	*19.5	✓		Et
4	*19.3	✓		Et
5	*19.5	✓		les
6	*19.3	✓		les
7	*19.1	✓	2030	et
8	*19.2	✓	①3010	les
9	20.5	✓		les
10	20.5	✓		les
11	20.5	✓		MM
12	20.3	✓		les
13	20.4	✓		les
14	~~*20.7~~		~~2800~~	CC
	20.5		2780	

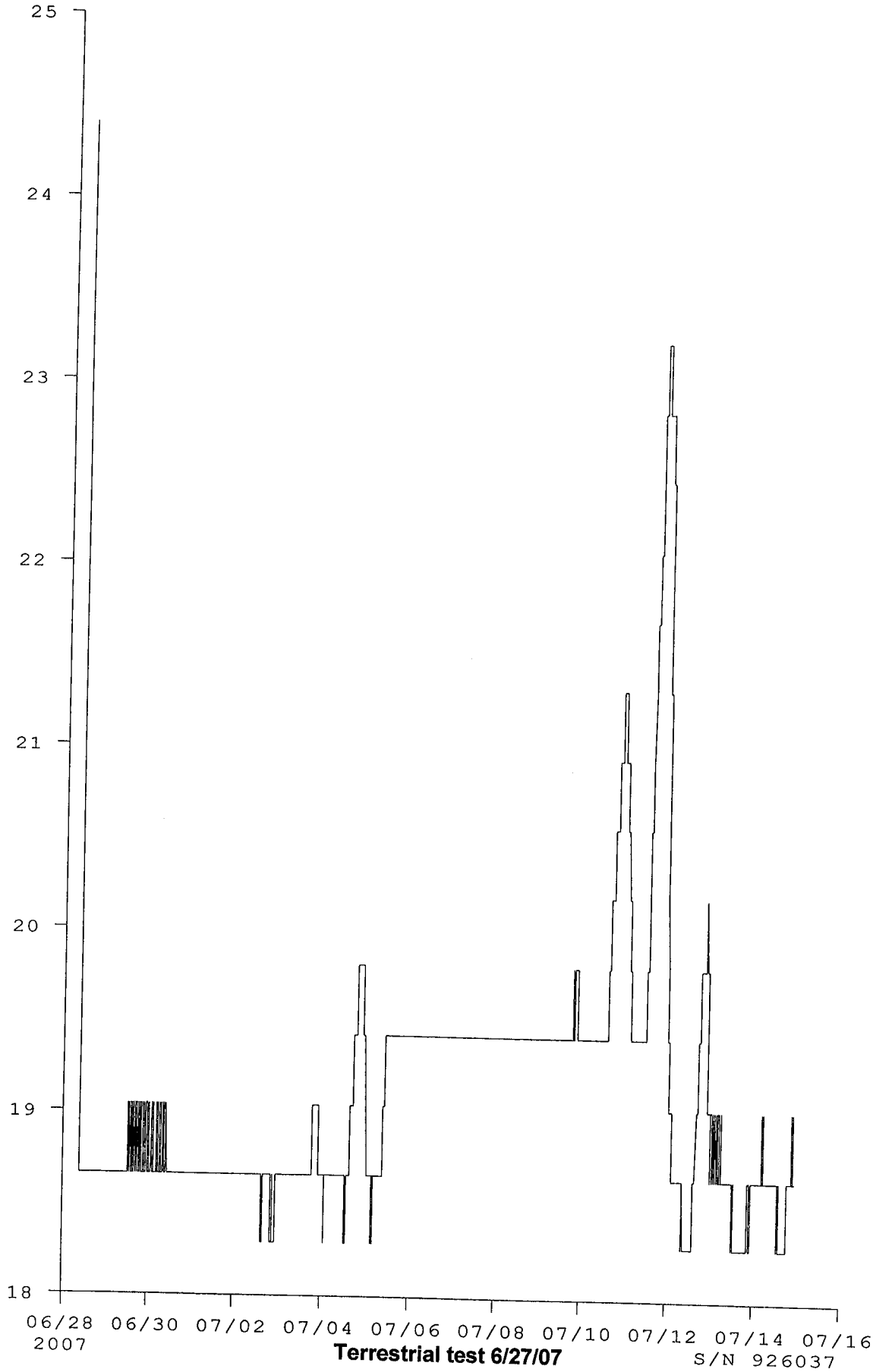
Conc. Or %	Soil Slurry pH (units)		Soil Supernatent pH (units)	
	initial	final	initial	final
CON	6.95	6.91	7.09	6.71
3.13	7.28	7.00	7.06	6.68
6.25	7.11	6.75	6.97	6.56
12.5	7.12	6.47	6.91	6.40
25	6.92	6.21	6.91	6.25
50	6.61	6.13	6.55	6.19
Tech Init.	AB	mm	AB	mm

Comments: * Temperature too low - see corrective action #07-012

7/5 One of the light bulbs burned out, both light bulbs were replaced

① New light intensity reading after bulb change.

QC Check: KT

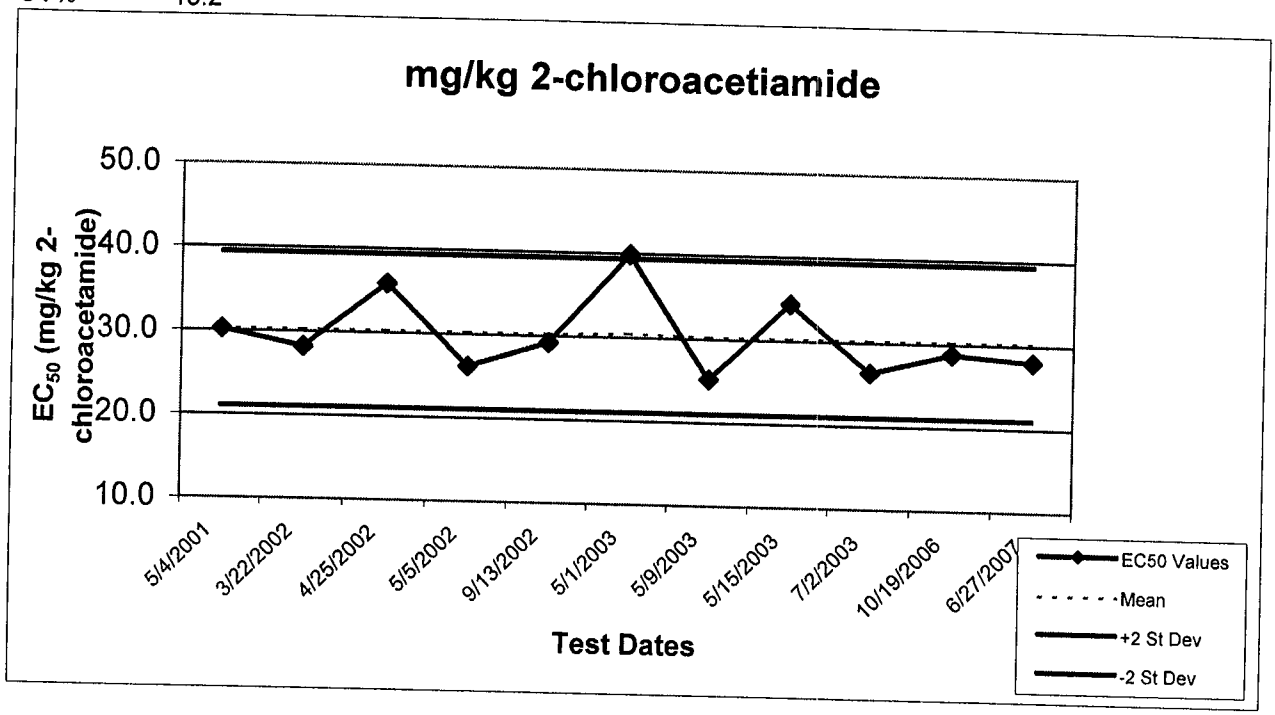

25
24
23
22
21
20
19
18
06/28
2007
06/30
07/02
07/04
07/06
07/08
07/10
07/12
07/14
07/16
Terrestrial test 6/27/07
S/N 926037

APPENDIX C - Reference Toxicant Tests

Eisenia fetida (earthworm)

Reference Toxicant Test Control Chart
Eisenia Fetida 14-day Survival

CV% = 15.2



Date		EC50 %		Mean	StDev	-2 SD	+2 SD
5/4/2001		30.2		30.2	4.6	21.0	39.4
3/22/2002		28.2		30.2	4.6	21.0	39.4
4/25/2002		35.9		30.2	4.6	21.0	39.4
5/5/2002		26.2		30.2	4.6	21.0	39.4
9/13/2002		29.2		30.2	4.6	21.0	39.4
5/1/2003		39.9		30.5	5.6	21.0	39.4
5/9/2003		25.2		30.2	4.6	21.0	39.4
5/15/2003		34.4		30.2	4.6	21.0	39.4
7/2/2003		26.4		30.2	4.6	21.0	39.4
10/19/2006		28.8		30.2	4.6	21.0	39.4
6/27/2007		28.0		30.2	4.6	21.0	39.4

CETIS Summary Report

Eisenia 14-d Survival Soil Test — **Nautilus Environmental WA**

Test Run No:	06-7533-6922	**Test Type:**	Survival	**Analyst:**	
Start Date:	27 Jun-07 18:00	**Protocol:**	WDOE 96-327	**Diluent:**	
Ending Date:	11 Jul-07 15:15	**Species:**	Eisenia fetida	**Brine:**	
Duration:	13d 21h	**Source:**		**Age:**	

Sample No:	02-7548-9644 Not applicable	**Code:**	275489544	**Client:**	Reference Toxicant Test
Sample Date:	27 Jun-07	**Material:**	2-chloroacetamide	**Project:**	King County Ellisport Creek
Receive Date:		**Source:**	Reference Toxicant		
Sample Age:	18h	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
11-8855-6432	Survival Rate	20	40	28.3	23.1%	Dunnett's Multiple Comparison Test

Point Estimate Summary

Analysis No	Endpoint	Effect-%	Conc-mg/k	95% LCL	95% UCL	Method
13-6127-6576	Survival Rate	50	28	24.8	31.6	Trimmed Spearman-Kärber

Survival Rate Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Control Sed	3	0.933	0.912	0.955	0.9	1	0.0105	0.0577	6.19%	0.0%
10		3	0.867	0.824	0.91	0.8	1	0.0211	0.115	13.3%	7.14%
20		3	0.833	0.812	0.855	0.8	0.9	0.0105	0.0577	6.93%	10.7%
40		3	0.1	0.0353	0.165	0	0.3	0.0316	0.173	173.0%	89.3%
80		3	0	0	0	0	0	0	0		100.0%

Survival Rate Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3
0	Control Sed	0.9	1	0.9
10		0.8	1	0.8
20		0.8	0.9	0.8
40		0	0.3	0
80		0	0	0

CETIS Analytical Report

Eisenia 14-d Survival Soil Test — **Nautilus Environmental WA**

Analysis No:	11-8855-6432	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 20:16	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)		C > T	Not Run	20	40	28.3	5	23.1%

Dunnett's Multiple Comparison Test

Control	vs	Conc-mg/kg	Test Stat	Critical	MSD	P-Value	Decision(5%)
Control Sed		10	0.797	2.47	0.293	0.4740	Non-Significant Effect
		20	1.26	2.47	0.293	0.2900	Non-Significant Effect
		40*	8.46	2.47	0.293	0.0000	Significant Effect
		80*	9.65	2.47	0.293	0.0000	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	3.615323	0.9038308	4	42.8	0.0000	Significant Effect
Error	0.211174	0.0211174	10			
Total	3.826497	0.9249482	14			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Mod Levene Equality of Varianc	1.38	5.99	0.3080	Equal Variances
Distribution	Shapiro-Wilk Normality	0.891		0.0700	Normal Distribution

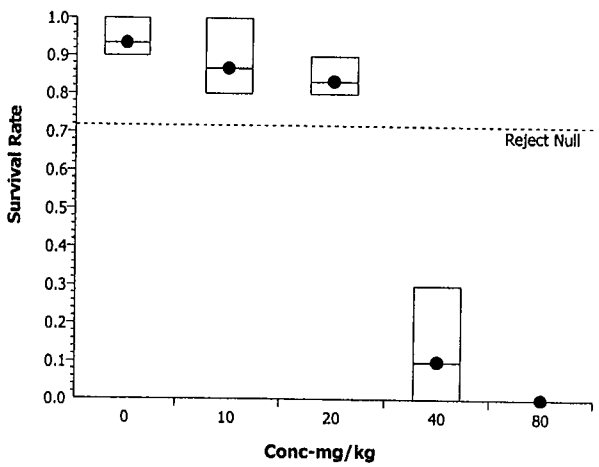
Survival Rate Summary

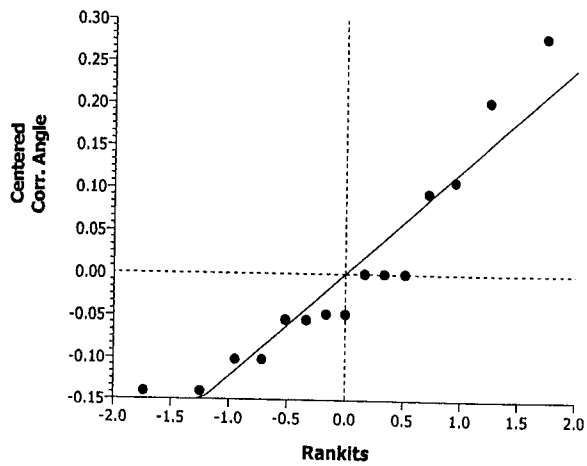
Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Control Sed	3	0.933	0.911	0.955	0.9	1	0.0107	0.0577	6.19%	0.0%
10		3	0.867	0.823	0.911	0.8	1	0.0214	0.115	13.3%	7.14%
20		3	0.833	0.811	0.855	0.8	0.9	0.0107	0.0577	6.93%	10.7%
40		3	0.1	0.0341	0.166	0	0.3	0.0322	0.173	173.0%	89.3%
80		3	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Control Sed	3	1.3	1.27	1.34	1.25	1.41	0.0175	0.0941	7.22%	0.0%
10		3	1.21	1.14	1.28	1.11	1.41	0.0327	0.176	14.6%	7.26%
20		3	1.15	1.12	1.19	1.11	1.25	0.0152	0.0819	7.1%	11.4%
40		3	0.299	0.207	0.391	0.159	0.58	0.0451	0.243	81.2%	77.1%
80		3	0.159	0.159	0.159	0.159	0.159	0	0	0.0%	87.8%

Graphics





CETIS Analytical Report

Link/Link Code: 19-0311-5351/RT062707EF

Eisenia 14-d Survival Soil Test — Nautilus Environmental WA

Analysis No:	13-6127-6576	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	14 Aug-07 20:17	**Analysis:**	Trimmed Spearman-Kärber	**Official Results:**	Yes

Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC/LC50	95% LCL	95% UCL
Control Threshold	0.0667	7.14%	1.45	0.0264	28	24.8	31.6

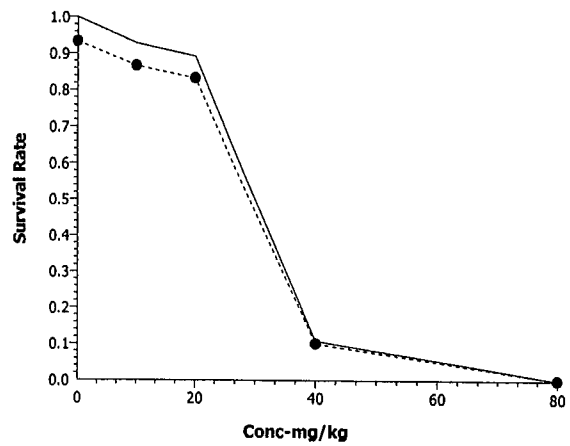
Survival Rate Summary

			Calculated Variate(A/B)								
Conc-mg/k	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%	A	B
0	Control Sed	3	0.933	0.9	1	0.0105	0.0577	6.19%	0.0%	28	30
10		3	0.867	0.8	1	0.0211	0.115	13.3%	7.14%	26	30
20		3	0.833	0.8	0.9	0.0105	0.0577	6.93%	10.7%	25	30
40		3	0.1	0	0.3	0.0316	0.173	173.0%	89.3%	3	30
80		3	0	0	0	0	0		100.0%	0	30

Survival Rate Detail

Conc-mg/k	Control Type	Rep 1	Rep 2	Rep 3
0	Control Sed	0.9	1	0.9
10		0.8	1	0.8
20		0.8	0.9	0.8
40		0	0.3	0
80		0	0	0

Graphics



Analyst: KT QA: KT

Environmental Quality Results - 14-Day Soil
Nautilus Environmental

Client/ Project ID: Reference Toxicant
Site ID: _____

Organism Tested: Eisenia fetida
Start Date/Time: 6-27-07 1800
End Date/Time: 7/11/07 1511

Test Day	Temp (°C)	Tech Initials
0	21.0	MC
1	19.9	MC
2	19.5	MM
3	19.6	EC
4	19.3	EF
5	19.2	LES
6	19.4	LES
7	19.1	EF
8	19.2	LES
9	20.5	LES
10	20.3	MM
11	20.4	LES
12	20.4	LES
13	20.2	LES
14	20.9	MC

Conc. mg/kg	Rep.	Container	% Moisture initial	% Moisture final	pH (units) initial	pH (units) final	Conductivity (uhom-cm initial	Conductivity (uhom-cm final	Survival initial	Survival final
CON	1	7							10	9
	2	3							10	10
	3	1							10	9
10	1	14							10	8
	2	11							10	10
	3	5							10	8
20	1	15							10	8
	2	9							10	9
	3	2							10	8
40	1	6							10	0
	2	12							10	3
	3	8							10	0
80	1	13							10	0
	2	10							10	0
	3	4							10	0

QA Review/Date: KT
Final Review/Date: KT

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Soil Data
14-Day Soil Toxicity Test

Client: Reference Toxicant
Sample ID.
Test No: RT 062707 F.E.
Log-In#: N/A

Start Date & Time: 6/27/07 1800
Stop Date & Time:
Test Species: Eisenia fetida

Soil Weights

Initial

Site	Pan weight	Initial (wet)	Final (dry)	~~MF~~
Tech Initials:				

Soil (Reftox) hydrated to 35% by adding 70 ml DI water to 200 mg artificial/garden soil

MF= (I-F)/[A-(I-F)]*100

MF= Moisture fraction of bulk soil (in %)
I= Initial wet weight of sample + crucible (in grams)
F=Final dry weight of sample + crucible (in grams)
A= Initial aliquot weight (in grams)

pH/ Conductivity

Site	pH (5 min)	Cond (5min)	pH (30 min)	Cond (30 min)
CON	6.88	0.504mS	~~6.94~~ 6.8	0.585
conC	7.42	0.655mS	7.30	0.659
10	6.97	0.560	6.90	~~0.631~~ 0.6 31
20	7.03	0.540	~~6.99~~ 6.99	0.697
40	7.02	0.623	6.98	0.662
80	6.88	0.534	6.91	0.599
Tech Initials:		SB		

To measure pH/Conductivity make a slurry of soil and DI in a 1:1 ratio. Put on stir plate for 5 minutes and record reading. Allow slurry to settle for 30 minutes and record reading

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Soil Data
14-Day Soil Toxicity Test

Client: Reference Toxicant
Sample ID. 80mg/L 2-Chloroacetamide
Test No: RTD62707EF
Log-In#: NA

Start Date & Time: 6-27-07 1800
Stop Date & Time: 7/11/07 1600
Test Species: Eisenia Fetida

Final

Soil Weights

Site	Pan weight	Initial (wet)	Final (dry)	MF
RT Con	1.65055	26.66779	19.658	38.9
~~Con b~~	~~1.64850~~	~~26.43671~~	~~19.876~~	~~40.8~~ 40.8
10	1.57550	26.89701	19.231	~~38.6~~ 38.6 — 40.8 %
20	1.67886	26.29300	19.876	~~51.1~~ 51 — 38.6 %
40	1.67709	25.78870	17.969	4 — 51.1 %
80	1.75655	↓	18.535	— 43.2 %
Tech Initials:		mw	JB	

MF= (I-F)/[A-(I-F)]*100

MF= Moisture fraction of bulk soil (in %)
I= Initial wet weight of sample + crucible (in grams)
F=Final dry weight of sample + crucible (in grams)
A= Initial aliquot weight (in grams)

pH/ Conductivity

Site	pH (5 min)	Cond (5min)	pH (30 min)	Cond (30 min)
RT Con	6.79	499	6.61	510
10	6.77	522	6.62	526
20	6.74	598	6.60	619
40	6.76	~~647~~ 601	6.60	630
80	6.72	595	6.59	590
Tech Initials:	mw	mw		

To measure pH/Conductivity make a slurry of soil and DI in a 1:1 ratio. Put on stir plate for 5 minutes and record reading. Allow slurry to settle for 30 minutes and record reading

Lactuca sativa **(butter crunch lettuce)**

Lactuca sativa 14-day Survival and Growth
Reference Toxicant Test Results
Test Initiated June 27, 2007

		Survival				Growth					
Concentration (mg/L Boric acid)	Rep	# Alive	% Survival	Mean % Survival	St. Dev.	Tare Weight (mg)	Total Weight (mg)	Total Seedling Weight (mg)	Growth per Seedling (mg)	Mean Growth per Org (mg)	St. Dev.
Laboratory Control	1	11	91.7	98.3	3.7	1630.50	1644.73	14.23	1.29	1.58	0.30
	2	12	100.0			1665.44	1690.02	24.58	2.05		
	3	12	100.0			1689.68	1706.41	16.73	1.39		
	4	12	100.0			1655.54	1675.54	20.00	1.67		
	5	12	100.0			1671.89	1689.92	18.03	1.50		
125	1	12	100.0	98.3	3.7	1637.18	1654.10	16.92	1.41	1.41	0.12
	2	12	100.0			1648.72	1665.41	16.69	1.39		
	3	12	100.0			1544.16	1560.64	16.48	1.37		
	4	12	100.0			1571.40	1590.77	19.37	1.61		
	5	11	91.7			1550.06	1564.08	14.02	1.27		
250	1	12	100.0	100.0	0.0	1704.22	1721.42	17.20	1.43	1.29	0.34
	2	12	100.0			1699.93	1709.48	9.55	0.80		
	3	12	100.0			1675.58	1694.78	19.20	1.60		
	4	12	100.0			1704.55	1717.76	13.21	1.10		
	5	12	100.0			1698.50	1716.91	18.41	1.53		
500	1	10	83.3	96.7	7.5	1686.72	1699.78	13.06	1.31	1.41	0.08
	2	12	100.0			1691.07	1707.88	16.81	1.40		
	3	12	100.0			1708.82	1727.12	18.30	1.53		
	4	12	100.0			1644.29	1661.25	16.96	1.41		
	5	12	100.0			1624.97	1642.03	17.06	1.42		
1000	1	12	100.0	100.0	0.0	1574.22	1590.02	15.80	1.32	1.42	0.18
	2	12	100.0			1605.55	1622.43	16.88	1.41		
	3	12	100.0			1538.53	1558.05	19.52	1.63		
	4	12	100.0			1567.50	1581.64	14.14	1.18		
	5	12	100.0			1557.20	1576.12	18.92	1.58		
2000	1	12	100.0	98.3	3.7	1520.82	1538.00	17.18	1.43	1.40	0.24
	2	12	100.0			1553.57	1569.27	15.70	1.31		
	3	11	91.7			1647.07	1666.36	19.29	1.75		
	4	12	100.0			1763.91	1781.25	17.34	1.44		
	5	12	100.0			1647.14	1660.17	13.03	1.09		

Soil Toxicity Test

Lettuce Seed Daily Germination Counts

Client/Project ID: Reference Tadicat **Test No:** RT062707LS **Start Date/Time:** 6/27/07 1645

Tray #: **Test Species:** Lactuca Sativa **End Date/Time:** 7-11-07 1300

Day 3

Row	1	2	3	4	5	6
Surrogate	3	5	3	0	0	0
A	5	5	7	1	1	6
B	5	4	2	3	2	1
C	3	4	4	3	3	5
D	3	3	6	2	4	5
E	1	2	0	1	1	0
Analyst	QT					

Day 4

Row	1	2	3	4	5	6
Surrogate	5	10	5	0	0	0
A	8	8	12	7	7	10
B	12	8	10	9	9	4
C	11	6	11	12	11	10
D	8	11	11	10	11	10
E	8	5	3	3	2	3
Analyst	QT					

Day 5

Row	1	2	3	4	5	6
Surrogate	12	12	11	—	—	—
A	12	12	12	12	+11 16	12
B	12	12	12	12	11	11
C	12	12	11	12	12	12
D	12	+11 19	11	12	12	11
E	10	11	9	11	6	7
Analyst	IES					

Day 6

Row	1	2	3	4	5	6
Surrogate	12	12	12	+2 14	—	—
A	12	12	12	12	11	12
B	12	12	12	12	11	12
C	12	12	12	12	12	12
D	12	12	12	12	12	12
E	10	12	11	12	10	11
Analyst	IES					

Day 7

Row	1	2	3	4	5	6
Surrogate	12	12	12	—	—	—
A	12	12	12	12	11	12
B	12	12	12	12	11	12
C	12	12	12	12	12	12
D	12	12	12	12	12	12
E	10	12	11	12	10	11
Analyst	QT					

Day 8

Row	1	2	3	4	5	6
Surrogate	12	12	12	—	—	—
A	12	12	12	12	12	12
B	12	12	12	12	11	12
C	12	12	12	12	12	12
D	12	12	12	12	12	12
E	10	12	11	12	11	12
Analyst	IES					

Day 9

Row	1	2	3	4	5	6
Surrogate	12	12	12	—	—	—
A	12	12	12	12	12	12
B	12	12	12	12	11	12
C	12	12	12	12	12	12
D	12	12	12	12	12	12
E	10	12	11	12	11	12
Analyst	IES					

Day 10

Row	1	2	3	4	5	6
Surrogate	12	12	12	—	—	—
A	12	12	12	12	12	12
B	12	12	12	12	11	12
C	12	12	12	12	12	12
D	12	12	12	12	12	12
E	10	12	11	12	11	12
Analyst	IES					

Day 11

Row	1	2	3	4	5	6
Surrogate	12	12	12	+2 14	—	—
A	12	12	12	12	12	12
B	12	12	12	12	11	12
C	12	12	12	12	12	12
D	12	12	12	12	12	12
E	10	12	11	12	11	12
Analyst	IES					

Day 12

Row	1	2	3	4	5	6
Surrogate	12	12	12	—	—	—
A	12	12	12	12	12	12
B	12	12	12	12	11	12
C	12	12	12	12	12	12
D	12	12	12	12	12	12
E	10	12	11	12	11	12
Analyst	IES					

Day 13

Row	1	2	3	4	5	6
Surrogate	12	12	12	—	—	—
A	12	12	12	12	12	12
B	12	12	12	12	11	12
C	12	12	12	12	12	12
D	12	12	12	12	12	12
E	10	12	11	12	11	12
Analyst	IES					

Day 14

Row	1	2	3	4	5	6
Surrogate	12	12	12	—	—	—
A	12	12	12	12	12	12
B	12	12	12	12	11 +2 13	12
C	12	12	12	12	12	12
D	12	12	12	12	12	12
E	10	12	11	12	11	12
Analyst	CC					

Comments: Some surrogates innoculated w/ seeds

QC Check: KJ **Final Review:** KJ

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Shoot and Root Weight Data
14-Day Soil Toxicity Test

Client: RT
Sample ID. 2000 mg/L Boric Acid
Test No: RT062707LS
Log-In#: NA

Start Date & Time: 6-27-07 1645
Stop Date & Time: 7-11-07 1300
Test Species: *Letuca sativa* (Butter Crunch Lettuce)

Conc.	Cont.	Rep.	No. Seedlings Emerged	Shoot Pan Tare Wt. (g)	Pan + Wet Shoot Wt. (g)	Pan + Dry Shoot Wt. (g)
Con	15	1	11	1.63050	1.95458	1.64473
	26	2	~~11~~ 12	1.66544	2.22528	1.69002
	29	3	12	1.68968	2.12624	1.70641
	18	4	12	1.65554	2.16019	1.67554
	7	5	12	1.67189	2.12556	1.68992
125	19	1	12	1.63718	2.08490	1.65410
	21	2	12	1.64872	2.10930	1.66541
	14	3	12	1.54416	2.00325	1.56064
	27	4	12	1.57140	2.05437	1.59077
	25	5	11	1.55006	1.87302	1.56408
250	8	1	12	1.70422	2.16562	1.72142
	3	2	12	~~1.700*~~	2.01277	1.70948
	11	3	12	1.67558	2.12227	1.69478
	10	4	12	1.70455	2.01451	1.71776
	20	5	12	1.69850	2.10903	1.71691
500	5	1	10	1.68672	2.05110	1.69978
	24	2	12	1.69107	2.15347	~~1.70978~~ * 1.70788
	17	3	12	1.70882	2.16505	1.72712
	13	4	12	1.64429	2.06218	1.66125
	12	5	12	1.62497	2.07284	1.64203
1000	4	1	12	1.57422	2.01197	1.59002
	9	2	12	1.60555	2.07808	1.62243
	23	3	12	1.53853	2.10237	1.55805
	1	4	12	1.56750	1.96170	1.58164
	28	5	12	1.55720	2.14736	1.57612
2000	16	1	12	1.52082	2.01811	1.53800
	6	2	12	1.55357	1.98465	1.56927
	22	3	11	1.64707	2.16919	1.66636
	30	4	12	1.76391	2.23329	1.78125
	2	5	12	1.64714	1.99863	1.66017
Tech Initials:			CC	ML	SB	AS

Comments: Initial number of seeds added to each replicate = 12
* 1.69993

Date/Time in: 7-11-07 1530
Oven Temp (°C): 60
Date/Time out: ~~7-11-07~~ 7/12/07 1600
Oven Temp (°C): 70

QC Check: [illegible]

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Sublethal Data
14-Day Soil Toxicity Test

Client: Reference Toxicant
Sample ID. 2000 ppm Boric Acid
Test No: RT062707LS
Log-In#: NA

Start Date & Time: 6-27-07 1645
Stop Date & Time: 7-11-07 1300
Test Species: *Lactuca sativa* (Butter Crunch Lett

Conc.	Cont.	Rep.	Comments
CON	15	1	
	26	2	
	29	3	
	18	4	1 smaller stem and long 1° leaves (bit between the cavdaliedons SP)
	7	5	
125	19	1	
	21	2	1 w/ smaller leaves
	14	3	
	27	4	
	25	5	
250	8	1	
	3	2	1 seedling yellow ~~brwn~~ brown in color
	11	3	
	10	4	
	20	5	

Tech Initials: CC

QC Check: KJ

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Sublethal Data
14-Day Soil Toxicity Test

Client: Reference Toxicant
Sample ID. 2000 ppm Boric Acid
Test No: RT062707LS
Log-In#: —

Start Date & Time: 6/27/07 1645
Stop Date & Time: 7/11/07 1300
Test Species: *Lactuca sativa* (Butter Crunch Lett

Conc.	Cont.	Rep.	Comments
500	5	1	~~seedli~~ 4 stems seem weaker than others
	24	2	
	17	3	
	13	4	
	12	5	
1000	4	1	1 smaller seedling
	9	2	
	23	3	
	1	4	
	28	5	
2000	16	1	
	6	2	
	22	3	
	30	4	
	2	5	

Tech Initials: VC
QC Check: KJ

Soil Toxicity Test

Soil Quality Measurments

Client: Reference Toxicant

Test Species: *Lactuca sativa* (butter crunch lettuce)

Sample ID: 2000 ppm Boric Acid

Start Date/Time: 6/27/07 1645

Test #: ~~RT06270715~~ RT06270715

End Date/Time: 7-11-07 1300

Test Day	Temperature (°C)	Were Plants Watered? (Y/N)	Light Intensity (lux)	Tech Initials
0	22.5	✓	2730	les
1	*19.6	✓		mc
2	*19.3	✓		MM
3	*19.5	✓		ef
4	*19.3	✓		ef
5	*19.0	✓		les
6	*19.2	✓		les
7	*19.1	✓	1810	ef
8	*19.9	✓	①2650	les
9	20.3	✓		les
10	20.4	✓		les
11	20.5	✓		MM
12	20.4	✓		les
13	20.5	✓		les
14	20.7		2800	CC

Conc. Or % (ppm)	Soil Slurry pH (units)		Soil Supernatent pH (units)	
	initial	final	initial	final
CON	7.03	6.91	6.86	6.77
~~0~~ 125	7.17	6.92	7.00	6.76
~~20~~ 250	6.99	6.90	6.95	6.79
~~40~~ 500	7.15	6.91	7.02	6.72
~~80~~ 1000	7.31	7.03	7.23	6.95
2000	7.27	6.91	7.21	6.88
Tech. Init.	SB	SB	SB	SB

Comments: * temperature too low - see corrective action # 07-012

1/5 bulbs burned out, both light bulbs replaced

① Low light intensity reading, after bulb change

QC Check: KJ

PLANTING MAP (RT)

surrogate	1	2	3	4	5	6
	SUR 60	SUR 125	SUR 250	SUR 500	SUR 1000	SUR 2000
A	1	6	11	16	21	26
B	2	7	12	17	22 200	27
C	3	8	13	18	23	28
D	4	9	14	19 40	24	29
E	5	10	15	20	25	30

APPENDIX D – Analytical Results

OnSite Environmental Inc.
14648 NE 95th Street, Redmond, WA 98052 • (425) 883-3881

June 21, 2007

Lance Peterson
CDM
P.O. Box 3885
Bellevue, WA 98009

Re: Analytical Data for Project 19897-52181
Laboratory Reference No. 0706-192

Dear Lance:

Enclosed are the analytical results and associated quality control data for samples submitted on June 20, 2007.

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Manager

Enclosures

Date of Report: June 21, 2007
Samples Submitted: June 20, 2007
Laboratory Reference: 0706-192
Project: 19897-52181

Case Narrative

Samples were collected on June 19, 2007 and received by the laboratory on June 20, 2007. They were maintained at the laboratory at a temperature of 2°C to 6°C except as noted below.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.

Date of Report: June 21, 2007
Samples Submitted: June 20, 2007
Laboratory Reference: 0706-192
Project: 19897-52181

NWTPH-Dx

Date Extracted:	6-20-07
Date Analyzed:	6-20-07
Matrix:	Soil
Units:	mg/kg (ppm)

Client ID:	**Source Soil**
Lab ID:	06-192-01
Diesel Range:	**51000**
PQL:	1600
Identification:	Bunker C
Lube Oil Range:	**ND**
PQL:	3200
Identification:	---
Surrogate Recovery	
o-Terphenyl:	---
Flags:	Y,S

Date of Report: June 21, 2007
Samples Submitted: June 20, 2007
Laboratory Reference: 0706-192
Project: 19897-52181

NWTPH-Dx
METHOD BLANK QUALITY CONTROL

Date Extracted:	6-20-07
Date Analyzed:	6-20-07
Matrix:	Soil
Units:	mg/kg (ppm)
Lab ID:	MB0620S2
Diesel Range:	**ND**
PQL:	25
Identification:	---
Lube Oil Range:	**ND**
PQL:	50
Identification:	---
Surrogate Recovery	
o-Terphenyl:	122%
Flags:	Y

Date of Report: June 21, 2007
Samples Submitted: June 20, 2007
Laboratory Reference: 0706-192
Project: 19897-52181

NWTPH-Dx
DUPLICATE QUALITY CONTROL

Date Extracted:	6-20-07
Date Analyzed:	6-20-07
Matrix:	Soil
Units:	mg/kg (ppm)

Lab ID:	06-192-01	06-192-01 DUP
Diesel Range:	**39300**	**33100**
PQL:	1300	1300
RPD:	17	
Surrogate Recovery		
o-Terphenyl:	---	---
Flags:	Y,S	Y,S

Date of Report: June 21, 2007
Samples Submitted: June 20, 2007
Laboratory Reference: 0706-192
Project: 19897-52181

% MOISTURE

Date Analyzed: 6-20-07

Client ID	Lab ID	% Moisture
Source Soil	06-192-01	23

OnSite Environmental Inc.

Data Qualifiers and Abbreviations

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

E - The value reported exceeds the quantitation range and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range are impacting the diesel range result.

M1 - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.

N - Hydrocarbons in the lube oil range are impacting the diesel range result.

O - Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

P - The RPD of the detected concentrations between the two columns is greater than 40.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

U1 - The practical quantitation limit is elevated due to interferences present in the sample.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a mercury cleanup procedure.

Y - Sample extract treated with an acid/silica gel cleanup procedure.

Z -

ND - Not Detected at PQL
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

Chain of Custody

Page 1 of 1

OnSite Environmental Inc.
14648 NE 95th Street • Redmond, WA 98052
Phone: (425) 883-3881 • Fax: (425) 885-4603

Company: COM
Project Number: 19897-52181
Project Name: King County / Ellisport CK
Project Manager: Lance Peterson
Sampled by: Alan Bergmann / Sam Backus

Turnaround Request (in working days)

(Check One)

- ☐ Same Day
- ☒ 1 Day
- ☐ 2 Day
- ☐ 3 Day
- ☐ Standard (7 working days) (TPH analysis 5 working days)
- ☐ See Lance (other)

Laboratory Number: 06-192

Requested Analysis

Lab ID	Sample Identification	Date Sampled	Time Sampled	Matrix	# of Cont.	NWTPH-HCID	NWTPH-Gx/BTEX	NWTPH-Dx (Bunker C)	Volatiles by 8260B	Halogenated Volatiles by 8260B	Semivolatiles by 8270C	PAHs by 8270C / SIM	PCBs by 8082	Pesticides by 8081A	Herbicides by 8151A	Total RCRA Metals (8)	TCLP Metals	HEM by 1664	VPH	EPH	% Moisture
1	Source Soil	6/19/07	1630	Soil	1			X													X

	Signature	Company	Date	Time
Relinquished by	Kara Tobiason	Northwest Environmental	6/19/07	1645
Received by	M. Vann	OSE	6/20/07	1130
Relinquished by				
Received by				
Relinquished by				
Received by				

Comments/Special Instructions:

4 g. subsample of 5 L Source soil sample. Collected by COM 6/19/07

Reviewed by/Date

Reviewed by/Date

Chromatograms with final report ☒

DISTRIBUTION LEGEND: White - OnSite Copy Yellow - Report Copy Pink - Client Copy

OnSite Environmental Inc.
14648 NE 95th Street, Redmond, WA 98052 • (425) 883-3881

July 12, 2007

Lance Peterson
CDM
P.O. Box 3885
Bellevue, WA 98009

Re: Analytical Data for Project 19897-52181
Laboratory Reference No. 0707-025

Dear Lance:

Enclosed are the analytical results and associated quality control data for samples submitted on July 3, 2005.

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Manager

Enclosures

Date of Report: July 12, 2007
Samples Submitted: July 3, 2005
Laboratory Reference: 0707-025
Project: 19897-52181

Case Narrative

Samples were collected on June 27 & 29, 2007 and received by the laboratory on July 3, 2007. They were maintained at the laboratory at a temperature of 2°C to 6°C except as noted below.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.

Date of Report: July 12, 2007
Samples Submitted: July 3, 2005
Laboratory Reference: 0707-025
Project: 19897-52181

NWTPH-Dx

Date Extracted: 7-10-07
Date Analyzed: 7-10-07

Matrix: Soil
Units: mg/kg (ppm)

Client ID:	Background Soil	Control Lab	3.13% CS
Lab ID:	07-025-01	07-025-02	07-025-03
Diesel Range:	**ND**	**ND**	**ND**
PQL:	30	26	29
Identification:	---	---	---
Bunker C Range:	**ND**	**810**	**930**
PQL:	60	52	59
Identification:	---		
Surrogate Recovery			
o-Terphenyl:	84%	69%	87%
Flags:	Y	T,Y	Y

Date of Report: July 12, 2007
Samples Submitted: July 3, 2005
Laboratory Reference: 0707-025
Project: 19897-52181

NWTPH-Dx

Date Extracted:	7-10-07
Date Analyzed:	7-10-07
Matrix:	Soil
Units:	mg/kg (ppm)

Client ID:	**6.25% CS**	**12.5% CS**	**25% CS**
Lab ID:	07-025-04	07-025-05	07-025-06
Diesel Range:	**ND**	**ND**	**ND**
PQL:	29	150	150
Identification:	---	---	---
Bunker C Range:	**1700**	**2800**	**6700**
PQL:	58	290	290
Identification:			
Surrogate Recovery			
o-Terphenyl:	81%	89%	104%
Flags:	Y	Y	Y

Date of Report: July 12, 2007
Samples Submitted: July 3, 2005
Laboratory Reference: 0707-025
Project: 19897-52181

NWTPH-Dx

Date Extracted:	7-10-07
Date Analyzed:	7-10-07
Matrix:	Soil
Units:	mg/kg (ppm)
Client ID:	**50% CS**
Lab ID:	07-025-07
Diesel Range:	**ND**
PQL:	310
Identification:	---
Bunker C Range:	**18000**
PQL:	610
Identification:	
Surrogate Recovery	
o-Terphenyl:	---
Flags:	Y,S

Date of Report: July 12, 2007
Samples Submitted: July 3, 2005
Laboratory Reference: 0707-025
Project: 19897-52181

NWTPH-Dx
METHOD BLANK QUALITY CONTROL

Date Extracted:	7-10-07
Date Analyzed:	7-10-07
Matrix:	Soil
Units:	mg/kg (ppm)
Lab ID:	MB0710S1
Diesel Range:	**ND**
PQL:	25
Identification:	---
Bunker C Range:	**ND**
PQL:	50
Identification:	---
Surrogate Recovery	
o-Terphenyl:	105%
Flags:	Y

Date of Report: July 12, 2007
Samples Submitted: July 3, 2005
Laboratory Reference: 0707-025
Project: 19897-52181

NWTPH-Dx
DUPLICATE QUALITY CONTROL

Date Extracted:	7-10-07
Date Analyzed:	7-10-07
Matrix:	Soil
Units:	mg/kg (ppm)

Lab ID:	07-025-02	07-025-02 DUP
Diesel Range:	**ND**	**ND**
PQL:	25	25
RPD:	N/A	
Surrogate Recovery		
o-Terphenyl:	69%	83%
Flags:	Y	Y

Date of Report: July 12, 2007
Samples Submitted: July 3, 2005
Laboratory Reference: 0707-025
Project: 19897-52181

% MOISTURE

Date Analyzed: 7-10-07

Client ID	Lab ID	% Moisture
Background Soil	07-025-01	16
Control-Lab	07-025-02	3
3.13% CS	07-025-03	15
6.25% CS	07-025-04	14
12.5% CS	07-025-05	14
25% CS	07-025-06	14
50% CS	07-025-07	18

OnSite Environmental Inc.

Data Qualifiers and Abbreviations

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

E - The value reported exceeds the quantitation range and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range are impacting the diesel range result.

M1 - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.

N - Hydrocarbons in the lube oil range are impacting the diesel range result.

O - Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

P - The RPD of the detected concentrations between the two columns is greater than 40.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

U1 - The practical quantitation limit is elevated due to interferences present in the sample.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a mercury cleanup procedure.

Y - Sample extract treated with an acid/silica gel cleanup procedure.

Z -

ND - Not Detected at PQL
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

Chain of Custody

Page 1 of 1

OnSite Environmental Inc.
14648 NE 95th Street • Redmond, WA 98052
Phone: (425) 883-3881 • Fax: (425) 885-4603

Company: COM
Project Number: 19897-52181
Project Name: King County Ellisport Creek
Project Manager: Lanie Petersen
Sampled by: Alan Berrmann

Turnaround Request (in working days)
(Check One)
☐ Same Day ☐ 1 Day
☐ 2 Day ☐ 3 Day
☒ Standard (7 working days)
(TPH analysis 5 working days)
☐ _____ (other)

Laboratory Number: 07-025

Requested Analysis

Lab ID	Sample Identification	Date Sampled	Time Sampled	Matrix	# of Cont.	NWTPH-HCID	NWTPH-Gx/BTEX	NWTPH-Dx	Volatiles by 8260B	Halogenated Volatiles by 8260B	Semivolatiles by 8270C	PAHs by 8270C / SIM	PCBs by 8082	Pesticides by 8081A	Herbicides by 8151A	Total RCRA Metals (8)	TCLP Metals	HEM by 1664	VPH	EPH	% Moisture
1	Background Soil	6/27/07	—	S	1			X													
2	Control-Lab	6/29/07	—	S	1			X													
3	3.13% CS	6/27/07	—	S	1			X													
4	6.25% CS	6/27/07	—	S	1			X													
5	12.5% CS	6/27/07	—	S	1			X													
6	25% CS	6/27/07	—	S	1			X													
7	50% CS	6/27/07	—	S	1			X													

	Signature	Company	Date	Time
Relinquished by	Ken Fisher	Nautilus Environmental	7/2/07	10:45
Received by	CM Vann	OSE	7/3/07	1000
Relinquished by				
Received by				
Relinquished by				
Received by				
Reviewed by/Date		Reviewed by/Date		

Comments/Special Instructions:
Please quantify as Bunker C

CONTRACT #:
E00255

Chromatograms with final report ☐

DISTRIBUTION LEGEND: White - OnSite Copy Yellow - Report Copy Pink - Client Copy

OnSite Environmental Inc.
14648 NE 95th Street, Redmond, WA 98052 • (425) 883-3881

September 5, 2007

Lance Peterson
CDM
P.O. Box 3885
Bellevue, WA 98009

Re: Analytical Data for Project 19897-52181; Ellisport
Laboratory Reference No. 0708-262

Dear Lance:

Enclosed are the analytical results and associated quality control data for samples submitted on August 29, 2007.

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Manager

Enclosures

Date of Report: September 5, 2007
Samples Submitted: August 29, 2007
Laboratory Reference: 0708-262
Project: 19897-52181; Ellisport

Case Narrative

Samples were collected on August 28, 2007 and received by the laboratory on August 29, 2007. They were maintained at the laboratory at a temperature of 2°C to 6°C except as noted below.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.

NWTPH-Dx Analysis

The chromatogram for sample Garden Soil is not similar to a typical Bunker C chromatogram.

Any other QA/QC issues associated with this extraction and analysis will be indicated with a footnote reference and discussed in detail on the Data Qualifier page.

Date of Report: September 5, 2007
Samples Submitted: August 29, 2007
Laboratory Reference: 0708-262
Project: 19897-52181; Ellisport

NWTPH-Dx

Date Extracted:	8-30-07
Date Analyzed:	9-4-07
Matrix:	Soil
Units:	mg/kg (ppm)

Client ID:	**Artificial Soil**	**Garden Soil**
Lab ID:	08-262-01	08-262-02
Diesel Range:	**ND**	**ND**
PQL:	26	27
Identification:	---	---
Bunker C Range:	**ND**	**2200**
PQL:	51	54
Identification:	---	
Surrogate Recovery		
o-Terphenyl:	94%	99%
Flags:	Y	Y,T

Date of Report: September 5, 2007
Samples Submitted: August 29, 2007
Laboratory Reference: 0708-262
Project: 19897-52181; Ellisport

NWTPH-Dx
METHOD BLANK QUALITY CONTROL

Date Extracted:	8-30-07
Date Analyzed:	8-30-07
Matrix:	Soil
Units:	mg/kg (ppm)
Lab ID:	MB0830S1
Diesel Range:	**ND**
PQL:	25
Identification:	---
Bunker C Range:	**ND**
PQL:	50
Identification:	---
Surrogate Recovery	
o-Terphenyl:	105%
Flags:	Y

Date of Report: September 5, 2007
Samples Submitted: August 29, 2007
Laboratory Reference: 0708-262
Project: 19897-52181; Ellisport

NWTPH-Dx
DUPLICATE QUALITY CONTROL

Date Extracted:	8-30-07	
Date Analyzed:	8-30-07	
Matrix:	Soil	
Units:	mg/kg (ppm)	
Lab ID:	08-268-14	08-268-14 DUP
Diesel Range:	**ND**	**ND**
PQL:	25	25
RPD:	N/A	
Surrogate Recovery		
o-Terphenyl:	91%	91%
Flags:	Y	Y

Date of Report: September 5, 2007
Samples Submitted: August 29, 2007
Laboratory Reference: 0708-262
Project: 19897-52181; Ellisport

% MOISTURE

Date Analyzed: 8-30-07

Client ID	Lab ID	% Moisture
Artificial Soil	08-262-01	2
Garden Soil	08-262-02	8

OnSite Environmental Inc.

Data Qualifiers and Abbreviations

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

E - The value reported exceeds the quantitation range and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range are impacting the diesel range result.

M1 - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.

N - Hydrocarbons in the lube oil range are impacting the diesel range result.

O - Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

P - The RPD of the detected concentrations between the two columns is greater than 40.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

U1 - The practical quantitation limit is elevated due to interferences present in the sample.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a mercury cleanup procedure.

Y - Sample extract treated with an acid/silica gel cleanup procedure.

Z -

ND - Not Detected at PQL
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

Chain of Custody

OnSite Environmental Inc.
14648 NE 95th Street - Redmond, WA 98052
Phone: (425) 883-3881 - Fax: (425) 885-4603

Company: CDM
Project Number: 19897-52181
Project Name: King County Ellisport Creek
Project Manager: Lance Peterson
Sampled by: Crystal McCraine

Turnaround Request (in working days)
(Check One)
☐ Same Day ☐ 1 Day
☐ 2 Day ☐ 3 Day
☒ Standard (7 working days)
(TPH analysis 5 working days)
☐ _____ (other)

Laboratory Number: 08-262

Requested Analysis

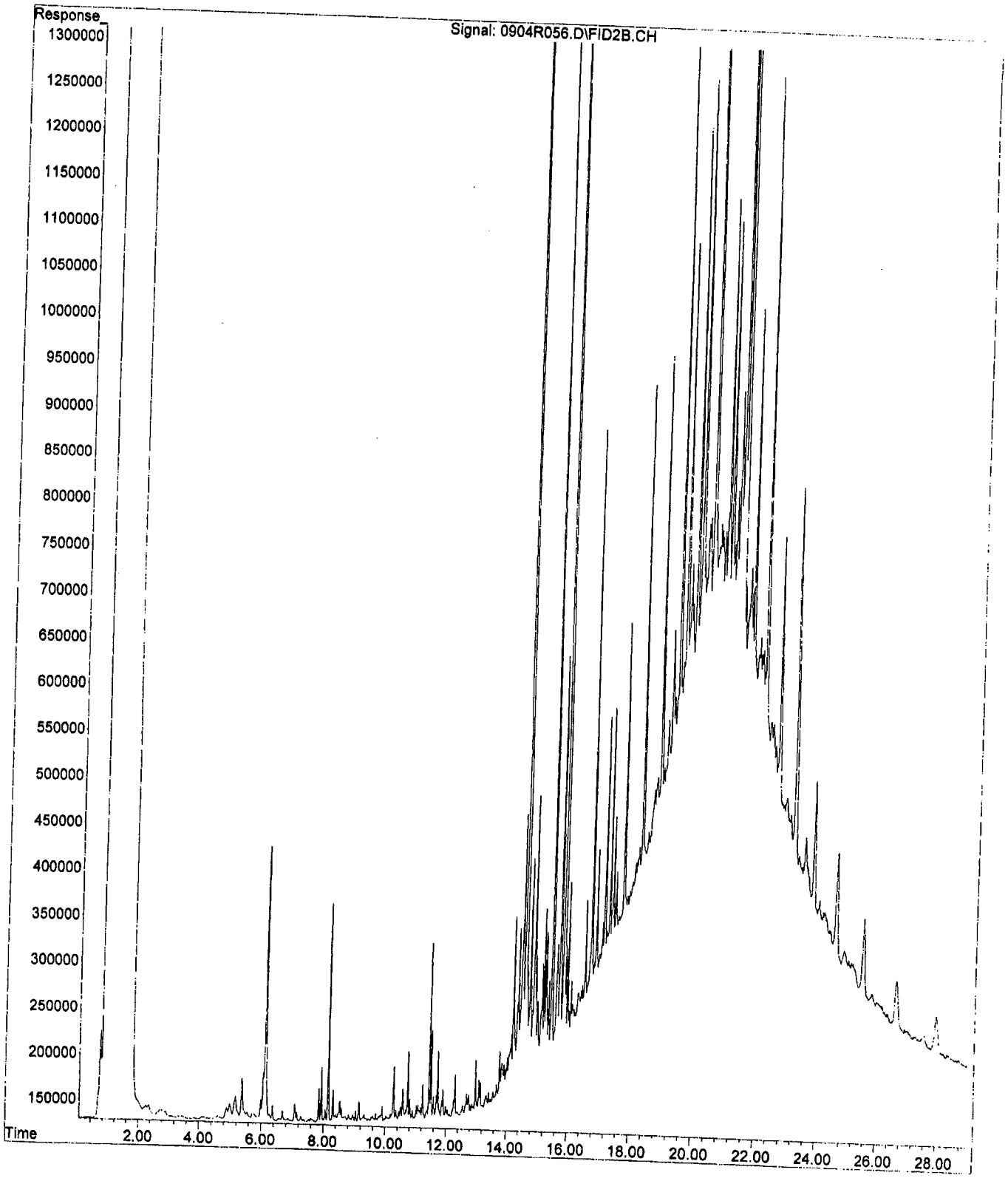
Lab ID	Sample Identification	Date Sampled	Time Sampled	Matrix	# of Cont	NWTPH-HCID	NWTPH-Gx/BTEX	NWTPH-Dx	Volatiles by 8260B	Halogenated Volatiles by 8260B	Semivolatiles by 8270C	PAHs by 8270C / SIM	PCBs by 8082	Pesticides by 8081A	Herbicides by 8151A	Total RCRA Metals (8)	TCLP Metals	HEM by 1664	VPH	EPH	% Moisture
1	Artificial Soil	8/28/07	1104	S	2			X													X
2	Garden Soil	8/28/07	1104	S	2			X													↓

	Signature	Company	Date	Time
Relinquished by	Crystal McCraine	Nautilus	8/28/07	1320
Received by	M. Nunn	OSE	8/29/07	1030
Relinquished by				
Received by				
Relinquished by				
Received by				
Reviewed by/Date		Reviewed by/Date		

Comments/Special Instructions: Please quantify as Bunker C

Chromatograms with final report ☒

File : X:\DIESELS\TERI\DATA\T070904.SEC\0904R056.D
Operator : DY
Acquired : 04 Sep 2007 14:22 using AcqMethod F070904.M
Instrument : Teri
Sample Name: 08-262-02 RR DBLAC
Misc Info : 2
Vial Number: 56



APPENDIX E - Chain-of-Custody Form

CDM

CHAIN-OF-CUSTODY

Date 6/19/07 Page 1 of 1

PROJECT INFORMATION

Project Manager: Lance Peterson
Project Name: King County / Ellisport Ck
Project Number: 19897-52181
Site Location: Vashon I., WA Sampled By: LP

DISPOSAL INFORMATION

☒ Lab Disposal (return if not indicated)
Disposal Method:
Disposed by: Disposal Date:

QC INFORMATION (check one)

☐ SW-846 ☐ CLP ☐ Screening ☐ CDM Std. ☐ Special

Laboratory Number:

ANALYSIS REQUEST

SAMPLE ID	DATE	TIME	MATRIX	LAB ID
Source Soil	6/19/07	1030	Soil	07-056
Background	6/19/07	1200	Soil	07-057

PETROLEUM HYDROCARBONS						ORGANIC COMPOUNDS								PESTS/PCBs					METALS						LEACHING TESTS				OTHER			NUMBER OF CONTAINERS
TPH-HCID State:	TPH-G State:	TPH-D State:	TPH-418.1 State:	8015M Fuel Hydrocarbon	TPH Special Instructions	8010 Halogenated VOCs	8020 Aromatic VOCs	8020M - BETX only	8240 GC/MS Volatiles	8270 GC/MS Semivolatiles	8310 PAHs	8040 Phenols	DWS - Volatiles and Semivolatiles	8080 OC Pest/PCBs	8080M PCBs only	8140 OP Pesticides	8150 OC Herbicides	DWS - Herb/Pest	Selected Metals: list	Organic Lead (Ca)	TCL Metals (23)	Priority Poll. Metals (13)	DWS - Metals	MFSP - Metals (Wa)	TCLP - Volatiles (ZHE)	TCLP - Semivolatiles	TCLP - Pesticides	TCLP - Metals	Plansay pesticides per SAP QAPP			
																													X	X	

LAB INFORMATION

Lab Name: Nautilus
Lab Address: 5009 Pac. Hwy E.
Tacoma, WA
Via: hand delivery

SAMPLE RECEIPT

Total Number of Containers:
Chain-of-Custody Seals: Y/N/NA
Intact?: Y/N/NA
Received in Good Condition/Cold:

Turn Around Time: ☐ Standard ☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 1 wk.

PRIOR AUTHORIZATION IS REQUIRED FOR RUSH DATA

Special Instructions:

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: Time: 1515	Signature: Time:	Signature: Time:
Printed Name: Lance Peterson Date: 6/19/07	Printed Name: Date:	Printed Name: Date:
Company: CDM	Company:	Company:
RECEIVED BY: 1.	**RECEIVED BY: 2.**	**RECEIVED BY: 3.**
Signature: Time: 1515	Signature: Time:	Signature: Time:
Printed Name: Karen L. Tobiason Date: 6/19/07	Printed Name: Date:	Printed Name: Date:
Company: Nautilus	Company:	Company:

CDM OFFICES: Bellevue: (206) 453-8383
rev. 2/02 Portland: (503) 232-1800

DISTRIBUTION: White, Canary to Analytical Laboratory; Pink to CDM Project Files; Gold to CDM Disposal Files

forms\field\chain of custody.p65

Appendix B
Additional Statistical Evaluation of Terrestrial Toxicity Tests

Nautilus Environmental, LLC

October 8, 2007

Memo: Additional statistical evaluation of terrestrial toxicity tests for King County Ellisport Creek Greenspace Project

To	Lance Peterson	*From*	Karen Tobiason
Company	CDM	*Tel*	253-922-4296
Phone	425-453-8383	*Fax*	253-922-5814
e-mail	petersonle@cdm.com	*e-mail*	karen@nautilusenvironmental.com

As requested, we have evaluated the dataset of the *Eisenia fetida* (earthworm) and *Lactuca sativa* (lettuce seed) terrestrial toxicity tests for LC05 and LC10 values. Table 1 provides a summary of those values as well as the previously reported LC25 and LC50 values. Data are presented in mg/kg of measured concentrations of Bunker C with associated 95% confidence intervals. The statistical analyses were conducted using the CETIS software package.

Table 1. Summary of statistical analyses

End-point	Statistical method	LC05/IC05	LC10/IC10	LC25/IC25	LC50/IC50
E. fetida 14d survival	Linear regression (LC values)	5760 (914 - 8870)	6980 (1560 - 10,100)	9620 (3740 - 12,700)	13,700 (8960 - 18,100)
L. sativa 14d survival	Linear interpolation (IC values)[a]	>18,000	>18,000	>18,000	>18,000
L. Sativa 14d growth	Linear interpolation (IC values)	1300 (NA)	1660 (NA)	>18,000 (NA)	>18,000 (NA)

NA- 95% confidence intervals not available; [a] Statistical assumptions are not met to run linear regression or spearman karber analyses. Linear interpolation values are presented in the table.

It should be noted that the survival dataset for *L. sativa* failed to meet the assumptions of the Linear Regression analysis and LC values using this method were not calculable. Analysis using Linear Interpolation estimates have been presented here and indicate that no effect on seedling survival occurred in any concentration.

Please feel free to contact me should you have any questions regarding these analyses. KT

Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424
Tel 253-922-4296
Fax 253-922-5814

CETIS Summary Report

Eisenia 14-d Survival Soil Test — **Nautilus Environmental WA**

Test Run No:	07-5416-1662	**Test Type:**	Survival	**Analyst:**	Karen Tobiason
Start Date:	27 Jun-07 16:00	**Protocol:**	WDOE 96-327	**Diluent:**	
Ending Date:	11 Jul-07 13:00	**Species:**	Eisenia fetida	**Brine:**	
Duration:	13d 21h	**Source:**		**Age:**	

Sample No:	04-2064-9698	**Code:**	420649698	**Client:**	Camper Dresser McKee
Sample Date:	19 Jun-07 10:30	**Material:**	Bunker C	**Project:**	King County Ellisport Creek
Receive Date:	19 Jun-07 15:15	**Source:**	CDM		
Sample Age:	8d 5h	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
18-5532-2275	Survival Rate	6700	18000	11000	44.9%	Dunnett's Multiple Comparison Test

Point Estimate Summary

Analysis No	Endpoint	Effect-%	Conc-mg/k	95% LCL	95% UCL	Method
04-3036-3988	Survival Rate	5	5760	914	8870	Linear Regression (MLE)
		10	6980	1560	10100	
08-0090-7657	Survival Rate	25	9620	3740	12700	Linear Regression (MLE)
		50	13700	8960	18100	

Survival Rate Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	3	0.9	0.863	0.937	0.8	1	0.0183	0.1	11.1%	0.0%
930		3	0.933	0.89	0.976	0.8	1	0.0211	0.115	12.4%	-3.7%
1700		3	0.8	0.735	0.865	0.7	1	0.0316	0.173	21.7%	11.1%
2800		3	0.867	0.81	0.924	0.7	1	0.0279	0.153	17.6%	3.7%
6700		3	0.8	0.735	0.865	0.7	1	0.0316	0.173	21.7%	11.1%
18000		3	0.267	0.159	0.374	0.1	0.6	0.0527	0.289	108.0%	70.4%

Survival Rate Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3
0	Backgtround So	0.9	0.8	1
930		0.8	1	1
1700		1	0.7	0.7
2800		0.7	1	0.9
6700		0.7	0.7	1
18000		0.6	0.1	0.1

CETIS Summary Report

Eisenia 14-d Survival Soil Test — **Nautilus Environmental WA**

Test Run No:	07-5416-1662	**Test Type:**	Survival	**Analyst:**	Karen Tobiason
Start Date:	27 Jun-07 16:00	**Protocol:**	WDOE 96-327	**Diluent:**	
Ending Date:	11 Jul-07 13:00	**Species:**	Eisenia fetida	**Brine:**	
Duration:	13d 21h	**Source:**		**Age:**	

Sample No:	04-2064-9698	**Code:**	420649698	**Client:**	Camper Dresser McKee
Sample Date:	19 Jun-07 10:30	**Material:**	Bunker C	**Project:**	King County Ellisport Creek
Receive Date:	19 Jun-07 15:15	**Source:**	CDM		
Sample Age:	8d 5h	**Station:**			

Point Estimate Summary

Analysis No	Endpoint	Effect-%	Conc-mg/k	95% LCL	95% UCL	Method
04-3036-3988	Survival Rate	5	5760	914	8870	Linear Regression (MLE)
		10	6980	1560	10100	

Survival Rate Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	3	0.9	0.863	0.937	0.8	1	0.0183	0.1	11.1%	0.0%
930		3	0.933	0.89	0.976	0.8	1	0.0211	0.115	12.4%	-3.7%
1700		3	0.8	0.735	0.865	0.7	1	0.0316	0.173	21.7%	11.1%
2800		3	0.867	0.81	0.924	0.7	1	0.0279	0.153	17.6%	3.7%
6700		3	0.8	0.735	0.865	0.7	1	0.0316	0.173	21.7%	11.1%
18000		3	0.267	0.159	0.374	0.1	0.6	0.0527	0.289	108.0%	70.4%

Survival Rate Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3
0	Backgtround So	0.9	0.8	1
930		0.8	1	1
1700		1	0.7	0.7
2800		0.7	1	0.9
6700		0.7	0.7	1
18000		0.6	0.1	0.1

Eisenia 14-d Survival Soil Test — **Nautilus Environmental WA**

Analysis No:	04-3036-3988	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	03 Oct-07 16:14	**Analysis:**	Linear Regression (MLE)	**Official Results:**	Yes

Linear Regression Options

Model Function	Threshold Option	Threshold	Optimized	Pooled	Het Corr	Weighted
Log-Normal [NED=A+B*log(X)]	Control Threshold	0.1	Yes	No	No	Yes

Regression Summary

Iters	LL	AICc	Mu	Sigma	G Stat	Chi-Sq	Critical	P-Value	Decision(5%)
10	-32.7	70.4	-2.99	0.23	0.42	19	22.4	0.1220	Non-Significant Heterogeneity

Point Estimates

Effect-%	Conc-mg/kg	95% LCL	95% UCL
5	5760	914	8870
10	6980	1560	10100

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(5%)
Threshold	0.125	0.0305	0.0647	0.184	4.08	0.0013	Significant Parameter
Slope	4.35	1.44	1.53	7.18	3.03	0.0097	Significant Parameter
Intercept	-13	6.01	-24.8	-1.25	-2.17	0.0493	Significant Parameter

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(5%)
Variances	Bartlett Equality of Variance	0.716	9.49	0.9490	Equal Variances
Distribution	Shapiro-Wilk Normality	0.883		0.0521	Normal Distribution

Survival Rate Summary

			Calculated Variate(A/B)								
Conc-mg/kg	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%	A	B
0	Backgtround Soil	3	0.9	0.8	1	0.0183	0.1	11.1%	0.0%	27	30
930		3	0.933	0.8	1	0.0211	0.115	12.4%	-3.7%	28	30
1700		3	0.8	0.7	1	0.0316	0.173	21.7%	11.1%	24	30
2800		3	0.867	0.7	1	0.0279	0.153	17.6%	3.7%	26	30
6700		3	0.8	0.7	1	0.0316	0.173	21.7%	11.1%	24	30
18000		3	0.267	0.1	0.6	0.0527	0.289	108.0%	70.4%	8	30

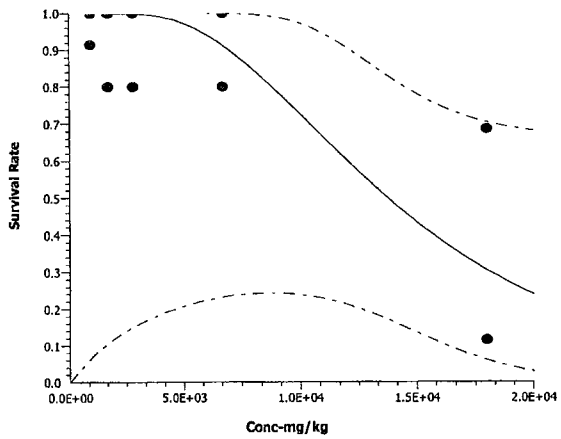
Survival Rate Detail

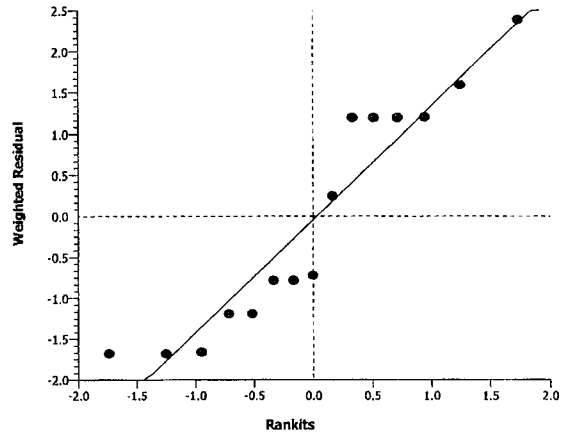
Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3
0	Backgtround Soil	0.9	0.8	1
930		0.8	1	1
1700		1	0.7	0.7
2800		0.7	1	0.9
6700		0.7	0.7	1
18000		0.6	0.1	0.1

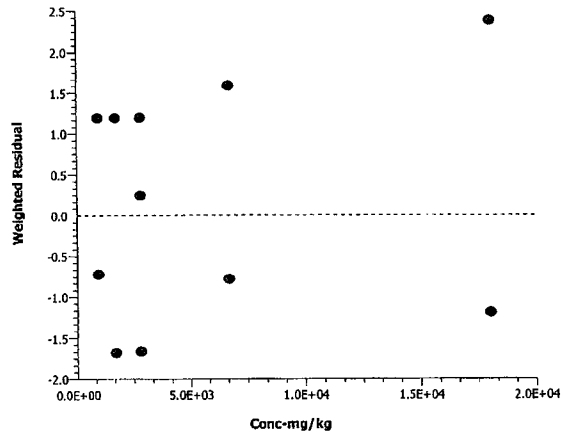
Elsenia 14-d Survival Soil Test — **Nautilus Environmental WA**

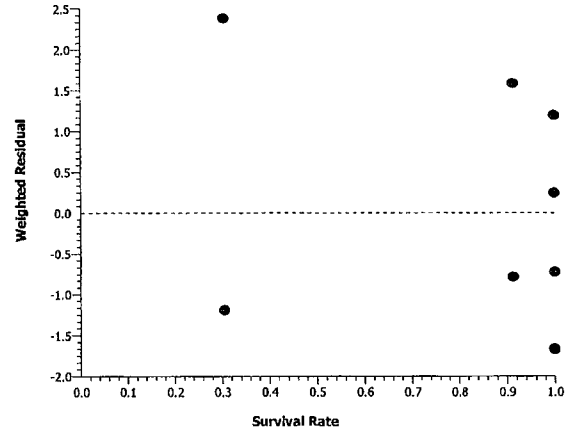
Analysis No:	04-3036-3988	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	03 Oct-07 16:14	**Analysis:**	Linear Regression (MLE)	**Official Results:**	Yes

Graphics









CETIS Summary Report

Early Seedling Growth — **Nautilus Environmental WA**

Test Run No:	09-1073-7649	**Test Type:**	Survival-Growth	**Analyst:**	Karen Tobiason
Start Date:	27 Jun-07 16:45	**Protocol:**	WDOE 96-324	**Diluent:**	
Ending Date:	11 Jul-07 16:45	**Species:**	Lactuca sativa	**Brine:**	
Duration:	14d 0h	**Source:**	Carolina Biological Supply	**Age:**	

Sample No:	04-2064-9698	**Code:**	420649698	**Client:**	Camper Dresser McKee
Sample Date:	19 Jun-07 10:30	**Material:**	Bunker C	**Project:**	King County Ellisport Creek
Receive Date:	19 Jun-07 15:15	**Source:**	CDM		
Sample Age:	8d 6h	**Station:**			

Point Estimate Summary

Analysis No	Endpoint	Effect-%	Conc-mg/k	95% LCL	95% UCL	Method
05-7541-8717	Mean Dry Biomass-mg	5	1300	N/A	N/A	Linear Interpolation (ICPIN)
		10	1660	N/A	N/A	
		25	>18000	N/A	N/A	
		50	>18000	N/A	N/A	
12-1215-4789	Survival Rate	5	>18000	N/A	N/A	Linear Interpolation (ICPIN)
		10	>18000	N/A	N/A	
		25	>18000	N/A	N/A	
		50	>18000	N/A	N/A	

Mean Dry Biomass-mg Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	5	0.898	0.802	0.995	0.61	1.23	0.047	0.258	28.7%	0.0%
930		5	0.949	0.898	1	0.819	1.12	0.0253	0.139	14.6%	-5.68%
1700		5	0.827	0.783	0.87	0.694	1.01	0.0215	0.118	14.2%	8.0%
2800		5	0.771	0.721	0.821	0.591	0.908	0.0243	0.133	17.2%	14.2%
6700		5	0.811	0.756	0.867	0.63	1.02	0.0269	0.147	18.2%	9.67%
18000		5	0.772	0.712	0.832	0.496	0.898	0.0293	0.16	20.8%	14.1%

Survival Rate Summary

Conc-mg/kg	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround S	5	0.8	0.728	0.872	0.583	1	0.035	0.192	24.0%	0.0%
930		5	0.983	0.969	0.997	0.917	1	0.0068	0.0373	3.79%	-22.9%
1700		5	0.933	0.919	0.947	0.917	1	0.0068	0.0373	3.99%	-16.7%
2800		5	0.883	0.836	0.931	0.75	1	0.0231	0.126	14.3%	-10.4%
6700		5	0.9	0.859	0.941	0.75	1	0.0198	0.109	12.1%	-12.5%
18000		5	0.883	0.836	0.931	0.667	1	0.0231	0.126	14.3%	-10.4%

Mean Dry Biomass-mg Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Backgtround So	0.834	0.723	1.23	1.1	0.61
930		0.852	0.878	1.12	1.08	0.819
1700		0.753	1.01	0.694	0.842	0.837
2800		0.898	0.591	0.732	0.908	0.727
6700		0.725	0.854	0.826	0.63	1.02
18000		0.851	0.84	0.898	0.775	0.496

Survival Rate Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Backgtround So	0.75	0.667	1	1	0.583
930		1	1	1	1	0.917
1700		1	0.917	0.917	0.917	0.917
2800		1	0.75	1	0.917	0.75
6700		0.917	1	0.833	0.75	1
18000		0.917	1	0.917	0.917	0.667

Early Seedling Growth — **Nautilus Environmental WA**

Analysis No:	05-7541-8717	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.6.3
Analyzed:	03 Oct-07 16:19	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Linear	Linear	7055475	280	Yes	Two-Point Interpolation

Point Estimates

Effect-%	Conc-mg/kg	95% LCL	95% UCL
5	1300	N/A	N/A
10	1660	N/A	N/A
25	> 18000	N/A	N/A
50	> 18000	N/A	N/A

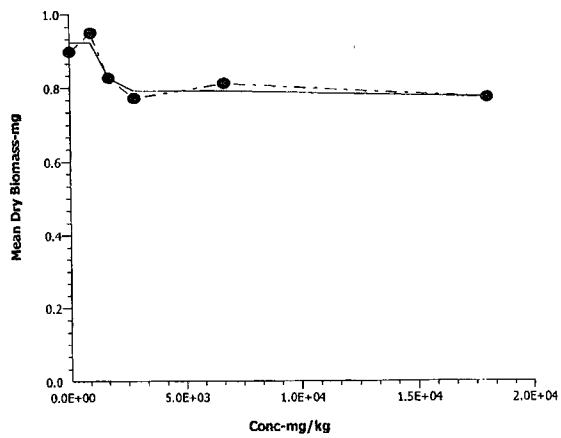
Mean Dry Biomass-mg Summary

			Calculated Variate						
Conc-mg/kg	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Backgtround Soil	5	0.898	0.61	1.23	0.047	0.258	28.7%	0.0%
930		5	0.949	0.819	1.12	0.0253	0.139	14.6%	-5.68%
1700		5	0.827	0.694	1.01	0.0215	0.118	14.2%	8.0%
2800		5	0.771	0.591	0.908	0.0243	0.133	17.2%	14.2%
6700		5	0.811	0.63	1.02	0.0269	0.147	18.2%	9.67%
18000		5	0.772	0.496	0.898	0.0293	0.16	20.8%	14.1%

Mean Dry Biomass-mg Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Backgtround Soil	0.834	0.723	1.23	1.1	0.61
930		0.852	0.878	1.12	1.08	0.819
1700		0.753	1.01	0.694	0.842	0.837
2800		0.898	0.591	0.732	0.908	0.727
6700		0.725	0.854	0.826	0.63	1.02
18000		0.851	0.84	0.898	0.775	0.496

Graphics



Early Seedling Growth — **Nautilus Environmental WA**

Analysis No:	12-1215-4789	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.6.3
Analyzed:	03 Oct-07 16:19	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Linear	Linear	7055475	280	Yes	Two-Point Interpolation

Point Estimates

Effect-%	Conc-mg/kg	95% LCL	95% UCL
5	> 18000	N/A	N/A
10	> 18000	N/A	N/A
25	> 18000	N/A	N/A
50	> 18000	N/A	N/A

Survival Rate Summary

			Calculated Variate(A/B)								
Conc-mg/kg	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%	A	B
0	Backgtround Soil	5	0.8	0.583	1	0.035	0.192	24.0%	0.0%	48	60
930		5	0.983	0.917	1	0.0068	0.0373	3.79%	-22.9%	59	60
1700		5	0.933	0.917	1	0.0068	0.0373	3.99%	-16.7%	56	60
2800		5	0.883	0.75	1	0.0231	0.126	14.3%	-10.4%	53	60
6700		5	0.9	0.75	1	0.0198	0.109	12.1%	-12.5%	54	60
18000		5	0.883	0.667	1	0.0231	0.126	14.3%	-10.4%	53	60

Survival Rate Detail

Conc-mg/kg	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
0	Backgtround Soil	0.75	0.667	1	1	0.583
930		1	1	1	1	0.917
1700		1	0.917	0.917	0.917	0.917
2800		1	0.75	1	0.917	0.75
6700		0.917	1	0.833	0.75	1
18000		0.917	1	0.917	0.917	0.667

Graphics