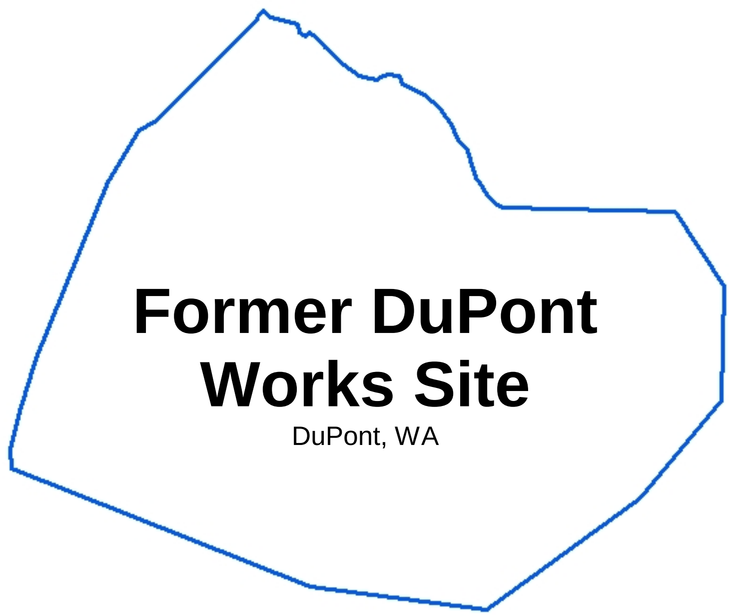
FINAL
Human Health and Ecological Risk Assessment for the Former DuPont Works Site



Prepared For:

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Preface

P.1 Introduction

These Volumes present information developed as part of the Final Remedial Investigation, Risk Assessment, and Feasibility Study (RI/RA/FS) for the Former DuPont Works Site (Site) located in DuPont, WA (See Figure P-1). These reports were stipulated in a Consent Decree, effective July 1991, between the lead agency, Washington State Department of Ecology (Ecology), and the principle responsible parties, Weyerhaeuser Company (Weyerhaeuser) and E.I. duPont de Nemours and Company, Inc. (DuPont). Per the Consent Decree, the reports were developed in accordance with the Model Toxics Control Act Cleanup Regulation (MTCA). Draft RI/RA/FS reports were completed in 1994 and 1995, submitted to Ecology, and underwent public review. The draft Final RI/RA/FS reports, presented here, have been developed to satisfy comments on the draft reports and to accurately reflect existing conditions and future land use at the Site. In addition, these reports incorporate a variety of agreements that have been reached with Ecology following completion of the draft studies in 1994 and 1995.

P.2 Property History

The Site property was originally used by Native Americans. European settlement began in 1832, when the Hudson's Bay Company established a cabin/storehouse on nearby Puget Sound at the mouth of Sequalitchew Creek, northwest of the Site (City of DuPont, 1995). In 1833, Hudson's Bay built Fort Nisqually, which was located in the northern portion of the Site. Ten years later, a new Fort Nisqually was built at a location adjacent to but outside the eastern edge of the Site.

The DuPont Company acquired the property in 1906 and constructed an explosives plant and the historical Village of DuPont as a company town for plant workers (the historical village area is located approximately 1 mile southeast of the Site). DuPont continued to manufacture explosives at the Site until the mid 1970s, when it sold the property and adjacent areas to the Weyerhaeuser Company. Weyerhaeuser and its subsidiary, Weyerhaeuser Real Estate Company (WRECO), still own the majority of the approximately 2,500 acres in the area, which they named Northwest Landing. Northwest Landing is a planned community in the City of DuPont and includes the Site. WRECO has begun to develop Northwest Landing on some of its lands within the City, but cannot develop the Site until the cleanup has been completed.

P.3 Site Regulatory History

The Site was used for the manufacture of commercial explosives from 1909 to 1976. Production of explosive material ceased and decommissioning of the buildings began in 1976, when Weyerhaeuser purchased the property from DuPont. As part of the cleanup process, asbestos was removed, salvageable materials were taken out, and structures were either burned or demolished. Actions taken at the Site subsequent to the shutdown in 1976 include the following:

- In 1985, Weyerhaeuser initiated studies to determine whether hazardous substances were present.
- In 1986, a Phase I Site Survey and Review was conducted to identify areas on Site that may be of environmental concern.
- In 1986, soil contamination was first documented and reported to Ecology.
- In 1987, a Phase II Site Characterization study was performed, which characterized the type, concentration, and distribution of constituents at 38 areas on the Site.

- In 1989, a Baseline Human Health Risk Assessment was performed using results of the Phase II survey.

- In 1991, Weyerhaeuser and DuPont signed a Consent Decree (No. 91 2 01703 1) with Ecology, where they agreed to study the Site and complete an RI, RA, and FS. The Site was divided into two main areas: Parcel 1 (approximately 636 acres); and Parcel 2 (approximately 205 acres).

- In 1994 and 1995, Draft RI, RA, and FS reports were submitted to Ecology and underwent public review.

- In 1996, based on the result of interim source removal actions, Ecology approved a Cleanup Action Plan (CAP) for Parcel 2 that provided for no further remediation activities except for the institutional controls to maintain the industrial use of Parcel 2.

- In 1997, Parcel 2 was deleted from the Consent Decree, and the deed requiring institutional controls to maintain the industrial use was recorded in the Pierce County Auditor's Office.

- Between 1990 and 2001, while studies and negotiations were ongoing, Weyerhaeuser and DuPont undertook numerous interim source removal actions to clean up soil and/or debris at the Site, in accordance with MTCA and the Consent Decree.

P.4 Description of Reports

In fulfillment of the provisions of the Consent Decree, RI, RA, and FS reports were prepared. A description of the contents of each of these reports is presented below.

- **RI** – The purpose of the RI was to collect sufficient information regarding the Site to enable the completion of the RA and FS. The RI characterizes the nature and extent of contamination based on the existing conditions at the Site. The RI Report presents the analytical data for the media that have been collected at the Site. The data are presented for each RI area, which was defined based on historical manufacturing and production operations at the Site.

- **RA** – In contrast to the RI, the RA evaluates Site conditions in relation to future land uses at the Site. The RA identifies default soil cleanup levels, and presents the methods used to derive Site-specific soil levels that are protective of human health and ecological receptors based on future land use. These cleanup levels and remediation levels are compared to Site constituent concentrations in order to identify which areas require additional evaluation in the FS.

- **FS** – The FS evaluates alternative potential cleanup methods designed to meet the remedial action objectives for the Site. The FS Report provides information for Weyerhaeuser and DuPont to recommend alternatives for remediation of selected areas, including both no action and action alternatives. Ecology will evaluate the FS and select the remedial measures it believes are appropriate. Weyerhaeuser and DuPont will complete the needed detailed design and implementation of the remedy selected by Ecology in the Cleanup Action Plan.

P.5 Report Organization and Documents

This RI/RA/FS report should be reviewed together to better understand the relationship between the Site study activities. The RI/RA/FS are interdependent Reports that are organized as follows:

Volume I – RI and Appendices
Appendix A - Field Procedures
Appendix B - Soil Quality Data
Appendix C - Groundwater, Surface Water and Freshwater Sediment Quality Data
Appendix D - Laboratory Physical Soils Testing

Appendix E - Data Quality Assessment

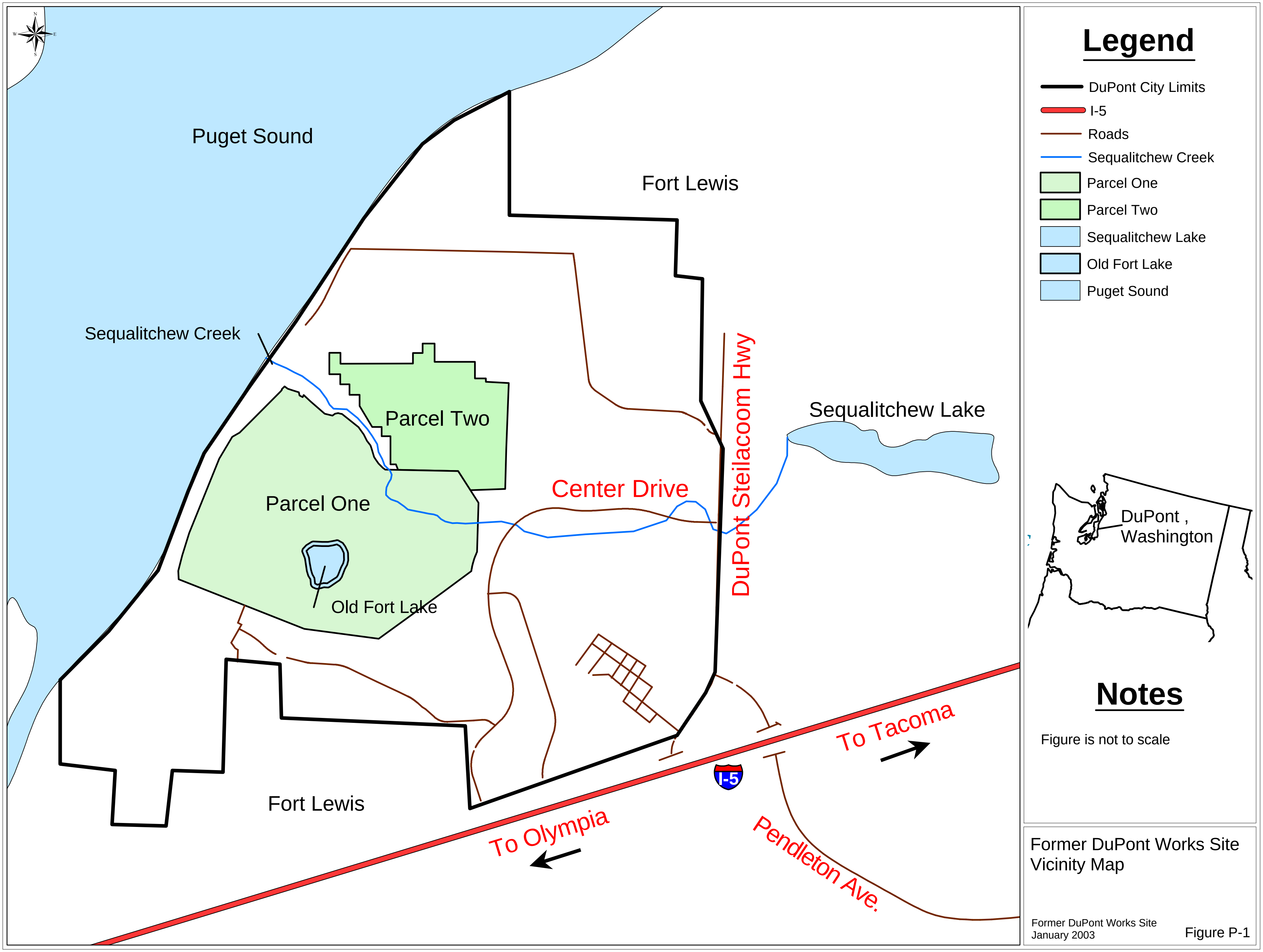
Volume II - RA and Appendices

Appendix A – Ecological Risk Assessment Summary
Appendix B – Evaluation Unit Sample Groupings
Appendix C – Letters and Other Documentation of Site-Specific Determinations
Appendix D – Toxicity Information For Select Constituents
Appendix E – Cleanup Level and Remediation Level Calculations
Appendix F – Summary Statistics and Comparison to Standards

Volume III - FS and Appendices

Appendix A – Description of Remediation Technologies for Soil
Appendix B – Overview of Soil Testing Procedures and Data Interpretation
Appendix C – Lead and Arsenic Soil characterization and Treatability Studies
Appendix D – Arsenic Wet Screening Study
Appendix E – Ranking of Alternatives
Appendix F – Cost Estimate for Remedial Alternatives Analyzed in Detail
Appendix G – Estimation of Minimum Soil Volume Required for Cost-Effective On-Site Treatment
Appendix H – Development of Soil Remediation Levels for the Golf Course Groundskeeper
Appendix I – Impracticability of Groundwater Remediation at the Former DuPont Works Site, DuPont, Washington.

An Executive Summary is included with each Volume.



Puget Sound
Fort Lewis
Sequalitchew Creek
Parcel Two
Parcel One
Old Fort Lake
Sequalitchew Lake
Center Drive
DuPont Steilacoom Hwy
Fort Lewis
I-5
To Tacoma
To Olympia
Pendleton Ave.
Legend
DuPont City Limits
I-5
Roads
Sequalitchew Creek
Parcel One
Parcel Two
Sequalitchew Lake
Old Fort Lake
Puget Sound
DuPont , Washington
Notes
Figure is not to scale
Former DuPont Works Site Vicinity Map
Former DuPont Works Site
January 2003
Figure P-1

P.6 References

City of DuPont. 1995 Comprehensive Plan. Adopted July 25, 1995.

MTCA (Model Toxics Control Act Cleanup Regulation). Chapter 173-340 WAC. Feb. 12, 2001. Ecology Publication 94-06.

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Table of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
BGS	Below Ground Surface
COPC	Constituent of Potential Concern
CPAHs	Carcinogenic Polycyclic Aromatic Hydrocarbons
CPF	Cancer Potency Factor
DNT	Dinitrotoluene
DuPont	E.I. duPont de Nemours and Company, Inc.
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
EU	Evaluation Unit
FS	Feasibility Study
IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead
MSL	Mean Sea Level
MTCA	Model Toxics Control Act
NGRR	Narrow Gauge Railroad
PAHs	Polycyclic Aromatic Hydrocarbons
RA	Risk Assessment
RfD	Reference Dose for Noncarcinogenic Health Effects
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
Subsurface	Greater than 1 foot to less than or equal to 15 feet below ground surface
Surface	0 to less than or equal to 1 foot below ground surface
TEF	Toxic Equivalency Factor
TNT	2,4,6-Trinitrotoluene
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
WAC	Washington Administrative Code
Weyerhaeuser	Weyerhaeuser Company
WRECO	Weyerhaeuser Real Estate

Executive Summary

ES.1 Introduction

This Risk Assessment (RA) was conducted to evaluate the potential for adverse impacts to human health and the environment associated with the potential exposure to residual constituents present at the former DuPont Works Explosives manufacturing site (Site) located in Pierce County, Washington. Residual constituents are those constituents that remain in the soil, or other media, after the explosives manufacturing facility was decommissioned and after interim source removal of soil and debris. This Executive Summary summarizes the methods, inputs, and assumptions used to determine Site-specific cleanup and remediation levels, and identifies areas on the Site that are not in compliance with these standards, and that will therefore be addressed in the Feasibility Study (FS). The RA was conducted in accordance with a Consent Decree, effective July 1991, between the lead agency, the Washington State Department of Ecology (Ecology), and the principal responsible parties, Weyerhaeuser Corporation (Weyerhaeuser) and E.I duPont de Nemours and Company (DuPont).

The Site initially consisted of two parcels and is located within the limits of the City of DuPont, Pierce County, Washington (See Figure ES-1). Parcel 2 was remediated and is now used for industrial purposes. Parcel 1, which is the focus of this RA, is located in the western part of the City of DuPont.

ES.2 Background Information

Two risk assessment reports for the Site were written prior to this RA. In 1989, a preliminary draft RA was completed, and a second RA was completed in 1994. The 1994 draft RA underwent review cycles with Ecology and others, but was never finalized.

The RA presented here incorporates comments received on the 1994 Draft RA, and agreements and actions completed at the Site subsequent to that report. This RA was prepared in accordance with the Model Toxics Control Act (MTCA) Cleanup Regulation, Chapter 173-430 WAC. Using MTCA guidance, risk-based cleanup and remediation levels were developed for each constituent considering future land use, exposed populations, exposure pathways, and toxicity information, using prescribed noncancer and cancer risk goals. This was accomplished through completion of the following three tasks:

1. Data Evaluation, Reduction, and Screening.

2. Identification/Development of Cleanup Standards.

3. Comparison of Site Media Concentrations to Cleanup Standards.

The results of each of these tasks are presented in the following sections.

ES.3 Data Evaluation, Reduction, and Screening

Future land uses of the Site, evaluation units (EUs), media of concern, and a preliminary list of constituents of potential concern (COPCs), were identified in this task.

ES.3.1 Future Land Use

Based on a restrictive covenant, and in accordance with the Final Environmental Impact Statement, future use of the Site will include commercial, golf course, historical, industrial, and open space use. Commercial use will include development of offices and retail businesses, and will comprise approximately 636 acres of the Site. Most of the soil in commercial areas will be covered by buildings, parking lots, and roads. The remaining soil will be either professionally landscaped or covered with sidewalks. A golf course will cover approximately 187 acres of the Site. Historical areas on the Site include the 1833 Hudson's Bay Fort, the Shell Midden Site, the 404 Burial Site, and the Methodist Mission site (specific location is unkown). In total, the 1833 Fort, the Shell Midden, and the 404 site historical areas comprise approximately 6 acres of the Site. Industrial use may include activities ranging from mining gravel to development of light industrial facilities. The area proposed for industrial use is north of Sequalitchew Creek and comprises approximately 36 acres of the Site. Open space use, which will occur in four areas of the Site, will encompass a total area of approximately 73 acres. The location of each of these future use areas is presented in Figure ES-2.

ES.3.2 Identification of Evaluation Units

The next step in the RA was identification of EUs. The EUs were developed based on the future Site uses described above, and were approved by Ecology. Future land use areas, such as the historical and open space areas, that were relatively small in size were evaluated without further division. The industrial land use area was also not divided. The commercial and golf course land use areas were divided into smaller EUs such that the smaller EUs were similar in size, consisted of contiguous property, and accounted for potential remedial alternatives. The RA EUs are presented in Figure ES-2.

ES.3.3 Media of Concern

Potentially affected media at the Site include surface soil (0-1 foot below ground surface [BGS]), subsurface soil (1 foot to 15 BGS), subsurface soil greater than 15 feet BGS, surface water (Old Fort Lake and Sequalitchew Creek), sediment (Old Fort Lake and Sequalitchew Creek), and groundwater. Based on the historical RI, preliminary and draft RAs, and ecological evaluations, it was determined that levels of COPCs in surface water and sediment were not of concern for protection of human and ecological receptors. Therefore, Ecology determined that no further action was warranted for these media (for more details see the current RI Report). In groundwater, DNT levels were slightly elevated above applicable groundwater standards.

ES.3.4 Preliminary Screening of COPCs

In the final step of this task, a preliminary list of COPCs was identified for further evaluation in the RA. This screening was conducted on a Site-wide basis (i.e., EUs were not screened individually in this step). In the initial screening step, sample results for all constituents were reviewed, and those constituents that were not detected in any samples were eliminated from further consideration. Following this screening step there were 38 detected constituents in surface soil and 52 detected constituents in subsurface soil >1 foot and ≤ 15 feet BGS, and 35 detected constituents in subsurface soil > 15 feet BGS.

In the last screening step, the maximum detected concentration for each constituent was compared to the most conservative (i.e., the lowest) soil cleanup levels and screening concentrations found in MTCA for the protection of groundwater, human health and ecological receptors. Following this screening step, there were 18 COPCs identified for surface soil and 19 COPCs identified for subsurface soil, and 3 COPCs identified for subsurface soil greater than 15 feet BGS. Constituents that did not have available risk-based screening concentrations were retained for further evaluation in the risk assessment. Soil samples analyzed for oil and grease were excluded from the RA due to the non-specificity of the analysis method, which measures both natural oils and greases and petroleum constituents.

ES.4 Identification of Soil Cleanup Levels and Remediation Levels

In this task, soil cleanup levels and remediation levels that are used to characterize potential impacts to human health and the environment, were identified. In addition, an area-specific background arsenic level was derived because the area background concentration is higher than MTCA soil cleanup levels. As previously mentioned, Ecology has determined that, with the exception of groundwater and soil, all media within the Consent Decree Boundary require “No Further Action”. Therefore, the cleanup levels and remediation levels identified were specific to soil. The presence of low levels of DNT in groundwater is addressed in the FS.

ES.4.1 Soil Cleanup Levels

Cleanup levels for soil are published in tables by Ecology, and are default values that can be used at any site. The only area on Site where these default cleanup levels apply is the industrial area located north of Sequalitchew Creek. These levels assume adult workers would be exposed to hazardous constituents through incidental soil ingestion, and were calculated using the algorithm and default exposure assumptions identified in WAC 173-340-745. The other cleanup level used was 2,000 mg/kg for total petroleum hydrocarbons (TPH/diesel or heavier oils), which was taken from the MTCA Method A Table, in WAC 173-340-900. In addition, Site-specific cleanup levels for mercury, TPH (bunker C), total 2,4-dinitrotoluene and 2,6-dinitrotoluene (DNT), and 2,4,6-trinitrotoluene (TNT) were approved for use at the Site by Ecology (See Appendix C).

ES.4.2 Soil Remediation Levels

Soil remediation levels are site-specific levels based on protection of human health that are developed using exposure assumptions and other media-specific factors that reflect future site conditions. Remediation levels are calculated using human health risk assessment procedures and site-specific information, as specified in WAC 173-340-708. In order to apply remediation levels to site cleanup decisions, institutional controls (such as deed restrictions) are placed on properties with residual contamination to ensure that the exposure conditions applied to the derivation of these levels are maintained at the site in the future. Remediation levels were calculated for all constituents detected in at least one soil sample, unless the constituent did not have available toxicity information and was not directly linked to historical site operations.

The equations used to calculate remediation levels for all constituents except lead were obtained from WAC 173-340-740. Soil remediation levels were calculated using these equations, considering the potential reasonable maximum exposure (RME) for humans under each proposed land use with the exception of industrial use (for industrial use, MTCA default industrial cleanup levels were used, as described above). For lead, EPA has chosen to evaluate the potential adverse health effects using a physiologically-based model. The model currently used by EPA for establishing lead remediation levels in non-residential areas is the Adult Lead Model (EPA, 1996b). Using this model, site-specific remediation levels were developed for golf course worker, commercial landscape worker, and industrial worker scenarios. A hybrid approach using both the Adult Lead Model and the child Integrated Exposure Uptake Biokinetic Model for Lead (IEUBK), was used to derive a remediation level for open space areas.

ES.4.3 Ecological Soil Screening Concentration for Lead

Ecology has performed an evaluation of the Site and determined that lead is the indicator constituent for potential terrestrial ecological impacts. As part of this evaluation, Ecology determined that based on Site-specific information the potential species groups of concern included ground-feeding birds and herbivorous small mammals. The screening level identified by Ecology is 118 mg/kg and is intended to be protective of wildlife, including birds and small mammals. Exceedance of this value does not necessarily indicate that cleanup must occur, but that various other options could be explored to demonstrate that lead does not pose a threat to ecological receptors at the Site.

ES.4.4 Determination of Arsenic Background Level in Soil

In addition to the cleanup levels and remediation levels, an area background soil concentration was calculated for arsenic. As part of the RI investigation, soil samples were collected outside of the Consent Decree boundary to define the "Site Area Background" level of arsenic. As stipulated in WAC 173-340-709, twenty soil samples were collected to statistically establish area background levels. Based on the results of these samples, the site area background concentration for arsenic is 32 mg/kg. This value represents the 90th percentile value of the distribution of the background samples.

A summary of the cleanup levels and remediation levels used for each future use scenario is presented in Table ES-1.

ES.5 Comparison of Site Soil Concentrations to Cleanup Levels and Remediation Levels

In this last task of the RA, soil concentrations for each EU were compared to the cleanup levels and remediation levels identified above. Only those COPCs that were detected in at least one sample and that had maximum concentrations that exceeded conservative risk-based screening criteria were evaluated in this task of the risk assessment.

The steps involved in this comparison included calculating the MTCA 95% Upper Confidence Limit (UCL) of the mean concentration (i.e., a conservative estimate of the mean) for each EU, comparing this concentration and the maximum detected concentration in each EU to cleanup standards applicable to the future use of each EU, and identifying EUs with COPC concentrations that do not comply with MTCA's Three-Fold Criteria [WAC 173-340-740 (7)(c),(d), and (e)]. In addition to the Three-Fold Criteria, constituents in each EU were also compared to MTCA's risk-based criteria.

ES.5.1 Comparison of EU Soil Concentrations to Cleanup Levels and Remediation Levels

The soil concentrations in each EU were compared to the cleanup standards to determine if the concentrations of COPCs in each EU comply with MTCA Three-Fold Criteria. The MTCA Three-Fold Criteria are the following:

1. The maximum soil concentration must be less than or equal to 2 times the site-specific cleanup level or remediation level.
2. The MTCA 95% UCL on the mean must be less than the site-specific cleanup level or remediation level.
3. Less than 10% of individual soil concentrations shall exceed the site-specific cleanup level or remediation level.

If any of these criteria are not met, then the EU is not in compliance, and was designated for evaluation in the FS.

ES.5.2 Comparison of EU Constituent Concentrations to MTCA Risk-Based Criteria

MTCA identifies risk-based criteria for constituents as follows:

1. The human health risk level for individual constituents may not exceed a hazard quotient of 1 or a cancer risk of one-in-a-million (1E-06) for historical, open space, golf course, and commercial EUs. The human health risk level for individual constituents may not exceed a hazard quotient of 1 or a cancer risk of one-in-one-hundred thousand (1E-05) for the industrial EU.
2. The total risk level at the site, based on cumulative exposure to all constituents, may not exceed a hazard index of 1 or a cancer risk of 1 in 100,000 (1E-05).

If an EU exceeds these criteria the EU does not comply with MTCA, and is carried through to the FS.

ES.5.3 Identification of EUs With COPCs in Soil That Exceed MTCA Three-Fold Criteria and/or MTCA Risk-Based Criteria

Each EU was evaluated using the MTCA Three-Fold Criteria and Risk-Based Criteria. Based on the results of this evaluation, the EU was determined to be in compliance or not in compliance with MTCA. The results of this evaluation are summarized below organized by future land use category.

ES.5.4 Commercial Land Use EUs

All commercial EUs were out of compliance with the MTCA Three-Fold Criteria and the Risk-Based Criteria. Arsenic and lead were the COPCs that exceeded the criteria most frequently.

ES.5.5 Golf Course Use EUs

All golf course EUs were out of compliance with the MTCA Three-Fold Criteria and the Risk-Based Criteria. Arsenic and lead were the COPCs that exceeded the criteria most frequently.

ES.5.6 Historical Use EUs

All historical EUs were out of compliance with the MTCA Three-Fold Criteria and the Risk-Based Criteria. Arsenic and lead were the COPCs that exceeded the criteria most frequently.

ES.5.7 Industrial Use EUs

There is only one industrial EU, which was in compliance with both the MTCA Three-Fold Criteria and the Risk-Based Criteria. There are a few instances though, where the soil concentrations exceed the soil-to-groundwater screening criteria.

ES.5.8 Open Space Use EUs

All open space EUs were out of compliance with the MTCA Three-Fold Criteria and the Risk-Based Criteria. Arsenic and lead were the COPCs that exceeded the criteria most frequently

ES.5.9 Summary of Results

All EUs were screened against MTCA's Three-Fold Criteria and Risk-Based Criteria. Using these criteria, all EUs except the industrial EU did not comply, and will require evaluation in the FS. Most criteria exceedances were noted in the surface soil samples. Arsenic and lead were the constituents responsible for almost all criteria exceedances in the EUs.

Table ES-2 presents a summary of the compliance status of each EU. Figures ES-3 and ES-4 present the EUs that did not comply with MTCA Three-Fold criteria and Risk-Based Criteria.

Table ES-1 – Soil Cleanup Levels and Remediation Levels Used for Evaluating EUs

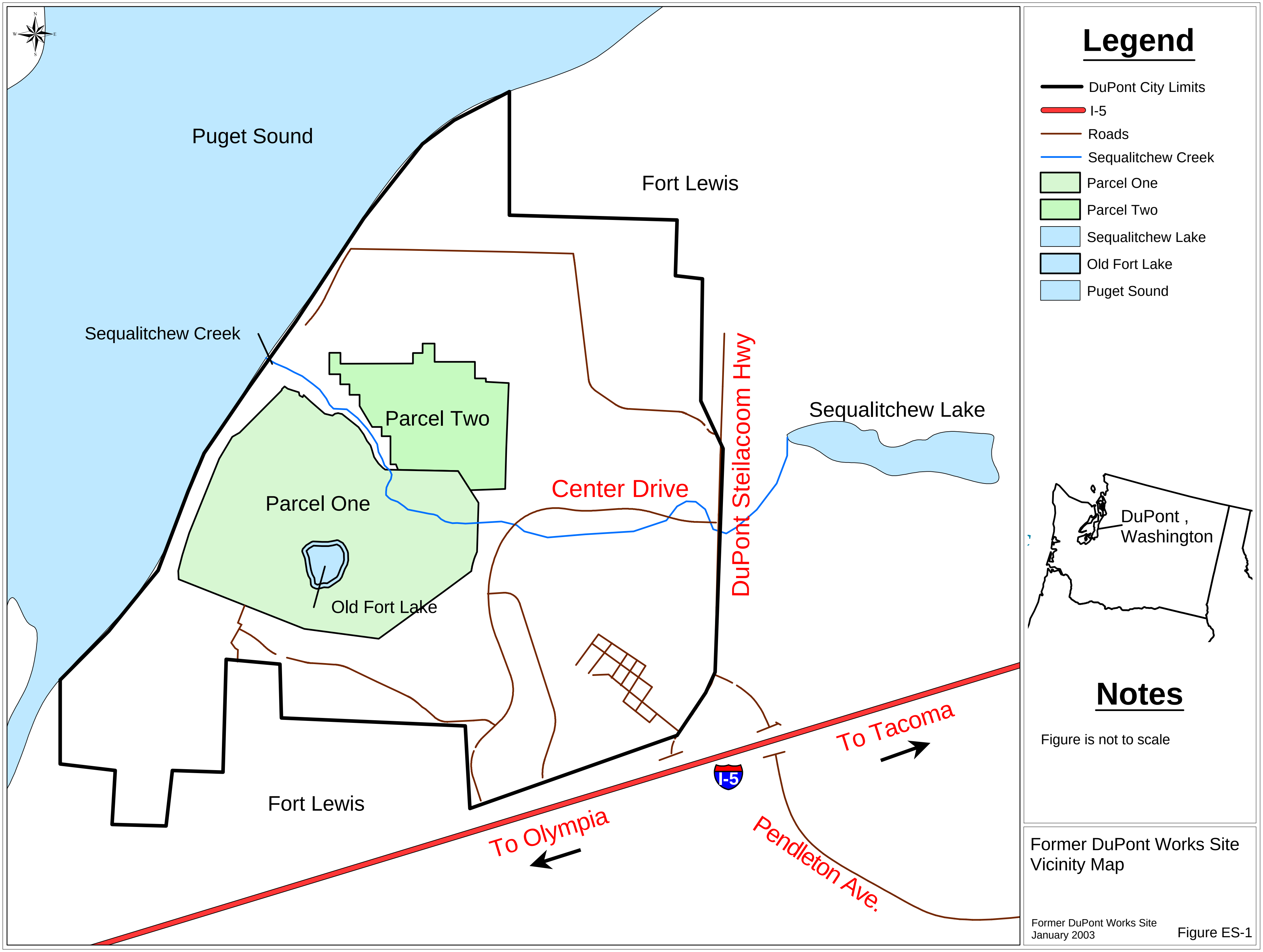
Constituent	Commercial and Golf Course EU Cleanup and Remediation Levels (mg/kg)	Historical and Open Space EU Cleanup and Remediation Levels (mg/kg)	Industrial EU Cleanup Levels (mg/kg)
Explosives			
Monomethylamine Nitrate	19,900(1)	6,680(1)	28,350
Nitroglycerine	6,580(1)	368(1)	4,080
2,4,6-Trinitrotoluene	1.75(2)	1.75(2)	1.75(2)
Petroleum Hydrocarbons			
TPH (418.1)	7,600(2)	7,600(4)	7,600(2)
Inorganics			
Aluminum	NC	825,000(1)	NC
Arsenic	60(2)	32(2)	90(2)
Copper	90,900(1)	30,500(1)	130,000
Lead	118(3)	118(3)	1,000(5)
Mercury	24(2)	24(2)	24(2)
PAHs			
Benzo(a)Anthracene	126(1)	7.1(1)	18
Benzo(a)Pyrene	12.6(1)	0.71(1)	18
Benzo(b)Fluoranthene	126(1)	7.1(1)	18
Benzo(k)Fluoranthene	1260(1)	71(1)	18
Chrysene	12,600(1)	710(1)	18
Dibenzo(a,h)Anthracene	12.6(1)	0.71(1)	18
Indeno(1,2,3-c,d)Pyrene	126(1)	7.1(1)	18
Pesticides/PCBs			
Aldrin	5(1)	0.3(1)	7.7

Notes:
NC = Not of Concern. Concentration calculated was equivalent to a 100 percent concentration. Therefore, this constituent is not of concern for this future land use.
Cleanup Levels are shaded and are either calculated using MTCA default parameters or measured site-specific information.
(1) Calculated using Site-specific parameters.
(2) Based on agreement with Ecology.
(3) Ecological screening concentration.
(4) Ecology agreement for TPH that originated as Bunker C fuel. One Area has TPH that did not originate from Bunker C fuel. Those TPH data were compared to the MTCA Table A value of 2,000 mg/kg for heavy oils.

(5) MTCA default value used for Parcel 2.

Table ES-2 – Summary of EUs to be Evaluated in the FS

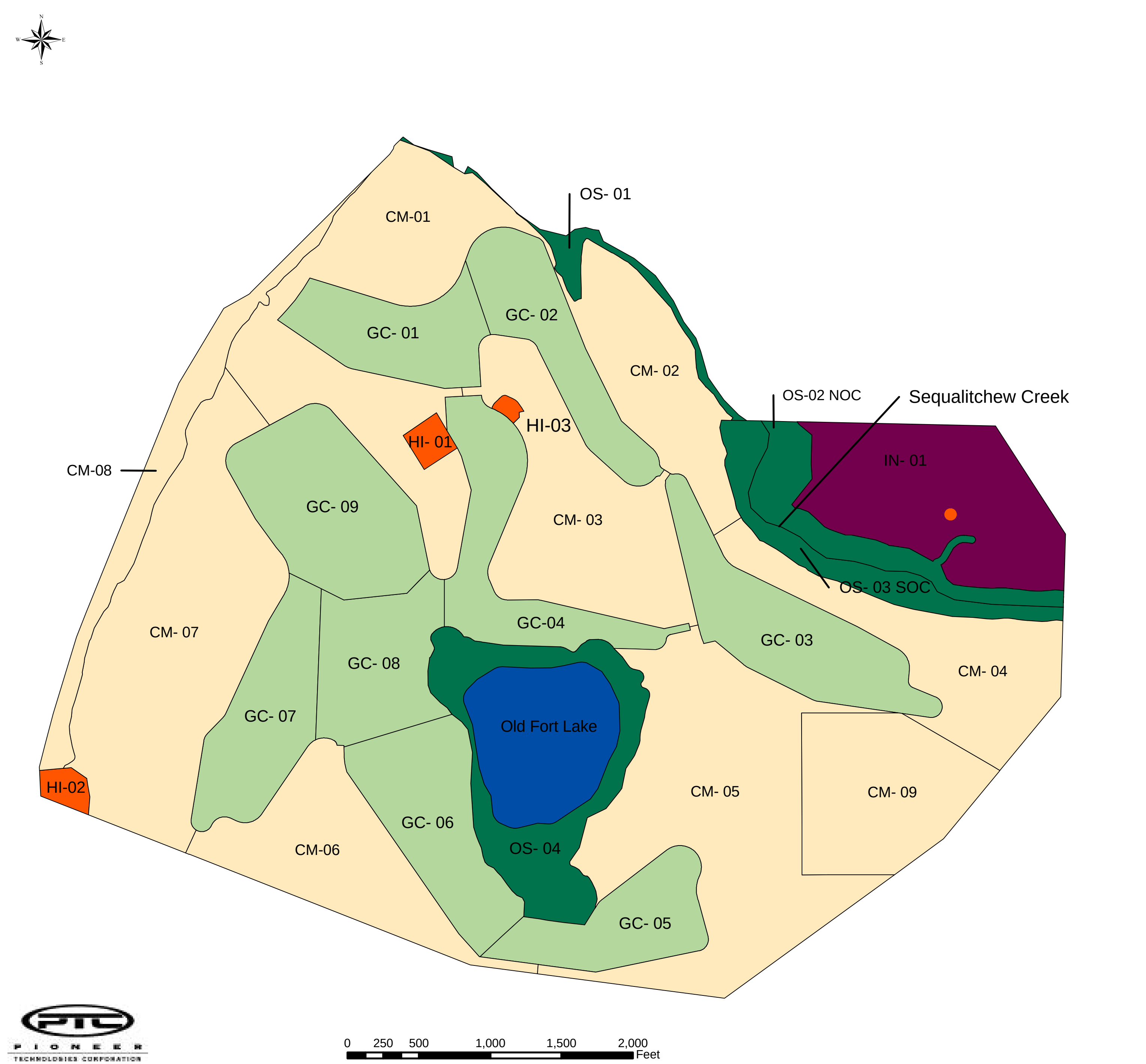
EU	EU to be Evaluated in FS
Commercial 1	Yes
Commercial 2	Yes
Commercial 3	Yes
Commercial 4	Yes
Commercial 5	Yes
Commercial 6	Yes
Commercial 7	Yes
Commercial 8	Yes
Commercial 9	Yes
Golf Course 1	Yes
Golf Course 2	Yes
Golf Course 3	Yes
Golf Course 4	Yes
Golf Course 5	Yes
Golf Course 6	Yes
Golf Course 7	Yes
Golf Course 8	Yes
Golf Course 9	Yes
Industrial 1	Yes
Open Space 1	Yes
Open Space 2	Yes
Open Space 3	Yes
Open Space 4	Yes
Historical 1	Yes
Historical 2	Yes
Historical 3	Yes



Former DuPont Works Site
Vicinity Map

Former DuPont Works Site
January 2003

Figure ES-1



Legend

- Golf Course
- Historical
- Industrial
- Open Space
- Old Fort Lake
- Commercial

Notes

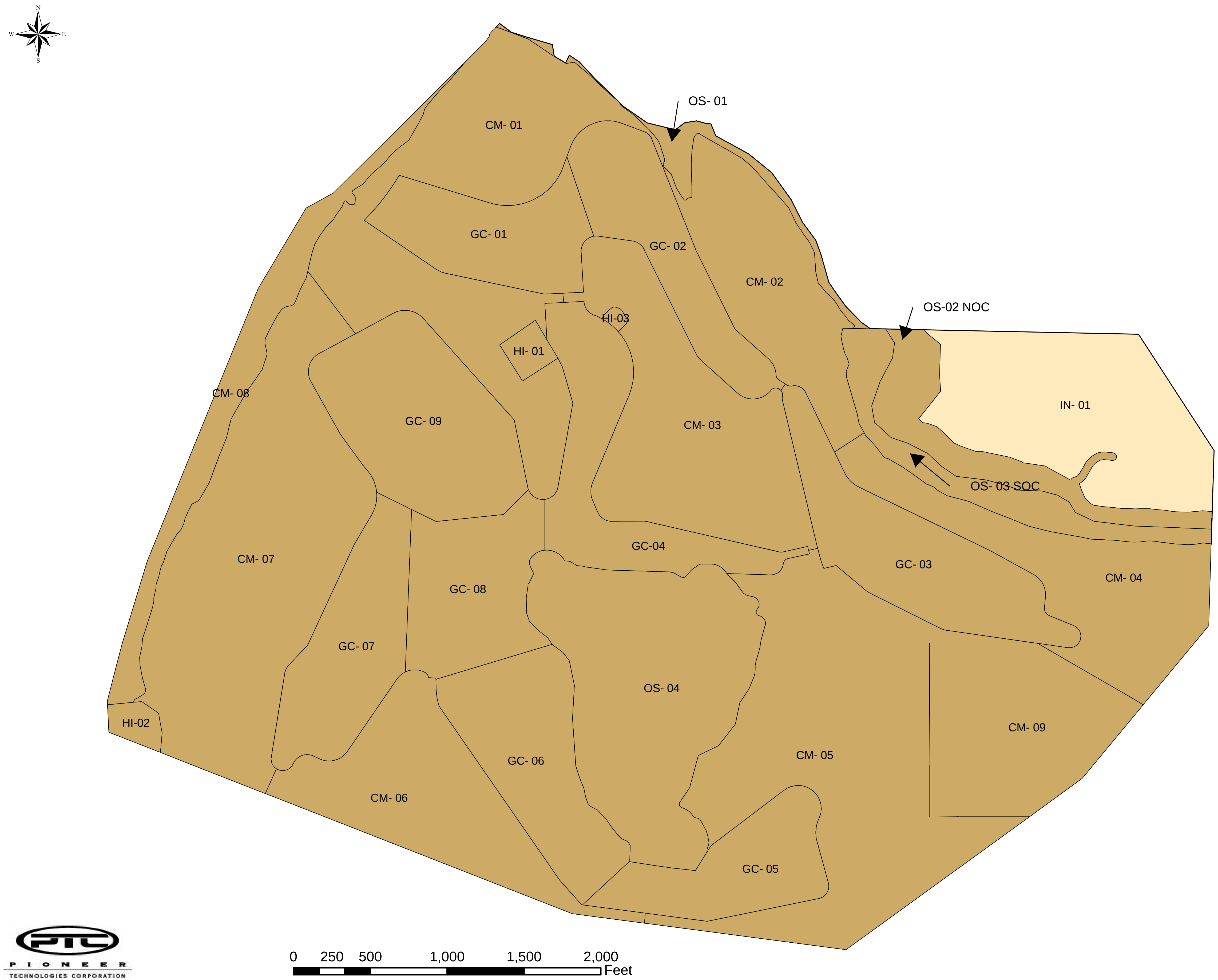
GC - Golf Course
HI - Historical
CM - Commercial
OS - Open Space
NOC - North of Creek
SOC - South of Creek

Historical location in the Industrial area is the Methodist Mission Marker. Actual location of the mission is unknown.

Risk Assessment
Evaluation Units

Former DuPont Works Site
July, 2003

Figure ES-2



Legend

- Eu in Compliance 0 to <1 ft
- EU not in Compliance 0 to <1 ft

Notes

GC - Golf Course
CM - Commercial
HI - Historical
OS - Open Space
NOC - North of Creek
SOC - South of Creek
IN - Industrial

EU Compliance Status for Arsenic and Lead in Surface Soil

Former DuPont Works Site
September, 2002

Figure ES-3

Legend

Eu in Compliance >1 to <15 ft

EU not in Compliance >1 to <15 ft

Notes

GC - Golf Course
CM - Commercial
HI - Historical
OS - Open Space
NOC - North of Creek
SOC - South of Creek
IN - Industrial

EU Compliance Status for Arsenic and Lead in Subsurface Soil

Former DuPont Works Site
September, 2002

Figure ES-4

Chapter 1 – Introduction

1.1 Introduction

This Risk Assessment (RA) was conducted to evaluate the potential for adverse impacts on human health and the environment associated with potential exposure to residual constituents present at the former DuPont Works Explosives manufacturing site (Site) located in Pierce County, Washington. Residual constituents are those constituents that remain in the soil, or other media, after the explosives manufacturing facility was decommissioned and after interim source removal of soil and debris. This report presents the methods, inputs, and assumptions used to identify areas on the Site with the potential for adverse impacts on human health and the environment that will be evaluated further in the feasibility study (FS). The RA was conducted in accordance with a Consent Decree, effective July 1991, between the lead agency, Washington State Department of Ecology (Ecology) and the principal responsible parties—The Weyerhaeuser Company (Weyerhaeuser) and E.I. duPont de Nemours and Company, Inc. (DuPont).

1.2 Location and Setting

1.2.1 Location and Site Characteristics

The Site initially consisted of two parcels and is located within the limits of the City of DuPont, Pierce County, Washington (see Figure 1-1). Remediation of Parcel 2 has been completed and this parcel was released for development by Ecology in December of 1997. Parcel 1, which is the focus of this RA, is located in the western part of the City of DuPont. The Site is bordered by Weyerhaeuser property to the north and west and Weyerhaeuser Real Estate Company (WRECO) property on the east, and south. Burlington Northern railroad property is adjacent to the Weyerhaeuser open space to the west. Puget Sound is located to the west of the Burlington Northern Railroad property.

1.2.2 Physical Setting

The significant physical features of relief across the Site are numerous glacial kettles (depressions), the east-west trending valley of Sequalitchew Creek, a steep bluff that partially borders Burlington Northern Railroad property, and a small kettle lake in the southern portion of the Site called Old Fort Lake. Site elevations generally range from 200 to 225 feet above mean sea level (MSL), except within the kettles, where elevations are approximately 150 feet above MSL. The Site lies in the Puget Sound area of the wet coniferous forest region and is generally forested with intermittent clearings associated with the former production activities. This document reflects Site conditions as of March 2002. Weyerhaeuser, DuPont, and Ecology recognize that there have been changes to the Site since that point in time.

Site soils consist primarily of Steilacoom gravels. These gravels are comprised of stratified sands and gravels. Soil horizons on top of the Steilacoom gravels consist of gravelly, sandy loam with variable amounts of organic matter.

Two water-bearing zones, or aquifers, occur beneath the Site—the shallow Water Table Aquifer, and the deeper Sea Level Aquifer. Across most of the Site, the relatively impermeable Aquitard within the "Olympia Beds/Possession Drift/Whidbey Formation/Double Bluff Drift sequence (Aquitard)" restricts vertical flow of groundwater, and separates the Water Table Aquifer from the deeper Sea Level Aquifer (Borden and Troost, 2001). Groundwater in the Water Table Aquifer flows toward the west-northwest, with local discharge via springs to upper Sequalitchew Creek. The deeper Sea Level Aquifer flows toward Puget Sound.

Surface water resources on the Site include Sequalitchew Creek and Old Fort Lake. The creek is fed by overflows from Sequalitchew Lake located approximately 1.4 miles east of the Site. The depth of Old Fort

Lake is shallow, and fluctuates with groundwater levels. Similar to Sequalitchew Creek, surface runoff to the lake is limited by rapid soil infiltration of rain water.

1.3 Risk Assessment Report Background

1.3.1 Preliminary Baseline Risk Assessment

In 1989, a preliminary baseline RA was conducted for the Site (ETI and Hart Crowser, 1989). Based on conditions present at the time, the preliminary baseline RA suggested that the estimated non-carcinogenic hazards associated with potential exposure to lead, arsenic and 2,4,6-trinitrotoluene (TNT) in soil were above levels of concern. In addition, the preliminary baseline RA suggested that the estimated cancer risks associated with potential exposure to 2,4-dinitrotoluene and 2,6-dinitrotoluene (DNT) and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) in soil were above levels of concern.

The preliminary RA also evaluated the potential for ecological impacts. The preliminary ecological RA indicated that aquatic organisms were not likely to be exposed to concentrations that could cause adverse impacts. A qualitative evaluation of the potential impacts on terrestrial wildlife indicated that potential impacts might be associated with exposure to constituents in hot spots which were present at the Site. These hot spots have subsequently been removed (PIONEER and West Shore, 2001).

1.3.2 Draft Risk Assessment Former DuPont Works Site, DuPont Washington

In 1994, a draft RA was conducted to evaluate potential exposures at each RI Area (i.e., former production areas and other areas of concern) to constituents detected above MTCA screening levels (DERS and Hart Crowser, 1994). Future land uses evaluated in the draft RA included residential, recreational (including open space and golf course), commercial, and industrial land use. The potential hazards and risks for each land use were evaluated, and the results of the draft human health RA indicated that several residential land use areas required further evaluation in the FS including: Areas 36, 38, 39, AP-C, AP-E, and the narrow gauge railroad (NGRR) based on exposure to arsenic, lead, and/or mercury in soil. The only future golf course or commercial land use areas that were identified in the draft RA as requiring further evaluation in the FS were Area 19 A and C, because of elevated concentrations of lead in soil (The location of these RI areas is shown in Chapter 2, Figure 2-3). No future industrial or open space land use areas required further evaluation based on the results of the draft RA.

A quantitative ecological RA was also conducted following the U.S. Environmental Protection Agency's (EPA) general framework. Historical and current surveys of the Site were used to determine indicator species including blacktail deer, red fox, red-tailed hawk, and Townsend vole. Potential risks to these indicator species were evaluated using available habitat and feeding habit information along with available toxicity data. The results of the draft ecological RA indicated no potential risk to large terrestrial mammals or avian species. Hazard quotients greater than one were calculated for voles in soil based on exposure to arsenic and/or mercury exposure in six areas of the Site (Areas 16, 26, 38, 39, AP-E, and Narrow Gauge Railroad (NGRR)).

1.3.3 Final Risk Assessment

The 1994 draft RA was reviewed by Ecology and others, and comments were provided. Since that time there have been a number of technical work group meetings, and meetings with Ecology, to evaluate and address various issues. The work, agreements, and changes in proposed land uses that resulted from these meetings include the following:

- Comments on the draft RA from Ecology and the Public.

- An agreement with Ecology on soil cleanup levels for total dinitrotoluene (2,4-dinitrotoluene and 2,6-dinitrotoluene) (Ecology, 1996), 2,4,6-trinitrotoluene (Ecology, 2001), mercury (Ecology, 1993), total petroleum hydrocarbons (TPH) and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) (Hart Crowser, 1996).

- An agreement with Ecology on a toxicity value for monomethylamine nitrate (MMAN) (Ecology and PIONEER, 1997).

- An agreement with Ecology on soil lead remediation levels for four land use types including, golf course, commercial, industrial, and open space (Ecology, 1999).

- An agreement with Ecology on soil arsenic remediation levels for three different land use types including, golf course, commercial, and industrial (Ecology, 1999b).

- A site background soil level for arsenic (See the RI).

- An agreement on the configuration of future land use evaluation units.

- A determination by Ecology that lead is the indicator compound for potential terrestrial ecological impacts.

- Extensive work to evaluate potential ecological risks at the Site (see Appendix A). Because no Site-specific agreements were reached regarding a lead cleanup level for ecological receptors, the current assessment utilizes an ecological soil screening concentration for lead developed by Ecology.

- Significant quantities of contaminated soil and debris have been removed and disposed of off-Site as the result of 2000 Hot Spot Removals and 2001 Interim Corrective Actions (PIONEER et al., 2000).

- Additional Site characterization data have been collected, including data for areas not addressed by the preliminary or draft RAs.

- Future land use has changed from what was evaluated in previous RAs.

1.4 Overview of the Risk Assessment Process

Risk assessment is an established approach to evaluate the potential for impacts to human health and the environment associated with exposure to toxic constituents. Risk assessment is a management-decision tool, and does not provide absolute statements about health and environmental impacts, and typically focuses on constituents and exposure pathways directly related to a site. These assessments do not address risks from other sources of exposure (e.g., dietary exposures), or risks from other constituents that are not associated with the site under evaluation. Risk managers use the results of risk assessments to assist in determining if a site, or portion thereof, requires remediation.

1.5 Comparison of the MTCA Risk Assessment Process with the EPA Superfund Risk Assessment Process

The risk assessment process identified in MTCA differs from the traditional EPA Superfund risk assessment process presented in Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (EPA, 1989). Under Superfund, risk assessments are typically comprised of the following five tasks:

1. **Data Evaluation, Reduction, and Screening**. This task identifies potential constituents of concern from analytical data obtained from the field-sampling program. Constituents detected in at least one sample during the field investigation are identified and screened against risk-based screening concentrations to obtain a final list of constituents of potential concern (COPCs) to be evaluated in the risk assessment.

2. **Exposure Assessment**. This task identifies potentially exposed populations (e.g., children, adults, and potentially, plants and animals), exposure scenarios, exposure pathways, and exposure factors. The algorithms used to calculate intake also are presented in this section.

3. **Toxicity Assessment**. This task identifies toxicity values for the COPCs identified in task 1. Toxicity values include noncarcinogenic reference doses and carcinogenic slope factors for humans and noncancer toxicity information for plants and animals.

4. **Risk Characterization**. This task presents the human noncancer and incremental cancer risks, and the ecological hazard quotients associated with exposure to the COPCs that were calculated using the information described in tasks 1 - 3.

5. **Uncertainty Analysis**. This task identifies key uncertainties that should be considered when assessing the risks developed in task 4.

After the initial Data Evaluation, Reduction, and Screening step, which is the first component of any evaluation, the MTCA risk assessment process could be described as performing an EPA Superfund risk assessment in "reverse". That is, risk-based cleanup levels and remediation levels are developed for each constituent considering land-use, exposed populations, exposure pathways, and toxicity information based on prescribed noncancer and incremental cancer risk levels. Under MTCA, human health risk assessments are typically comprised of the following 3 tasks:

1. **Data Evaluation, Reduction, and Screening (Chapter 2)**. This task identifies potential constituents of concern from analytical data obtained from the field-sampling program. Constituents detected in at least one sample during the field investigation are identified for further evaluation in the risk assessment. This is similar to task 1 in the Superfund risk assessment process.

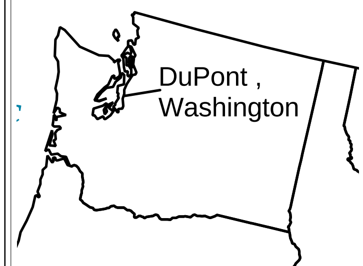
2. **Development of Cleanup Levels and Remediation Levels (Chapter 3)**. This task identifies concentrations for each constituent that are protective of human health and/or the environment. For noncarcinogenic constituents these concentrations are established at levels that would not cause illness in humans. For carcinogenic constituents these concentrations are established at levels that would not cause exceedances of the allowable level of excess cancer risk (as defined in MTCA) in humans. If applicable to a particular site, cleanup levels and remediation levels also are established for each constituent at levels that would be protective of terrestrial or aquatic receptors (e.g., plants and animals). For human health risk assessments, this task generally incorporates elements of task 2 – Exposure Assessment and task 3 – Toxicity Assessment of the Superfund risk assessment process. That is, cleanup levels and remediation levels are developed for specific land-uses, potentially exposed populations, and typically incorporate the most current toxicity information.

3. **Comparison of Site Media Concentrations to Cleanup Levels and Remediation Levels (Chapter 4)**. This task compares the site media concentrations, identified and summarized in task 1, with the cleanup levels and remediation levels identified in task 2. This task is similar to the risk characterization task of the Superfund risk assessment process; but, the results of EPA Superfund risk assessments and MTCA risk assessments are expressed differently. The results of an EPA Superfund risk assessment are expressed as noncancer health effects or incremental cancer risks. In contrast, the results of a MTCA Risk Assessment are expressed as exceedances of the cleanup levels and remediation levels.

Throughout this report, tables and figures are presented at the end of each chapter in which they are discussed. Chapters in this report are supplemented by Appendices, that provide supporting documentation of items discussed in the text.

Legend

- DuPont City Limits
- I-5
- Roads
- Sequalitchew Creek
- Parcel One
- Parcel Two
- Sequalitchew Lake
- Old Fort Lake
- Puget Sound



Notes

Figure is not to scale

Former DuPont Works Site
Vicinity Map

Former DuPont Works Site
January 2003

Figure 1-1

1.6 References

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Chapter 2 – Future Land Use, RA Evaluation Units and Identification of COPCs

2.1 Introduction

The purpose of this Chapter is to identify the future land uses for the Site, delineate evaluation units (EUs), identify media of concern, and to identify COPCs that will be evaluated further in the risk assessment.

2.2 Future Land Use

In October 1999, Weyerhaeuser Company and WRECO filed a Declaration of Restrictive Covenant that specifies allowable land uses for the Site. The Restrictive Covenant was filed with the Pierce County Auditor (document no. 9910290750) and states that none of the property shall be developed or used for residential uses, schools, daycare facilities, parks or other recreational uses – with the exception that the golf course and related amenities shall be allowed. These restrictions on land uses apply to the current landowners and all future landowners, unless determined otherwise in a legal venue and with Ecology's approval.

Future Site use, according to the Final Environmental Impact Statement (Ecology, 2000), will include commercial, golf course, historical, industrial and open space uses (See Figure 2-1). North of Sequalitchew Creek is planned for industrial use and open space. South of Sequalitchew Creek is planned for mixed use. Most of the Site will undergo changes during development, including grading, paving, placement of buildings, addition of topsoil, soil amendments, and landscaping. Future Site use plans, as reflected in this RA, enable an assessment of potential future risk.

2.2.1 Commercial

The majority of the Site property will be used for commercial purposes such as offices and retail businesses. The majority of the soil in this area will be covered by buildings, parking lots, and roads. Areas that are not covered by a building or parking lot will have sidewalks and professionally maintained, landscaped areas. These landscaped areas will be prepared for planting by adding imported topsoil, plants, and shrubs. A layer of mulch, or similar cover, will be added for aesthetic and practical purposes (e.g., weed control). Figure 2-1 identifies the commercial land use areas that comprise approximately 334 acres.

2.2.2 Golf Course

Ecology has agreed that a golf course facility is compatible with the planned future use of the Site (Ecology, 2000). A golf course serves as an effective means to isolate soil on the Site that is contaminated with lead or arsenic. The golf course layout was designed in order to maximize coverage of areas that have elevated soil arsenic and lead concentrations. The golf course, presented in Figure 2-1, covers approximately 187 acres.

2.2.3 Historical

Three historical areas have been identified on the Site, including the Fort Nisqually Cemetery (45Pl404), the Shell Midden (45Pl72), and the 1833 Fort Nisqually Site (45Pl155). The historical areas consist of approximately 6 acres. The Methodist Mission site is an additional historical site (45-PI-66) but, whereas the size and actual location of the site are unknown, a stone marker has been placed in its approximate location. The location of each of these areas is identified in Figure 2-1.

2.2.4 Industrial

The area north of Sequalitchew Creek will be used for industrial purposes. Industrial use may include activities ranging from mining gravel to development of light industrial facilities. This area occupies 36 acres and is identified in Figure 2-1.

2.2.5 Open Space

A number of areas on the Site will be used for open space. The open space area north of Sequalitchew Creek encompasses the creek and the former NGRR bed leading down to Puget Sound. The open space area south of Sequalitchew Creek borders the creek and extends to the northern most portion of the consent decree boundary. The area surrounding Old Fort Lake has also been designated as open space. The open space areas comprise approximately 73 acres, 22 acres of which is the lake itself. The location of each of these areas is identified in Figure 2-1.

2.3 Identification of Evaluation Units

The RI Report presents data by RI Areas. For the purposes of the RI, the Site was separated into different areas based on former production activities or other related activities that may have resulted in releases of COPCs to the environment. For the RA, the Site has been separated into different EUs based on future land use. Figure 2-3 presents both the RI areas and RAs for comparison. In addition, Appendix B of the RA presents the sample numbers for each EU and identifies their associated RI Areas.

The EUs were derived based on future land uses of the Site and were approved by Ecology. Future land use areas such as the historical and open space areas, that are relatively small in size, were evaluated without further division. The industrial land use area also was not divided. The commercial and golf course areas were subdivided into smaller EUs using the following decision rules:

- EUs should be similar in size.
- EUs should consist of contiguous property.
- EU boundaries should take into account potential remedial alternatives. For example, the commercial area on the bluff overlooking Puget Sound would require a different remedial approach than the rest of the Site due to the topography. Therefore, this area was designated, as its own EU. Other small EUs include the 65-foot commercial buffers, which are on the southern, southeastern, and eastern borders of the Site. These areas may be left in their current state as a buffer, depending on the results of the RA.
- EUs for the Golf Course should be divided between groups of golf holes.

The RA EUs are presented in Figure 2-3 and the number of acres for each EU is summarized in Table 2-1.

2.4 Potentially Affected Media

Potentially affected media at the Site include surface soil (0-1 foot below ground surface [BGS]), subsurface soil (1 foot to 15 BGS), subsurface soil (greater than 15 feet BGS), surface water (Old Fort Lake and Sequalitchew Creek), sediment (Old Fort Lake and Sequalitchew Creek), and groundwater. Based on the historical RI, preliminary and draft RAs, and ecological evaluations, it was determined that levels of COPCs in surface water and sediment were not of concern for protection of human and ecological receptors. Therefore, Ecology determined that no further action was warranted for these media (for more details see the RI Report, Volume I). Soil and groundwater are discussed below. COPC concentrations in the RI indicated that, other than low DNT concentrations that were detected in 6 wells, groundwater is not a medium of concern. The presence of low levels of DNT in groundwater is addressed in the FS.

The RI identified elevated levels of COPCs in surface and subsurface soil. COPCs are identified for surface and subsurface soil based on frequency of detection and risk-based screening criteria in the following section.

2.5 Identification of COPCs

In an effort to focus the risk assessment on those constituents most likely to pose risk to human and ecological receptors, preliminary screening was performed. This screening was conducted on a Site-wide basis (e.g., EUs were not screened individually in this step), and consisted of eliminating COPCs that were not detected in any samples, and eliminating COPCs that had maximum detected concentrations that were below conservative risk-based screening concentrations. These screening steps are discussed below.

Data quality has been assessed and is discussed in the RI (See Appendix E). The data review involved verification that chain-of-custody protocols were followed, verification that the laboratory followed its quality assurance program, and an independent evaluation by URS Inc. of any data quality exceptions noted by the laboratory. Although there were some data quality exceptions indicating that some concentrations are estimates, all of the data presented in the RI were deemed of sufficient quality to retain for use in the risk assessment.

2.5.1 Screening of Non-Detected COPCs

Sample results for all COPCs were reviewed, and those constituents that were not detected in any samples were eliminated from further consideration. A total of 38 detected constituents were detected in surface soil and 52 in subsurface soil. A summary of the COPCs detected in surface and subsurface soil is shown in Table 2-2.

2.5.2 Risk-Based Screening of COPCs

In this last screening step, the maximum detected concentrations of COPCs were compared to the most conservative (i.e., the lowest) soil screening concentrations found in MTCA. These screening criteria were based on the direct exposure to soil for both human and ecological receptors.

For protection of human health, based on direct contact exposure pathways with soil, the screening levels for all constituents except lead, gasoline, and total petroleum hydrocarbons (TPH 418.1) were MTCA Method B residential soil concentrations, obtained from Ecology's *Cleanup Levels and Risk Calculation (CLARC) Tables* (Ecology, 2001*).* These values were chosen because they were the most conservative values found for protection of human health. The screening concentrations for gasoline and TPH 418.1 were obtained from the MTCA Method A tables for soil because there are no corresponding MTCA Method B values. Soil greater than 15 feet BGS was not screened against these values as this depth of soil is not available for human contact.

Surface and subsurface soil COPC concentrations were also compared to MTCA soil screening concentrations that were derived to be protective of groundwater. Even though groundwater monitoring has shown DNT to be the only constituent of concern this screening was performed to identify any areas where leaching of COPCs from soil may potentially impact groundwater. The screening levels used were Ecology's MTCA Method B levels derived for the protection of groundwater, obtained from Ecology's *CLARC Tables* (Ecology, 2001*)*, and Site-specific levels designated for use by Ecology.

Ecology has performed an evaluation of the Site and determined that lead is the indicator compound for potential terrestrial ecological impacts. As part of this evaluation, Ecology determined that, based on site-specific information, the potential species groups of concern included ground-feeding birds and herbivorous small mammals. The soil screening level identified for lead by Ecology is 118 mg/kg, and is intended to be protective of wildlife, including birds and small mammals.

2.5.2.1 Screening Results for Soil-to-Groundwater

Results of this screening step for surface soil are shown in Table 2-3, results for subsurface soil (>1 foot to ≤15 feet bgs) are shown in Table 2-4, and results for deep subsurface soil (>15 feet bgs) are shown in Table 2-5. Based on this screening step, there were 5 COPCs that exceeded the soil-to-groundwater screening criteria in surface soil, 5 COPCs that exceeded the criteria in subsurface soil >1 foot to ≤15 feet BGS, and 3 COPCs that exceeded the criteria in subsurface soil > 15 feet BGS. A summary of the COPCs that exceeded soil-to-groundwater screening criteria is presented in Table 2-6. Groundwater remediation options for these COPCs are presented in the FS and groundwater was not evaluated further in the risk assessment as a medium of concern.

2.5.2.2 Screening Results for Soil

Results of this screening step for surface soil are shown in Table 2-3, and the results for subsurface soil (>1 foot to ≤15 feet BGS) are shown in Table 2-4. Following this screening step, there were 16 COPCs in surface soil that exceeded the screening criteria and 17 COPCs that exceeded the criteria in subsurface soil >1 foot to ≤15 feet BGS.

A summary of these COPCs identified in surface and subsurface soil is shown in Table 2-7. Those constituents that did not have available risk-based screening concentrations were included as COPCs to be carried through to the risk assessment. These constituents are also identified in Table 2-7. Soil samples analyzed for oil and grease (EPA Method 413.2) were excluded from the RA due to the non-specificity of the analysis method. This method measures natural oils and greases in addition to petroleum constituents.

Table 2-1 – Evaluation Unit Size

Evaluation Unit	Acres
Commercial	
CM-01	47.2
CM-02	24.6
CM-03	37.5
CM-04	28.5
CM-05	64.2
CM-06	28.6
CM-07	60.6
CM-08	15.3
CM-09	27.5
Average	**37.1**
TOTAL	**334.0**
Golf Course	
GC-01	17.1
GC-02	18.3
GC-03	24.7
GC-04	20.5
GC-05	16.1
GC-06	22.8
GC-07	20.5
GC-08	19.1
GC-09	28.4
Average	**20.8**
TOTAL	**187.5**
Historical	
HI-01 - 1843 Fort Site	3.3
HI-02 – Midden	1.9
HI-03 - 404 Site Boundary	0.5
Average	**1.9**
TOTAL	**5.7**
Industrial	
Industrial	35.7
Open Space	
OS-01	4.3
OS-02	12.4
OS-03	11.3
OS-04[(1)]	45.2
Average	**18.3**
TOTAL	**73.2**
Grand Total Acreage for Parcel 1	***636.1***

Notes:
[(1)]Old Fort Lake comprises 22.35 of the acreage of this EU.

Table 2-2 – Summary of Constituents Detected in Each Depth Interval

Constituent	Soil Depth ≤ 1 Foot BGS	Soil Depth >1 Foot and ≤ 15 Feet BGS	Soil Depth > 15 Feet BGS
Explosives			
Dinitrotoluene, 2,4-	✓	✓	✓
Dinitrotoluene, 2,6-	✓	✓	✓
Monomethylamine Nitrate	– –	✓	– –
Nitrobenzene	✓	✓	– –
Nitroglycerine	✓	✓	– –
Trinitrobenzene, 1,3,5-	– –	✓	✓
Trinitrotoluene, 2,4,6-	✓	✓	✓
Petroleum Hydrocarbons			
#2 Diesel	– –	✓	✓
TPH (418.1) (1)	✓	✓	✓
Gasoline	✓	✓	– –
Oil and Grease(2)	✓	✓	✓
Inorganics			
Aluminum	✓	✓	✓
Antimony (metallic)	✓	✓	– –
Arsenic	✓	✓	✓
Beryllium	✓	✓	✓
Cadmium	✓	✓	✓
Chromium	✓	✓	✓
Copper	✓	✓	✓
Lead	✓	✓	✓
Mercury (inorganic)	✓	✓	✓
Nickel (soluble salts)	✓	✓	✓
Selenium (and compounds)	✓	✓	– –
Silver	✓	✓	✓
Thallium	✓	– –	– –
Zinc and Compounds	✓	✓	✓
PAHs			
Acenaphthene	– –	– –	✓
Anthracene	✓	✓	✓
Benzo(a)Anthracene	✓	✓	✓
Benzo(a)Pyrene	✓	✓	✓
Benzo(b)Fluoranthene	✓	✓	✓
Benzo(g,h,i)Perylene	✓	✓	✓
Benzo(k)Fluoranthene	✓	✓	✓
Chrysene	✓	✓	✓
Dibenz(a,h)anthracene	✓	✓	✓
Fluoranthene	✓	✓	✓
Fluorene	✓	✓	✓
Indeno(1,2,3-cd)pyrene	✓	✓	✓
Methylnaphthalene, 2-	– –	✓	✓
Naphthalene	– –	✓	– –
Phenanthrene	✓	✓	✓
Pyrene	✓	✓	✓
Pesticides/PCBs			
Aroclor 1254	– –	✓	– –
Aldrin	✓	– –	– –

Table 2-2 – Summary of Constituents Detected in Each Depth Interval

Constituent	Soil Depth ≤ 1 Foot BGS	Soil Depth >1 Foot and ≤ 15 Feet BGS	Soil Depth > 15 Feet BGS
Endrin	✓	✓	– –
Semi-Volatiles			
Benzoic Acid	✓	✓	– –
Bis(2-ethylhexyl)Phthalate	– –	✓	✓
Butyl Benzyl Phthalate	– –	✓	– –
Dibutyl Phthalate	– –	✓	– –
Diethyl Phthalate	– –	✓	– –
Di-N-Octylphthalate	– –	✓	✓
Volatiles			
Ethyl Benzene	– –	✓	– –
Methyl Ethyl Ketone	– –	✓	– –
Tetrachloroethene	– –	✓	– –
Xylenes	– –	✓	– –

Notes:
(1) This includes Bunker C and heavy oil.
(2) Oil and Grease data (EPA Method 413.2) were excluded from further evaluation in the risk assessment due to the non-specificity of the analysis method. This method measures natural oils and greases in addition to petroleum constituents.
– – Not detected in this depth interval.

Table 2-3 – Constituents That Exceed Risk-Based Screening Concentrations for Soil ≤ 1 Foot BGS

Constituent	Maximum Detected Concentration (mg/kg)	MTCA Method B Soil Screening Concentration (mg/kg)(1)	MTCA Method B Soil Screening Concentration Protective of Groundwater (mg/kg)(2)	Screening Level Exceeded
Explosives				
Dinitrotoluene, 2,4-	0.87	160	1.5(3)	No
Dinitrotoluene, 2,6-	0.52	80	1.5(3)	No
Nitrobenzene	0.08	40	0.0511	Yes
Nitroglycerine	1.1			NV
Trinitrotoluene, 2,4,6-	0.64	33.3	1.75(3)	No
Petroleum Hydrocarbons				
Gasoline	12	100(4)		No
TPH (418.1)	10,000	2,000(4)		Yes
Inorganics				
Aluminum	24,000			NV
Antimony (metallic)	3.3	32		No
Arsenic (inorganic)	970	0.67	92,400(5)	Yes
Beryllium	0.78	160		No
Cadmium	20	80	2.21	Yes
Chromium	120	120,000		No
Copper	190	2,960		No
Lead (and compounds)	25,000	118(6)	162,000(5)	Yes
Mercury (inorganic)	130	24	24(3)	Yes
Nickel (soluble salts)	26	1,600	417	No
Selenium (and compounds)	2.3	400	8.32	No
Silver	1.2	400		No
Thallium	1.7	5.6		No
Zinc and Compounds	1,700	24,000	5,970	No
PAHs				
Anthracene	1.1	24,000	1,140	No
Benzo(a)Anthracene	8.6	0.14	34.3(3)	Yes
Benzo(a)Pyrene	5.6	0.14	34.3(3)	Yes
Benzo(b)Fluoranthene	7	0.14	34.3(3)	Yes
Benzo(g,h,i)Perylene	4.9			NV
Benzo(k)Fluoranthene	2.6	0.14	34.3(3)	Yes
Chrysene	14	0.14	34.3(3)	Yes
Dibenz(a,h)anthracene	0.51	0.14	34.3(3)	Yes
Fluoranthene	29	3,200	631	No
Fluorene	0.02	3,200	101	No
Indeno(1,2,3-cd)pyrene	1.6	0.14	34.3(3)	Yes
Phenanthrene	7.1			NV
Pyrene	9.1	2,400	655	No
Pesticides/PCBs				

Table 2-3 – Constituents That Exceed Risk-Based Screening Concentrations for Soil ≤ 1 Foot BGS

Constituent	Maximum Detected Concentration (mg/kg)	MTCA Method B Soil Screening Concentration (mg/kg)(1)	MTCA Method B Soil Screening Concentration Protective of Groundwater (mg/kg)(2)	Screening Level Exceeded
Aldrin	0.6	0.06	0.005	Yes
Endrin	0.02	24	1.06	No
Semi-Volatiles				
Benzoic Acid	0.27	320,000	257	No

Notes:
Shaded rows identify constituents with maximum concentrations that exceed ecological or human health screening values.
NV= No screening value was available.
(1)The derivation of these values is presented in WAC 173-340-740.
(2)The derivation of these values is presented in WAC 173-340-747.
(3)Value is a Site-specific value designated by Ecology for the protection of groundwater. The site-specific value for Total DNT is 3.0 mg/kg. For the purposes of screening the value was divided by 2 and used as a screening criterion for 2,4 and 2,6-dinitrotoluene. For carcinogenic PAHs, the Site-specific value was 240 mg/kg for total carcinogenic PAHs; when this value is divided by 7 (there are seven carcinogenic PAHs), the value for each individual carcinogenic PAH becomes 34.3.
(4)Value is from MTCA Method A Table, presented in WAC 173-340-740.
(5)Value is a Site-specific value based on Site-specific leaching Studies (Hart Crowser, 1996).
(6)Value is an ecological screening concentration identified by Ecology.

Table 2-4 – Constituents That Exceed Risk-Based Screening Concentrations for Soil > 1 Foot and ≤ 15 Feet BGS

Constituent	Maximum Detected Concentration (mg/kg)	MTCA Method B Soil Screening Concentration (mg/kg)(1)	MTCA Method B Soil Screening Concentration Protective of Groundwater (mg/kg)(2)	Screening Level Exceeded
Explosives				
Dinitrotoluene, 2,4-	1	160	1.5(3)	No
Dinitrotoluene, 2,6-	1.1	80	1.5(3)	No
Monomethylamine Nitrate	30,000			NV
Nitrobenzene	0.17	40	0.05	Yes
Nitroglycerine	3.7			NV
Trinitrobenzene, 1,3,5-	0.24	214,000		No
Trinitrotoluene, 2,4,6-	42	33.3	1.75(3)	Yes
Petroleum Hydrocarbons				
#2 Diesel	1,000	2,000(4)		No
Gasoline	87	100 (4)		No
TPH (418.1)	36,000	2,000(4)		Yes
Inorganics				
Aluminum	26,200			NV
Antimony (metallic)	4	32		No
Arsenic (inorganic)	1,500	0.667	92,400(5)	Yes
Beryllium	0.7	160		No
Cadmium	2.9	80	2.21	Yes
Chromium	55	120,000		No
Copper	24,000	2,960	263	Yes
Lead (and compounds)	4,000	118(6)	162,000(5)	Yes
Mercury (inorganic)	13	24	24(3)	No
Nickel (soluble salts)	100	1,600	417	No
Selenium (and compounds)	0.27	400	8.32	No
Silver	1.5	400		No
Zinc and Compounds	1,100	24,000	5,970	No
PAHs				
Anthracene	0.07	24,000	1,140	No
Benzo(a)Anthracene	0.23	0.14	34.3(3)	Yes
Benzo(a)Pyrene	0.22	0.14	34.3(3)	Yes
Benzo(b)Fluoranthene	0.15	0.14	34.3(3)	Yes
Benzo(g,h,i)Perylene	0.1			NV
Benzo(k)Fluoranthene	0.17	0.14	34.3(3)	Yes
Chrysene	0.36	0.14	34.3(3)	Yes
Dibenz(a,h)anthracene	0.12	0.14	34.3(3)	No
Fluoranthene	0.36	3,200	631	No
Fluorene	0.01	3,200	101	No
Indeno(1,2,3-cd)pyrene	0.14	0.14	34.3(3)	Yes

Table 2-4 – Constituents That Exceed Risk-Based Screening Concentrations for Soil > 1 Foot and ≤ 15 Feet BGS

Constituent	Maximum Detected Concentration (mg/kg)	MTCA Method B Soil Screening Concentration (mg/kg)(1)	MTCA Method B Soil Screening Concentration Protective of Groundwater (mg/kg)(2)	Screening Level Exceeded
Methylnaphthalene, 2-	0.04			NV
Naphthalene	0.4	1,600	4.46	No
Phenanthrene	0.2			NV
Pyrene	0.54	2,400	655	No
Pesticides/PCBs				
Aroclor 1254	0.58	1.6		No
Endrin	0.85	24	1.06	No
Semi-Volatiles				
Benzoic Acid	0.08	320,000	257	No
Bis(2-ethylhexyl)Phthalate	6.21	71.4	13.9	No
Butyl Benzyl Phthalate, N-	0.26	16,000	893	No
Dibutyl Phthalate	0.25	8,000	56.5	No
Diethyl Phthalate	2.7	64,000	72.2	No
Di-N-Octylphthalate	0.63	1,600	532,000	No
Volatiles				
Ethyl Benzene	1.5	8,000	6.91	No
Methyl Ethyl Ketone	0.41	48,000		No
Tetrachloroethene	0.06	19.6	0.009	Yes
Xylenes	2.8	160,000	135	No

Notes:
Shaded rows identify constituents with maximum concentrations that exceed ecological or human health screening values.
NV= No screening value was available.
(1)The derivation of these values is presented in WAC 173-340-740.
(2)The derivation of these values is presented in WAC 173-340-747.
3)Value is a Site-specific value designated by Ecology for the protection of groundwater. The site-specific value for Total DNT is 3.0 mg/kg. For the purposes of screening the value was divided by 2 and used as a screening criterion for 2,4 and 2,6-dinitrotoluene. For carcinogenic PAHs, the Site-specific value was 240 mg/kg for total carcinogenic PAHs; when this value is divided by 7 (there are seven carcinogenic PAHs), the value for each individual carcinogenic PAH becomes 34.3.
(4)Value is from MTCA Method A Table, presented in WAC 173-340-740.
(5)Value is a Site-specific value based on Site-specific leaching Studies (Hart Crowser, 1996).
(6)Value is an ecological screening concentration identified by Ecology.

Table 2-5 – Constituents That Exceed Risk-Based Screening Concentrations for Soil > 15 Feet BGS

Constituent	Maximum Detected Concentration (mg/kg)	MTCA Method B Soil Screening Concentration Protective of Groundwater (mg/kg)[(1)]	Screening Level Exceeded
Explosives			
Dinitrotoluene, 2,4-	0.95	1.5[(2)]	No
Dinitrotoluene, 2,6-	1.90	1.5[(2)]	Yes[(3)]
Trinitrobenzene, 1,3,5-	0.62		NV
Trinitrotoluene, 2,4,6-	7.40	1.75[(2)]	Yes
Petroleum Hydrocarbons			
#2 Diesel	660		NV
TPH (418.1)	11,000	7,600[(4)]	Yes
Inorganics			
Aluminum	11,400		NV
Arsenic (inorganic)	18	92,400[(5)]	No
Beryllium	0.2		NV
Cadmium	0.14	2.21	No
Chromium	13.5		NV
Copper	22	263	No
Lead (and compounds)	1,800	162,000[(5)]	No
Mercury (inorganic)	0.14	24[(2)]	No
Nickel (soluble salts)	18	417	No
Silver	0.3		NV
Zinc and Compounds	63	5,970	No
PAHs			
Acenaphthene	0.04	105	No
Anthracene	0.07	1,140	No
Benzo(a)Anthracene	0.20	34.3[(2)]	No
Benzo(a)Pyrene	0.23	34.3[(2)]	No
Benzo(b)Fluoranthene	0.16	0.14	No
Benzo(g,h,i)Perylene	0.21		NV
Benzo(k)Fluoranthene	0.10	34.3[(2)]	No
Chrysene	0.28	34.3[(2)]	No
Dibenz(a,h)anthracene	0.19	34.3[(2)]	No
Fluoranthene	0.36	631	No
Fluorene	0.04	101	No
Indeno(1,2,3-cd)pyrene	1.10	34.3[(2)]	No
Methylnaphthalene, 2-	0.04		NV
Phenanthrene	0.54		NV
Pyrene	0.63	655	No
Semi-Volatiles			
Bis(2-ethylhexyl)Phthalate	0.04	13.9	No

Table 2-5 – Constituents That Exceed Risk-Based Screening Concentrations for Soil > 15 Feet BGS

Constituent	Maximum Detected Concentration (mg/kg)	MTCA Method B Soil Screening Concentration Protective of Groundwater (mg/kg)(1)	Screening Level Exceeded
Di-N-Octylphthalate	0.14	532,000	No

(1)The derivation of these values is presented in WAC 173-340-747.
(2)Value is a Site-specific value designated by Ecology for the protection of groundwater. The site-specific value for Total DNT is 3.0 mg/kg. For the purposes of screening the value was divided by 2 and used as a screening criterion for 2,4 and 2,6-dinitrotoluene. For carcinogenic PAHs, the Site-specific value was 240 mg/kg for total carcinogenic PAHs; when this value is divided by 7 (there are seven carcinogenic PAHs), the value for each individual carcinogenic PAH becomes 34.3.
(3)The site-specific cleanup level that is protective of groundwater and human health for total DNT is 3.0 mg/kg.
(4)Site-specific value that is protective of groundwater and human health for Bunker C fuel oil.
(5)Site-specific value that is protective of groundwater based on site-specific leaching studies (Hart Crowser, 1996).

Table 2-6 – Summary of Constituents That Exceeded Soil-to-Groundwater Screening Criteria in Each Depth Interval

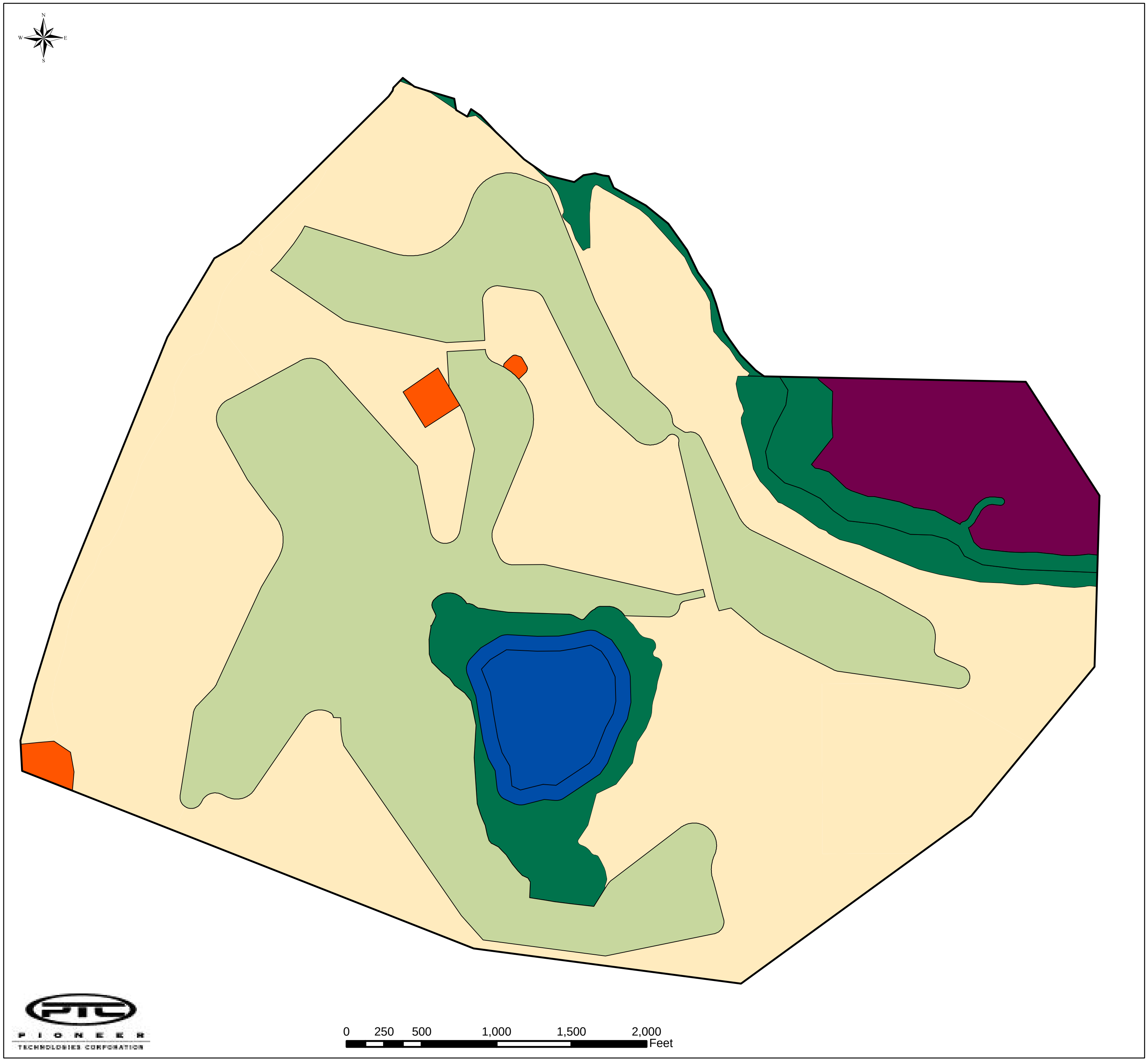
Constituent	Soil Depth ≤ 1 Foot BGS	Soil Depth >1 Foot and ≤ 15 Feet BGS	Soil Depth > 15 Feet BGS
Explosives			
Dinitrotoluene, 2,6-	– –	– –	✓
Nitrobenzene	✓	✓	– –
Trinitrotoluene, 2,4,6-	– –	✓	✓
Inorganics			
Cadmium	✓	✓	– –
Petroleum Hydrocarbons			
TPH (418.1) [Bunker C Fuel Oil]	✓	– –	✓
Copper	– –	✓	– –
Mercury (inorganic)	✓	– –	– –
Pesticides/PCBs			
Aldrin	✓	– –	– –
Volatiles			
Tetrachloroethene	– –	✓	– –

Note:
– – Not a COPC for this depth interval.

Table 2-7 – Summary of Constituents to be Evaluated in Risk Assessment for Each Depth Interval

Constituent	Soil Depth ≤ 1 Foot BGS	Soil Depth > 1 Foot and ≤ 15 Feet BGS
Explosives		
Monomethylamine Nitrate	– –	✓
Nitroglycerine	✓	✓
Trinitrotoluene, 2,4,6-	– –	✓
Petroleum Hydrocarbons		
TPH (418.1)	✓	✓
Inorganics		
Aluminum	✓	✓
Arsenic	✓	✓
Copper	– –	✓
Lead	✓	✓
Mercury	✓	– –
PAHs		
Benzo(a)Anthracene	✓	✓
Benzo(a)Pyrene	✓	✓
Benzo(b)Fluoranthene	✓	✓
Benzo(g,h,i)Perylene	✓	✓
Benzo(k)Fluoranthene	✓	✓
Chrysene	✓	✓
Dibenz(a,h)anthracene	✓	– –
Indeno(1,2,3-cd)pyrene	✓	✓
Methylnaphthalene, 2-	– –	✓
Phenanthrene	✓	✓
Pesticides/PCBs		
Aldrin	✓	– –

Notes:
Shaded rows identify COPCs with no available MTCA risk-based screening values. These COPCs are carried through the risk assessment.
– – Not a COPC for this depth interval.



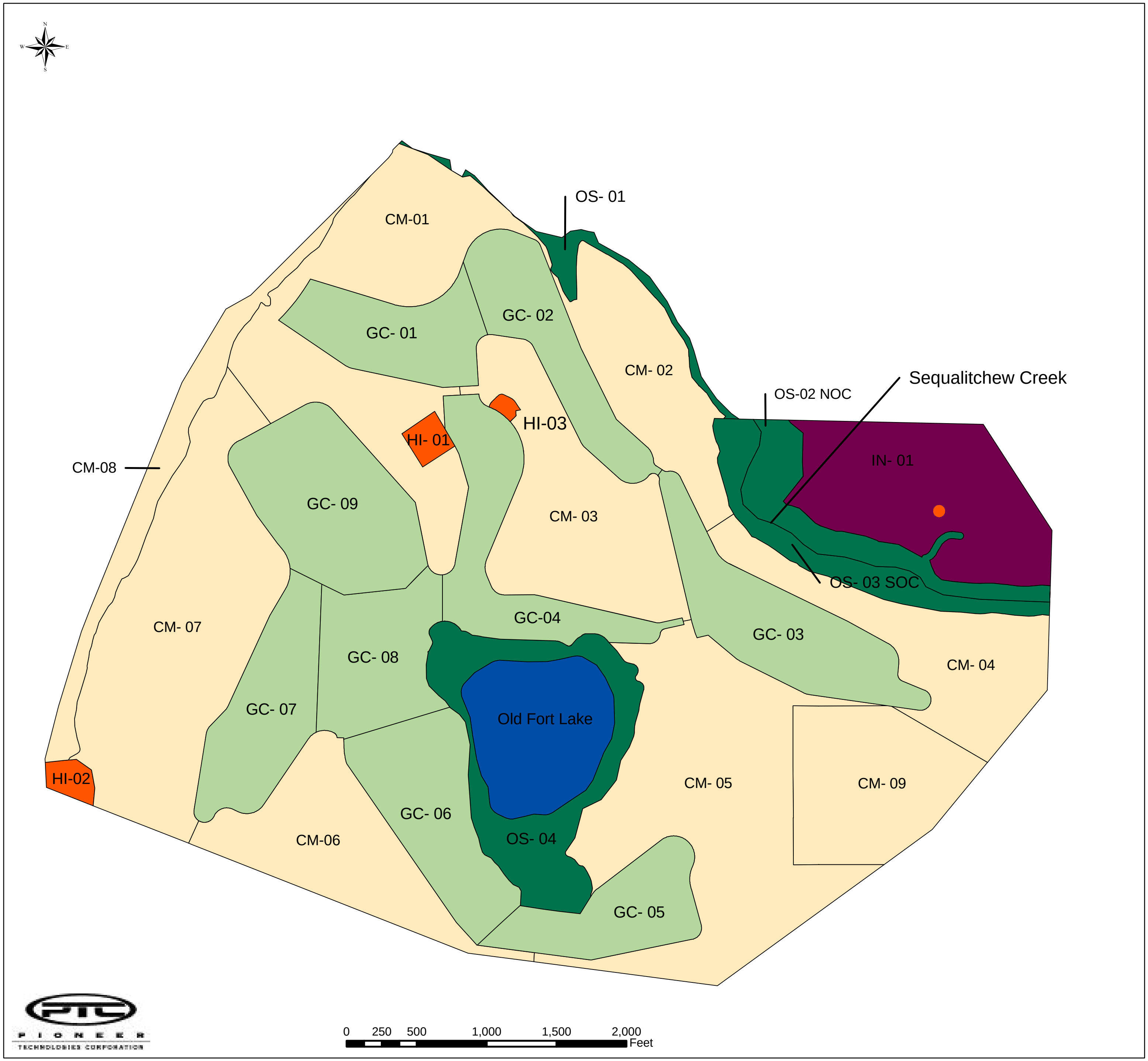
Legend

- Industrial
- Open Space
- Old Fort Lake
- Golf Course
- Historical
- Commercial

Parcel One Future Land Use

Former DuPont Works Site
September, 2002

Figure 2-1



Legend

- Historical
- Golf Course
- Industrial
- Open Space
- Old Fort Lake
- Commercial

Notes

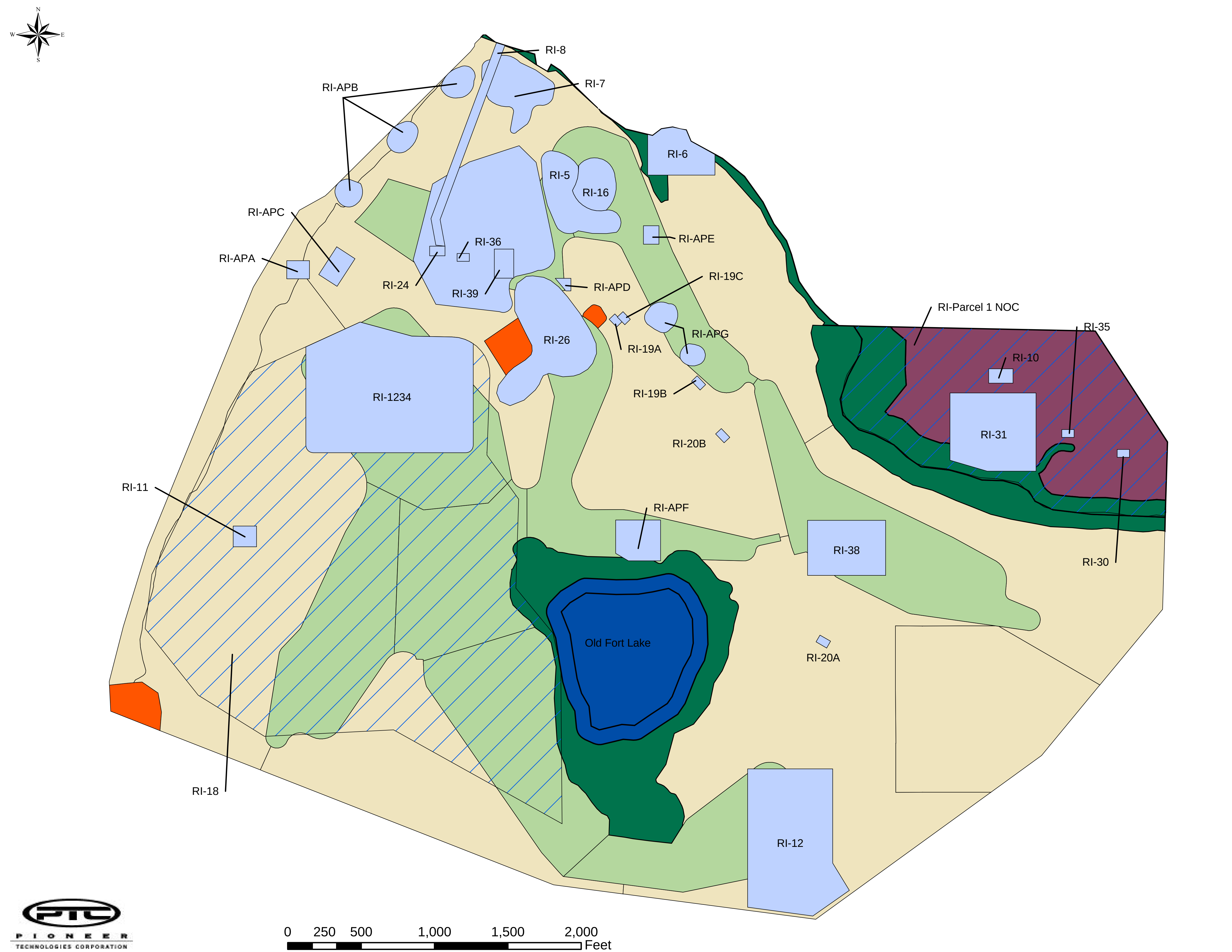
GC - Golf Course
HI - Historical
CM - Commercial
OS - Open Space
NOC - North of Creek
SOC - South of Creek

Historical location in the Industrial area is the Methodist Mission Marker. Actual location of the mission is unknown.

Risk Assessment Evaluation Units

Former DuPont Works Site
July, 2003

Figure 2-2



Legend

- Historical RI Areas
- Golf Course
- Commercial
- Historical
- Old Fort Lake
- Industrial
- Open Space

Notes

RI Areas with blue hatch lines allow underlying EU's to be visible.

NOC - North of Creek

Comparison of RI Areas and RA Evaluation Units

Former DuPont Works Site
September, 2002

Figure 2-3

2.6 References

Ecology (Washington State Department of Ecology). 2001. Cleanup Levels and Risk Calculation (CLARC) Table Updates, Version 3.1, November. 2001.

Ecology (Washington State Department of Ecology). 2000. Final Environmental Impact Statement: Former DuPont Works Site.

Hart Crowser (Hart Crowser, Inc.). 1996. Revised Golf Course Leachability Documents. Appendix III Lead Cleanup Summary. Appendix VII Arsenic Cleanup Summary.

URS (URS, Inc.). 2002. Remedial Investigation Former Dupont Works Site, DuPont, Washington.

Chapter 3 – Identification of Cleanup Levels and Remediation Levels

3.1 Introduction

This chapter identifies the cleanup levels and remediation levels that will be used in Chapter 4 to identify areas of the Site that will require further consideration in the FS. As stated in MTCA, preparation of the RI should involve identification of cleanup levels and remediation levels. Instead of including cleanup levels and remediation levels in the RI, they are presented here, so that their development can be explained in the context of protection of human and ecological receptors. For this Site, numerical criteria include cleanup levels, remediation levels, and an ecological screening concentration for lead.

As discussed in Chapter 2 of the RA, Ecology has determined that, with the exception of groundwater and soil, all media within the Consent Decree Boundary require "No Further Action" (See the RI) (URS, 2002). Groundwater was evaluated in Chapter 2, and carried from there to the FS where remediation options are considered. Therefore, the cleanup levels and remediation levels described below are specific to soil that is available for direct contact by human and ecological receptors.

3.2 Soil Cleanup Levels

Soil cleanup levels are published in tables (i.e., CLARC) by Ecology, and are default values that can be used at any site. Cleanup levels specified in MTCA are concentrations that are protective of humans for specific exposure scenarios (i.e., industrial land use and unrestricted future land use) (WAC 173-340-200). To supplement these MTCA table values, Ecology has approved Site-specific cleanup levels for a select group of constituents.

The only area on the Site where default cleanup levels are used is the industrial area located north of Sequalitchew Creek. These levels assume adult workers would be exposed to hazardous constituents through incidental soil ingestion, and were calculated using the algorithm and default exposure assumptions identified in WAC 173-340-745. These values are presented in Table 3-1. The other cleanup level used was 2,000 mg/kg for total petroleum hydrocarbons (TPH 418.1), which was obtained from the MTCA Method A Table, WAC 173-340-900.

Site-specific cleanup levels for mercury, total petroleum hydrocarbons (TPH), total dinitrotoluenes (DNT), and trinitrotoluene (TNT) are presented in Table 3-2. These Site-specific levels were approved for use at the DuPont Site by Ecology (See Appendix C).

3.3 Determination of Arsenic Background Level in Soil

In addition to the cleanup levels, an area background level was calculated for arsenic in soil because the cleanup level is below the background concentration. As part of the RI, soil samples were collected outside of the Consent Decree boundary to define the "Site Area Background" level of arsenic (See Chapter 2 of the RI). Area background samples are collected to determine the concentration of a constituent that is consistently present in the environment in the vicinity of a site, as a result of human activities unrelated to releases from the site.

As stipulated in MTCA regulations (WAC 173-340-709), twenty soil samples were collected to statistically establish area background levels. Based on the results of these samples, the site area background concentration for arsenic is 32 mg/kg. This value represents the 90^{th} percentile value of the distribution of the background samples. In accordance with MTCA (WAC 173-340-708), the cleanup level established for a constituent shall not be adjusted below the area background level.

3.4 Ecological Soil Screening Concentration for Lead

Ecology performed an evaluation of the Site and determined that lead is the indicator compound for potential terrestrial ecological impacts. As part of this evaluation, Ecology determined that based on site-specific information, the potential species groups of concern included ground-feeding birds and herbivorous small mammals.

The soil screening level identified for lead by Ecology is 118 mg/kg. This value was obtained from the MTCA site-specific procedures for evaluating potential impacts to populations of terrestrial ecological receptors (WAC 173-340-7493). This value was derived by Ecology, using exposure models and chemical-specific input values for avian and mammalian species. Exceedance of this value does not necessarily indicate that cleanup must occur, but that various other options could be explored to demonstrate that lead does not pose a threat to ecological receptors at the site. Site-specific ecological studies and evaluations that have been performed are summarized in Appendix A.

3.5 Determination of Soil Remediation Levels

Soil remediation levels are site-specific levels based on protection of human health that are developed using exposure assumptions and other media-specific factors that reflect future site conditions. Remediation levels are calculated using human health risk assessment procedures and site-specific information, as specified in WAC 173-340-708. In order to apply remediation levels to site remediation decisions, institutional controls (such as deed restrictions) are placed on properties with residual contamination to ensure that the exposure conditions applied to the derivation of these levels are maintained at the site in the future. Remediation levels were calculated for all constituents detected in at least one soil sample, unless the constituent did not have available toxicity information and was not directly linked to historical site operations.

Remediation levels were calculated assuming exposure via incidental soil ingestion. The other most likely exposure pathway, inhalation of particulates, was not considered based on historical air monitoring conducted at the Site. As part of interim corrective actions on the Site, air monitoring was performed during times of soil excavation, where maximum soil disturbance was occurring in the most contaminated areas (i.e., hot spots) of the Site. Results from this air sampling indicated that airborne concentrations of arsenic and lead (the primary constituents of concern) were below analytical detection limits. The results from the most recent air monitoring activities are presented in *Interim Source Removal Actions: Air Monitoring Report* (PIONEER and West Shore, 2002). In addition, the majority of the Site will be developed and used for commercial purposes, industrial purposes, or for a golf course. The future development will result in very little property being available as a source for wind-blown particulate matter. Dermal contact with soil was not considered because the main constituents of concern at the Site (i.e., arsenic and lead) are not readily absorbed through the skin.

3.5.1 Scenarios for Future Site Use

According to the Final Environmental Impact Statement, future Site use will be commercial, golf course, historical, industrial, and open space (Ecology, 2000). As stated in Chapter 2, a restrictive covenant was filed for this Site stating that none of the property shall be developed or used for residential uses, schools, daycare facilities, parks, or other recreational purposes, aside from golf course use. The soil remediation levels presented below are based on these land uses. Each future Site use, including the potentially exposed populations is described briefly below. A more detailed description of the future land use at the Site is presented in Chapter 2.

3.5.1.1 Commercial Use

Some Site locations are anticipated to contain retail and commercial establishments, including municipal buildings. Most of the soil in these areas will be covered by buildings, parking lots, and roads. The receptor most likely to be exposed to soil in the commercial land use area is a professional adult landscaper who plants and maintains shrubs. The pathway of exposure considered for this worker is incidental soil ingestion.

3.5.1.2 Golf Course

Development of Site areas for a golf course will require addition of topsoil and turf to achieve the proper contouring. The finished golf course will have contouring soil plus turf separating golfers from residual constituents left in surface and subsurface soils. Under conditions of normal use, exposure to constituents in soil will only occur for adult groundskeepers, who may be exposed while repairing irrigation lines, maintaining drainage ditches, or planting trees. The pathway of exposure considered for this worker is incidental soil ingestion. The FS evaluates a variety of different remedial alternatives including an engineered CAP/Cover. The RLs associated with an engineered cap/cover remedial alternative are discussed in Section 6.5.4 of the FS.

3.5.1.3 Historical Areas

Although access to historical areas on the Site will be limited to preserve any artifacts that remain, older children or adults occasionally may walk through these areas. Exposure to younger children (i.e., less than six years old) is considered unlikely due to access limitations. Exposure to these areas on the Site is assumed to be infrequent, and exposure to constituents in the soil in these areas is unlikely. However, to be conservative, it was assumed that an adolescent (age 7 to 18) could be exposed to constituents in soil in these areas in the same way they could be exposed in open space areas. As with open space areas, the pathway of exposure considered was incidental soil ingestion.

3.5.1.4 Industrial Use

Future industrial use may include activities ranging from mining gravel to development of light industrial facilities. Adult workers may have direct contact with soil containing residual levels of COPCs. As described in Section 3.2, Ecology has already developed soil cleanup levels based on default industrial exposure assumptions. These cleanup levels that were used for Parcel 2 of this Site will also be applied as cleanup levels in Parcel 1.

3.5.1.5 Open Space Areas

Part of the Site will be preserved as open space. Exposure to soil in these areas may occur to adolescents while playing there. Such exposure would be random, occurring primarily during the warmer, drier months. The pathway of exposure considered for the adolescents is incidental soil ingestion.

3.5.2 Remediation Level Equations

The equations used to calculate remediation levels were obtained from WAC 173-340-740. Soil remediation levels were calculated using these equations, considering the potential reasonable maximum exposure for humans under each proposed land use with the exception of industrial use (for industrial use, MTCA default industrial cleanup levels were used, as identified in Section 3.2).

3.5.2.1 Equation for Noncarcinogens

$$\text{Soil Remediation Level (mg/kg)} = \frac{RfD \; x \; ABW \; x UCF \; x \; HQ \; x \; AT_n}{SIR \; x \; AB1 \; x \; EF \; x \; ED}$$

3.5.2.2 Equation for Carcinogens

$$\text{Soil Remediation Level (mg/kg)} = \frac{RISK \; x \; ABW \; x \; AT_c \; x UCF}{CPF \; x \; SIR \; x \; AB1 \; x \; EF \; x \; ED}$$

Where:

- RfD = Reference Dose (oral) for noncarcinogenic health effects (mg/kg-day).
- ABW = Average Body Weight for the exposed person exposed (kg).
- UCF = Unit Conversion Factor (mg/kg).
- HQ = Target Hazard Quotient (unitless).
- AT_n = Averaging Time for noncarcinogenic effects (days).
- AT_c = Averaging Time for cancer effects (days).
- SIR = Soil Ingestion Rate (mg/day).
- AB1 = Gastrointestinal Absorption Fraction (unitless).
- EF = Exposure Frequency (days/year).

ED = Exposure Duration (years).
RISK = Target Cancer Risk (unitless).
CPF = Carcinogenic Potency Factor $(mg/kg\text{-}day)^{-1}$.

3.5.2.3 Equation Input Values

The input values for these equations consist of exposure factors, which describe the exposure patterns of the receptors (i.e., exposure frequency, exposure duration, ingestion rate, gastrointestinal absorption fraction, body weight, and averaging time); toxicity values (i.e., reference doses and carcinogenic potency factors), and benchmark risks (i.e., target hazard quotients and target cancer risks). These input values are discussed below.

Exposure Factors

Exposure factors are used to estimate the intake level of a constituent. Using this estimated intake and incorporating the other input values, including toxicity values and benchmark risks (as defined in MTCA), soil constituent concentrations that are protective for each future Site use were calculated. Each of the exposure factors has a range of possible values associated with it. The exposure factor values chosen for each receptor (i.e., commercial, golf course, historical, industrial, and open space) were selected so that the combination of all exposure variables resulted in a reasonable maximum exposure (RME) for the given receptor. The six basic exposure factors are described below. All of these values were derived in collaboration with Ecology (Ecology, 1999a and 1999b).

- *Exposure Frequency* – The number of days per year that a person is exposed. For the commercial worker and golf course groundskeeper, exposure is assumed to occur 52 days/year (once per week); for the historical area and open space users, exposure is assumed to occur 104 days/year (2 days/week).

- *Exposure Duration* – The number of years over which exposure is assumed to occur. For the commercial landscaper and the golf course groundskeeper, the exposure duration was assumed to be 20 years, which is the MTCA default value for worker exposure duration. For the historical area and open space users, the exposure duration was assumed to be 12 years, which is the age range of the adolescent receptor.

- *Ingestion Rate* – The amount of soil ingested per day of exposure. For the commercial landscaper, golf course groundskeeper, historical area user, and open space user the soil ingestion rate was assumed to be 200 mg/day. This is a conservative (i.e., health protective) ingestion rate typically assumed for childhood exposure. For comparison, the MTCA default ingestion rate value typically used for adults is 50 mg/day.

- *Gastrointestinal Absorption Fraction* – This is the percentage of a constituent that is available for absorption by the gastrointestinal tract once ingested. This is typically a constituent-specific value, but based on direction given by Ecology this value was conservatively chosen to be 100% for all constituents.

- *Body Weight* – The average body weight, in kilograms, of the receptor being evaluated. For the commercial landscaper and golf course groundskeeper this value was assumed to be the MTCA default of 70 kg, the average weight of an adult (average of both females and males). For the recreational users (both historical and open space areas), this value was assumed to be 47 kg, the average weight of females and males between the ages of 7 and 18 (EPA, 1996a).

- *Averaging Time* – The number of days over which exposure is averaged. Exposure levels for carcinogens are averaged over the lifetime of the exposed individual (i.e., 75 years) while exposure levels for noncarcinogens are averaged over the duration of exposure. Therefore, for carcinogens, the averaging time is calculated as the exposure frequency (days/year) X 75 years lifetime expectancy. The averaging time for noncarcinogens is calculated as the exposure frequency (days/year) X exposure duration (years). The carcinogenic averaging time is calculated using 75 years as the exposure duration because it is assumed that exposure to a carcinogen can cause cancer at any later time in your life. For noncarcinogens, it is assumed that the effect of exposure will be seen during the period of exposure.

A summary of the exposure factors used to calculate remediation levels is presented in Table 3-3.

3.5.2.4 Toxicity Values

The toxicity values used in this assessment include noncarcinogenic reference doses (RfDs) and carcinogenic potency factors (CPFs). Both carcinogenic and noncarcinogenic health effects must be considered when evaluating potential human health impacts. The potential for producing carcinogenic effects is limited to certain constituents (i.e., carcinogens); conversely, adverse noncarcinogenic health effects can potentially result from exposure to any constituent. Therefore, in many cases a constituent may only have a noncancer toxicity value and no carcinogenic toxicity value.

RfDs and CPFs are derived through an evaluation of the relationship between the amount of a constituent (either administered, absorbed or believed to be effective) and changes in certain aspects of the biological system (usually toxic effects) in the exposed population (animals and/or humans) in response to that chemical. EPA has evaluated numerous chemicals and has published the corresponding toxicity values, which have undergone peer review. The following sources of toxicity information were consulted to identify toxicity values for this assessment:

- The Integrated Risk Information System (IRIS) (EPA, 2001).
- The Health Effects Assessment Summary Tables–Annual Update (HEAST) (EPA, 1997).
- Ecology's Cleanup Levels and Risk Calculation (CLARC) Table Updates (Ecology, 2001b).
- EPA Region IX Preliminary Remediation Goal (PRG) Tables (EPA, 2000).

The values presented in IRIS have been "verified" by either the EPA Reference Dose/Reference Concentration (RfD/RfC) Work Group or the EPA Carcinogen Risk Assessment Verification Endeavor (CRAVE). These agency work groups conduct a verification process that leads to internal agency scientific consensus regarding risk assessment information for a chemical. All of the toxicity values presented in the HEAST document are considered "provisional" by EPA because an agency work group has not verified them. Provisional values are not listed in IRIS. EPA Region IX PRG Tables were consulted because they frequently contain provisional values published internally within EPA, by the National Center for Environmental Assessment (NCEA).

Since multiple toxicity values were available for some chemicals, the sources of toxicity information were prioritized as follows to select the toxicity values used in the risk assessment:

1. IRIS values
2. HEAST values
3. CLARC table values
4. PRG table values

The toxicity of any chemical depends on its route of entry into the body. In some cases a chemical may produce toxicity only at or near a specific route of entry and may not be toxic through other routes of exposure. Only oral toxicity values were used in the derivation of remediation levels because soil ingestion was the only exposure pathway considered. A description of RfDs and CPFs, including an explanation of how they are derived, is provided below.

<u>Reference Doses Definition</u>

The term RfD was developed by EPA to refer to a daily intake of a constituent to which an individual, including sensitive subpopulations, can be exposed without any expectation of adverse noncarcinogenic health effects (e.g., organ damage, biochemical alterations, birth defects). EPA has developed RfDs for subchronic (i.e., short-term exposures) and chronic exposures (multiple exposures occurring over an extended period of time). An RfD is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subgroups, that is likely to be without an appreciable risk of deleterious effects during a portion of the lifetime (EPA, 1989)." RfDs are expressed in units of mg/kg-day.

RfD Derivation

Noncarcinogenic constituents are thought to exhibit threshold characteristics. That is, exposures less than a specific threshold dose will not result in adverse health effects, whereas exposures exceeding the threshold dose may produce adverse health effects. The assumption of a threshold for toxicity is based on the concept that the body has certain protective mechanisms that must be overcome before adverse effects are manifest. For example, there could be a large number of cells performing the same or similar function whose population must be significantly depleted before the effect is seen.

The threshold concept is important in the regulatory context. The individual threshold hypothesis holds that a range of exposures from zero to some finite value can be tolerated by the organism without expression of the toxic effect. Further, it is often prudent to focus on the most sensitive members of the population; therefore, regulatory efforts are generally made to keep exposures below the population threshold, which is defined as the lowest of the thresholds of the individuals within a population (EPA, 2001).

In general, an RfD is derived from a no-observed-adverse-effects-level (NOAEL) or a lowest-observed-adverse-effects-level (LOAEL) obtained from animal studies (however, occasionally they may be derived from human studies) by the application of standard order-of-magnitude uncertainty factors. In certain cases, an additional modifying factor is employed to account for professional assessment of scientific uncertainties in the available data (EPA, 1989).

A NOAEL is an experimentally determined dose at which there was no statistically or biologically significant indication of the toxic effect of concern. The study chosen to establish the NOAEL is based on the criterion that the measured endpoint represents the most sensitive target organ or tissue (i.e., critical organ) for that chemical. In an experiment with several NOAELs, generally the lowest one is chosen as the critical NOAEL. Since many constituents can produce toxic effects on several organ systems, with each toxic effect possibly having a separate threshold dose, the distinction of the critical toxic effect provides added confidence that the NOAEL is protective of human health.

Once the critical NOAEL is identified, the next step is to derive the RfD by dividing the NOAEL by safety factors, as follows:

$$RfD\ (average\ daily\ human\ dose) = \frac{NOAEL_{Experimental\ Dose}}{Safety\ Factors + Modifying\ Factor}$$

Generally, each safety factor represents a specific area of uncertainty inherent in the available data and accounts for uncertainties, such as:

- Differences in responsiveness between humans and animals in prolonged exposure studies (factor of 10) (EPA, 2001).
- Variation in susceptibility among individuals in the human population (factor of 10) (EPA, 2001).
- Incomplete databases (e.g., those for which only the results of subchronic studies are available) (factor of 10) (EPA, 2001).

In addition to the safety factors, EPA applies a modifying factor in some instances. Modifying factors range from 0 to 10 and are included to reflect a qualitative professional assessment of additional uncertainties in the critical study and in the entire database for the chemical not explicitly addressed by the uncertainty factors. The default value for the modifying factor is 1 (EPA, 1997).

Cancer Potency Factors Definition

A cancer potency factor (CPF) is a numerical estimate of the carcinogenic potency of a constituent. CPFs are expressed in units of the inverse of milligrams of constituent per kilogram of body weight per day (kg-day/mg). CPFs were used in this assessment to calculate remediation levels that would result in carcinogenic risks within acceptable benchmark levels (see explanation of benchmark levels presented below).

CPF Derivation

The mechanism for carcinogenesis is considered to be a "non-threshold" process, since any level of exposure to such a constituent is considered to pose a small, but finite, probability of generating a carcinogenic response. Since risk at low exposure levels cannot be measured directly either by animal experiments or by epidemiologic studies, a number of mathematical models and procedures have been developed for use in extrapolating from high to low doses. Different extrapolation models or procedures, while they may reasonably fit the observed data, may lead to large differences in the projected risk at low doses. EPA assumes in developing CPFs that a single interaction with DNA can initiate cancer, so that low-dose extrapolation can be performed to nearly zero exposure. Making zero a data point affects the slope of the extrapolation curve and, therefore affects the CPF. This means that the relatively high doses that are often used in animal studies can be extrapolated downward to extremely small doses, with some incremental risk of cancer always possible. This assumes that even a small number of molecules (possibly a single molecule) of a carcinogen may cause changes in a single cell that could result in the cell dividing in an uncontrolled manner, eventually leading to cancer.

There is some dispute as to whether linear extrapolation to zero is a valid approach since cells have a number of detoxification mechanisms, such as DNA repair enzymes, that can repair damage from carcinogens at low doses. This would result in a threshold below which damage from carcinogens could be rectified. The presence of a threshold would result in a different slope for the extrapolated dose-response curve, and would result in a different CPF.

CPFs are usually derived by EPA using a linearized multistage model and reflect the upper-bound limit of cancer potency of any constituent. As a result, the calculated carcinogenic risk is likely to represent a plausible upper limit to the risk. The actual risk is unknown, but is likely to be lower than the predicted risk, and may be as low as zero (EPA, 1989).

Previously, EPA used a weight-of-evidence approach to classify the likelihood that a constituent is a carcinogen. Each chemical was placed in one of the weight-of-evidence groups presented in Table 3-4. New EPA guidance recommends using a different weight-of-evidence approach for characterizing carcinogens. EPA though, has not made any changes to IRIS reflecting the new weight-of-evidence guidelines.

Toxic Equivalency Factors Used to Derive CPFs

Toxic equivalency factors (TEFs) were used to derive CPFs for the carcinogenic polycyclic aromatic hydrocarbons (PAHs) evaluated in this assessment. TEFs are estimates of the toxicity of carcinogenic PAHs relative to the toxicity of benzo(a)pyrene, which is assigned a TEF of 1.0. The CPF for a carcinogenic PAH was derived by multiplying the CPF of benzo(a)pyrene by the TEF value for the carcinogenic PAH. The TEF values used in this assessment are presented in Table 3-5.

COPCs With No Available Toxicity Values

The COPCs with no available toxicity information were benzo(g,h,i)perylene, 2-methylnaphthalene, monomethylamine nitrate (MMAN), and phenanthrene. With the exception of MMAN, remediation levels were not calculated for these COPCs. Because MMAN is a constituent that was directly linked to explosives manufacturing at the Site, special effort was made to derive a toxicity value for use in this assessment. A description of the steps used to derive the toxicity value for MMAN is presented in Appendix D.

Toxicity Values Used to Calculate Remediation Levels

The toxicity values used to calculate remediation levels for each constituent are presented in Table 3-6.

Risk Benchmark Values

The last category of equation input values are the risk benchmark values that Ecology has used to define the "acceptable" risk level for a person exposed to COPCs. The benchmark values used are the target hazard quotient (HQ), which is the benchmark for noncarcinogenic effects, and the target cancer risk (RISK), which is the benchmark for carcinogenic risk. These are discussed below.

Target Hazard Quotient

The potential for adverse noncarcinogenic effects from exposure to a site-related constituent is quantitatively expressed as a hazard quotient (HQ). The HQ is the ratio of the estimated dose of a particular constituent to the reference dose (RfD) for that constituent:

$$HQ = Estimated\ Dose \div RfD$$

The RfD is the average daily intake of a constituent to which an individual, including members of sensitive subpopulations, can be exposed for a lifetime of 70 years without any expectation of adverse noncarcinogenic health effects (e.g., organ damage, biochemical alterations, birth defects). The average daily intake was calculated using the exposure factors described in this Chapter.

If the HQ for a constituent is less than 1.0, it indicates that adverse noncarcinogenic health effects are unlikely. If the hazard quotient is greater than 1.0, it indicates that adverse health effects are possible but the magnitude of these effects is uncertain. In other words, the hazard quotient does not represent a probability of occurrence or a quantification of the magnitude of noncarcinogenic health effects. In accordance with MTCA guidance (173-340-740 WAC and 173-340-745 WAC) the target HQ for individual constituents was set at 1.0 for all land use scenarios.

Target Cancer Risk

The risk of developing cancer from exposure to a constituent is described in terms of the probability that an exposed individual will develop cancer during a lifetime from that exposure. The risk estimate is calculated by multiplying the estimated dose of a particular constituent over a lifetime by the carcinogenic potency factor.

$$RISK = Estimated\ Dose \times CPF$$

A 1 in 1,000,000 cancer risk (i.e., 1E-06) means that an individual could have an additional 1 in 1,000,000 chance of developing cancer over a 70-year lifetime due to exposure to the constituent. The target RISK for individual constituents was set at 1E-06 for open space and historical land uses (using the target risk for residential exposures set by MTCA in 173-340-740 WAC) and at 1E-05 for commercial and golf course land uses (using the target risk for industrial exposures set by MTCA in 173-340-745 WAC).

3.5.2.5 Site-Specific Remediation Levels

The Site-specific remediation levels calculated for future commercial, golf course, historical, and open space uses are presented in Table 3.7. Spreadsheets containing remediation level calculations are presented in Appendix E.

3.5.3 Approach for Derivation of Soil Lead Remediation Levels

EPA has chosen to evaluate the potential adverse health effects of lead using a physiologically-based model. Therefore, lead has not been assigned toxicity values (i.e., no RfD or CPF is available), which are required to calculate Site-specific remediation levels using the MTCA formulas described above. The model currently used by EPA for establishing lead remediation levels in non-residential areas is the Adult Lead Model (EPA, 1996b). This model utilizes a methodology to estimate a fetal blood lead concentration in women exposed to lead contaminated soils. A developing fetus is considered the most sensitive receptor associated with adult exposure to lead. The adult lead model is the only currently available tool for the development of non-residential remediation levels that has undergone sufficient peer review and technical refinement to justify its use in Washington State (Ecology, 1998). Using this model, Site-specific remediation levels were developed for golf course worker, commercial worker, and industrial worker scenarios. A hybrid approach using both the Adult Lead Model and the child Integrated Exposure Uptake Biokinetic Model for Lead (IEUBK) (EPA, 1994) was used to derive a remediation level for open space areas. This approach is discussed separately below.

3.5.3.1 Derivation of Commercial, Golf Course, and Industrial Remediation Levels

The adult lead model used to derive commercial, golf course, and industrial remediation levels uses a simplified representation of lead biokinetics to predict quasi-steady state blood lead concentrations among adults (i.e., women of child-bearing age) who have relatively steady patterns of exposure to lead contaminated soil. Fetal blood lead concentrations are then predicted assuming that they are proportional to maternal blood lead concentrations. The acceptable lead concentration in soil is based on limiting the fetal blood lead level to 10 *u*g/dL. The equations used to calculate the risk-based remediation level (RBRL) are the following:

$$RBRL = PbS = \frac{\left(PbB_{adult,central,goal} - PbB_{adult,0}\right) \times AT}{\left(BKSF \times IR_s \times AF_s \times EF_s\right)}$$

and

$$PbB_{adult,central,goal} = \frac{PbB_{fetal,0.95,goal}}{GSD_{i,adult}^{1.645} \times R_{fetal/maternal}}$$

Where:

RBRL	=	Risk-based remediation level for lead (ug/g).
PbS	=	Soil lead concentration that would be expected to result in a protective fetal blood lead concentration (ug/g).
$PbB_{adult,central,goal}$	=	Goal for the central estimate of blood lead concentration (ug/dL) in women of child-bearing age that have site exposures. The goal is intended to ensure that $PbB_{fetal,\ 0.95,goal}$ does not exceed 10 ug/dL.
$PbB_{adult,0}$	=	Typical blood lead concentration (ug/dL) in a woman of child-bearing age who does not receive exposure to lead-contaminated soil at the site.
AT	=	Averaging time; the total period during which soil contact may occur (365 days/year).
BKSF	=	Biokinetic slope factor relating (quasi-steady state) increase in typical adult blood lead concentration to average daily lead uptake (ug/dL blood lead increase per ug/day lead uptake).
IR_S	=	Intake rate of soil, including both outdoor soil and indoor soil-derived dust (g/day).
AF_S	=	Absolute gastrointestinal absorption fraction for ingested lead in soil and lead in dust derived from soil (unitless).
EF_S	=	Exposure frequency for contact with assessed soils and/or dust derived in part from these soils during the averaging time (days/year).
$PbB_{fetal,0.95,goal}$	=	Goal for the 95^{th} percentile blood lead concentration (ug/dL) among fetuses born to women having exposures to the site soil lead.
$GSD_{i,adult}$	=	Estimated value of the geometric standard deviation (unitless) for women of child-bearing age. This value addresses the difference in response (i.e., difference in intakes and biokinetics) among women exposed to similar on-site concentrations. The exponent, 1.645, is the value used to calculate the 95^{th} percentile

$R_{fetal/maternal}$ = Proportionality constant between fetal blood lead concentration and maternal blood lead concentration (unitless).

More detailed information regarding the derivation of this equation and assumptions used in the model are presented in *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (EPA, 1996b). The equation input parameters used for each scenario are presented below in Table 3-8.

3.5.3.2 Derivation of Historical and Open Space Use Remediation Level

The historical and open space use remediation level for lead was derived by Ecology, using a hybrid approach that combined results from using the IEUBK with results obtained from using the Adult Lead Model (Ecology, 1999a). A hybrid approach was used for recreational use areas because exposure under this scenario is to a child of age between 7 and 18 years and neither model used is specific for this age group. There is no specific age at which an older child's biokinetics respond similarly to an adult (it is therefore hard to determine how applicable the adult model is), and most researchers agree that young children (0-6 years old- the age that the IEUBK was designed for) absorb lead more readily than an older child. The use of each lead model and the final derivation of the historical and open space use remediation level are described below.

Use of the IEUBK Model

The IEUBK model evaluates childhood residential exposures to lead. The model was developed considering children since they are more sensitive to the neurological effects of lead than adults. The IEUBK model integrates exposure from lead in air, water, soil, dust, diet, and paint with pharmacokinetic modeling to arrive at a "screening level" for lead in residential soils (EPA, 1994). Using Site-specific and standard default input parameters, a soil lead screening level of 450 ug/g was obtained (Ecology, 1997). At this soil concentration, the probability of exceeding a child's target blood lead concentration of 10 ug/dl should be no more than 5 percent.

Using the screening level of 450 mg/kg, an exposure ratioing approach was used to modify this number to reflect the exposure frequency expected for a child playing in the open space areas on the Site (the exposure frequency assumed in derivation of the screening level is 7 days/week, which is much higher than that assumed for a child playing in open space areas). Accordingly, if a child were assumed to play in the open space areas one day per week, the screening level would be modified as follows:

(7 days/week ÷ 1 day/week) * (450 mg/kg) = 3,150 mg/kg

Exposure frequencies of 2 and 3 days per week result in remediation levels of 1,575 and 1,050, respectively.

Use of the Adult Lead Model

The adult lead model is described in detail in Section 3.5.3.1. For use in calculating remediation levels for an older child, the maternal/fetal blood lead ratio was eliminated and the goal of protecting 95% of the older child population from exceeding 10 ug/dl blood lead was retained. The geometric standard deviation and baseline blood lead level input remained unchanged. Using the Adult Lead Model in this manner, and assuming exposure frequencies of 1, 2,and 3 days per week resulted in remediation levels of 3,512 mg/kg, 1,756 mg/kg, and 1,171 mg/kg, respectively.

Historical and Open Space Use Remediation Level

Use of the two different models yielded remediation levels of approximately 1,050 to 3,150 mg/kg (IEUBK Model) and 1,200 to 3,500 mg/kg (Adult Lead Model). Using these ranges, and considering the previously developed site-specific residential cleanup level for lead of 450 mg/kg, Ecology set the soil-lead remediation level for historical and open space areas at 1,500 mg/kg. This decision was based on consideration of the range of calculated values and on best professional judgment regarding risk management at this site. Ecology thought than an exposure frequency of twice a week was appropriate, resulting in remediation levels of 1,575 and 1,750 mg/kg using the ratio approach (IEUBK model) and the Adult Lead Model, respectively.

3.6 Summary of Site Cleanup Levels and Remediation Levels

This chapter identified the soil cleanup levels and remediation levels that will be used to evaluate Site conditions based on future land use in Chapter 4. A summary of the future use scenarios and applicable cleanup and/or remediation levels is presented in Table 3-9.

Because more than one cleanup or remediation level was available for some constituents, some values were given precedence over others. In deciding which value to use for screening constituent concentrations, priority was given to levels that were specifically agreed upon with Ecology (Table 3-2 values). After these values, priority was given to the lowest available cleanup or remediation level applicable to the land use in question. A summary of the specific screening values used for commercial and golf course land uses, industrial land use, and historical and open space land uses are presented in Tables 3-10, 3-11, and 3-12, respectively.

Table 3-1 – Human Health Industrial Cleanup Levels

Constituent	MTCA Method C Industrial Cleanup Level (mg/kg)[(1)]
Explosives	
Monomethylamine Nitrate	28,350
Nitrobenzene	3,500
Nitroglycerine	4,080
2,4,6-Trinitrotoluene	7,000
Inorganics	
Aluminum	NC
Arsenic	90
Copper	130,000
Lead	NA
Mercury	1,050
PAHs	
Benzo(a)Anthracene	18
Benzo(a)Pyrene	18
Benzo(b)Fluoranthene	18
Benzo(k)Fluoranthene	18
Chrysene	18
Dibenzo(a,h)Anthracene	18
Indeno(1,2,3-c,d)Pyrene	18
Pesticides/PCBs	
Aldrin	7.7

Notes:
NA = No toxicity value for lead is available.
NC = Not of Concern: Concentration calculated was equivalent to a 100 percent concentration. Therefore, this constituent is not of concern through this exposure scenario.
[(1)]Industrial cleanup levels were calculated using equations and exposure factors identified for MTCA Method C (WAC 173-340-745), and toxicity factors identified in Table 3-7.

Table 3-2 – Site-Specific Soil Cleanup Levels[(1)]

Constituent	Concentration (mg/kg)
Mercury	24
TPH – Bunker C	7,600
Total DNT	3[(2)]
TNT	1.75

Notes:
[(1)]Information regarding these concentrations can be found in Appendix C.
[(2)]Includes the sum of the concentrations of 2,4-DNT and 2,6-DNT.

Table 3-3 – Exposure Factors Used to Calculate Site-Specific Soil Remediation Levels

		Exposure Scenario			
		Site-Specific Commercial Landscaper	Site-Specific Historical Areas	Site-Specific Open Space Areas	Site-Specific Golf Course Grounds-keeper
Exposure Factor[1]		Adult	Adolescent Child	Adolescent Child	Adult
Average Body Weight (kg)	ABW	70	47[2]	47[2]	70
Unit Conversion Factor (unitless)	UCF	1E+06	1.0E+6	1.0E+6	1.0E+6
Averaging Time (noncarcinogenic) (days)	AT_n	7,300	4,380	4,380	7,300
Averaging Time (carcinogenic) (days)	AT_c	27,375	27,375	27,375	27,375
Soil Ingestion Rate (mg/day)	SIR	200	200	200	200
Gastrointestinal Absorption Rate (unitless)	AB1	100%	100%	100%	100%
Exposure Frequency (days/year)	EF	52	104	104	52
Exposure Duration (years)	ED	20	12	12	20

Notes:
[1]Factors were derived in collaboration with Ecology (Ecology 1999a; Ecology 1999b). Memorandums outlining the derivation of these factors are contained in Appendix C.
[2]Value is the average weight of females and males between the ages of 6 and 18 (EPA, 1996a).

Table 3-4 – EPA Weight-of-Evidence Categories for Carcinogenicity[1]

EPA Group	Description of Group	Description of Evidence
Group A	Human carcinogen.	Sufficient evidence from epidemiological studies to support a causal association between exposure and cancer.
Group B	Probable human carcinogen.	B1: Limited evidence of carcinogenicity in humans from epidemiological studies; sufficient evidence in animals. B2: Sufficient evidence of carcinogenicity in animals and no or inadequate evidence in humans.
Group C	Possible human carcinogen.	Limited evidence of carcinogenicity in animals.
Group D	Not classified.	Inadequate evidence of carcinogenicity in animals.
Group E	No evidence of carcinogenicity in humans.	No evidence of carcinogenicity in at least two adequate animal tests or in both epidemiological and animal studies.

Notes:
[1]Carcinogenic classification group information was obtained from IRIS (EPA, 2001).

Table 3-5 – Toxicity Equivalency Factors (TEF) for Carcinogenic PAHs

Constituent	TEF[1]	Slope Factor $(mg/kg\text{-}day)^{-1}$
Benzo(a)pyrene	1.0	7.3
Benzo(a)anthracene	0.1	0.73
Benzo(b)fluoranthene	0.1	0.73
Benzo(k)fluoranthene	0.01	0.073
Chrysene	0.001	0.0073
Dibenz(a,h)anthracene	1.0	7.3
Indeno(1,2,3-cd)pyrene	0.1	0.73

Notes:
(1)Values were taken from the Supplemental Guidance for RAGS, Region IV Bulletins, Human Health Risk Assessment. EPA Region IV, Atlanta, GA 1995.

Table 3-6 – Oral Reference Doses and Carcinogenic Potency Factors Used in Remediation Level Calculations

Constituent	RfD (mg/kg-day)	Source of RfD	CPF $(mg/kg\text{-}day)^{-1}$	EPA Carcinogen Classification Group	Source of CPF
Explosives					
Monomethylamine Nitrate	0.0081	Site-specific value approved by Ecology	ND	NE	--
Nitroglycerine	ND	ND	0.014	Not listed	EPA Region IX
2,4,6-Trinitrotoluene	0.0005	IRIS	0.03	C	IRIS
Inorganics[(1)]					
Aluminum	1.0	EPA Region IX	NA	NE	ND
Arsenic	0.0003	IRIS	1.5	A	IRIS
Copper	0.037	HEAST	NA	D	ND
Mercury	0.0003	IRIS	NA	D	ND
PAHs					
Benzo(a)anthracene	ND	ND	0.73	B2	EPA Region IV
Benzo(a)pyrene	ND	ND	7.3	B2	IRIS
Benzo(b)fluoranthene	ND	ND	0.73	B2	EPA Region IV
Benzo(k)fluoranthene	ND	ND	0.073	B2	EPA Region IV
Chrysene	ND	ND	0.0073	B2	EPA Region IV
Dibenz(a,h)anthracene	ND	ND	7.3	B2	EPA Region IV
Indeno(1,2,3-cd)pyrene	ND	ND	0.73	B2	EPA Region IV
Pesticide					
Aldrin	0.00003	IRIS	17.0	B2	IRIS

Notes:
[(1)]Lead is evaluated using a different approach. See Section 3.5.3.
ND = No toxicity value is available.
NA = Not applicable; this constituent is not classified as a carcinogen.
NE = EPA has not evaluated for carcinogenic potential.
IRIS = EPA's Integrated Risk Information System Database (EPA, 2001).
HEAST = EPA's Health Effects Assessment Summary Tables (EPA, 1997).
EPA Region IV = Supplemental Guidance to RAGS, Region IV Bulletins (EPA, 1995).
EPA Region IX = Region IX PRG Table (EPA, 2000).

Table 3-7 – Site-Specific Remediation Levels[1]

Constituent	Commercial Remediation Level (mg/kg)	Golf Course Remediation Level (mg/kg)	Historical and Open Space Use Remediation Level (mg/kg)
Explosives			
Monomethylamine Nitrate	19,900	19,900	6,680
Nitroglycerine	6,580	6,580	368
2,4,6-Trinitrotoluene	1,230	1,230	172
Inorganics			
Aluminum	NC	NC	825,000
Arsenic	60	60	32[2]
Copper	90,900	90,900	30,500
Lead[3]	2,100	2,100	1,500
Mercury	737[4]	737[4]	247[4]
PAHs			
Benzo(a)Anthracene	126	126	7
Benzo(a)Pyrene	13	13	0.7
Benzo(b)Fluoranthene	126	126	7
Benzo(k)Fluoranthene	1,260	1,260	71
Chrysene	12,600	12,600	706
Dibenzo(a,h)Anthracene	13	13	0.7
Indeno(1,2,3-c,d)Pyrene	126	1,090	7
Pesticides/PCBs			
Aldrin	5	5	0.3

Notes:
NC = Not of Concern: Concentration calculated was equivalent to a 100 percent concentration. Therefore, this constituent is not of concern through this exposure scenario.
[1]Where remediation levels were calculated for both carcinogenic and noncarcinogenic effects, the value shown in the table is the lower of the two values.

[2]Value is site-specific background level for arsenic. This level was approved for use by Ecology (Ecology, 1999b).
[3]Values were derived by Ecology using the lead biokinetic models for children and adults (Ecology, 1999a).
[4]These levels represent levels based on direct contact with soil. The site-specific cleanup level of 24 mg/kg takes into account potential impacts to groundwater.

Table 3-8 – Site-Specific Input Parameters[1] and Results of the Adult Lead Model

Input Parameter	Units	Commercial Exposure Scenario	Golf Course Exposure Scenario	Industrial Exposure Scenario
$PbB_{fetal,0.95}$	ug/dl	10	10	10
$R_{fetal/maternal}$	(unitless)	0.9	0.9	0.9
BKSF	ug/dl per ug/day	0.4	0.4	0.4
$GSD_{i,adult}$	(unitless)	1.81	1.81	1.81
$PbB_{adult,0}$	ug/dl	1.36	1.36	1.36
IR_S	g/day	0.200	0.200	0.050
AF_S	(unitless)	0.12	0.12	0.12
EF	days/year	52	52	219
AT	days/year	365	365	365
Results				
RBRL	ug/g	2,067[2]	2,067[2]	1,963[3]

Notes:
[1]These site-specific values were specified for use by Ecology (Ecology, 1999a).
[2]This value was rounded up to 2,100 ug/g.
[3]This value was reduced to 1,000 ug/g to match the Model Toxics Control Act Method A industrial cleanup value established for Parcel #2 of the site in the 1997 Cleanup Action Plan.

Table 3-9 – Soil Cleanup Levels and Remediation Levels Associated with Future Site Use

Cleanup Levels and Remediation Levels	Future Site Use			
	Commercial Area	**Golf Course**	**Industrial Area**	**Recreational Area (Historical and Open Space Areas)**
Ecological Indicator Concentrations	**X**	**X**		**X**
Human Health Industrial Cleanup Levels and Remediation Levels (MTCA C)			**X**	
Site-Specific Commercial Remediation Levels	**X**			
Site-Specific Golf Course Remediation Levels		**X**		
Site-Specific Recreational Remediation Levels (for Historical and Open Space Areas)				**X**

Notes:
An "X" identifies the cleanup and/or remediation level that will be compared to soil concentrations in the different future land use areas.

Table 3-10 – Soil Cleanup and Remediation Levels Used for Evaluating Commercial and Golf Course Land Uses

Constituent	Cleanup/Remediation Level (mg/kg)	Source
Explosives		
Monomethylamine Nitrate	19,900	Remediation Level – Calculated Using Site-Specific Parameters
Nitroglycerine	6,580	Remediation Level – Calculated Using Site-Specific Parameters.
2,4,6-Trinitrotoluene	1.75	Cleanup Level – Ecology Agreement.
Petroleum Hydrocarbons		
TPH (418.1)	7,600	Cleanup Level – Ecology Agreement for TPH that originated as Bunker C fuel. One Area (Area 26 in GC-04 has TPH (418.1) that did not originate from Bunker C fuel. Those TPH data were compared to the MTCA value of 2,000 mg/kg for heavy oils.
Inorganics		
Aluminum	NC	Calculated Using Site-Specific Parameters.
Arsenic	60	Remediation Level – Ecology Agreement.
Copper	90,900	Remediation Level – Calculated Using Site-Specific Parameters.
Lead	118	Cleanup Level – Ecological Screening Concentration.
Mercury	24	Cleanup Level – Ecology Agreement.
PAHs		
Benzo(a)Anthracene	126	Remediation Level – Calculated Using Site-Specific Parameters
Benzo(a)Pyrene	12.6	Remediation Level – Calculated Using Site-Specific Parameters.
Benzo(b)Fluoranthene	126	Remediation Level – Calculated Using Site-Specific Parameters
Benzo(k)Fluoranthene	1260	Remediation Level – Calculated Using Site-Specific Parameters.
Chrysene	12,600	Remediation Level – Calculated Using Site-Specific Parameters.
Dibenzo(a,h)Anthracene	12.6	Remediation Level – Calculated Using Site-Specific Parameters.
Indeno(1,2,3-c,d)Pyrene	126	Remediation Level – Calculated Using Site-Specific Parameters.
Pesticide		
Aldrin	5	Remediation Level – Calculated Using Site-Specific Parameters.

Notes:
NC = Not of Concern: Concentration calculated was equivalent to a 100 percent concentration. Therefore, this constituent is not of concern through this exposure scenario.

Table 3-11 – Soil Cleanup Levels Used for Evaluating Industrial Land Use

Constituent	Cleanup/Remediation Level (mg/kg)	Source
Explosives		
Monomethylamine Nitrate	28,350	Remediation Level – Calculated Using MTCA Method C Parameters.
Nitroglycerine	4,080	Remediation Level – Calculated Using MTCA Method C Parameters.
2,4,6-Trinitrotoluene	1.75	Cleanup Level – Ecology Agreement.
Petroleum Hydrocarbons		
TPH (418.1)	7,600	Cleanup Level – Ecology Agreement for TPH that originated as Bunker C fuel.
Inorganics		
Aluminum	NC	Cleanup Level – MTCA Method C Value.
Arsenic	90	Cleanup Level – Ecology Agreement.
Copper	130,000	Cleanup LevelMTCA Method C Value.
Lead	1,000	Cleanup Level – MTCA default value used for Parcel 2.
Mercury	24	Cleanup Level – Ecology Agreement.
PAHs		
Benzo(a)Anthracene	18	Cleanup Level – MTCA Method C Value.
Benzo(a)Pyrene	18	Cleanup Level – MTCA Method CValue.
Benzo(b)Fluoranthene	18	Cleanup Level – MTCA Method CValue.
Benzo(k)Fluoranthene	18	Cleanup Level – MTCA Method CValue.
Chrysene	18	Cleanup Level – MTCA Method CValue.
Dibenzo(a,h)Anthracene	18	Cleanup Level – MTCA Method C Value.
Indeno(1,2,3-c,d)Pyrene	18	Cleanup Level – MTCA Method CValue.
Pesticide		
Aldrin	7.7	Cleanup Level – MTCA Method C Value.

Notes:
NC = Not of Concern: Concentration calculated was equivalent to a 100 percent concentration. Therefore, this constituent is not of concern through this exposure scenario.

Table 3-12 – Soil Cleanup and Remediation Levels Used for Evaluating Historical and Open Space Land Uses

Constituent	Cleanup/Remediation Level (mg/kg)	Source
Explosives		
Monomethylamine Nitrate	6,680	Remediation Level –Calculated Using Site-Specific Parameters.
Nitroglycerine	368	Remediation Level –Calculated Using Site-Specific Parameters.
2,4,6-Trinitrotoluene	1.75	Cleanup Level – Ecology Agreement.
Petroleum Hydrocarbons		
TPH (418.1)	7,600	Cleanup Level – Ecology Agreement for TPH that originated as Bunker C fuel.
Inorganics		
Aluminum	825,000	Remediation Level –Calculated Using Site-Specific Parameters.
Arsenic	32	Cleanup Level – Site Background Level (Ecology Agreement).
Copper	30,500	Remediation Level –Calculated Using Site-Specific Parameters.
Lead	118	Cleanup Level – Ecological Screening Value.
Mercury	24	Cleanup Level – Ecology Agreement.
PAHs		
Benzo(a)Anthracene	7.1	Remediation Level –Calculated Using Site-Specific Parameters.
Benzo(a)Pyrene	0.71	Remediation Level –Calculated Using Site-Specific Parameters.
Benzo(b)Fluoranthene	7.1	Remediation Level –Calculated Using Site-Specific Parameters.
Benzo(k)Fluoranthene	71	Remediation Level –Calculated Using Site-Specific Parameters.
Chrysene	710	Remediation Level –Calculated Using Site-Specific Parameters.
Dibenzo(a,h)Anthracene	0.71	Remediation Level –Calculated Using Site-Specific Parameters.
Indeno(1,2,3-c,d)Pyrene	7.1	Remediation Level –Calculated Using Site-Specific Parameters
Pesticides/PCBs		
Aldrin	0.3	Remediation Level –Calculated Using Site-Specific Parameters.

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Chapter 4 – Comparison of Site Concentrations to Cleanup and Remediation Levels

4.1 Introduction

In this chapter soil concentrations for each EU (identified in Chapter 2) are compared to cleanup and remediation levels identified in Chapter 3 to determine if the EU is in compliance with the MTCA three-fold criteria [WAC 173-340-740 (7)(d) and (e)]. As noted in Chapter 2, only those COPCs that were detected in at least one sample and had maximum concentrations that exceeded conservative risk-based screening criteria, were evaluated in this chapter of the risk assessment. In addition, EU COPC concentrations are compared to MTCA Risk-Based Criteria to evaluate if individual COPC concentrations and cumulative COPC concentrations in each EU meet risk-based goals.

4.2 Comparison of EU Soil Concentrations to Cleanup and Remediation Levels

4.2.1 MTCA Three-Fold Criteria

The soil concentrations in each EU were compared to the cleanup and remediation levels identified in Chapter 3 to determine if the concentrations of COPCs in each EU comply with MTCA three-fold criteria. The three-fold criteria are:

1. The maximum soil concentration for a COPC must be less than or equal to 2 times the site-specific COPC cleanup or remediation level.
2. The MTCA 95%UCL must be less than the site-specific cleanup or remediation level.
3. Less than 10% of individual soil concentrations shall exceed the site-specific cleanup or remediation level.

A modified version of this three-fold criteria is used when the cleanup level is based on a background concentration (i.e., historical and open space land use areas, for evaluation of arsenic only). The modified three-fold criteria are the following:

1. The maximum allowable concentration depends on the number of samples collected in the EU, the percentile used in development of the background concentration, and the coefficient of variability of the lognormal distribution (for EU samples). For relatively small sample sizes ($n < 30$) the criterion of no sample concentration more that two times the background concentration is suitable. In other cases, a higher factor of exceedance is required (requires consultation with Ecology).
2. The 95% UCL on the mean must be less than the background concentration.
3. For sample sizes less than 30, not more than 20% of the samples should exceed a background concentration that was based on the 90^{th} percentile background concentration. Ecology is consulted for other cases.

If an EU has any COPCs that exceed any element of the three-fold criteria outlined above, then the EU does not comply with MTCA, and is carried through to the FS for evaluation of remediation options. Results of this three-fold criteria evaluation are presented below.

4.2.2 MTCA Non-Cancer and Cancer Risk-Based Criteria

In addition to the three-fold criteria, MTCA identifies risk-based criteria for constituents as follows (WAC 173-340-708(4) and (5):

- The human health risk level for individual constituents may not exceed a hazard quotient of 1 or a cancer risk of one-in-a-million (1E-06) for historical and open space EUs. The human health risk level for individual constituents may not exceed a hazard quotient of 1 or a cancer risk of one-in-one-hundred thousand (1E-05) for the golf course, commercial and industrial EUs.
- The total risk level at the site, based on cumulative exposure to all constituents, may not exceed a hazard index of 1 or a cancer risk of 1 in 100,000 (1E-05).

If an EU exceeds these criteria, the EU does not comply with MTCA and is carried through to the FS.

4.2.3 Calculation of EU Soil Concentrations

Representative soil concentrations for each EU were calculated using SiteSTAT™ Statistical Software. Following combination of duplicate samples, statistical concentrations were calculated. The concentrations used for comparison to cleanup levels and remediation levels were the MTCA 95% Upper Confidence Limit (UCL) concentration and the maximum detected concentration.

The MTCA UCL concentration was calculated based on the following criteria:

1. The 95%UCL of the mean concentration for normally distributed data sets.
2. The Logarithmic 95%UCL (Log 95%UCL) of the mean concentration for all lognormally distributed and non-normally distributed data sets.
3. The maximum detected concentration in instances where the 95%UCL or Log 95%UCL exceeded the maximum detected concentration.

Before statistical calculations were performed, duplicate samples were combined to produce one concentration for each sample location. The decision rules used for combining duplicate samples were the following:

1. If both results were detected values, then the two values were averaged.
2. If one result was detected and one was not detected, then the highest detected value was used as the concentration for that sample location.
3. If both results were not detected, the highest detection limit value was used as the concentration for that sample.

The MTCA UCL calculations and other summary statistics calculated for the COPCs in each EU are presented in Appendix F. The statistical formulas used by the SiteSTAT are also presented in Appendix F.

4.3 Identification of EUs With COPCs That Exceed MTCA Three-Fold Criteria

Each EU was screened using the MTCA Three-Fold Criteria. Based on the results of this evaluation, the EU was determined to be in compliance or not in compliance with MTCA. Results of this evaluation are summarized below, organized by future land use category of the EUs. A detailed list of all screening results for each EU is presented in Appendix F.

EU evaluations of soils data over a depth interval of 1 to 15 feet are broad and they may not reflect realistic exposure scenarios. In addition, there is the potential to “dilute” exposure point concentrations. For remediation purposes, initial soil excavation depths will be determined based on individual characterization sample results and depths.

4.3.1 Commercial Land Use EUs

The compliance status of each EU is presented below in Table 4-1. As seen in this table, all EUs were out of compliance for at least one depth. Most criteria exceedances were found in surface soil, and arsenic and lead were the COPCs that exceeded the criteria most frequently.

4.3.2 Golf Course Use EUs

The compliance status of each EU is presented below in Table 4-2. As seen in this table, all EUs were out of compliance for at least one depth, and all but 2 EUs were out of compliance at both soil depth intervals. Arsenic and lead were the COPCs that exceeded the criteria most frequently.

4.3.3 Historical Use EUs

The compliance status of each EU is presented below in Table 4-3. As seen in this table, all EUs were out of compliance, and arsenic and lead were the COPCs that exceeded the criteria most frequently. There were no samples collected from subsurface soil, therefore all exceedances pertain to the top foot of soil.

4.3.4 Industrial Use EUs

The compliance status of this EU is presented below in Table 4-4. As seen in this table, the industrial EU passed the MTCA three-fold criteria.

4.3.5 Open Space Use EUs

The compliance status of each EU is presented below in Table 4-5. As seen in this table, all EUs were out of compliance in at least one depth. Most criteria exceedances were found in the surface soil, and arsenic and lead were the only COPCs that exceeded the criteria.

4.4 Identification of EUs that Exceed the MTCA Risk-Based Criteria

Each EU was screened using the MTCA Risk-Based Criteria. Based on the results of this evaluation, the EU was determined to be in compliance or not in compliance with MTCA. Results of this evaluation are summarized below, organized by future land use category of the EUs. Table 4-6 presents the individual hazard quotient and cancer risk for each COPC for each EU. Table 4-7 presents the total hazard index and the cumulative cancer risks for each EU.

4.4.1 Commercial Land Use EUs

When risk due to individual constituents was evaluated, only EU (COM 8) was out of compliance based on the cancer risk associated with arsenic. In addition, the individual non-cancer risk was out of compliance for TPH in one of the EUs. When cumulative risk was evaluated, one EU was out of compliance based on the cumulative non-cancer hazard index, and three were out of compliance based on the cumulative cancer risk.

4.4.2 Golf Course Use EUs

When risk due to individual COPCs was evaluated, all EUs were out of compliance based on the cancer risk associated with arsenic. In two EUs, the individual cancer risk was also out of compliance for benzo(a)pyrene. When cumulative risk was evaluated, nine of the EUs were out of compliance based on the cumulative cancer risk.

4.4.3 Historical Use EUs

When risk due to individual COPCs was evaluated, all EUs were out of compliance based on the cancer risk associated with arsenic. In addition, the individual cancer risk was out of compliance for aldrin in one of the EUs. When cumulative risk was evaluated, all of the EUs were in compliance.

4.4.4 Industrial Use EUs

The industrial EU was in compliance with the MTCA risk-based criteria.

4.4.5 Open Space Use EUs

When risk due to individual COPCs was evaluated, all EUs were out of compliance based on the cancer risk associated with arsenic. When cumulative risk was evaluated, all of the EUs were in compliance.

4.5 Summary of Screening Results

All EUs were screened against MTCA's Three-Fold Criteria and Risk Criteria. Using these criteria, all EUs except the industrial EU were not in compliance, and will require evaluation in the FS. More criteria exceedances were noted in the surface soil samples than in the subsurface soil samples. Arsenic and lead were the COPCs responsible for most criteria exceedances in the EUs.

Table 4-8 presents a summary of the compliance status of each EU. Figure 4-1 presents a map of the Site showing the compliance status of each EU with MTCA criteria arsenic and lead in the surface soil. Figure 4-2 presents a map of the Site showing the compliance status of each EU with MTCA criteria for arsenic and lead in subsurface soil.

Table 4-1 – Summary of COPCs that Exceed MTCA Three-Fold Criteria for Commercial EUs

EU	Soil Depth	COPCs Exceeding Criteria	Criteria Exceeded[(1)]	EU in Compliance with MTCA Three-Fold Criteria
COM 1	≤1 Foot BGS	Arsenic	10%; 2X	No
		Lead	UCL; 10%; 2X	
		TPH	UCL	
	>1 to ≤15 Feet BGS	Lead	UCL; 10%; 2X	No
COM 2	≤1 Foot BGS	Lead	10%; 2X	No
	>1 to ≤15 Feet BGS	None	None	Yes
COM 3	<1 Foot BGS	Arsenic	10%; 2X	No
		Lead	UCL; 10%; 2X	
	>1 to <15 Feet BGS	None	None	Yes
COM 4	≤1 Foot BGS	Arsenic	10%; 2X	No
		Lead	UCL; 10%; 2X	
	>1 to ≤15 Feet BGS	None	None	Yes
COM 5	≤1 Foot BGS	Arsenic	10%; 2X	No
		Lead	10%; 2X	
COM 6	≤1 Foot BGS	Lead	UCL; 10%; 2X	No
	>1 to ≤15 Feet BGS	None	None	Yes
COM 7	≤1 Foot BGS	Arsenic	10%; 2X	No
		Lead	UCL; 10%; 2X	
	>1 to ≤15 Feet BGS	2,4,6-Trinitrotoluene	UCL; 2X	No
		Lead	UCL; 10%; 2X	
COM 8	≤1 Foot BGS	Arsenic	UCL; 10%	No
		Lead	UCL; 10%; 2X	
	>1 to ≤15 Feet BGS	None	None	Yes
COM 9	≤1 Foot BGS	Arsenic	2X	No
	>1 to ≤15 Feet BGS	None	None	Yes

Notes:
COM = Commercial Areas.
[(1)]Criteria Exceeded: UCL = 95% Upper Confidence Limit concentration exceeds the cleanup levels and remediation levels. 10% = Ten percent of the COPC concentrations exceed the cleanup levels and remediation levels. 2X = Maximum concentration is greater than 2 times the cleanup levels and remediation levels.
[(2)]TPH 418.1 results above the cleanup levels and remediation levels were all associated with paraffin-coated cardboard except in one location where automobile parts were observed. Paraffin wax is generally regarded as biologically inert. Additionally, no CPAHs were detected in samples analyzed from this area. Thus there is no toxic fraction associated with paraffin-derived TPH concentrations.

Table 4-2 – Summary of COPCs that Exceed MTCA Three-Fold Criteria for Golf Course EUs

EU	Soil Depth	COPCs Exceeding Criteria	Criteria Exceeded[1]	EU in Compliance with MTCA Three-Fold Criteria
GC 1	<1 Foot BGS	Arsenic	UCL;10%; 2X	No
		Lead	UCL; 10%; 2X	
	>1 to <15 Feet BGS	Arsenic	10%	No
		Lead	UCL; 10%; 2X	
GC 2	<1 Foot BGS	Arsenic	UCL; 10%; 2X	No
		Lead	UCL; 10%; 2X	
		Mercury	UCL; 10%; 2X	
	>1 to <15 Feet BGS	Arsenic	UCL; 10%; 2X	No
		Lead	UCL; 10%; 2X	
GC 3	<1 Foot BGS	Arsenic	UCL; 10%; 2X	No
		Lead	UCL; 10%; 2X	
GC 4	≤1 Foot BGS	Arsenic	UCL; 10%; 2X	No[2]
		Lead	UCL; 10%; 2X	
		TPH	UCL; 10%; 2X	
	>1 to ≤15 Feet BGS	Lead	UCL; 10%; 2X	No
GC 5	≤1 Foot BGS	Arsenic	UCL; 2X	No
		Lead	UCL; 2X	
GC 6	≤1 Foot BGS	Arsenic	UCL; 10%; 2X	No
		Lead	UCL; 10%; 2X	
	>1 to ≤15 Feet BGS	Lead	UCL; 10%; 2X	No
GC 7	≤1 Foot BGS	Arsenic	UCL; 10%; 2X	No
		Lead	2X	
	>1 to ≤15 Feet BGS	Lead	2X	No
GC 8	<1 Foot BGS	Arsenic	UCL; 10%; 2X	No
		Lead	10%; 2X	
	>1 to <15 Feet BGS	None	None	Yes
GC 9	<1 Foot BGS	Arsenic	10%; 2X	No
		Lead	UCL; 10%; 2X	
	>1 to <15 Feet BGS	Lead	2X	No

Notes:
GC = Golf Course Areas
(1)Criteria Exceeded: UCL = 95% Upper Confidence Limit concentration exceeds the cleanup levels and remediation levels. 10% = Ten percent of the COPC concentrations exceed the cleanup levels and remediation levels. 2X = Maximum concentration is greater than 2 times the cleanup levels and remediation levels.
(2)TPH 418.1 results above the cleanup levels and remediation levels were all associated with paraffin-coated cardboard except in one location where automobile parts were observed. Paraffin wax is generally regarded as biologically inert. Additionally, no CPAHs were detected in samples analyzed from this area. Thus there is no toxic fraction associated with paraffin-derived TPH concentrations.

Table 4-3 – Summary of COPCs that Exceed MTCA Three-Fold Criteria for Industrial EU

EU	Soil Depth	COPCs Exceeding Criteria	Criteria Exceeded[1]	EU in Compliance with MTCA Three-Fold Criteria[(1)]
IN 1	≤1 Foot BGS	None	None	Yes
	>1 to ≤15 Feet BGS	None	None	Yes

Notes:
IN = Industrial Areas
[(1)]This EU was also evaluated for compliance using an alternative method in which each interim corrective action excavation was treated as an individual EU. The Industrial Area was also found to be in compliance using alternative EUs. See PIONEER Technologies Corporation, West Shore Corporation, NW, and URS. 2000. Hot Spot Interim Action Report Former DuPont Works Site DuPont, Washington.

Table 4-4 – Summary of COPCs that Exceed MTCA Three-Fold Criteria for Open Space EUs

EU	Soil Depth	COPCs Exceeding Criteria	Criteria Exceeded[1]	EU in Compliance with MTCA Three-Fold Criteria
OS 1	≤1 Foot BGS	Lead	UCL; 10%; 2X	No
	>1 to ≤15 Feet BGS	None	None	Yes
OS 2	≤1 Foot BGS	Arsenic	UCL; 10%; 2X	No
		Lead	UCL; 10%; 2X	
	>1 to ≤15 Feet BGS	Arsenic	UCL; 10%; 2X	No
OS 3	≤1 Foot BGS	Arsenic	UCL; 10%; 2X	No
	>1 to ≤15 Feet BGS	None	None	Yes
OS 4	≤1 Foot BGS	Arsenic	UCL; 10%	No
	>1 to ≤15 Feet BGS	None	None	Yes

Notes:
OS = Open Space Areas
[1]Criteria Exceeded: UCL = 95% Upper Confidence Limit concentration exceeds the cleanup levels and remediation levels. 10% = Ten percent of the COPC concentrations exceed the cleanup levels and remediation levels. 2X = Maximum concentration is greater than 2 times the cleanup levels and remediation levels.

Table 4-5 – Summary of COPCs that Exceed MTCA Three-Fold Criteria for Historical EUs

EU	Soil Depth	COPCs Exceeding Criteria	Criteria Exceeded[1]	EU in Compliance with MTCA Three-Fold Criteria
HI 1	≤1 Foot BGS	Arsenic	UCL; 10%; 2X	No
		Lead	UCL; 10%	
	>1 to ≤15 Feet BGS	No Data in this EU	None	NA
HI 2	≤1 Foot BGS	Arsenic	UCL; 10%; 2X	No
		Lead	UCL; 10%; 2X	
		Aldrin	UCL; 10%	
	>1 to ≤15 Feet BGS	No Data in this EU	None	NA
HI 3	≤1 Foot BGS	Arsenic	UCL; 10%; 2X	No
		Lead	UCL; 10%; 2X	
	>1 to ≤15 Feet BGS	No Data in this EU	None	NA

Notes:
HI = Historical Areas
[1]Criteria Exceeded: UCL = 95% Upper Confidence Limit concentration exceeds the cleanup levels and remediation levels. 10% = Ten percent of the COPC concentrations exceed the cleanup levels and remediation levels. 2X = Maximum concentration is greater than 2 times the cleanup levels and remediation levels.
NA = Not Applicable.

Table 4-6 – Individual COPC Hazard Quotients and Cancer Risks

EU	Depth	Hazard Quotient		Cancer Risk		
		Arsenic	TPH (418_1)	Aldrin	Arsenic	Benzo(a)Pyrene
COM 1	<1 Foot BGS	- -	1.3	- -	7.7E-06	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	1.8E-06	- -
COM 2	≤1 Foot BGS	- -	- -	- -	6.8E-06	- -
COM 3	≤1 Foot BGS	- -	- -	- -	8.1E-06	- -
COM 4	≤1 Foot BGS	- -	- -	- -	1.0E-05	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	4.7E-06	- -
COM 5	≤1 Foot BGS	- -	- -	- -	8.7E-06	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	7.5E-06	- -
COM 6	≤1 Foot BGS	- -	- -	- -	9.4E-06	- -
COM 7	≤1 Foot BGS	- -	- -	- -	9.1E-06	- -
COM 8	≤1 Foot BGS	- -	- -	- -	1.2E-05	- -
COM 9	≤1 Foot BGS	- -	- -	- -	5.9E-06	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	2.2E-06	- -
GC 1	≤1 Foot BGS	- -	- -	- -	1.1E-05	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	8.6E-06	- -
GC 2	≤1 Foot BGS	- -	- -	- -	1.4E-05	2.2E-06
	>1 to ≤15 Feet BGS	- -	- -	- -	7.3E-05	- -
GC 3	≤1 Foot BGS	- -	- -	- -	2.2E-05	- -
GC 4	≤1 Foot BGS	- -	- -	- -	1.4E-05	4.4E-06
	>1 to ≤15 Feet BGS	- -	- -	- -	5.7E-06	- -
GC 5	≤1 Foot BGS	- -	- -	- -	1.1E-05	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	1.7E-06	- -
GC 6	≤1 Foot BGS	- -	- -	- -	2.3E-05	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	7.5E-06	- -
GC 7	≤1 Foot BGS	- -	- -	- -	2.2E-05	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	2.1E-06	- -
GC 8	≤1 Foot BGS	- -	- -	- -	2.0E-05	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	1.2E-06	- -
GC 9	≤1 Foot BGS	- -	- -	- -	1.0E-05	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	1.7E-06	- -
HI 1	≤1 Foot BGS	- -	- -	- -	2.1E-06	- -
HI 2	≤1 Foot BGS	- -	- -	2.0E-06	2.3E-06	- -
HI 3	≤1 Foot BGS	- -	- -	- -	3.4E-06	- -
IN 1	≤1 Foot BGS	- -	- -	- -	5.8E-06	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	1.4E-06	- -
OS 1	≤1 Foot BGS	- -	- -	- -	- -	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	- -	- -
OS 2	≤1 Foot BGS	1.2	- -	- -	9.2E-06	- -
	>1 to ≤15 Feet BGS	- -	- -	- -	3.8E-06	- -
OS 3	≤1 Foot BGS	- -	- -	- -	1.9E-06	- -
OS 4	≤1 Foot BGS	- -	- -	- -	1.1E-06	- -

Notes:
COM = Commerical. GC = Industrial. HI = Historical. IN = Industrial. OS = Open Space.
Shaded values indicate risk levels that exceed MTCA's risk criteria. The EUs associated with these risks will be evaluated in the FS. Non-cancer hazards or risks for EUs and associated COPCs not presented in the table are below a HI of 1 and a cancer risk of 1E-06, respectively.
- - = Constituent has a hazard quotient less than 1, a cancer risk less than 1E-06, or is not a COPC for that EU.
[(1)]The background soil concentration for arsenic is 32 mg/kg. This Site-specific background concentration, in combination with the different exposure scenarios, results in cancer risks of 5.3E-06 for Commercial and Golf Course Land Use, 1.0E-05 for

Historical and Open Space and 3.6E-06 for Industrial. Consistent with MTCA, these areas would not be considered to be out of compliance unless the cancer risk exceeded these levels.

Table 4-7 – Cumulative Hazard Indices and Cancer Risks for Each EU

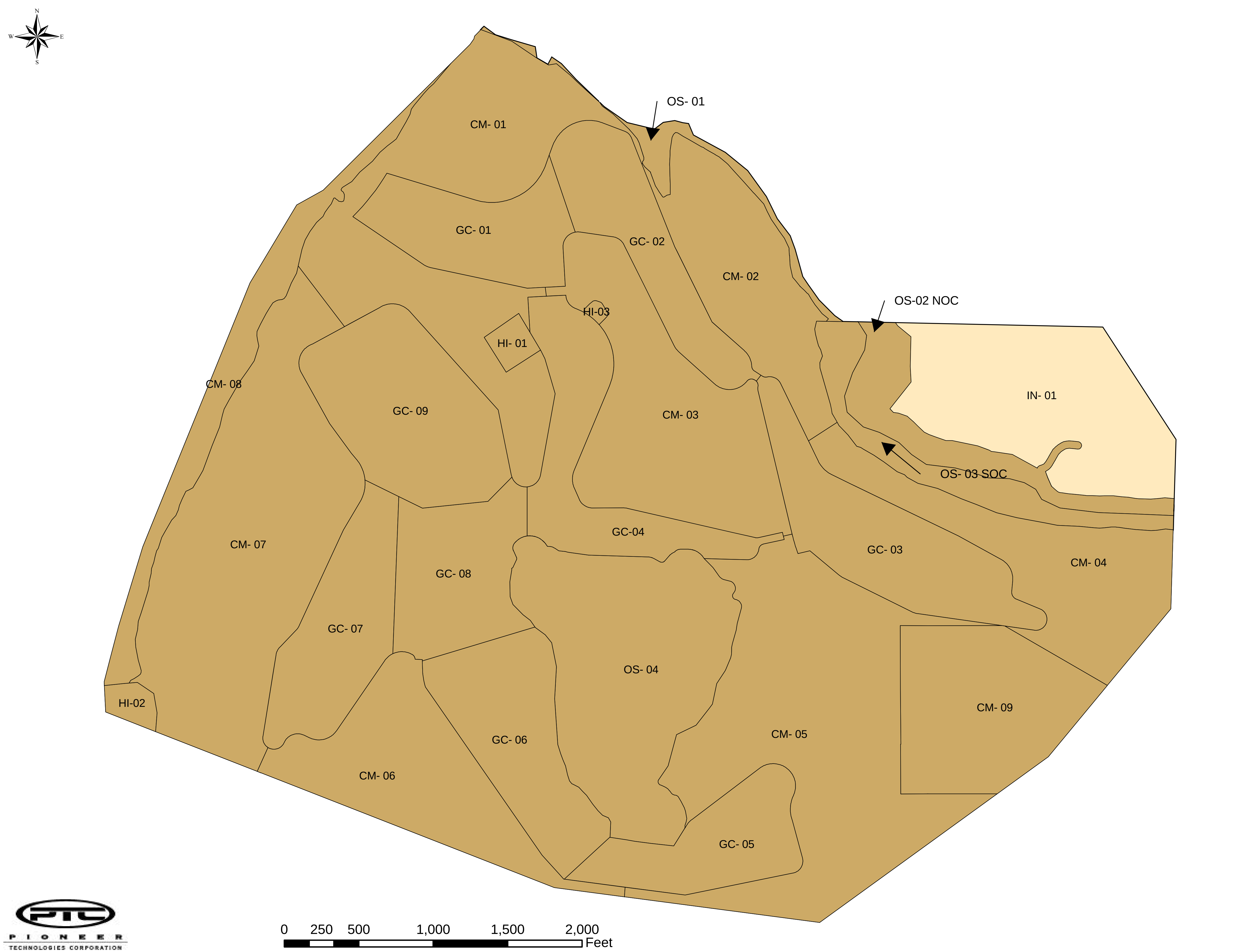
Evaluation Unit	Depth	Hazard Index	Cumulative Cancer Risk
COM 1	≤1 Foot BGS	1.4	2.2E-05
	>1 to ≤15 Feet BGS	0.038	2.0E-06
COM 2	<1 Foot BGS	0.055	6.8E-06
	>1 to <15 Feet BGS	0.024	7.8E-07
COM 3	≤1 Foot BGS	0.13	8.7E-06
	>1 to ≤15 Feet BGS	0.023	6.2E-07
COM 4	≤1 Foot BGS	0.084	1.0E-05
	>1 to ≤15 Feet BGS	0.038	4.7E-06
COM 5	≤1 Foot BGS	0.095	8.7E-06
	>1 to ≤15 Feet BGS	0.23	7.5E-06
COM 6	≤1 Foot BGS	0.077	9.4E-06
	>1 to ≤15 Feet BGS	0.0080	9.7E-07
COM 7	≤1 Foot BGS	0.090	9.1E-06
	>1 to ≤15 Feet BGS	0.061	7.0E-07
COM 8	≤1 Foot BGS	0.10	1.2E-05
	>1 to ≤15 Feet BGS	0.0081	1.0E-06
COM 9	≤1 Foot BGS	0.048	5.9E-06
	>1 to ≤15 Feet BGS	0.018	2.2E-06
GC 1	≤1 Foot BGS	0.087	1.1E-05
	>1 to ≤15 Feet BGS	0.076	8.7E-06
GC 2	≤1 Foot BGS	0.46	2.0E-05
	>1 to ≤15 Feet BGS	0.61	7.3E-05
GC 3	≤1 Foot BGS	0.21	2.2E-05
	>1 to ≤15 Feet BGS	0.022	8.7E-07
GC 4	≤1 Foot BGS	0.86	2.8E-05
	>1 to ≤15 Feet BGS	0.053	5.8E-06
GC 5	≤1 Foot BGS	0.11	1.1E-05
	>1 to ≤15 Feet BGS	0.031	1.7E-06
GC 6	≤1 Foot BGS	0.20	2.3E-05
	>1 to ≤15 Feet BGS	0.061	7.7E-06
GC 7	≤1 Foot BGS	0.18	2.2E-05
	>1 to ≤15 Feet BGS	0.018	2.1E-06
GC 8	≤1 Foot BGS	0.17	2.0E-05
	>1 to ≤15 Feet BGS	0.010	1.2E-06
GC 9	≤1 Foot BGS	0.081	1.0E-05
	>1 to ≤15 Feet BGS	0.014	1.7E-06
HI 1	≤1 Foot BGS	0.28	2.1E-06
HI 2	≤1 Foot BGS	0.34	4.3E-06
HI 3	≤1 Foot BGS	0.44	3.4E-06
IN 1	≤1 Foot BGS	0.050	5.8E-06
	>1 to ≤15 Feet BGS	0.021	1.5E-06
OS 1	≤1 Foot BGS	0.29	2.8E-06
OS 2	≤1 Foot BGS	1.2	9.2E-06
	>1 to ≤15 Feet BGS	0.49	3.8E-06
OS 3	≤1 Foot BGS	0.24	1.9E-06
	>1 to ≤15 Feet BGS	0.015	1.2E-07
OS 4	≤1 Foot BGS	0.14	1.1E-06

Notes:
COM = Commerical. GC = Industrial. HI = Historical. IN = Industrial. OS = Open Space. HI = Hazard Index (i.e., sum of all of the hazard quotients). CR = Cancer Risk (i.e., cumulative cancer risk).
Shaded values indicate levels that exceed MTCA's risk criteria. The EUs associated with these risks will be evaluated in the FS.

Table 4-8 – Summary of EUs to be Evaluated in the FS

EU	Evaluated in FS
COM 1	Yes
COM 2	Yes
COM 3	Yes
COM 4	Yes
COM 5	Yes
COM 6	Yes
COM 7	Yes
COM 8	Yes
COM 9	Yes
GC 1	Yes
GC 2	Yes
GC 3	Yes
GC 4	Yes
GC 5	Yes
GC 6	Yes
GC 7	Yes
GC 8	Yes
GC 9	Yes
IN 1	Yes(1)
OS 1	Yes
OS 2	Yes
OS 3	Yes
OS 4	Yes
HI 1	Yes
HI 2	Yes
HI 3	Yes

Notes:
COM = Commerical. GC = Industrial. HI = Historical. IN = Industrial. OS = Open Space.
(1)Evaluated in the FS based on potential impacts to groundwater.



Legend

- Eu in Compliance 0 to <1 ft
- EU not in Compliance 0 to <1 ft

Notes

GC - Golf Course
CM - Commercial
HI - Historical
OS - Open Space
NOC - North of Creek
SOC - South of Creek
IN - Industrial

EU Compliance Status for Arsenic and Lead in Surface Soil

Former DuPont Works Site
September, 2002

Figure 4-1

Legend

- Eu in Compliance >1 to <15 ft
- EU not in Compliance >1 to <15 ft

Notes

GC - Golf Course
CM - Commercial
HI - Historical
OS - Open Space
NOC - North of Creek
SOC - South of Creek
IN - Industrial

EU Compliance Status for Arsenic and Lead in Subsurface Soil

Former DuPont Works Site
September, 2002

Figure 4-2

Chapter 5 – Uncertainty Analysis

5.1 Introduction

The results presented in this RA depend on a number of factors, including the availability of pertinent scientific information, standard RA practices, exposure assumptions, toxicity assumptions, and Ecology policy decisions.

Uncertainties are introduced into a RA because a range of values could be used for each assumption (i.e., parameter). Typically, more conservative (i.e., upper bound) values are generally chosen for each parameter, while other values (i.e., values closer to the central tendency) may be more representative of site-specific conditions. Choosing upper bound values for each parameter typically results in overly conservative risks that do not reflect site-specific conditions.

5.2 Uncertainties

Sources of uncertainty identified in the human health evaluation and professional judgment regarding the direction and magnitude of the impacts on the risk results are presented in Table 5-1. The direction and magnitude are those assumed to remain after any actions listed in the comment field have been implemented. This is done to qualitatively evaluate how much the risks and associated CLs might change if different values were used or if an alternative assumption or decision was made. In other words this uncertainty analysis provides a qualitative estimate of the confidence that the cleanup and remediation levels presented herein will be protective of the land-use and receptors on which they are based. The key study-specific uncertainties associated with the risk calculations and associated CLs and RLs are discussed in detail below.

5.2.1 Future Land Use

There is uncertainty associated with future land use at the Site. The RA assumed that future land use would include commercial, recreational (i.e., a golf course), historical, and open space for the purposes of developing RLs. If the Site was used for other purposes (e.g., residential) the RLs may not be protective. This uncertainty is very low because there are land use restrictions being imposed on the property to ensure that future land use is consistent with the assumptions made in the RA. Deed restrictions to limit Site uses will be imposed for different land uses including commercial, recreational (golf course), historical, industrial, and open space (Ecology, 2003). The City of DuPont zoning for the Site does not include any areas to be used for residential purposes (City of DuPont, 2001). An additional deed restriction will be required for the property inside the golf course footprint that limits this property to that sole use and places restrictions on activities that could disturb the cap/cover. In addition, the construction of an engineered cap/cover as part of the golf course placement areas also reduces the uncertainty that the property will be used for other purposes which would result in unaccounted for exposures to affected soil. Overall, the confidence that the future land-use will be consistent with what was evaluated in the RA is very high.

5.2.2 Exposure Factors

There is uncertainty associated with the exposure factors used to determine the CLs and RLs including the incidental soil ingestion rates. The default MTCA Method C scenario assumes that an adult industrial worker ingests 50 mg of soil each day. The CLs and RLs identified in this evaluation are based on the assumption that the commercial or golf course worker ingests 200 mg of soil each day. The uncertainty surrounding incidental soil ingestion rates is low due to the fact that a higher ingestion rate was used to develop the CLs and RLs.

5.2.3 Groundwater as a drinking water source

Drinking water was not evaluated in the RA because COPC concentrations in the RI indicated that, other than low DNT concentrations that were detected in 6 wells, groundwater is not a medium of concern. There is though, uncertainty associated with the use of groundwater as a drinking water source. Site groundwater is not currently used as a drinking water source. In the future, a deed restriction will be placed on the Site to restrict the use of groundwater to non-potable uses only, until such time as it meets

CLs. In addition, the capacity of off-Site drinking water supplies (which are located upgradient of the Site) is more than double the capacity needed for the projected population of DuPont through the year 2020 (WSNW, 2003). Therefore, the uncertainty associated with future groundwater use is low.

5.2.4 Arsenic Area Background Concentration

There is uncertainty associated with determining the background arsenic concentration at the Site. This area background concentration was determined after collecting twenty-three soil samples from unbiased locations outside of the Site consent decree boundary to define “Site background” soil quality in accordance with MTCA. The majority of samples were obtained from locations to the south and east of the Site. Ecology approved the use of the 32 mg/kg (i.e., ppm) as the area background concentration for arsenic in 1996. The confidence in this value being representative of area background concentrations is high.

5.2.5 Ecological Evaluation

There is uncertainty associated with ecological evaluation. Ecology performed an evaluation of the Site and determined that lead is the indicator compound for potential terrestrial ecological impacts. As part of this evaluation, Ecology determined that, based on site-specific information, the potential species groups of concern included ground-feeding birds and herbivorous small mammals. The soil screening level identified for lead by Ecology is 118 mg/kg, and is intended to be protective of wildlife, including birds and small mammals. This concentration is based on an exposure scenario which assumes that there are earthworms present in the contaminated soil and that robins are eating the earthworms. Overall, the confidence in this value being protective of ecological receptors is very high.

5.3 Conclusion

The MTCA rule, scientific information, site-specific factors, and the associated uncertainties were considered during the process of developing CLs and RLs. In general, when faced with uncertainty, more stringent assumptions were used in the evaluation so that the final result is CLs and RLs that are more health protective.

Table 5-1
Summary of Uncertainties in the Human Health Evaluation and Site-Specific Characteristics

Source of Uncertainty	Direction[a]	Magnitude[b],[c]	Comment
Key Uncertainties			
Future Land Use	+/-	0	Deed restrictions, zoning, and physical cap over the placement areas in the golf course together minimize the chance that future land use will be different than what was assumed in the RA.
Incidental Soil Ingestion Rate	+	2	The incidental soil ingestion rate that was used is 4 times higher than the MTCA default value.
Groundwater as a drinking water source.	+/-	0	The groundwater at the Site is not currently used as a drinking water source and deed restrictions will ensure that it is not used as a source in the future.
Area-wide arsenic background concentration	+/-	0	The area-wide concentration was determined according to the methodology prescribed in MTCA and ultimately approved by Ecology for use at the Site.
Ecological Evaluation	+	2	The screening concentration identified by Ecology was used as the cleanup level.
Other Uncertianties			
Quality of Analytical Data	+/-	0	Quality-assured data were used in the evaluation.
Identification and characterization of COCs present in soil.	+/-	0	The Site is well characterized with 21,933 soil sample analyses (5,182 samples), 12,038 groundwater sample analyses (283 samples), and 1,528 surface water sample analyses (344 samples).
Soil samples were not sieved through a < 250 mm screen.	-	1	EPA issued guidance recommending sieving soil samples for lead only. If this was done the lead concentrations in soil would be higher (i.e., the lead concentrations reported by the laboratory would be higher because lead is generally found in the finer soil fraction).
Exposure Frequency and Duration	+	1	MTCA default and Site-specific exposure Factors were used in the evaluation. The exposure frequency assumes that a commercial landscaper is working in the affected soil 2 days/week for 20 years.
Extrapolation from animal studies to human toxicity	+	3	U.S. EPA's conservative approach incorporating safety factors and upper-bound estimates was used in the evaluation.
Historical versus recent RA assumptions impact on CLs and RLs	+/-	0	Site-specific CLs and RLs have been developed over the course of many years and in some cases this results in differences in exposure scenarios and associated assumptions (see Appendix C) between older and newer agreements.

[a]Direction of Effect on Risk Calculations   + = May result in risks that are overly conservative.
- = May result in risks that are not conservative.

(b)Magnitude of Effect on Risk Calculations

0 = Negligible impact on risk calculations.
1 = Small effect on risks calculations.
2 = Medium effect on risk calculations.
3 = Large effect on risk calculations.

(c)Direction and Magnitude values based on professional judgment.

5.4 References

City of DuPont. 2001. City of DuPont Comprehensive Land Use Plan. Adopted by Ordinance No. 01-698. November 13, 2001.

Ecology. Washington State Department of Ecology. 2003. Cleanup Action Plan for the Former DuPont Works Site, DuPont, WA.

WSNW. West Shore Corporation NW. 2003. Feasibility Study for the Former DuPont Works Site, DuPont, Washington.

Appendix A – Ecological Risk Assessment Summary

A.1 Introduction

In 1991, a Consent Decree between Ecology, Weyerhaeuser, and DuPont was signed. The MTCA regulations, as well as the Consent Decree, require that potential risks to human health and the environment be evaluated at the Site. This memo summarizes the qualitative and quantitative evaluations performed to evaluate the potential impacts to ecological receptors at the Former DuPont Works Site.

A.2 Nature and Extent of Contamination

Soil, groundwater, surface water (fresh and marine), and sediment were all potentially impacted from the activities of the Former DuPont Works. Constituent concentrations in these media (except for soil where there are no published standards) were compared to Federal and State environmental standards that are protective of the environment. No constituent concentrations in surface water and fresh water sediments exceeded any of the standards. Based on these comparisons and other factors such as diversity of species in fresh water sediments, it was determined that surface soil is the only medium of potential ecological concern (Hart Crowser, 1994).

Petroleum, DNT, TNT, mercury, arsenic, and lead were detected in soil at the Site. Petroleum, DNT, TNT, and mercury have been remediated and residual concentrations do not pose a risk to upland species of plants and animals. Human health standards for arsenic are protective of ecological organisms. Therefore, remediating arsenic contamination to meet human health standards will ensure protection for ecological receptors. The only remaining COPC for ecological receptors is lead.

The bulk of lead contamination in surface soil at the Site is, in general, localized around building foundations which will be remediated. The removal of soil around these foundations will reduce significantly the overall lead contamination Site-wide, and therefore, the overall risk to ecological receptors. Nevertheless, as currently envisioned, there will remain relatively small areas on the Site where either remediation or active land development are not planned. It is these areas, such as future Open Space and buffer areas, where the potential for exposure of ecological receptors to lead remains. The concerns raised by potential exposure to lead in these areas, and approaches to addressing these concerns is the focus of the following discussion.

A.3 Ecological Risk Assessment

A.3.1 General

Ecological risk assessment is a process that is used to estimate the likelihood and magnitude of harm to ecological receptors that results from exposure to one or more stressors. It is a tool that helps in the decision making process, hence the results of the ecological risk assessment are one of several considerations involved in making the ultimate decision as to what action might need to be taken at a site. In general, the ecological assessment process follows the concept of tiering. The assessment begins with a relatively simple screening process which allows the risk assessor to determine what receptors and what constituents are of concern. If the potential for ecological impacts are not found during this screening step, the assessment ends. If, however, there are potential ecological risks found, the assessment may progress to more complex and lengthy investigations. In this way, evidence is collected in a stepwise fashion allowing the decision maker to determine whether or not additional information is needed to make a scientifically supportable decision. Where sufficient information is available, such that the decision maker is no longer faced with a high degree of uncertainty, there may be no need for further assessment. There are at least two, perhaps more, approaches to ecological risk assessment: the top down approach, and the bottom up approach.

A.3.2 Top Down Approach

The top down approach takes a macro scale view of the existing conditions on-Site, including the plants, animals and habitats, and considers whether or not there are obvious signs of harm. The judgment as to whether or not harm is present is based on a comparison of the area of interest to a similar nearby area where the stressors of concern, such as metals, are not present. If the comparison suggests that there are no obvious signs of harm (i.e., the nearby site is not substantially different than the site of interest), the assessment can typically be stopped. The strength of the top down approach is that the "sum" of the functioning of the plants and animals is measured, and judged against a similar "sum" from a relatively clean area. It is analogous to "taking a big picture view of potential ecological risks". A weakness of this approach is that the resolution, or ability to see small things clearly, is not great enough to observe subtle, micro scale differences that might be present.

A.3.3 Bottom Up Approach

Conversely, the bottom up approach begins by measuring concentrations of constituents in important media, perhaps conducting toxicological tests on these media, and later attempting to integrate these measures into an estimate of ecological risk. The bottom up approach is analogous to viewing the individual trees in the forest and using that information to determine if there has been harm to the total forest. In contrast, the top down approach does not look at individual trees *per se*, but the total forest, to determine if there is potential harm. The strength of the bottom up approach is that discrete measurements of potential exposure and harm to individual components of the system are made, providing both a qualitative and quantitative estimate of potential risk. A weakness of this approach is that the overall functioning of the plants and animals, the "sum" of the system, may or may not match up with the bottom up information. That is, the overall system may be functioning appropriately even when individual components may not be.

At the former DuPont Works Site, both the top down and the bottom up approaches were applied as discussed below. Taken together, the two approaches complement one another and thus reduce the likelihood that either micro scale or macro scale problems are missed.

A.4 Site-Specific Ecological Studies - A Top Down Approach

A number of Site-specific qualitative and quantitative ecological studies have been conducted at the former DuPont Works Site. These included the following:

- **Biological Survey** – Terrestrial ecology studies were conducted from January 1977 through February 1978 to document existing conditions including the diversity and composition of plant and animal species (Melchiors and Motobu, 1978). The investigations included determining the species composition and extent of plant communities, bird, large and small mammals (e.g., mark-recapture trapping of small mammals), reptiles and amphibian populations.

- **Biological Resources Summary (The Weyerhaeuser Export Facility FEIS)** – This document provides a detailed summary of all previous biological investigation work regarding existing flora, fauna, and associated habitats at and in the vicinity of the Site (U.S. Army Corps of Engineers, 1982). The document also provides a series of maps and tables compiling all of the biotic information related to the Site. These data and observations support the conclusion that the former DuPont Works site is a relatively robust ecological area containing a diverse assemblage of plants and animals common to the Pacific Northwest.

- **Biological Resource Assessment** — To update the FEIS and previous work on Site, a biological resource assessment was performed in 1996 to re-evaluate the diversity of plant and animal species (Adolphsson and Associates, 1996). The studies compared highly contaminated areas within the Consent Decree boundary to similar uncontaminated off-Site reference areas by placing grids over the study areas and identifying and counting plants and wildlife. The majority of plants and animals observed were common to the on-Site and off-Site areas with small differences likely attributable to the higher degree of physical disturbance within the Consent Decree associated with various human activities, such as Site cleanup. There was no indication of plant or animal stress within the Consent

Decree areas. The study concluded that plant and animal populations appear to be healthy. No abnormal growth forms or patterns were observed in either plants or animals in the course of the study. Plant communities appear to be generally healthy and responding to changes in their physical environment that have resulted from initial cleanup and forest thinning activities. Wildlife also are relatively abundant on the Site, and at least some species were observed nesting and/or rearing young within the Consent Decree boundary. This comparative biological assessment found little differences between off-Site and on-Site communities; however, only gross impacts would have been noticed.

A.5 Site-Specific Ecological Studies - A Bottom Up Approach

Quantitative Site-specific studies have been conducted at the former DuPont Works Site as shown below.

- **Screening Soil Bioassays** — The Washington State Department of Ecology performed screening level bioassays on soil samples from the Site as part of its ongoing effort to develop methods to assess potential biological impacts (Norton and Stinson, 1993). The bioassays included (1) *Daphnia magna* percent survival; (2) Plant vigor based on biomass, percent germination, and percent survival; (3) Earthworm percent survival; (4) Fathead Minnow percent survival; (5) FETAX (Frog Embryo Teratogenesis Assay) percent survival, percent malformation, and mean growth of *Xenopus laevis* as presented in Table A-1. These bioassay results suggest that potentially detrimental effects were only observed at the high concentrations (the high concentration was 110,000 ppm). During 1999, 2000, and 2001 the areas with the highest lead concentrations (i.e., any sample where the lead concentration exceeded 4,100 mg/kg) have been removed from the Site (See the RI).

- **Draft Ecological Risk Assessment** — This study evaluated the impacts of Site-related COPCs on the environment (DERS and Hart Crowser, 1994). The assessment employed a food web model to quantify potential exposure of larger animals to contaminants in the soil and compared surface water and sediment constituent concentrations to standards. The assessment concluded that: (1) the potential risk to avian species under current Site conditions was minimal; (2) cleanup of lead to levels protective of human health would be reasonably protective of ecological receptors; and (3) that no potential risks to aquatic species were indicated under current Site conditions. Results of the food web modeling analysis indicated that no potential risk to large terrestrial mammals exists (deer and fox). Potential risks to herbivorous rodents (voles) were identified for some areas. A short coming of this study was that it did not take into account future land use (i.e., what habitat will remain after remediation and development).

- **Food Web Modeling** — A nationally recognized ecological risk assessor selected by Ecology and the PLPs initiated the development of a food web model which focused on highly exposed indicator species found at the site and taking into account the COPCs (Greg Linder, 1996). Ecology and the PLPs came to separate but similar conclusions that future land use was becoming an overriding factor with respect to potential ecological risk: hence this evaluation was no longer needed for making a final decision at the Site.

A.6 Conclusions

A variety of different studies, using both the top down and bottom up approaches to ecological risk assessment, have been conducted at the Site in order to provide information for making an ecologically-based, risk management decision. The conclusions that can be drawn from these studies include:

- The only constituent and medium of potential ecological concern is lead in surface soil. Ecology has performed an evaluation of the Site and determined that lead is the indicator compound for potential terrestrial ecological impacts. As part of this evaluation, Ecology determined that based on site-specific information, the potential species groups of concern included ground-feeding birds and herbivorous small mammals. The conclusion that lead is the only constituent of concern is supported by the fact that the value for arsenic (see Table 749-3 of MTCA) that is protective of wildlife is higher than any of the proposed soil arsenic remediation levels (except for the golf course placement area remediation levels where an ecological exposure barrier will be present) that are protective of human health.

- Areas that will not be developed in the future are the only areas of concern for evaluating the potential impacts to ecological receptors.
- Lead contamination in surface soil at the Site is primarily localized around building foundations. The soil around these foundations will be remediated, reducing or eliminating exposure to lead.
- No differences in the numbers or condition of plants and animals in contaminated and uncontaminated areas were observed in the qualitative environmental evaluations at the Site. Generations of plants and animals have lived at the Site in the current state since the plant began operating in 1909.
- Screening bioassays performed at the Site suggest that some impacts might be expected to occur to ecological receptors of concern where concentrations of lead are greater than 500 mg/kg. With the exception of soils adjacent to the building foundations, there are minimal areas on site where this level of contamination is present.
- The potential ecological concerns at the site have diminished as development plans have become more concrete and as a result of the Interim Source Removals and Interim Corrective Actions.

As discussed previously, the results of the ecological risk assessment are but one of several pieces of information used by decision makers in reaching risk management decisions. In the case of the former DuPont Works Site, there are healthy and robust flora and fauna Site-wide. Remedial actions planned to protect human health will substantially reduce or eliminate further risk to ecological receptors in many areas of the Site, except in relatively small areas which will remain as Open Space or buffers. In these latter areas, based on the Site-specific data generated to date, the potential risk to ecological receptors is believed to be minimal. Two lines of evidence support this conclusion: 1) the presence of viable, healthy flora and fauna; and, 2) the comparatively small areas where soil lead is in excess of 500 mg/kg. Based on planned land use, it is also evident that these viable and valued habitats will remain so in the future. Overall, the incremental reduction of ecological risk that might be gained by active remediation in the Open Space and buffers is insufficient to outweigh the ecological costs that would result. Therefore, not pursuing additional remedial action in the Open Space and bugger areas will result in a net environmental benefit.

Table A-1 – Soil Bioassay Results

COPC Concentrations	Lead (mg/kg)	Results
Low	8.8	No significant effects.
Medium	490	Four of five bioassay results indicated no significant effects. FETAX results were different from the controls for percent survival and percent malformations.
High	110,000	Three of five bioassay results indicated effects different from the controls. These included percent survival in the *Daphnia magna* and Earthworms, and percent survival and percent malformations for the FETAX bioassay.

A.7 References

Adolphson and Associates. 1996. Biological Resources Assessment. The Weyerhaeuser/DuPont Site. DuPont, Washington.

DERS (DuPont Environmental Remediation Services) and Hart Crowser. 1994. Draft Risk Assessment, Former DuPont Works Site. DuPont, Washington.

Greg Linder, 1996

Hart Crowser. 1994. DRAFT Remedial Investigation, Former DuPont Works site, DuPont, Washington.

Melchiors, M.A. and D.T. Motobu. 1978. Final Report: Terrestrial Ecology of the DuPont Site, Washington. Weyerhaeuser Company. Western Forestry Research Center. Centralia, WA.

Norton, D. and M. Stinson. 1993. Soil Bioassay Pilot Study: Evaluation of Screening Levels Bioassays for Use in Soil Toxicity Assessments at Hazardous Waste Sites Under the Model Toxics Control Act. Olympia, Washington.

U.S. Army Corps of Engineers. 1982. Final Environmental Impact Statement, Weyerhaeuser Export Facility at DuPont, DuPont, Washington.

Appendix B – Evaluation Unit Sample Groupings

B.1 Introduction

This appendix presents all of the samples that were included in each evaluation unit. The short sample identifier, and the RI evaluation are presented for each sample. This provides a way to examine specific samples that are presented in the RI. Note that verification samples (i.e., data that were collected after soil was excavated) were excluded from the RA to ensure that the summary statistics were not biased low.

The following Tables are presented in Appendix B:

- Table B-1 – Commercial Area Samples <= 1 Foot BGS.
- Table B-2 Commercial Area Samples >1 Foot and <=15 Feet BGS.
- Table B-3 – Golf Course Area Samples <=1 Foot BGS.
- Table B-4 – Golf Course Samples >1 Foot and <=15 Feet BGS.
- Table B-5 – Historical Area Samples <=1 Foot BGS.
- Table B-6 – Industrial Area Samples <=1 Foot BGS.
- Table B-7 – Industrial Area Samples >1 Foot and <=15 Feet BGS.
- Table B-8 – Open Space Area Samples <=1 Foot BGS.
- Table B-9 – Open Space Area Samples >1 Foot and <=15 Feet BGS.

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
Commercial Area 1 (0 to <=1foot)		
1234-TP-517-S-1	1234-TP-517-S-1	1234
18-SS-514	18-SS-514	18 North
18-SS-515	18-SS-515	18 North
18-SS-516	18-SS-516	18 North
18-SS-518	18-SS-518	18 North
18-SS-519	18-SS-519	18 North
18-SS-520	18-SS-520	18 North
18-SS-699	18-SS-699	18 North
18-SS-701	18-SS-701	18 North
18-SS-702-DAVG	18-SS-702-DAVG	18 North
18-SS-703	18-SS-703	18 North
18-SS-711	18-SS-711	18 North
18-SS-713	18-SS-713	18 North
18-SS-870	18-SS-870	18 North
18-SS-871	18-SS-871	18 North
18-SS-880	18-SS-880	18 North
18-SS-881	18-SS-881	18 North
18-SS-882	18-SS-882	18 North
18-SS-883	18-SS-883	18 North
18-SS-915	18-SS-915	18 North
18-SS-920	18-SS-920	18 North
18-SS-921	18-SS-921	18 North
18-SS-922	18-SS-922	18 North
18-SS-924	18-SS-924	18 North
18-SS-925	18-SS-925	18 North
18-SS-926	18-SS-926	18 North
18-SS-932	18-SS-932	18 North
18-SS-933	18-SS-933	18 North
18-SS-934	18-SS-934	18 North
18-SS-935	18-SS-935	18 North
18-SS-GS-55	18-SS-GS-55	18
18-SS-GS-56	18-SS-GS-56	18
18-TP-502-S-1	18-TP-502-S-1	18 North
18R-404	18R-404	18-REF
18R-404A-DAVG	18R-404A-DAVG	18-REF
18R-405	18R-405	18-REF
18R-409	18R-409	18-REF
25-SS-503	25-SS-503	25
25-SS-510	25-SS-510	25
25-SS-511	25-SS-511	25

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
25-TP-509-S-1	25-TP-509-S-1	25
25-TP-510-S-1	25-TP-510-S-1	25
26-SS-405-DAVG	26-SS-405-DAVG	26
26-TP-520-S-1	26-TP-520-S-1	26
26-TP-521-S-1	26-TP-521-S-1	26
36-SS-29	36-SS-29	36
36-SS-30	36-SS-30	36
5-SS-401	5-SS-401	5
7-B-501-S-1	7-B-501-S-1	7
7-B-502-S-1	7-B-502-S-1	7
7-B-503-S-1	7-B-503-S-1	7
7-B-504-S-1-DAVG	7-B-504-S-1-DAVG	7
7-HA-501-S-1-DAVG	7-HA-501-S-1-DAVG	7
7-HA-503-S-1	7-HA-503-S-1	7
7-HA-504-S-1	7-HA-504-S-1	7
7-SS-401	7-SS-401	7
7-SS-402	7-SS-402	7
7-SS-501	7-SS-501	7
7-SS-502	7-SS-502	7
7-SS-503	7-SS-503	7
7-SS-504	7-SS-504	7
7-SS-505	7-SS-505	7
7-SS-506	7-SS-506	7
7-TP-501-S-1	7-TP-501-S-1	7
7-TP-502-S-1	7-TP-502-S-1	7
7-TP-503-S-1	7-TP-503-S-1	7
7-TP-504-S-1	7-TP-504-S-1	7
7-VS-1	7-VS-1	7
7-VS-2	7-VS-2	7
7-VS-3	7-VS-3	7
7-VS-4	7-VS-4	7
APA-SS-502	APA-SS-502	LR
APA-TP-501-S-1-DAVG	APA-TP-501-S-1-DAVG	LR
APC-SS-401	APC-SS-401	AP-C
APC-SS-501	APC-SS-501	AP-C
APC-SS-510	APC-SS-510	AP-C
APC-SS-511	APC-SS-511	AP-C
APC-SS-512	APC-SS-512	AP-C
APC-SS-513	APC-SS-513	AP-C
APC-SS-514	APC-SS-514	AP-C
APH-SS-516	APH-SS-516	25

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
APH-SS-518	APH-SS-518	25
APH-SS-519	APH-SS-519	25
LR-001	LR-001	LR
LR-002	LR-002	LR
LR-003	LR-003	LR
LR-004	LR-004	LR
LR-005	LR-005	LR
LR-006	LR-006	LR
LR-007	LR-007	LR
LR-009-1	LR-009-1	LR
LR-009-2	LR-009-2	LR
LR-010-DAVG	LR-010-DAVG	LR
LR-017-1	LR-017-1	LR
LR-017-2	LR-017-2	LR
LR-017-S-2	LR-017-S-2	LR
LR-024	LR-024	LR
LR-025	LR-025	LR
LR-025-S-2	LR-025-S-2	LR
LR-035-1	LR-035-1	LR
LR-035-2	LR-035-2	LR
LR-036-DAVG	LR-036-DAVG	LR
LR-036E	LR-036E	LR
LR-036E2	LR-036E2	LR
LR-075	LR-075	LR
LR-090	LR-090	LR
LR-12W	LR-12W	LR
LR-301	LR-301	LR
LR-302	LR-302	LR
LR-303	LR-303	LR
LR-306	LR-306	LR
LR-307	LR-307	LR
RR-506	RR-506	LR
RR-507	RR-507	LR
RR-509	RR-509	LR
RR-510-DAVG	RR-510-DAVG	25
RR-530	RR-530	RR-N
RR-589	RR-589	RR-N
Commercial Area 2 (0 to <=1foot)		
01-C011-SS-[R19C55]-D1-000	01-C011-SS-[R19C55]-D1-000	AFAS
01-C011-SS-[R20C55]-D1-000	01-C011-SS-[R20C55]-D1-000	AFAS
01-C011-SS-[R20C56]-D1-000	01-C011-SS-[R20C56]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C011-SS-[R21C55]-D1-000	01-C011-SS-[R21C55]-D1-000	AFAS
01-C011-SS-[R21C56]-D1-000	01-C011-SS-[R21C56]-D1-000	AFAS
01-C011-SS-[R21C57]-D1-000	01-C011-SS-[R21C57]-D1-000	AFAS
01-C011-SS-[R21C58]-D1-000	01-C011-SS-[R21C58]-D1-000	AFAS
01-C011-SS-[R22C55]-D1-000	01-C011-SS-[R22C55]-D1-000	AFAS
01-C011-SS-[R22C56]-D1-000-DAVG	01-C011-SS-[R22C56]-D1-000-DAVG	AFAS
01-C011-SS-[R22C57]-D1-000	01-C011-SS-[R22C57]-D1-000	AFAS
01-C011-SS-[R22C58]-D1-000	01-C011-SS-[R22C58]-D1-000	AFAS
01-C011-SS-[R22C59]-D1-000	01-C011-SS-[R22C59]-D1-000	AFAS
01-C011-SS-[R23C55]-D1-000	01-C011-SS-[R23C55]-D1-000	AFAS
01-C011-SS-[R23C56]-D1-000	01-C011-SS-[R23C56]-D1-000	AFAS
01-C011-SS-[R23C57]-D1-000	01-C011-SS-[R23C57]-D1-000	AFAS
01-C011-SS-[R23C58]-D1-000	01-C011-SS-[R23C58]-D1-000	AFAS
01-C011-SS-[R23C59]-D1-000	01-C011-SS-[R23C59]-D1-000	AFAS
01-C011-SS-[R24C55]-D1-000	01-C011-SS-[R24C55]-D1-000	AFAS
01-C011-SS-[R24C56]-D1-000	01-C011-SS-[R24C56]-D1-000	AFAS
01-C011-SS-[R24C57]-D1-000	01-C011-SS-[R24C57]-D1-000	AFAS
01-C011-SS-[R24C58]-D1-000	01-C011-SS-[R24C58]-D1-000	AFAS
01-C011-SS-[R24C59]-D1-000	01-C011-SS-[R24C59]-D1-000	AFAS
01-C011-SS-[R24C60]-D1-000	01-C011-SS-[R24C60]-D1-000	AFAS
01-C011-SS-[R25C55]-D1-000	01-C011-SS-[R25C55]-D1-000	AFAS
01-C011-SS-[R25C56]-D1-000	01-C011-SS-[R25C56]-D1-000	AFAS
01-C011-SS-[R25C57]-D1-000	01-C011-SS-[R25C57]-D1-000	AFAS
01-C011-SS-[R25C58]-D1-000	01-C011-SS-[R25C58]-D1-000	AFAS
01-C011-SS-[R25C59]-D1-000	01-C011-SS-[R25C59]-D1-000	AFAS
01-C011-SS-[R25C60]-D1-000	01-C011-SS-[R25C60]-D1-000	AFAS
01-C011-SS-[R26C55]-D1-000	01-C011-SS-[R26C55]-D1-000	AFAS
01-C011-SS-[R26C56]-D1-000	01-C011-SS-[R26C56]-D1-000	AFAS
01-C011-SS-[R26C57]-D1-000	01-C011-SS-[R26C57]-D1-000	AFAS
01-C011-SS-[R26C58]-D1-000	01-C011-SS-[R26C58]-D1-000	AFAS
01-C011-SS-[R26C59]-D1-000	01-C011-SS-[R26C59]-D1-000	AFAS
01-C011-SS-[R26C60]-D1-000	01-C011-SS-[R26C60]-D1-000	AFAS
01-C011-SS-[R26C61]-D1-000	01-C011-SS-[R26C61]-D1-000	AFAS
01-C011-SS-[R27C55]-D1-000	01-C011-SS-[R27C55]-D1-000	AFAS
01-C011-SS-[R27C56]-D1-000	01-C011-SS-[R27C56]-D1-000	AFAS
01-C011-SS-[R27C57]-D1-000	01-C011-SS-[R27C57]-D1-000	AFAS
01-C011-SS-[R27C58]-D1-000	01-C011-SS-[R27C58]-D1-000	AFAS
01-C011-SS-[R27C59]-D1-000	01-C011-SS-[R27C59]-D1-000	AFAS
01-C011-SS-[R27C60]-D1-000	01-C011-SS-[R27C60]-D1-000	AFAS
01-C011-SS-[R27C61]-D1-000	01-C011-SS-[R27C61]-D1-000	AFAS
01-C011-SS-[R28C55]-D1-000	01-C011-SS-[R28C55]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C011-SS-[R28C56]-D1-000	01-C011-SS-[R28C56]-D1-000	AFAS
01-C011-SS-[R28C57]-D1-000	01-C011-SS-[R28C57]-D1-000	AFAS
01-C011-SS-[R28C58]-D1-000	01-C011-SS-[R28C58]-D1-000	AFAS
01-C011-SS-[R28C59]-D1-000	01-C011-SS-[R28C59]-D1-000	AFAS
01-C011-SS-[R28C60]-D1-000	01-C011-SS-[R28C60]-D1-000	AFAS
01-C011-SS-[R28C61]-D1-000	01-C011-SS-[R28C61]-D1-000	AFAS
01-C011-SS-[R28C62]-D1-000	01-C011-SS-[R28C62]-D1-000	AFAS
01-C011-SS-[R29C55]-D1-000-DAVG	01-C011-SS-[R29C55]-D1-000-DAVG	AFAS
01-C011-SS-[R29C56]-D1-000	01-C011-SS-[R29C56]-D1-000	AFAS
01-C011-SS-[R29C57]-D1-000	01-C011-SS-[R29C57]-D1-000	AFAS
01-C011-SS-[R29C59]-D1-000	01-C011-SS-[R29C59]-D1-000	AFAS
01-C011-SS-[R29C60]-D1-000	01-C011-SS-[R29C60]-D1-000	AFAS
01-C011-SS-[R29C61]-D1-000-DAVG	01-C011-SS-[R29C61]-D1-000-DAVG	AFAS
01-C011-SS-[R29C62]-D1-000	01-C011-SS-[R29C62]-D1-000	AFAS
01-C011-SS-[R30C55]-D1-000-DAVG	01-C011-SS-[R30C55]-D1-000-DAVG	AFAS
01-C011-SS-[R30C56]-D1-000	01-C011-SS-[R30C56]-D1-000	AFAS
01-C011-SS-[R30C57]-D1-000	01-C011-SS-[R30C57]-D1-000	AFAS
01-C011-SS-[R30C58]-D1-000	01-C011-SS-[R30C58]-D1-000	AFAS
01-C011-SS-[R30C59]-D1-000	01-C011-SS-[R30C59]-D1-000	AFAS
01-C011-SS-[R30C60]-D1-000	01-C011-SS-[R30C60]-D1-000	AFAS
01-C011-SS-[R30C61]-D1-000	01-C011-SS-[R30C61]-D1-000	AFAS
01-C011-SS-[R30C62]-D1-000	01-C011-SS-[R30C62]-D1-000	AFAS
01-C011-SS-[R31C55]-D1-000-DAVG	01-C011-SS-[R31C55]-D1-000-DAVG	AFAS
01-C011-SS-[R31C56]-D1-000	01-C011-SS-[R31C56]-D1-000	AFAS
01-C011-SS-[R31C57]-D1-000	01-C011-SS-[R31C57]-D1-000	AFAS
01-C011-SS-[R31C58]-D1-000	01-C011-SS-[R31C58]-D1-000	AFAS
01-C011-SS-[R31C59]-D1-000	01-C011-SS-[R31C59]-D1-000	AFAS
01-C011-SS-[R31C60]-D1-000	01-C011-SS-[R31C60]-D1-000	AFAS
01-C011-SS-[R31C61]-D1-000	01-C011-SS-[R31C61]-D1-000	AFAS
01-C011-SS-[R31C62]-D1-000	01-C011-SS-[R31C62]-D1-000	AFAS
01-C011-SS-[R31C63]-D1-000	01-C011-SS-[R31C63]-D1-000	AFAS
01-C011-SS-[R32C56]-D1-000	01-C011-SS-[R32C56]-D1-000	AFAS
01-C011-SS-[R32C57]-D1-000	01-C011-SS-[R32C57]-D1-000	AFAS
01-C011-SS-[R32C58]-D1-000	01-C011-SS-[R32C58]-D1-000	AFAS
01-C011-SS-[R32C59]-D1-000	01-C011-SS-[R32C59]-D1-000	AFAS
01-C011-SS-[R32C60]-D1-000	01-C011-SS-[R32C60]-D1-000	AFAS
01-C011-SS-[R32C61]-D1-000	01-C011-SS-[R32C61]-D1-000	AFAS
01-C011-SS-[R32C62]-D1-000	01-C011-SS-[R32C62]-D1-000	AFAS
01-C011-SS-[R32C63]-D1-000	01-C011-SS-[R32C63]-D1-000	AFAS
01-C011-SS-[R32C64]-D1-000	01-C011-SS-[R32C64]-D1-000	AFAS
01-C011-SS-[R33C56]-D1-000	01-C011-SS-[R33C56]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C011-SS-[R33C57]-D1-000	01-C011-SS-[R33C57]-D1-000	AFAS
01-C011-SS-[R33C58]-D1-000	01-C011-SS-[R33C58]-D1-000	AFAS
01-C011-SS-[R33C59]-D1-000	01-C011-SS-[R33C59]-D1-000	AFAS
01-C011-SS-[R33C60]-D1-000	01-C011-SS-[R33C60]-D1-000	AFAS
01-C011-SS-[R33C61]-D1-000	01-C011-SS-[R33C61]-D1-000	AFAS
01-C011-SS-[R33C62]-D1-000	01-C011-SS-[R33C62]-D1-000	AFAS
01-C011-SS-[R33C63]-D1-000	01-C011-SS-[R33C63]-D1-000	AFAS
01-C011-SS-[R33C64]-D1-000	01-C011-SS-[R33C64]-D1-000	AFAS
01-C011-SS-[R34C57]-D1-000	01-C011-SS-[R34C57]-D1-000	AFAS
01-C011-SS-[R34C58]-D1-000	01-C011-SS-[R34C58]-D1-000	AFAS
01-C011-SS-[R34C59]-D1-000	01-C011-SS-[R34C59]-D1-000	AFAS
01-C011-SS-[R34C60]-D1-000	01-C011-SS-[R34C60]-D1-000	AFAS
01-C011-SS-[R34C61]-D1-000	01-C011-SS-[R34C61]-D1-000	AFAS
01-C011-SS-[R34C62]-D1-000	01-C011-SS-[R34C62]-D1-000	AFAS
01-C011-SS-[R34C63]-D1-000	01-C011-SS-[R34C63]-D1-000	AFAS
01-C011-SS-[R34C64]-D1-000	01-C011-SS-[R34C64]-D1-000	AFAS
01-C011-SS-[R35C58]-D1-000	01-C011-SS-[R35C58]-D1-000	AFAS
01-C011-SS-[R35C59]-D1-000	01-C011-SS-[R35C59]-D1-000	AFAS
01-C011-SS-[R35C60]-D1-000	01-C011-SS-[R35C60]-D1-000	AFAS
01-C011-SS-[R35C61]-D1-000	01-C011-SS-[R35C61]-D1-000	AFAS
01-C011-SS-[R35C62]-D1-000	01-C011-SS-[R35C62]-D1-000	AFAS
01-C011-SS-[R35C63]-D1-000	01-C011-SS-[R35C63]-D1-000	AFAS
01-C011-SS-[R35C64]-D1-000	01-C011-SS-[R35C64]-D1-000	AFAS
01-C011-SS-[R35C65]-D1-000	01-C011-SS-[R35C65]-D1-000	AFAS
01-C011-SS-[R36C59]-D1-000	01-C011-SS-[R36C59]-D1-000	AFAS
01-C011-SS-[R36C60]-D1-000	01-C011-SS-[R36C60]-D1-000	AFAS
01-C011-SS-[R36C61]-D1-000	01-C011-SS-[R36C61]-D1-000	AFAS
01-C011-SS-[R36C62]-D1-000	01-C011-SS-[R36C62]-D1-000	AFAS
01-C011-SS-[R36C63]-D1-000	01-C011-SS-[R36C63]-D1-000	AFAS
01-C011-SS-[R36C64]-D1-000	01-C011-SS-[R36C64]-D1-000	AFAS
01-C011-SS-[R36C65]-D1-000	01-C011-SS-[R36C65]-D1-000	AFAS
01-C011-SS-[R37C60]-D1-000	01-C011-SS-[R37C60]-D1-000	AFAS
01-C011-SS-[R37C61]-D1-000	01-C011-SS-[R37C61]-D1-000	AFAS
01-C011-SS-[R37C62]-D1-000-DAVG	01-C011-SS-[R37C62]-D1-000-DAVG	AFAS
01-C011-SS-[R37C63]-D1-000-DAVG	01-C011-SS-[R37C63]-D1-000-DAVG	AFAS
01-C011-SS-[R37C64]-D1-000	01-C011-SS-[R37C64]-D1-000	AFAS
01-C011-SS-[R37C65]-D1-000	01-C011-SS-[R37C65]-D1-000	AFAS
01-C011-SS-[R38C62]-D1-000	01-C011-SS-[R38C62]-D1-000	AFAS
01-C011-SS-[R38C63]-D1-000	01-C011-SS-[R38C63]-D1-000	AFAS
01-C011-SS-[R38C64]-D1-000	01-C011-SS-[R38C64]-D1-000	AFAS
01-C011-SS-[R38C65]-D1-000	01-C011-SS-[R38C65]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C011-SS-[R39C62]-D1-000	01-C011-SS-[R39C62]-D1-000	AFAS
01-C011-SS-[R39C63]-D1-000	01-C011-SS-[R39C63]-D1-000	AFAS
01-C011-SS-[R39C64]-D1-000	01-C011-SS-[R39C64]-D1-000	AFAS
01-C011-SS-[R39C65]-D1-000	01-C011-SS-[R39C65]-D1-000	AFAS
01-C011-SS-[R40C63]-D1-000	01-C011-SS-[R40C63]-D1-000	AFAS
01-C011-SS-[R40C64]-D1-000	01-C011-SS-[R40C64]-D1-000	AFAS
01-C011-SS-[R40C65]-D1-000	01-C011-SS-[R40C65]-D1-000	AFAS
01-C011-SS-[R40C66]-D1-000	01-C011-SS-[R40C66]-D1-000	AFAS
01-C011-SS-[R41C63]-D1-000	01-C011-SS-[R41C63]-D1-000	AFAS
01-C011-SS-[R41C64]-D1-000	01-C011-SS-[R41C64]-D1-000	AFAS
01-C011-SS-[R41C65]-D1-000	01-C011-SS-[R41C65]-D1-000	AFAS
01-C011-SS-[R41C66]-D1-000	01-C011-SS-[R41C66]-D1-000	AFAS
01-C011-SS-[R42C64]-D1-000-DAVG	01-C011-SS-[R42C64]-D1-000-DAVG	AFAS
01-C011-SS-[R42C65]-D1-000	01-C011-SS-[R42C65]-D1-000	AFAS
01-C011-SS-[R42C66]-D1-000	01-C011-SS-[R42C66]-D1-000	AFAS
01-C011-SS-[R43C64]-D1-000	01-C011-SS-[R43C64]-D1-000	AFAS
01-C011-SS-[R43C65]-D1-000	01-C011-SS-[R43C65]-D1-000	AFAS
01-C011-SS-[R43C66]-D1-000	01-C011-SS-[R43C66]-D1-000	AFAS
01-C011-SS-[R44C65]-D1-000	01-C011-SS-[R44C65]-D1-000	AFAS
01-C011-SS-[R45C65]-D1-000	01-C011-SS-[R45C65]-D1-000	AFAS
6-SS-402	6-SS-402	6
6-TP-502-S-1	6-TP-502-S-1	6
LR-014	LR-014	LR
LR-015	LR-015	LR
LR-021	LR-021	LR
LR-022-1	LR-022-1	LR
LR-022-2	LR-022-2	LR
LR-023	LR-023	LR
LR-029	LR-029	LR
LR-030	LR-030	LR
LR-031	LR-031	LR
LR-040-DAVG	LR-040-DAVG	LR
LR-041	LR-041	LR
LR-042	LR-042	LR
LR-048	LR-048	LR
LR-049	LR-049	LR
LR-050	LR-050	LR
LR-065	LR-065	LR
LR-066-1	LR-066-1	LR
LR-066-2	LR-066-2	LR
LR-083-DAVG	LR-083-DAVG	LR

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
Commercial Area 3 (0 to <=1foot)		
01-H404-SS[10]D1-005	H404-10	MISC
01-H404-SS[4]D1-005	H404-4	MISC
01-H404-SS[6]D1-005	H404-6	MISC
19-VS-28	19-VS-28	19a
19-VS-34	19-VS-34	MISC
19-VS-36	19-VS-36	MISC
19-VS-40	19-VS-40	MISC
19-VS-41	19-VS-41	MISC
19-VS-46-DAVG	19-VS-46-DAVG	19a
19-VS-48	19-VS-48	MISC
19-VS-54	19-VS-54	MISC
19-VS-62	19-VS-62	19c
38-VS-86	38-VS-86	MISC
38-VS-88	38-VS-88	MISC
APD-TP-501-S-1	APD-TP-501-S-1	26
APF-SS-522	APF-SS-522	APF
APF-SS-523	APF-SS-523	APF
APF-VS-2	APF-VS-2	MISC
APF-VS-4	APF-VS-4	MISC
APG-TP-501-S-1	APG-TP-501-S-1	LR
APH-SS-501	APH-SS-501	26
APH-SS-502	APH-SS-502	26
APH-SS-503-DAVG	APH-SS-503-DAVG	26
APH-SS-504	APH-SS-504	26
APH-SS-506	APH-SS-506	25
LR-037	LR-037	LR
LR-038-DAVG	LR-038-DAVG	LR
LR-038E-DAVG	LR-038E-DAVG	LR
LR-038S	LR-038S	LR
LR-038W	LR-038W	LR
LR-045A	LR-045A	LR
LR-046	LR-046	LR
LR-062E	LR-062E	LR
LR-062N	LR-062N	LR
LR-062S	LR-062S	RR-N
LR-062W	LR-062W	RR-N
LR-063	LR-063	LR
LR-078	LR-078	LR
LR-079	LR-079	LR
LR-081	LR-081	LR

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
LR-093-1	LR-093-1	LR
LR-093-2	LR-093-2	LR
LR-094	LR-094	LR
LR-095-1	LR-095-1	LR
LR-095-2	LR-095-2	LR
LR-108	LR-108	LR
LR-109	LR-109	LR
LR-110	LR-110	LR
LR-111	LR-111	LR
LR-113	LR-113	LR
LR-127	LR-127	LR
LR-128	LR-128	LR
LR-129	LR-129	LR
LR-315	LR-315	LR
LR-38	LR-38	LR
RR-134-DAVG	RR-134-DAVG	LR
RR-135	RR-135	LR
RR-136	RR-136	LR
RR-140-A1	RR-140-A1	LR
RR-140-B1	RR-140-B1	LR
RR-142	RR-142	LR
RR-511-DAVG	RR-511-DAVG	LR
RR-512	RR-512	LR
RR-520-DAVG	RR-520-DAVG	LR
RR-521	RR-521	LR
RR-521-S-2-DAVG	RR-521-S-2-DAVG	LR
RR-522	RR-522	LR
RR-542-A1	RR-542-A1	LR
RR-542-B1	RR-542-B1	LR
RR-543-A1	RR-543-A1	LR
RR-543-B1	RR-543-B1	LR
RR-558	RR-558	LR
RR-558-A1	RR-558-A1	LR
RR-558-B1	RR-558-B1	LR
RR-583	RR-583	RR-N
Commercial Area 4 (0 to <=1foot)		
01-C011-SS-[R43C67]-D1-000	01-C011-SS-[R43C67]-D1-000	AFAS
01-C011-SS-[R44C66]-D1-000	01-C011-SS-[R44C66]-D1-000	AFAS
01-C011-SS-[R44C67]-D1-000	01-C011-SS-[R44C67]-D1-000	AFAS
01-C011-SS-[R44C68]-D1-000	01-C011-SS-[R44C68]-D1-000	AFAS
01-C011-SS-[R45C66]-D1-000	01-C011-SS-[R45C66]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C011-SS-[R45C67]-D1-000	01-C011-SS-[R45C67]-D1-000	AFAS
01-C011-SS-[R45C68]-D1-000	01-C011-SS-[R45C68]-D1-000	AFAS
01-C011-SS-[R45C69]-D1-000	01-C011-SS-[R45C69]-D1-000	AFAS
01-C011-SS-[R45C70]-D1-000	01-C011-SS-[R45C70]-D1-000	AFAS
01-C011-SS-[R46C66]-D1-000	01-C011-SS-[R46C66]-D1-000	AFAS
01-C011-SS-[R46C67]-D1-000	01-C011-SS-[R46C67]-D1-000	AFAS
01-C011-SS-[R46C68]-D1-000	01-C011-SS-[R46C68]-D1-000	AFAS
01-C011-SS-[R46C69]-D1-000	01-C011-SS-[R46C69]-D1-000	AFAS
01-C011-SS-[R46C70]-D1-000	01-C011-SS-[R46C70]-D1-000	AFAS
01-C011-SS-[R46C71]-D1-000	01-C011-SS-[R46C71]-D1-000	AFAS
01-C011-SS-[R47C67]-D1-000	01-C011-SS-[R47C67]-D1-000	AFAS
01-C011-SS-[R47C68]-D1-000	01-C011-SS-[R47C68]-D1-000	AFAS
01-C011-SS-[R47C69]-D1-000	01-C011-SS-[R47C69]-D1-000	AFAS
01-C011-SS-[R47C70]-D1-000	01-C011-SS-[R47C70]-D1-000	AFAS
01-C011-SS-[R48C69]-D1-000	01-C011-SS-[R48C69]-D1-000	AFAS
01-C011-SS-[R48C70]-D1-000	01-C011-SS-[R48C70]-D1-000	AFAS
38-VS-24	38-VS-24	MISC
LR-099-1	LR-099-1	LR
LR-099-2	LR-099-2	LR
LR-116	LR-116	RR-N
LR-116A	LR-116A	LR
LR-131	LR-131	LR
LR-132	LR-132	LR
LR-133	LR-133	LR
LR-133-S-2	LR-133-S-2	LR
LR-134	LR-134	LR
LR-150	LR-150	LR
LR-151	LR-151	LR
LR-152	LR-152	LR
LR-153	LR-153	LR
LR-165	LR-165	LR
LR-166	LR-166	LR
LR-167	LR-167	LR
LR-168	LR-168	LR
LR-178	LR-178	LR
LR-179	LR-179	LR
LR-180	LR-180	LR
LR-194	LR-194	LR
LR181-VS-2	LR181-VS-2	MISC
LR181-VS-3	LR181-VS-3	MISC
LR181-VS-4	LR181-VS-4	MISC

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
LR181-VS-9-DAVG	LR181-VS-9-DAVG	MISC
RR-144	RR-144	LR
RR-145	RR-145	LR
RR-146	RR-146	LR
RR-147	RR-147	LR
RR-148	RR-148	LR
RR-149	RR-149	LR
RR-150	RR-150	LR
RR-151	RR-151	LR
RR-152	RR-152	LR
RR-153	RR-153	LR
RR-504	RR-504	LR
RR-516	RR-516	LR
RR-517-A2	RR-517-A2	LR
RR-517-B2	RR-517-B2	LR
RR-555-A1	RR-555-A1	LR
RR-555-A2	RR-555-A2	LR
RR-555-B1	RR-555-B1	LR
RR-555-DAVG	RR-555-DAVG	LR
Commercial Area 5 (0 to <=1foot)		
01-C012-SS-[R61C69]-D1-000	01-C012-SS-[R61C69]-D1-000	AFAS
01-C012-SS-[R61C70]-D1-000	01-C012-SS-[R61C70]-D1-000	AFAS
01-C012-SS-[R61C71]-D1-000	01-C012-SS-[R61C71]-D1-000	AFAS
01-C012-SS-[R61C72]-D1-000	01-C012-SS-[R61C72]-D1-000	AFAS
01-C012-SS-[R62C67]-D1-000	01-C012-SS-[R62C67]-D1-000	AFAS
01-C012-SS-[R62C68]-D1-000	01-C012-SS-[R62C68]-D1-000	AFAS
01-C012-SS-[R62C69]-D1-000	01-C012-SS-[R62C69]-D1-000	AFAS
01-C012-SS-[R62C70]-D1-000	01-C012-SS-[R62C70]-D1-000	AFAS
01-C012-SS-[R62C71]-D1-000	01-C012-SS-[R62C71]-D1-000	AFAS
01-C012-SS-[R62C72]-D1-000	01-C012-SS-[R62C72]-D1-000	AFAS
01-C012-SS-[R63C67]-D1-000	01-C012-SS-[R63C67]-D1-000	AFAS
01-C012-SS-[R63C68]-D1-000	01-C012-SS-[R63C68]-D1-000	AFAS
01-C012-SS-[R63C69]-D1-000	01-C012-SS-[R63C69]-D1-000	AFAS
01-C012-SS-[R63C70]-D1-000	01-C012-SS-[R63C70]-D1-000	AFAS
01-C012-SS-[R63C71]-D1-000	01-C012-SS-[R63C71]-D1-000	AFAS
01-C012-SS-[R63C72]-D1-000	01-C012-SS-[R63C72]-D1-000	AFAS
01-C012-SS-[R64C67]-D1-000	01-C012-SS-[R64C67]-D1-000	AFAS
01-C012-SS-[R64C68]-D1-000	01-C012-SS-[R64C68]-D1-000	AFAS
01-C012-SS-[R64C69]-D1-000	01-C012-SS-[R64C69]-D1-000	AFAS
01-C012-SS-[R64C70]-D1-000	01-C012-SS-[R64C70]-D1-000	AFAS
01-C012-SS-[R64C71]-D1-000	01-C012-SS-[R64C71]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C012-SS-[R64C72]-D1-000	01-C012-SS-[R64C72]-D1-000	AFAS
01-C012-SS-[R65C67]-D1-000	01-C012-SS-[R65C67]-D1-000	AFAS
01-C012-SS-[R65C68]-D1-000	01-C012-SS-[R65C68]-D1-000	AFAS
01-C012-SS-[R65C69]-D1-000	01-C012-SS-[R65C69]-D1-000	AFAS
01-C012-SS-[R65C70]-D1-000	01-C012-SS-[R65C70]-D1-000	AFAS
01-C012-SS-[R65C71]-D1-000	01-C012-SS-[R65C71]-D1-000	AFAS
01-C012-SS-[R65C72]-D1-000	01-C012-SS-[R65C72]-D1-000	AFAS
01-C012-SS-[R66C67]-D1-000	01-C012-SS-[R66C67]-D1-000	AFAS
01-C012-SS-[R66C68]-D1-000	01-C012-SS-[R66C68]-D1-000	AFAS
01-C012-SS-[R66C69]-D1-000	01-C012-SS-[R66C69]-D1-000	AFAS
01-C012-SS-[R66C70]-D1-000	01-C012-SS-[R66C70]-D1-000	AFAS
01-C012-SS-[R66C71]-D1-000	01-C012-SS-[R66C71]-D1-000	AFAS
01-C012-SS-[R66C72]-D1-000	01-C012-SS-[R66C72]-D1-000	AFAS
01-C012-SS-[R67C67]-D1-000	01-C012-SS-[R67C67]-D1-000	AFAS
01-C012-SS-[R67C68]-D1-000	01-C012-SS-[R67C68]-D1-000	AFAS
01-C012-SS-[R67C69]-D1-000	01-C012-SS-[R67C69]-D1-000	AFAS
01-C012-SS-[R67C70]-D1-000	01-C012-SS-[R67C70]-D1-000	AFAS
01-C012-SS-[R67C71]-D1-000	01-C012-SS-[R67C71]-D1-000	AFAS
01-C012-SS-[R67C72]-D1-000	01-C012-SS-[R67C72]-D1-000	AFAS
01-C012-SS-[R68C67]-D1-000	01-C012-SS-[R68C67]-D1-000	AFAS
01-C012-SS-[R68C68]-D1-000	01-C012-SS-[R68C68]-D1-000	AFAS
01-C012-SS-[R68C69]-D1-000	01-C012-SS-[R68C69]-D1-000	AFAS
01-C012-SS-[R68C70]-D1-000	01-C012-SS-[R68C70]-D1-000	AFAS
01-C012-SS-[R68C71]-D1-000	01-C012-SS-[R68C71]-D1-000	AFAS
01-C012-SS-[R68C72]-D1-000	01-C012-SS-[R68C72]-D1-000	AFAS
01-C012-SS-[R69C67]-D1-000	01-C012-SS-[R69C67]-D1-000	AFAS
01-C012-SS-[R69C68]-D1-000	01-C012-SS-[R69C68]-D1-000	AFAS
01-C012-SS-[R69C69]-D1-000	01-C012-SS-[R69C69]-D1-000	AFAS
01-C012-SS-[R69C70]-D1-000	01-C012-SS-[R69C70]-D1-000	AFAS
01-C012-SS-[R69C71]-D1-000	01-C012-SS-[R69C71]-D1-000	AFAS
01-C012-SS-[R69C72]-D1-000-DAVG	01-C012-SS-[R69C72]-D1-000-DAVG	AFAS
01-C012-SS-[R70C67]-D1-000	01-C012-SS-[R70C67]-D1-000	AFAS
01-C012-SS-[R70C68]-D1-000	01-C012-SS-[R70C68]-D1-000	AFAS
01-C012-SS-[R70C69]-D1-000	01-C012-SS-[R70C69]-D1-000	AFAS
01-C012-SS-[R70C70]-D1-000	01-C012-SS-[R70C70]-D1-000	AFAS
01-C012-SS-[R70C71]-D1-000	01-C012-SS-[R70C71]-D1-000	AFAS
01-C012-SS-[R70C72]-D1-000	01-C012-SS-[R70C72]-D1-000	AFAS
01-C012-SS-[R71C67]-D1-000	01-C012-SS-[R71C67]-D1-000	AFAS
01-C012-SS-[R71C68]-D1-000	01-C012-SS-[R71C68]-D1-000	AFAS
01-C012-SS-[R71C69]-D1-000	01-C012-SS-[R71C69]-D1-000	AFAS
01-C012-SS-[R71C70]-D1-000	01-C012-SS-[R71C70]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C012-SS-[R71C71]-D1-000	01-C012-SS-[R71C71]-D1-000	AFAS
01-C012-SS-[R71C72]-D1-000	01-C012-SS-[R71C72]-D1-000	AFAS
01-C012-SS-[R72C67]-D1-000	01-C012-SS-[R72C67]-D1-000	AFAS
01-C012-SS-[R72C68]-D1-000	01-C012-SS-[R72C68]-D1-000	AFAS
01-C012-SS-[R72C69]-D1-000	01-C012-SS-[R72C69]-D1-000	AFAS
01-C012-SS-[R72C70]-D1-000	01-C012-SS-[R72C70]-D1-000	AFAS
01-C012-SS-[R72C71]-D1-000-DAVG	01-C012-SS-[R72C71]-D1-000-DAVG	AFAS
01-C012-SS-[R72C72]-D1-000	01-C012-SS-[R72C72]-D1-000	AFAS
01-C012-SS-[R73C67]-D1-000	01-C012-SS-[R73C67]-D1-000	AFAS
01-C012-SS-[R73C68]-D1-000	01-C012-SS-[R73C68]-D1-000	AFAS
01-C012-SS-[R73C69]-D1-000	01-C012-SS-[R73C69]-D1-000	AFAS
01-C012-SS-[R73C70]-D1-000	01-C012-SS-[R73C70]-D1-000	AFAS
01-C012-SS-[R73C71]-D1-000	01-C012-SS-[R73C71]-D1-000	AFAS
01-C012-SS-[R73C72]-D1-000	01-C012-SS-[R73C72]-D1-000	AFAS
01-C012-SS-[R74C67]-D1-000-DAVG	01-C012-SS-[R74C67]-D1-000-DAVG	AFAS
01-C012-SS-[R74C68]-D1-000	01-C012-SS-[R74C68]-D1-000	AFAS
01-C012-SS-[R74C69]-D1-000-DAVG	01-C012-SS-[R74C69]-D1-000-DAVG	AFAS
01-C012-SS-[R74C70]-D1-000	01-C012-SS-[R74C70]-D1-000	AFAS
01-C012-SS-[R74C71]-D1-000	01-C012-SS-[R74C71]-D1-000	AFAS
01-C012-SS-[R74C72]-D1-000	01-C012-SS-[R74C72]-D1-000	AFAS
01-C012-SS-[R75C67]-D1-000	01-C012-SS-[R75C67]-D1-000	AFAS
01-C012-SS-[R75C68]-D1-000	01-C012-SS-[R75C68]-D1-000	AFAS
01-C012-SS-[R75C69]-D1-000	01-C012-SS-[R75C69]-D1-000	AFAS
01-C012-SS-[R75C70]-D1-000	01-C012-SS-[R75C70]-D1-000	AFAS
01-C012-SS-[R75C71]-D1-000	01-C012-SS-[R75C71]-D1-000	AFAS
01-C012-SS-[R75C72]-D1-000	01-C012-SS-[R75C72]-D1-000	AFAS
01-C012-SS-[R76C67]-D1-000	01-C012-SS-[R76C67]-D1-000	AFAS
01-C012-SS-[R76C68]-D1-000	01-C012-SS-[R76C68]-D1-000	AFAS
01-C012-SS-[R76C69]-D1-000	01-C012-SS-[R76C69]-D1-000	AFAS
01-C012-SS-[R76C70]-D1-000	01-C012-SS-[R76C70]-D1-000	AFAS
01-C012-SS-[R76C71]-D1-000	01-C012-SS-[R76C71]-D1-000	AFAS
01-C012-SS-[R76C72]-D1-000	01-C012-SS-[R76C72]-D1-000	AFAS
01-C012-SS-[R76C73]-D1-000	01-C012-SS-[R76C73]-D1-000	AFAS
01-C012-SS-[R76C74]-D1-000	01-C012-SS-[R76C74]-D1-000	AFAS
01-C012-SS-[R77C67]-D1-000	01-C012-SS-[R77C67]-D1-000	AFAS
01-C012-SS-[R77C68]-D1-000	01-C012-SS-[R77C68]-D1-000	AFAS
01-C012-SS-[R77C69]-D1-000	01-C012-SS-[R77C69]-D1-000	AFAS
01-C012-SS-[R77C70]-D1-000	01-C012-SS-[R77C70]-D1-000	AFAS
01-C012-SS-[R77C71]-D1-000	01-C012-SS-[R77C71]-D1-000	AFAS
01-C012-SS-[R77C72]-D1-000	01-C012-SS-[R77C72]-D1-000	AFAS
01-C012-SS-[R77C73]-D1-000-DAVG	01-C012-SS-[R77C73]-D1-000-DAVG	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C012-SS-[R77C74]-D1-000	01-C012-SS-[R77C74]-D1-000	AFAS
01-C012-SS-[R78C67]-D1-000	01-C012-SS-[R78C67]-D1-000	AFAS
01-C012-SS-[R78C68]-D1-000	01-C012-SS-[R78C68]-D1-000	AFAS
01-C012-SS-[R78C69]-D1-000	01-C012-SS-[R78C69]-D1-000	AFAS
01-C012-SS-[R78C70]-D1-000	01-C012-SS-[R78C70]-D1-000	AFAS
01-C012-SS-[R78C71]-D1-000	01-C012-SS-[R78C71]-D1-000	AFAS
01-C012-SS-[R78C72]-D1-000	01-C012-SS-[R78C72]-D1-000	AFAS
01-C012-SS-[R78C73]-D1-000	01-C012-SS-[R78C73]-D1-000	AFAS
01-C012-SS-[R78C74]-D1-000	01-C012-SS-[R78C74]-D1-000	AFAS
01-C012-SS-[R79C67]-D1-000	01-C012-SS-[R79C67]-D1-000	AFAS
01-C012-SS-[R79C68]-D1-000	01-C012-SS-[R79C68]-D1-000	AFAS
01-C012-SS-[R79C69]-D1-000	01-C012-SS-[R79C69]-D1-000	AFAS
01-C012-SS-[R79C70]-D1-000	01-C012-SS-[R79C70]-D1-000	AFAS
01-C012-SS-[R79C71]-D1-000	01-C012-SS-[R79C71]-D1-000	AFAS
01-C012-SS-[R79C72]-D1-000	01-C012-SS-[R79C72]-D1-000	AFAS
01-C012-SS-[R79C73]-D1-000	01-C012-SS-[R79C73]-D1-000	AFAS
01-C012-SS-[R79C74]-D1-000-DAVG	01-C012-SS-[R79C74]-D1-000-DAVG	AFAS
01-C012-SS-[R80C67]-D1-000	01-C012-SS-[R80C67]-D1-000	AFAS
01-C012-SS-[R80C68]-D1-000	01-C012-SS-[R80C68]-D1-000	AFAS
01-C012-SS-[R80C69]-D1-000	01-C012-SS-[R80C69]-D1-000	AFAS
01-C012-SS-[R80C70]-D1-000	01-C012-SS-[R80C70]-D1-000	AFAS
01-C012-SS-[R80C71]-D1-000	01-C012-SS-[R80C71]-D1-000	AFAS
01-C012-SS-[R80C72]-D1-000	01-C012-SS-[R80C72]-D1-000	AFAS
01-C012-SS-[R80C73]-D1-000	01-C012-SS-[R80C73]-D1-000	AFAS
01-C012-SS-[R81C67]-D1-000	01-C012-SS-[R81C67]-D1-000	AFAS
01-C012-SS-[R81C68]-D1-000	01-C012-SS-[R81C68]-D1-000	AFAS
01-C012-SS-[R81C69]-D1-000	01-C012-SS-[R81C69]-D1-000	AFAS
01-C012-SS-[R81C70]-D1-000	01-C012-SS-[R81C70]-D1-000	AFAS
01-C012-SS-[R81C71]-D1-000	01-C012-SS-[R81C71]-D1-000	AFAS
01-C012-SS-[R81C72]-D1-000	01-C012-SS-[R81C72]-D1-000	AFAS
01-C012-SS-[R82C67]-D1-000	01-C012-SS-[R82C67]-D1-000	AFAS
01-C012-SS-[R82C68]-D1-000	01-C012-SS-[R82C68]-D1-000	AFAS
01-C012-SS-[R82C69]-D1-000	01-C012-SS-[R82C69]-D1-000	AFAS
01-C012-SS-[R82C70]-D1-000	01-C012-SS-[R82C70]-D1-000	AFAS
01-C012-SS-[R83C67]-D1-000	01-C012-SS-[R83C67]-D1-000	AFAS
01-C012-SS-[R83C68]-D1-000	01-C012-SS-[R83C68]-D1-000	AFAS
01-C012-SS-[R83C69]-D1-000	01-C012-SS-[R83C69]-D1-000	AFAS
01-C012-SS-[R84C67]-D1-000	01-C012-SS-[R84C67]-D1-000	AFAS
01-C013-SS-[R76C75]-D1-000	01-C013-SS-[R76C75]-D1-000	AFAS
01-C013-SS-[R76C76]-D1-000	01-C013-SS-[R76C76]-D1-000	AFAS
01-C013-SS-[R76C77]-D1-000	01-C013-SS-[R76C77]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C013-SS-[R76C78]-D1-000	01-C013-SS-[R76C78]-D1-000	AFAS
01-C013-SS-[R77C75]-D1-000	01-C013-SS-[R77C75]-D1-000	AFAS
01-C013-SS-[R77C76]-D1-000	01-C013-SS-[R77C76]-D1-000	AFAS
01-C013-SS-[R77C77]-D1-000	01-C013-SS-[R77C77]-D1-000	AFAS
01-C013-SS-[R78C75]-D1-000	01-C013-SS-[R78C75]-D1-000	AFAS
01-C013-SS-[R78C76]-D1-000	01-C013-SS-[R78C76]-D1-000	AFAS
12-1-B-501A-S-1	12-1-B-501A-S-1	12
12-6-B-501-S-1	12-6-B-501-S-1	12
12-6-TP-501-S-1	12-6-TP-501-S-1	12
12-6-TP-502-S-1	12-6-TP-502-S-1	12
12-7-B-501-S-1	12-7-B-501-S-1	12
12-7-TP-501-S-1-DAVG	12-7-TP-501-S-1-DAVG	12
12-SS-402	12-SS-402	12
12-SS-406	12-SS-406	12
12-SS-407	12-SS-407	12
12-SS-408	12-SS-408	12
12-SS-409	12-SS-409	12
12-TP-504-S-1-DAVG	12-TP-504-S-1-DAVG	12
12-TP-505-S-1-DAVG	12-TP-505-S-1-DAVG	12
12-VS-10	12-VS-10	MISC
LR-145	LR-145	LR
LR-146	LR-146	LR
LR-157-DAVG	LR-157-DAVG	LR
LR-157-S-2	LR-157-S-2	LR
LR-158	LR-158	LR
LR-159	LR-159	LR
LR-160	LR-160	LR
LR-170	LR-170	LR
LR-171	LR-171	LR
LR-172	LR-172	LR
LR-173-DAVG	LR-173-DAVG	LR
LR-174	LR-174	LR
LR-184	LR-184	LR
LR-185	LR-185	LR
LR-186	LR-186	LR
LR-187	LR-187	LR
LR-188	LR-188	LR
LR-198	LR-198	LR
LR-199	LR-199	LR
LR-200	LR-200	LR
LR-201	LR-201	LR

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
LR-202	LR-202	LR
LR-215	LR-215	LR
LR-216	LR-216	LR
LR-217	LR-217	LR
LR-218	LR-218	LR
LR-219	LR-219	LR
LR-220	LR-220	LR
LR-233	LR-233	LR
LR-234	LR-234	LR
LR-235	LR-235	LR
LR-236	LR-236	LR
LR-237-DAVG	LR-237-DAVG	LR
LR-250	LR-250	LR
LR-251	LR-251	LR
LR-252	LR-252	LR
LR-253	LR-253	LR
LR-262	LR-262	LR
LR-263	LR-263	LR
LR-265	LR-265	LR
LR-266	LR-266	LR
LR-267	LR-267	LR
RR-102	RR-102	RR-N
RR-502	RR-502	LR
RR-544-A2	RR-544-A2	RR-N
RR-544-B1	RR-544-B1	LR
RR-544-B2	RR-544-B2	LR
RR-545-A2	RR-545-A2	RR-N
RR-545-B1	RR-545-B1	LR
RR-545-B2	RR-545-B2	LR
Commercial Area 6 (0 to <=1foot)		
18R-458	18R-458	18-REF
18R-464E	18R-464E	18-REF
18R-465	18R-465	18-REF
18R-466	18R-466	18-REF
LR-210	LR-210	LR
LR-211	LR-211	LR
LR-212	LR-212	LR
LR-213	LR-213	LR
LR-225-DAVG	LR-225-DAVG	LR
LR-225A	LR-225A	LR
LR-226	LR-226	LR

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
LR-227	LR-227	LR
LR-228	LR-228	LR
LR-229	LR-229	LR
LR-230	LR-230	LR
LR-241	LR-241	LR
LR-242	LR-242	LR
LR-243	LR-243	LR
LR-244	LR-244	LR
LR-254	LR-254	LR
LR-254A	LR-254A	LR
LR-255	LR-255	LR
LR-264	LR-264	LR
RR-538-A	RR-538-A	RR-N
RR-538-B	RR-538-B	LR
RR-538-C	RR-538-C	LR
Commercial Area 7 (0 to <=1foot)		
11-B-501-S-1	11-B-501-S-1	11
11-TP-501-S-1	11-TP-501-S-1	11
11-TP-502-S-1	11-TP-502-S-1	11
11-TP-503-S-1-DAVG	11-TP-503-S-1-DAVG	11
11-TP-504-S-1	11-TP-504-S-1	11
18-SS-501-DAVG	18-SS-501-DAVG	18 North
18-SS-502	18-SS-502	18 North
18-SS-503	18-SS-503	18 North
18-SS-510	18-SS-510	18 North
18-SS-511	18-SS-511	18 North
18-SS-529	18-SS-529	18 North
18-SS-530	18-SS-530	18 North
18-SS-531	18-SS-531	18 North
18-SS-532	18-SS-532	18 North
18-SS-533	18-SS-533	18
18-SS-534	18-SS-534	18
18-SS-536	18-SS-536	18 North
18-SS-537	18-SS-537	18 North
18-SS-538	18-SS-538	18 North
18-SS-546	18-SS-546	18
18-SS-547	18-SS-547	18
18-SS-548	18-SS-548	18
18-SS-551	18-SS-551	18
18-SS-560-DAVG	18-SS-560-DAVG	18
18-SS-561	18-SS-561	18

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
18-SS-575	18-SS-575	18
18-SS-576	18-SS-576	18
18-SS-595	18-SS-595	18
18-SS-630	18-SS-630	18
18-SS-636	18-SS-636	18 North
18-SS-664-DAVG	18-SS-664-DAVG	18 North
18-SS-665	18-SS-665	18 North
18-SS-667	18-SS-667	18
18-SS-671	18-SS-671	18
18-SS-672	18-SS-672	18
18-SS-673	18-SS-673	18
18-SS-674	18-SS-674	18
18-SS-675	18-SS-675	18
18-SS-676	18-SS-676	18
18-SS-677	18-SS-677	18
18-SS-678	18-SS-678	18
18-SS-679	18-SS-679	18
18-SS-680	18-SS-680	18
18-SS-681	18-SS-681	18
18-SS-682	18-SS-682	18
18-SS-691	18-SS-691	18
18-SS-802	18-SS-802	18 North
18-SS-803	18-SS-803	18
18-SS-804	18-SS-804	18
18-SS-806	18-SS-806	18
18-SS-807	18-SS-807	18
18-SS-808	18-SS-808	18 North
18-SS-809	18-SS-809	18 North
18-SS-810	18-SS-810	18 North
18-SS-811	18-SS-811	18 North
18-SS-812	18-SS-812	18 North
18-SS-813	18-SS-813	18 North
18-SS-814	18-SS-814	18 North
18-SS-815-DAVG	18-SS-815-DAVG	18
18-SS-816	18-SS-816	18
18-SS-817	18-SS-817	18
18-SS-819	18-SS-819	18
18-SS-820	18-SS-820	18
18-SS-821	18-SS-821	18 North
18-SS-822	18-SS-822	18 North
18-SS-823	18-SS-823	18 North

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
18-SS-824	18-SS-824	18 North
18-SS-825	18-SS-825	18 North
18-SS-826	18-SS-826	18 North
18-SS-827	18-SS-827	18 North
18-SS-828	18-SS-828	18 North
18-SS-829	18-SS-829	18
18-SS-831	18-SS-831	18 North
18-SS-832	18-SS-832	18 North
18-SS-833	18-SS-833	18 North
18-SS-834	18-SS-834	18 North
18-SS-GS-05	18-SS-GS-05	18
18-SS-GS-06	18-SS-GS-06	18
18-SS-GS-11	18-SS-GS-11	18
18-SS-GS-12	18-SS-GS-12	18
18-SS-GS-14	18-SS-GS-14	18
18-SS-GS-18	18-SS-GS-18	18
18-TP-504-S-1	18-TP-504-S-1	18 North
18-TP-517-S-1	18-TP-517-S-1	18
18-TP-520-S-1	18-TP-520-S-1	18
18-TP-531-S-1-DAVG	18-TP-531-S-1-DAVG	18
18-TP-535-S-1-DAVG	18-TP-535-S-1-DAVG	18 North
18-TP-536-S-1	18-TP-536-S-1	18 North
18-TP-538-S-1	18-TP-538-S-1	18
18-TP-539-S-1	18-TP-539-S-1	18
18-TP-541-S-1	18-TP-541-S-1	18
18-TP-GS-17-S-1	18-TP-GS-17-S-1	18
18-TP-GS-23-S-1	18-TP-GS-23-S-1	18
18-TR-104W,S-1	18-TR-104W,S-1	18
18-TR-107N,S-1	18-TR-107N,S-1	18
18-TR-117E,S-3	18-TR-117E,S-3	18
18R-01-DAVG	18R-01-DAVG	18-REF
18R-04	18R-04	18-REF
18R-05	18R-05	18-REF
18R-08	18R-08	18-REF
18R-102	18R-102	18-REF
18R-13-DAVG	18R-13-DAVG	18-REF
18R-17	18R-17	18-REF
18R-24	18R-24	18-REF
18R-401	18R-401	18-REF
18R-406	18R-406	18-REF
18R-406-S-2	18R-406-S-2	18-REF

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
18R-410	18R-410	18-REF
18R-411	18R-411	18-REF
18R-417	18R-417	18-REF
18R-421	18R-421	18-REF
18R-429	18R-429	18-REF
18R-430	18R-430	18-REF
18R-431	18R-431	18-REF
18R-433	18R-433	18-REF
18R-434	18R-434	18-REF
18R-435	18R-435	18-REF
18R-436	18R-436	18-REF
18R-437	18R-437	18-REF
18R-440	18R-440	18-REF
18R-441	18R-441	18-REF
18R-444-DAVG	18R-444-DAVG	18-REF
18R-445	18R-445	18-REF
18R-445-S-2	18R-445-S-2	18-REF
18R-446	18R-446	18-REF
18R-447	18R-447	18-REF
18R-455	18R-455	18-REF
18R-456	18R-456	18-REF
18R-461	18R-461	18-REF
18R-461-S-2	18R-461-S-2	18-REF
18R-462	18R-462	18-REF
LR-034	LR-034	LR
LR-044	LR-044	LR
LR-169	LR-169	LR
LR-196	LR-196	LR
LR-208	LR-208	LR
LR-209-DAVG	LR-209-DAVG	LR
Commercial Area 8 (0 to <=1foot)		
18-SS-550	18-SS-550	18
APA-SS-401-DAVG	APA-SS-401-DAVG	LR
APB-TP-502-S-1	APB-TP-502-S-1	LR
LR-003W	LR-003W	LR
LR-008W	LR-008W	LR
LR-016	LR-016	LR
LR-032	LR-032	LR
LR-043	LR-043	LR
LR-059-1	LR-059-1	LR
LR-059-2	LR-059-2	LR

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
LR-059-S-2	LR-059-S-2	LR
LR-074	LR-074	LR
LR-105-DAVG	LR-105-DAVG	LR
LR-138	LR-138	LR
LR-154	LR-154	LR
LR-17N	LR-17N	LR
LR-182	LR-182	LR
UC-10	UC-10	LR
UC-11	UC-11	LR
UC-12	UC-12	LR
UC-13	UC-13	LR
UC-14	UC-14	LR
UC-15	UC-15	LR
UC-16	UC-16	LR
UC-2	UC-2	LR
UC-5	UC-5	LR
UC-6	UC-6	LR
UC-7	UC-7	LR
UC-8	UC-8	LR
UC-9	UC-9	LR
Commercial Area 9 (0 to <=1foot)		
01-C012-SS-[R61C73]-D1-000	01-C012-SS-[R61C73]-D1-000	AFAS
01-C012-SS-[R61C74]-D1-000	01-C012-SS-[R61C74]-D1-000	AFAS
01-C012-SS-[R62C73]-D1-000	01-C012-SS-[R62C73]-D1-000	AFAS
01-C012-SS-[R62C74]-D1-000	01-C012-SS-[R62C74]-D1-000	AFAS
01-C012-SS-[R63C73]-D1-000	01-C012-SS-[R63C73]-D1-000	AFAS
01-C012-SS-[R63C74]-D1-000-DAVG	01-C012-SS-[R63C74]-D1-000-DAVG	AFAS
01-C012-SS-[R64C73]-D1-000	01-C012-SS-[R64C73]-D1-000	AFAS
01-C012-SS-[R64C74]-D1-000	01-C012-SS-[R64C74]-D1-000	AFAS
01-C012-SS-[R65C73]-D1-000	01-C012-SS-[R65C73]-D1-000	AFAS
01-C012-SS-[R65C74]-D1-000	01-C012-SS-[R65C74]-D1-000	AFAS
01-C012-SS-[R66C73]-D1-000	01-C012-SS-[R66C73]-D1-000	AFAS
01-C012-SS-[R66C74]-D1-000	01-C012-SS-[R66C74]-D1-000	AFAS
01-C012-SS-[R67C73]-D1-000	01-C012-SS-[R67C73]-D1-000	AFAS
01-C012-SS-[R67C74]-D1-000	01-C012-SS-[R67C74]-D1-000	AFAS
01-C012-SS-[R68C73]-D1-000	01-C012-SS-[R68C73]-D1-000	AFAS
01-C012-SS-[R68C74]-D1-000	01-C012-SS-[R68C74]-D1-000	AFAS
01-C012-SS-[R69C73]-D1-000	01-C012-SS-[R69C73]-D1-000	AFAS
01-C012-SS-[R69C74]-D1-000	01-C012-SS-[R69C74]-D1-000	AFAS
01-C012-SS-[R70C73]-D1-000	01-C012-SS-[R70C73]-D1-000	AFAS
01-C012-SS-[R70C74]-D1-000	01-C012-SS-[R70C74]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C012-SS-[R71C73]-D1-000	01-C012-SS-[R71C73]-D1-000	AFAS
01-C012-SS-[R71C74]-D1-000	01-C012-SS-[R71C74]-D1-000	AFAS
01-C012-SS-[R72C73]-D1-000	01-C012-SS-[R72C73]-D1-000	AFAS
01-C012-SS-[R72C74]-D1-000-DAVG	01-C012-SS-[R72C74]-D1-000-DAVG	AFAS
01-C012-SS-[R73C73]-D1-000	01-C012-SS-[R73C73]-D1-000	AFAS
01-C012-SS-[R73C74]-D1-000	01-C012-SS-[R73C74]-D1-000	AFAS
01-C012-SS-[R74C73]-D1-000	01-C012-SS-[R74C73]-D1-000	AFAS
01-C012-SS-[R74C74]-D1-000	01-C012-SS-[R74C74]-D1-000	AFAS
01-C012-SS-[R75C73]-D1-000	01-C012-SS-[R75C73]-D1-000	AFAS
01-C012-SS-[R75C74]-D1-000	01-C012-SS-[R75C74]-D1-000	AFAS
01-C013-SS-[R61C75]-D1-000	01-C013-SS-[R61C75]-D1-000	AFAS
01-C013-SS-[R61C76]-D1-000	01-C013-SS-[R61C76]-D1-000	AFAS
01-C013-SS-[R61C77]-D1-000	01-C013-SS-[R61C77]-D1-000	AFAS
01-C013-SS-[R61C79]-D1-000	01-C013-SS-[R61C79]-D1-000	AFAS
01-C013-SS-[R61C80]-D1-000	01-C013-SS-[R61C80]-D1-000	AFAS
01-C013-SS-[R61C81]-D1-000	01-C013-SS-[R61C81]-D1-000	AFAS
01-C013-SS-[R61C82]-D1-000	01-C013-SS-[R61C82]-D1-000	AFAS
01-C013-SS-[R62C75]-D1-000	01-C013-SS-[R62C75]-D1-000	AFAS
01-C013-SS-[R62C76]-D1-000-DAVG	01-C013-SS-[R62C76]-D1-000-DAVG	AFAS
01-C013-SS-[R62C77]-D1-000	01-C013-SS-[R62C77]-D1-000	AFAS
01-C013-SS-[R62C78]-D1-000	01-C013-SS-[R62C78]-D1-000	AFAS
01-C013-SS-[R62C79]-D1-000	01-C013-SS-[R62C79]-D1-000	AFAS
01-C013-SS-[R62C81]-D1-000	01-C013-SS-[R62C81]-D1-000	AFAS
01-C013-SS-[R62C82]-D1-000	01-C013-SS-[R62C82]-D1-000	AFAS
01-C013-SS-[R62C83]-D1-000	01-C013-SS-[R62C83]-D1-000	AFAS
01-C013-SS-[R62C84]-D1-000	01-C013-SS-[R62C84]-D1-000	AFAS
01-C013-SS-[R63C75]-D1-000	01-C013-SS-[R63C75]-D1-000	AFAS
01-C013-SS-[R63C76]-D1-000	01-C013-SS-[R63C76]-D1-000	AFAS
01-C013-SS-[R63C77]-D1-000	01-C013-SS-[R63C77]-D1-000	AFAS
01-C013-SS-[R63C78]-D1-000	01-C013-SS-[R63C78]-D1-000	AFAS
01-C013-SS-[R63C79]-D1-000	01-C013-SS-[R63C79]-D1-000	AFAS
01-C013-SS-[R63C80]-D1-000	01-C013-SS-[R63C80]-D1-000	AFAS
01-C013-SS-[R63C81]-D1-000	01-C013-SS-[R63C81]-D1-000	AFAS
01-C013-SS-[R63C83]-D1-000	01-C013-SS-[R63C83]-D1-000	AFAS
01-C013-SS-[R63C84]-D1-000	01-C013-SS-[R63C84]-D1-000	AFAS
01-C013-SS-[R63C85]-D1-000	01-C013-SS-[R63C85]-D1-000	AFAS
01-C013-SS-[R63C86]-D1-000-DAVG	01-C013-SS-[R63C86]-D1-000-DAVG	AFAS
01-C013-SS-[R64C75]-D1-000	01-C013-SS-[R64C75]-D1-000	AFAS
01-C013-SS-[R64C76]-D1-000	01-C013-SS-[R64C76]-D1-000	AFAS
01-C013-SS-[R64C77]-D1-000	01-C013-SS-[R64C77]-D1-000	AFAS
01-C013-SS-[R64C78]-D1-000	01-C013-SS-[R64C78]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C013-SS-[R64C79]-D1-000	01-C013-SS-[R64C79]-D1-000	AFAS
01-C013-SS-[R64C80]-D1-000	01-C013-SS-[R64C80]-D1-000	AFAS
01-C013-SS-[R64C81]-D1-000	01-C013-SS-[R64C81]-D1-000	AFAS
01-C013-SS-[R64C82]-D1-000	01-C013-SS-[R64C82]-D1-000	AFAS
01-C013-SS-[R64C83]-D1-000	01-C013-SS-[R64C83]-D1-000	AFAS
01-C013-SS-[R64C84]-D1-000	01-C013-SS-[R64C84]-D1-000	AFAS
01-C013-SS-[R64C86]-D1-000	01-C013-SS-[R64C86]-D1-000	AFAS
01-C013-SS-[R64C87]-D1-000-DAVG	01-C013-SS-[R64C87]-D1-000-DAVG	AFAS
01-C013-SS-[R64C88]-D1-000	01-C013-SS-[R64C88]-D1-000	AFAS
01-C013-SS-[R65C75]-D1-000	01-C013-SS-[R65C75]-D1-000	AFAS
01-C013-SS-[R65C76]-D1-000	01-C013-SS-[R65C76]-D1-000	AFAS
01-C013-SS-[R65C77]-D1-000	01-C013-SS-[R65C77]-D1-000	AFAS
01-C013-SS-[R65C78]-D1-000	01-C013-SS-[R65C78]-D1-000	AFAS
01-C013-SS-[R65C79]-D1-000	01-C013-SS-[R65C79]-D1-000	AFAS
01-C013-SS-[R65C80]-D1-000	01-C013-SS-[R65C80]-D1-000	AFAS
01-C013-SS-[R65C81]-D1-000-DAVG	01-C013-SS-[R65C81]-D1-000-DAVG	AFAS
01-C013-SS-[R65C82]-D1-000	01-C013-SS-[R65C82]-D1-000	AFAS
01-C013-SS-[R65C83]-D1-000	01-C013-SS-[R65C83]-D1-000	AFAS
01-C013-SS-[R65C84]-D1-000	01-C013-SS-[R65C84]-D1-000	AFAS
01-C013-SS-[R65C85]-D1-000	01-C013-SS-[R65C85]-D1-000	AFAS
01-C013-SS-[R65C86]-D1-000	01-C013-SS-[R65C86]-D1-000	AFAS
01-C013-SS-[R65C88]-D1-000	01-C013-SS-[R65C88]-D1-000	AFAS
01-C013-SS-[R65C89]-D1-000-DAVG	01-C013-SS-[R65C89]-D1-000-DAVG	AFAS
01-C013-SS-[R66C75]-D1-000	01-C013-SS-[R66C75]-D1-000	AFAS
01-C013-SS-[R66C76]-D1-000	01-C013-SS-[R66C76]-D1-000	AFAS
01-C013-SS-[R66C77]-D1-000	01-C013-SS-[R66C77]-D1-000	AFAS
01-C013-SS-[R66C78]-D1-000	01-C013-SS-[R66C78]-D1-000	AFAS
01-C013-SS-[R66C79]-D1-000	01-C013-SS-[R66C79]-D1-000	AFAS
01-C013-SS-[R66C80]-D1-000	01-C013-SS-[R66C80]-D1-000	AFAS
01-C013-SS-[R66C81]-D1-000	01-C013-SS-[R66C81]-D1-000	AFAS
01-C013-SS-[R66C82]-D1-000	01-C013-SS-[R66C82]-D1-000	AFAS
01-C013-SS-[R66C83]-D1-000	01-C013-SS-[R66C83]-D1-000	AFAS
01-C013-SS-[R66C84]-D1-000	01-C013-SS-[R66C84]-D1-000	AFAS
01-C013-SS-[R66C85]-D1-000	01-C013-SS-[R66C85]-D1-000	AFAS
01-C013-SS-[R66C86]-D1-000	01-C013-SS-[R66C86]-D1-000	AFAS
01-C013-SS-[R66C87]-D1-000	01-C013-SS-[R66C87]-D1-000	AFAS
01-C013-SS-[R66C88]-D1-000	01-C013-SS-[R66C88]-D1-000	AFAS
01-C013-SS-[R66C89]-D1-000-DAVG	01-C013-SS-[R66C89]-D1-000-DAVG	AFAS
01-C013-SS-[R67C75]-D1-000	01-C013-SS-[R67C75]-D1-000	AFAS
01-C013-SS-[R67C76]-D1-000	01-C013-SS-[R67C76]-D1-000	AFAS
01-C013-SS-[R67C77]-D1-000	01-C013-SS-[R67C77]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C013-SS-[R67C78]-D1-000	01-C013-SS-[R67C78]-D1-000	AFAS
01-C013-SS-[R67C79]-D1-000	01-C013-SS-[R67C79]-D1-000	AFAS
01-C013-SS-[R67C80]-D1-000	01-C013-SS-[R67C80]-D1-000	AFAS
01-C013-SS-[R67C81]-D1-000	01-C013-SS-[R67C81]-D1-000	AFAS
01-C013-SS-[R67C82]-D1-000	01-C013-SS-[R67C82]-D1-000	AFAS
01-C013-SS-[R67C83]-D1-000	01-C013-SS-[R67C83]-D1-000	AFAS
01-C013-SS-[R67C84]-D1-000	01-C013-SS-[R67C84]-D1-000	AFAS
01-C013-SS-[R67C85]-D1-000	01-C013-SS-[R67C85]-D1-000	AFAS
01-C013-SS-[R67C86]-D1-000	01-C013-SS-[R67C86]-D1-000	AFAS
01-C013-SS-[R67C87]-D1-000	01-C013-SS-[R67C87]-D1-000	AFAS
01-C013-SS-[R67C88]-D1-000	01-C013-SS-[R67C88]-D1-000	AFAS
01-C013-SS-[R68C75]-D1-000	01-C013-SS-[R68C75]-D1-000	AFAS
01-C013-SS-[R68C76]-D1-000	01-C013-SS-[R68C76]-D1-000	AFAS
01-C013-SS-[R68C77]-D1-000	01-C013-SS-[R68C77]-D1-000	AFAS
01-C013-SS-[R68C78]-D1-000	01-C013-SS-[R68C78]-D1-000	AFAS
01-C013-SS-[R68C79]-D1-000	01-C013-SS-[R68C79]-D1-000	AFAS
01-C013-SS-[R68C80]-D1-000	01-C013-SS-[R68C80]-D1-000	AFAS
01-C013-SS-[R68C81]-D1-000	01-C013-SS-[R68C81]-D1-000	AFAS
01-C013-SS-[R68C82]-D1-000	01-C013-SS-[R68C82]-D1-000	AFAS
01-C013-SS-[R68C83]-D1-000	01-C013-SS-[R68C83]-D1-000	AFAS
01-C013-SS-[R68C84]-D1-000	01-C013-SS-[R68C84]-D1-000	AFAS
01-C013-SS-[R68C85]-D1-000	01-C013-SS-[R68C85]-D1-000	AFAS
01-C013-SS-[R68C86]-D1-000	01-C013-SS-[R68C86]-D1-000	AFAS
01-C013-SS-[R68C87]-D1-000	01-C013-SS-[R68C87]-D1-000	AFAS
01-C013-SS-[R68C88]-D1-000-DAVG	01-C013-SS-[R68C88]-D1-000-DAVG	AFAS
01-C013-SS-[R69C75]-D1-000	01-C013-SS-[R69C75]-D1-000	AFAS
01-C013-SS-[R69C76]-D1-000	01-C013-SS-[R69C76]-D1-000	AFAS
01-C013-SS-[R69C77]-D1-000	01-C013-SS-[R69C77]-D1-000	AFAS
01-C013-SS-[R69C78]-D1-000	01-C013-SS-[R69C78]-D1-000	AFAS
01-C013-SS-[R69C79]-D1-000	01-C013-SS-[R69C79]-D1-000	AFAS
01-C013-SS-[R69C80]-D1-000	01-C013-SS-[R69C80]-D1-000	AFAS
01-C013-SS-[R69C81]-D1-000	01-C013-SS-[R69C81]-D1-000	AFAS
01-C013-SS-[R69C82]-D1-000	01-C013-SS-[R69C82]-D1-000	AFAS
01-C013-SS-[R69C83]-D1-000	01-C013-SS-[R69C83]-D1-000	AFAS
01-C013-SS-[R69C84]-D1-000	01-C013-SS-[R69C84]-D1-000	AFAS
01-C013-SS-[R69C85]-D1-000	01-C013-SS-[R69C85]-D1-000	AFAS
01-C013-SS-[R69C86]-D1-000	01-C013-SS-[R69C86]-D1-000	AFAS
01-C013-SS-[R69C87]-D1-000	01-C013-SS-[R69C87]-D1-000	AFAS
01-C013-SS-[R70C75]-D1-000	01-C013-SS-[R70C75]-D1-000	AFAS
01-C013-SS-[R70C76]-D1-000	01-C013-SS-[R70C76]-D1-000	AFAS
01-C013-SS-[R70C77]-D1-000	01-C013-SS-[R70C77]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C013-SS-[R70C78]-D1-000	01-C013-SS-[R70C78]-D1-000	AFAS
01-C013-SS-[R70C79]-D1-000	01-C013-SS-[R70C79]-D1-000	AFAS
01-C013-SS-[R70C80]-D1-000	01-C013-SS-[R70C80]-D1-000	AFAS
01-C013-SS-[R70C81]-D1-000	01-C013-SS-[R70C81]-D1-000	AFAS
01-C013-SS-[R70C82]-D1-000	01-C013-SS-[R70C82]-D1-000	AFAS
01-C013-SS-[R70C83]-D1-000	01-C013-SS-[R70C83]-D1-000	AFAS
01-C013-SS-[R70C84]-D1-000	01-C013-SS-[R70C84]-D1-000	AFAS
01-C013-SS-[R70C85]-D1-000	01-C013-SS-[R70C85]-D1-000	AFAS
01-C013-SS-[R70C86]-D1-000	01-C013-SS-[R70C86]-D1-000	AFAS
01-C013-SS-[R71C75]-D1-000	01-C013-SS-[R71C75]-D1-000	AFAS
01-C013-SS-[R71C76]-D1-000	01-C013-SS-[R71C76]-D1-000	AFAS
01-C013-SS-[R71C77]-D1-000	01-C013-SS-[R71C77]-D1-000	AFAS
01-C013-SS-[R71C78]-D1-000	01-C013-SS-[R71C78]-D1-000	AFAS
01-C013-SS-[R71C79]-D1-000	01-C013-SS-[R71C79]-D1-000	AFAS
01-C013-SS-[R71C80]-D1-000	01-C013-SS-[R71C80]-D1-000	AFAS
01-C013-SS-[R71C81]-D1-000	01-C013-SS-[R71C81]-D1-000	AFAS
01-C013-SS-[R71C82]-D1-000	01-C013-SS-[R71C82]-D1-000	AFAS
01-C013-SS-[R71C83]-D1-000	01-C013-SS-[R71C83]-D1-000	AFAS
01-C013-SS-[R71C84]-D1-000	01-C013-SS-[R71C84]-D1-000	AFAS
01-C013-SS-[R72C75]-D1-000	01-C013-SS-[R72C75]-D1-000	AFAS
01-C013-SS-[R72C76]-D1-000	01-C013-SS-[R72C76]-D1-000	AFAS
01-C013-SS-[R72C77]-D1-000	01-C013-SS-[R72C77]-D1-000	AFAS
01-C013-SS-[R72C78]-D1-000	01-C013-SS-[R72C78]-D1-000	AFAS
01-C013-SS-[R72C79]-D1-000	01-C013-SS-[R72C79]-D1-000	AFAS
01-C013-SS-[R72C80]-D1-000	01-C013-SS-[R72C80]-D1-000	AFAS
01-C013-SS-[R72C81]-D1-000	01-C013-SS-[R72C81]-D1-000	AFAS
01-C013-SS-[R72C82]-D1-000	01-C013-SS-[R72C82]-D1-000	AFAS
01-C013-SS-[R72C83]-D1-000	01-C013-SS-[R72C83]-D1-000	AFAS
01-C013-SS-[R72C84]-D1-000-DAVG	01-C013-SS-[R72C84]-D1-000-DAVG	AFAS
01-C013-SS-[R73C75]-D1-000	01-C013-SS-[R73C75]-D1-000	AFAS
01-C013-SS-[R73C76]-D1-000	01-C013-SS-[R73C76]-D1-000	AFAS
01-C013-SS-[R73C77]-D1-000	01-C013-SS-[R73C77]-D1-000	AFAS
01-C013-SS-[R73C78]-D1-000	01-C013-SS-[R73C78]-D1-000	AFAS
01-C013-SS-[R73C79]-D1-000	01-C013-SS-[R73C79]-D1-000	AFAS
01-C013-SS-[R73C80]-D1-000	01-C013-SS-[R73C80]-D1-000	AFAS
01-C013-SS-[R73C81]-D1-000	01-C013-SS-[R73C81]-D1-000	AFAS
01-C013-SS-[R73C82]-D1-000	01-C013-SS-[R73C82]-D1-000	AFAS
01-C013-SS-[R73C83]-D1-000-DAVG	01-C013-SS-[R73C83]-D1-000-DAVG	AFAS
01-C013-SS-[R74C75]-D1-000	01-C013-SS-[R74C75]-D1-000	AFAS
01-C013-SS-[R74C76]-D1-000	01-C013-SS-[R74C76]-D1-000	AFAS
01-C013-SS-[R74C77]-D1-000	01-C013-SS-[R74C77]-D1-000	AFAS

Table B-1 – Commercial Area Samples <= 1 Foot BGS

Sample ID	Short Sample ID	RI Area
01-C013-SS-[R74C78]-D1-000	01-C013-SS-[R74C78]-D1-000	AFAS
01-C013-SS-[R74C79]-D1-000	01-C013-SS-[R74C79]-D1-000	AFAS
01-C013-SS-[R74C80]-D1-000	01-C013-SS-[R74C80]-D1-000	AFAS
01-C013-SS-[R74C81]-D1-000	01-C013-SS-[R74C81]-D1-000	AFAS
01-C013-SS-[R75C75]-D1-000	01-C013-SS-[R75C75]-D1-000	AFAS
01-C013-SS-[R75C76]-D1-000	01-C013-SS-[R75C76]-D1-000	AFAS
01-C013-SS-[R75C77]-D1-000	01-C013-SS-[R75C77]-D1-000	AFAS
01-C013-SS-[R75C78]-D1-000	01-C013-SS-[R75C78]-D1-000	AFAS
01-C013-SS-[R75C79]-D1-000	01-C013-SS-[R75C79]-D1-000	AFAS
01-C013-SS-[R75C80]-D1-000	01-C013-SS-[R75C80]-D1-000	AFAS
02-C013-SS[R71C85-03]D1-000	R71C85-03	AFAS
02-C013-SS[R71C85-04]D1-000	R71C85-04	AFAS
02-C013-SS[R71C85-05]D1-000	R71C85-05	AFAS
02-C013-SS[R71C85-06]D1-000	R71C85-06	AFAS
LR-175	LR-175	LR
LR-176	LR-176	LR
LR-177	LR-177	LR
LR-189	LR-189	LR
LR-190	LR-190	LR
LR-191	LR-191	LR
LR-192	LR-192	LR
LR-193	LR-193	LR
LR-203	LR-203	LR
LR-204	LR-204	LR
LR-205	LR-205	LR
LR-206	LR-206	LR
LR-207	LR-207	LR
LR-207-S-2	LR-207-S-2	LR
LR-221	LR-221	LR
LR-222	LR-222	LR
LR-223	LR-223	LR
LR-224	LR-224	LR
LR-238	LR-238	LR
LR-239	LR-239	LR
LR-240	LR-240	LR

Table B-2 – Commercial Area Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
Commercial Area 1 (1 to <=15 feet)		
1234-TP-517-S-2	1234-TP-517-S-2	1234
1234-TP-517-S-3	1234-TP-517-S-3	1234
18-TP-502-S-2	18-TP-502-S-2	18 North
18-TP-502-S-3	18-TP-502-S-3	18 North
25-TP-509-S-2	25-TP-509-S-2	25
25-TP-510-S-2	25-TP-510-S-2	25
25-TP-514-S-3	25-TP-514-S-3	25
25-TP-514-S-4	25-TP-514-S-4	25
25-TP-518-S-2	25-TP-518-S-2	25
26-TP-508-S-2	26-TP-508-S-2	26
26-TP-508-S-3	26-TP-508-S-3	26
26-TP-509-S-2	26-TP-509-S-2	26
26-TP-509-S-3	26-TP-509-S-3	26
26-TP-512-S-2	26-TP-512-S-2	26
26-TP-512-S-3	26-TP-512-S-3	26
26-TP-520-S-2	26-TP-520-S-2	26
26-TP-521-S-2	26-TP-521-S-2	26
7-B-1,S-1	7-B-1,S-1	7
7-B-3,S-1	7-B-3,S-1	7
7-B-3,S-3	7-B-3,S-3	7
7-B-3,S-5	7-B-3,S-5	7
7-B-4,S-1-DAVG	7-B-4,S-1-DAVG	7
7-B-4,S-3	7-B-4,S-3	7
7-B-4,S-5	7-B-4,S-5	7
7-B-5,S-1-DAVG	7-B-5,S-1-DAVG	7
7-B-5,S-3	7-B-5,S-3	7
7-B-5,S-5	7-B-5,S-5	7
7-B-501-S-1A	7-B-501-S-1A	7
7-B-501-S-2-DAVG	7-B-501-S-2-DAVG	7
7-B-501-S-3-DAVG	7-B-501-S-3-DAVG	7
7-B-502-S-1A	7-B-502-S-1A	7
7-B-502-S-2	7-B-502-S-2	7
7-B-502-S-3	7-B-502-S-3	7
7-B-503-S-1C-DAVG	7-B-503-S-1C-DAVG	7
7-B-503-S-2-DAVG	7-B-503-S-2-DAVG	7
7-B-503-S-2A	7-B-503-S-2A	7
7-B-503-S-3	7-B-503-S-3	7
7-B-504-S-2	7-B-504-S-2	7

Table B-2 – Commercial Area Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
7-B-504-S-3A	7-B-504-S-3A	7
7-B-6,S-1	7-B-6,S-1	7
7-B-6,S-3	7-B-6,S-3	7
7-B-6,S-5	7-B-6,S-5	7
7-B-7,S-4-DAVG	7-B-7,S-4-DAVG	7
7-HA-501-S-2	7-HA-501-S-2	7
7-HA-502-S-2-DAVG	7-HA-502-S-2-DAVG	7
7-HA-502-S-3	7-HA-502-S-3	7
7-HA-503-S-2	7-HA-503-S-2	7
7-HA-504-S-2	7-HA-504-S-2	7
7-TP-501-S-2-DAVG	7-TP-501-S-2-DAVG	7
7-TP-501-S-3	7-TP-501-S-3	7
7-TP-502-S-2	7-TP-502-S-2	7
7-TP-502-S-3	7-TP-502-S-3	7
7-TP-503-S-2	7-TP-503-S-2	7
7-TP-503-S-3	7-TP-503-S-3	7
7-TP-504-S-2	7-TP-504-S-2	7
7-TP-504-S-3	7-TP-504-S-3	7
8-TPS-04-S-1	8-TPS-04-S-1	8
APA-TP-501-S-2	APA-TP-501-S-2	LR
APC-TP-502-S-3	APC-TP-502-S-3	AP-C
LR-017-S-3	LR-017-S-3	LR
LR-025-S-3	LR-025-S-3	LR
Commercial Area 2 (1 to <=15 feet)		
6-TP-501-S-2	6-TP-501-S-2	6
6-TP-501-S-3	6-TP-501-S-3	6
6-TP-502-S-2	6-TP-502-S-2	6
6-TP-502-S-3	6-TP-502-S-3	6
Commercial Area 3 (1 to <=15 feet)		
19B-OI-TP-1 (S-1)	19B-OI-TP-1 (S-1)	19B
19B-OI-TP-1 (S-2)	19B-OI-TP-1 (S-2)	19B
APD-TP-501-S-2	APD-TP-501-S-2	26
APG-TP-501-S-2	APG-TP-501-S-2	LR
RR-521-S-3	RR-521-S-3	LR
Commercial Area 4 (1 to <=15 feet)		
LR-133-S-3	LR-133-S-3	LR
LR-181-S-3	LR-181-S-3	LR
Commercial Area 5 (1 to <=15 feet)		
01-C012-SS-[R61C68]-D1-000-DAVG	01-C012-SS-[R61C68]-D1-000-DAVG	AFAS
12-1-B-501A-S-2	12-1-B-501A-S-2	12

Table B-2 – Commercial Area Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
12-1-B-501A-S-3	12-1-B-501A-S-3	12
12-1-TP-501-S-2	12-1-TP-501-S-2	12
12-1-TP-504-S-2	12-1-TP-504-S-2	12
12-1-TP-6,S-1	12-1-TP-6,S-1	12
12-1-TP-6,S-2	12-1-TP-6,S-2	12
12-4-TP-2,S-1	12-4-TP-2,S-1	12
12-5-TP-3,S-1	12-5-TP-3,S-1	12
12-5-TP-3,S-2	12-5-TP-3,S-2	12
12-5-TP-501-S-2	12-5-TP-501-S-2	12
12-5-TP-501-S-3	12-5-TP-501-S-3	12
12-5-TP-502-S-2-DAVG	12-5-TP-502-S-2-DAVG	12
12-5-TP-502-S-3-DAVG	12-5-TP-502-S-3-DAVG	12
12-5-TP-503-S-2	12-5-TP-503-S-2	12
12-5-TP-503-S-3	12-5-TP-503-S-3	12
12-5-TP-503-S-4	12-5-TP-503-S-4	12
12-6-B-501-S-2	12-6-B-501-S-2	12
12-6-B-501-S-3	12-6-B-501-S-3	12
12-6-TP-3,S-1	12-6-TP-3,S-1	12
12-6-TP-3,S-2-DAVG	12-6-TP-3,S-2-DAVG	12
12-6-TP-501-S-2	12-6-TP-501-S-2	12
12-6-TP-501-S-3	12-6-TP-501-S-3	12
12-6-TP-502-S-2	12-6-TP-502-S-2	12
12-6-TP-502-S-3	12-6-TP-502-S-3	12
12-7-B-501-S-2	12-7-B-501-S-2	12
12-7-B-501-S-3	12-7-B-501-S-3	12
12-7-TP-501-S-2	12-7-TP-501-S-2	12
12-7-TP-501-S-3	12-7-TP-501-S-3	12
12-TP-504-S-2-DAVG	12-TP-504-S-2-DAVG	12
12-TP-504-S-3	12-TP-504-S-3	12
12-TP-505-S-2-DAVG	12-TP-505-S-2-DAVG	12
12-TP-505-S-3	12-TP-505-S-3	12
LR-157-S-3	LR-157-S-3	LR
Commercial Area 6 (1 to <=15 feet)		
18-TP-546-S-2	18-TP-546-S-2	18
18-TP-546-S-3	18-TP-546-S-3	18
Commercial Area 7 (1 to <=15 feet)		
11-B-501-S-2	11-B-501-S-2	11
11-B-501-S-3	11-B-501-S-3	11
11-TP-1,S-2	11-TP-1,S-2	11
11-TP-5,S-1	11-TP-5,S-1	11
11-TP-5,S-2-DAVG	11-TP-5,S-2-DAVG	11

Table B-2 – Commercial Area Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
11-TP-501-S-2	11-TP-501-S-2	11
11-TP-501-S-3	11-TP-501-S-3	11
11-TP-502-S-2	11-TP-502-S-2	11
11-TP-502-S-3	11-TP-502-S-3	11
11-TP-503-S-2	11-TP-503-S-2	11
11-TP-503-S-3	11-TP-503-S-3	11
11-TP-504-S-2	11-TP-504-S-2	11
11-TP-504-S-3	11-TP-504-S-3	11
11-TP-6,S-1	11-TP-6,S-1	11
11-TP-6,S-2	11-TP-6,S-2	11
18-TP-25,S-1	18-TP-25,S-1	18
18-TP-26,S-1	18-TP-26,S-1	18
18-TP-27,S-1	18-TP-27,S-1	18
18-TP-28,S-1	18-TP-28,S-1	18
18-TP-29,S-1	18-TP-29,S-1	18
18-TP-30,S-1	18-TP-30,S-1	18 North
18-TP-31,S-1	18-TP-31,S-1	18 North
18-TP-33,S-1-DAVG	18-TP-33,S-1-DAVG	18
18-TP-504-S-2	18-TP-504-S-2	18 North
18-TP-504-S-3	18-TP-504-S-3	18 North
18-TP-517-S-2	18-TP-517-S-2	18
18-TP-517-S-3	18-TP-517-S-3	18
18-TP-519-S-2-DAVG	18-TP-519-S-2-DAVG	18
18-TP-519-S-3	18-TP-519-S-3	18
18-TP-520-S-2-DAVG	18-TP-520-S-2-DAVG	18
18-TP-520-S-3	18-TP-520-S-3	18
18-TP-531-S-2	18-TP-531-S-2	18
18-TP-531-S-3	18-TP-531-S-3	18
18-TP-535-S-2	18-TP-535-S-2	18 North
18-TP-535-S-3	18-TP-535-S-3	18 North
18-TP-536-S-2	18-TP-536-S-2	18 North
18-TP-536-S-3	18-TP-536-S-3	18 North
18-TP-537-S-2	18-TP-537-S-2	18
18-TP-537-S-3	18-TP-537-S-3	18
18-TP-538-S-2	18-TP-538-S-2	18
18-TP-538-S-3	18-TP-538-S-3	18
18-TP-539-S-2	18-TP-539-S-2	18
18-TP-539-S-3	18-TP-539-S-3	18

Table B-2 – Commercial Area Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
18-TP-540-S-2-DAVG	18-TP-540-S-2-DAVG	18
18-TP-540-S-3	18-TP-540-S-3	18
18-TP-541-S-2	18-TP-541-S-2	18
18-TP-541-S-3	18-TP-541-S-3	18
18-TP-542-S-2-DAVG	18-TP-542-S-2-DAVG	18
18-TP-542-S-3	18-TP-542-S-3	18
18-TP-GS-16-S-2	18-TP-GS-16-S-2	18
18-TP-GS-17-S-2	18-TP-GS-17-S-2	18
18-TP-GS-23-S-2	18-TP-GS-23-S-2	18
18-TR-104E,S-3	18-TR-104E,S-3	18
18-TR-104E,S-4	18-TR-104E,S-4	18
18-TR-104W,S-2	18-TR-104W,S-2	18
18-TR-107N,S-2	18-TR-107N,S-2	18
18-TR-117E,S-4	18-TR-117E,S-4	18
18-TR-117W,S-1	18-TR-117W,S-1	18
18-TR-117W,S-2	18-TR-117W,S-2	18
18-TR-119S,S-4	18-TR-119S,S-4	18
18R-406-S-3	18R-406-S-3	18-REF
18R-445-S-3	18R-445-S-3	18-REF
18R-461-S-3	18R-461-S-3	18-REF
Commercial Area 8 (1 to <=15 feet)		
APB-TP-502-S-2	APB-TP-502-S-2	LR
LR-059-S-3	LR-059-S-3	LR
Commercial Area 9 (1 to <=15 feet)		
LR-207-S-3	LR-207-S-3	LR

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
Golf Course Area 1 (0 to <=1 foot)		
25-SS-514	25-SS-514	25
25-SS-516	25-SS-516	25
25-SS-518	25-SS-518	25
25-SS-519	25-SS-519	25
25-SS-520	25-SS-520	25
25-SS-521	25-SS-521	25
25-SS-522	25-SS-522	25
25-SS-523	25-SS-523	25
25-SS-524	25-SS-524	25
25-SS-525	25-SS-525	25
25-SS-526	25-SS-526	25
25-SS-527	25-SS-527	25
25-SS-528-DAVG	25-SS-528-DAVG	25
25-SS-529	25-SS-529	25
25-SS-530-DAVG	25-SS-530-DAVG	25
25-TP-502-S-1	25-TP-502-S-1	25
25-TP-506-S-1	25-TP-506-S-1	25
25-TP-511-S-1-DAVG	25-TP-511-S-1-DAVG	25
25-TP-515-S-1	25-TP-515-S-1	25
25-TP-516-S-1	25-TP-516-S-1	25
25-TP-517-S-1	25-TP-517-S-1	25
25-TP-524-S-1	25-TP-524-S-1	25
26-TP-514-S-1	26-TP-514-S-1	26
26-TP-517-S-1	26-TP-517-S-1	26
26-TP-518-S-1	26-TP-518-S-1	26
26-TP-522-S-1-DAVG	26-TP-522-S-1-DAVG	26
26-VS-1	26-VS-1	25
26-VS-2	26-VS-2	26
26-VS-3	26-VS-3	26
26-VS-4	26-VS-4	26
36-SS-07	36-SS-07	36
36-SS-10	36-SS-10	36
36-SS-18	36-SS-18	36
36-SS-20	36-SS-20	36
36-SS-21	36-SS-21	36
36-SS-24	36-SS-24	36
36-SS-25	36-SS-25	36
36-SS-26	36-SS-26	36
36-SS-27	36-SS-27	36
36-SS-31	36-SS-31	36

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
36-SS-32	36-SS-32	36
36-TP-6-S-1	36-TP-6-S-1	36
36-VS-13	36-VS-13	25
36-VS-16	36-VS-16	25
36-VS-17	36-VS-17	25
36-VS-19	36-VS-19	25
36-VS-5	36-VS-5	25
36-VS-6	36-VS-6	36
36-VS-9	36-VS-9	25
39-SS-01	39-SS-01	39
39-SS-03	39-SS-03	39
39-SS-04	39-SS-04	39
39-SS-05	39-SS-05	39
39-SS-06	39-SS-06	39
39-SS-08	39-SS-08	39
39-SS-12	39-SS-12	39
39-SS-16	39-SS-16	39
5-SS-402	5-SS-402	5
5-VS-107	5-VS-107	5
5-VS-108	5-VS-108	5
5-VS-109	5-VS-109	5
5-VS-110	5-VS-110	5
5-VS-111	5-VS-111	5
5-VS-112	5-VS-112	5
APH-SS-510	APH-SS-510	25
APH-SS-512	APH-SS-512	25
APH-SS-515	APH-SS-515	25
LR-012	LR-012	LR
LR-018	LR-018	LR
LR-019	LR-019	LR
LR-019E	LR-019E	LR
LR-019N	LR-019N	LR
LR-019S	LR-019S	LR
LR-019W	LR-019W	LR
RR-524	RR-524	LR
RR-525	RR-525	25
RR-526	RR-526	25
RR-582	RR-582	LR
Golf Course Area 2 (0 to <=1 foot)		
5-HA-513-S-1	5-HA-513-S-1	5
5-HA-514-S-1	5-HA-514-S-1	5

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
5-HA-515-S-1	5-HA-515-S-1	5
5-HA-516-S-1	5-HA-516-S-1	5
5-HA-517-S-1	5-HA-517-S-1	5
5-SS-403	5-SS-403	5
5-SS-404	5-SS-404	5
5-VS-100	5-VS-100	5
5-VS-101	5-VS-101	5
5-VS-102	5-VS-102	5
5-VS-99	5-VS-99	5
5D-TPS-11-S-3	5D-TPS-11-S-3	5D
5D-TPS-12-S-3	5D-TPS-12-S-3	5D
5D-TPS-15-S-2	5D-TPS-15-S-2	5D
5D-TPS-18-S-4	5D-TPS-18-S-4	5D
5D-TPS-19-S-2	5D-TPS-19-S-2	5D
5D-TPS-6-S-3	5D-TPS-6-S-3	5D
5D-TPS-7-S-3	5D-TPS-7-S-3	5D
5D-TPS-9-S-3	5D-TPS-9-S-3	5D
APE-SS-501-DAVG	APE-SS-501-DAVG	APE
APE-SS-502-DAVG	APE-SS-502-DAVG	APE
APE-SS-503	APE-SS-503	APE
APE-SS-504-DAVG	APE-SS-504-DAVG	APE
APE-SS-505	APE-SS-505	APE
APE-SS-506	APE-SS-506	APE
APE-SS-507	APE-SS-507	APE
APE-SS-509	APE-SS-509	APE
APE-SS-510	APE-SS-510	APE
APE-SS-511	APE-SS-511	APE
APE-SS-512	APE-SS-512	APE
APE-TP-501-S-1-DAVG	APE-TP-501-S-1-DAVG	APE
APE-TP-502-S-1-DAVG	APE-TP-502-S-1-DAVG	APE
APG-SS-401	APG-SS-401	LR
APG-SS-501	APG-SS-501	LR
APG-SS-502	APG-SS-502	LR
APG-SS-503	APG-SS-503	LR
APG-TP-503-S-1	APG-TP-503-S-1	LR
APG-TP-504-S-1	APG-TP-504-S-1	LR
LR-011-1	LR-011-1	LR
LR-011-2	LR-011-2	LR
LR-020 6"-12"	LR-020 6"-12"	LR
LR-020-1	LR-020-1	LR
LR-020-2	LR-020-2	LR

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
LR-020-S-2	LR-020-S-2	LR
LR-028	LR-028	LR
LR-039-1	LR-039-1	LR
LR-039-2	LR-039-2	LR
LR-047	LR-047	LR
LR-064-1	LR-064-1	LR
LR-064-2	LR-064-2	LR
16-B-501-S-1-DAVG	16-B-501-S-1-DAVG	16
16-B-505-S-1-DAVG	16-B-505-S-1-DAVG	16
16-SS-401	16-SS-401	16
16-SS-402	16-SS-402	16
16-SS-504	16-SS-504	16
16-SS-505	16-SS-505	16
16-SS-506	16-SS-506	16
16-SS-507	16-SS-507	16
16-SS-508	16-SS-508	16
16-SS-509	16-SS-509	16
16-SS-510	16-SS-510	16
16-SS-511	16-SS-511	16
16-SS-512	16-SS-512	16
16-SS-513	16-SS-513	16
16-SS-514	16-SS-514	16
16-SS-515	16-SS-515	16
16-SS-517	16-SS-517	16
16-SS-518	16-SS-518	16
16-SS-519	16-SS-519	16
16-SS-520	16-SS-520	16
16-SS-521	16-SS-521	16
16-SS-522	16-SS-522	16
16-SS-523	16-SS-523	16
16-SS-524-DAVG	16-SS-524-DAVG	16
16-TP-501-S-1	16-TP-501-S-1	16
RR-622	RR-622	RR-N
Golf Course Area 3 (0 to <=1 foot)		
38-HA-501-DAVG	38-HA-501-DAVG	38
38-HA-502-S-1	38-HA-502-S-1	38
38-HA-503-S-1	38-HA-503-S-1	38
38-SS-401	38-SS-401	38
38-SS-501	38-SS-501	38
38-SS-505	38-SS-505	38
38-SS-507	38-SS-507	38

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
38-SS-508	38-SS-508	38
38-SS-509	38-SS-509	38
38-SS-510	38-SS-510	38
38-SS-511	38-SS-511	38
38-SS-512	38-SS-512	38
38-SS-514	38-SS-514	38
38-SS-515	38-SS-515	38
38-SS-516-DAVG	38-SS-516-DAVG	38
38-SS-517	38-SS-517	38
38-SS-518	38-SS-518	38
38-SS-519	38-SS-519	38
38-SS-520	38-SS-520	38
38-VS-119	38-VS-119	MISC
38-VS-130	38-VS-130	MISC
38-VS-26	38-VS-26	MISC
38-VS-27	38-VS-27	MISC
38-VS-32	38-VS-32	MISC
38-VS-35	38-VS-35	MISC
38-VS-36	38-VS-36	MISC
38-VS-39	38-VS-39	MISC
38-VS-40	38-VS-40	MISC
38-VS-45	38-VS-45	MISC
38-VS-48-DAVG	38-VS-48-DAVG	MISC
38-VS-52	38-VS-52	MISC
38-VS-53	38-VS-53	MISC
38-VS-56	38-VS-56	MISC
38-VS-57	38-VS-57	38
38-VS-60	38-VS-60	38
38-VS-61	38-VS-61	38
38-VS-65	38-VS-65	MISC
38-VS-69	38-VS-69	38
38-VS-72	38-VS-72	38
38-VS-73	38-VS-73	MISC
LR-082	LR-082	LR
LR-097-1	LR-097-1	LR
LR-097-2	LR-097-2	LR
LR-098	LR-098	LR
LR-114	LR-114	LR
LR-115	LR-115	LR
LR-131W	LR-131W	LR
LR-147	LR-147	LR

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
LR-148-DAVG	LR-148-DAVG	LR
LR-149	LR-149	LR
LR-161-DAVG	LR-161-DAVG	LR
LR-162-DAVG	LR-162-DAVG	LR
LR-163	LR-163	LR
LR-164	LR-164	LR
RR-503	RR-503	LR
RR-513	RR-513	LR
RR-518	RR-518	LR
RR-557	RR-557	38
01-C004-SS[38-VS-151]C2-2.00	38-VS-151	MISC
01-C004-SS[38-VS-152]C2-2.00	38-VS-152	38
01-C004-SS[38-VS-153]C2-2.00	38-VS-153	MISC
01-C011-SS-[R47C66]-D1-000-DAVG	01-C011-SS-[R47C66]-D1-000-DAVG	AFAS
01-C011-SS-[R48C66]-D1-000	01-C011-SS-[R48C66]-D1-000	AFAS
RR-591-B1-DAVG	RR-591-B1-DAVG	LR
RR-591-B2	RR-591-B2	LR
Golf Course Area 4 (0 to <=1 foot)		
18-SS-GS-67	18-SS-GS-67	18
26-B-501-S-1-DAVG	26-B-501-S-1-DAVG	26
26-B-502-S-1	26-B-502-S-1	26
26-B-503-S-1-DAVG	26-B-503-S-1-DAVG	26
26-HA-501-S-1	26-HA-501-S-1	26
26-HA-504-S-1	26-HA-504-S-1	26
26-SS-403	26-SS-403	26
26-SS-404	26-SS-404	26
26-SS-501	26-SS-501	26
26-SS-502-DAVG	26-SS-502-DAVG	26
26-SS-503	26-SS-503	26
26-SS-504	26-SS-504	26
26-SS-506	26-SS-506	26
26-SS-507	26-SS-507	26
26-SS-509	26-SS-509	26
26-SS-510-DAVG	26-SS-510-DAVG	26
26-TP-501-S-1-DAVG	26-TP-501-S-1-DAVG	26
26-TP-502-S-1	26-TP-502-S-1	26
26-TP-503-S-1	26-TP-503-S-1	26
26-TP-504-S-1	26-TP-504-S-1	26
26-TP-505-S-1	26-TP-505-S-1	26
26-TP-506-S-1	26-TP-506-S-1	26
26-TP-507-S-1	26-TP-507-S-1	26

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
26-TP-510-S-1-DAVG	26-TP-510-S-1-DAVG	26
26-TP-516-S-1	26-TP-516-S-1	26
26-TP-519-S-1	26-TP-519-S-1	26
26-VS-10	26-VS-10	26
26-VS-11	26-VS-11	26
26-VS-12	26-VS-12	26
26-VS-13	26-VS-13	26
26-VS-14	26-VS-14	26
26-VS-15	26-VS-15	26
26-VS-16	26-VS-16	26
26-VS-27	26-VS-27	MISC
26-VS-28	26-VS-28	MISC
26-VS-29	26-VS-29	MISC
26-VS-30	26-VS-30	MISC
26-VS-36	26-VS-36	MISC
26-VS-37	26-VS-37	MISC
26-VS-38	26-VS-38	MISC
26-VS-44-DAVG	26-VS-44-DAVG	MISC
26-VS-50	26-VS-50	26
26-VS-51	26-VS-51	26
APF-HA-501-S-1	APF-HA-501-S-1	APF
APF-SS-501	APF-SS-501	APF
APF-SS-502	APF-SS-502	APF
APF-SS-503	APF-SS-503	APF
APF-SS-504	APF-SS-504	APF
APF-SS-505	APF-SS-505	APF
APF-SS-506	APF-SS-506	APF
APF-SS-507	APF-SS-507	APF
APF-SS-508	APF-SS-508	APF
APF-SS-509	APF-SS-509	APF
APF-SS-510-DAVG	APF-SS-510-DAVG	APF
APF-SS-511	APF-SS-511	APF
APF-SS-512	APF-SS-512	APF
APF-SS-513	APF-SS-513	APF
APF-SS-514	APF-SS-514	APF
APF-SS-515	APF-SS-515	APF
APF-SS-516	APF-SS-516	APF
APF-SS-517	APF-SS-517	APF
APF-SS-518	APF-SS-518	APF
APF-SS-520-DAVG	APF-SS-520-DAVG	APF
APF-SS-521	APF-SS-521	APF

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
APF-TP-501-S-1	APF-TP-501-S-1	APF
APF-VS-10	APF-VS-10	APF
APF-VS-11	APF-VS-11	MISC
APF-VS-12	APF-VS-12	MISC
APF-VS-9	APF-VS-9	MISC
APH-SS-507	APH-SS-507	26
APH-SS-508	APH-SS-508	26
APH-SS-509	APH-SS-509	26
LR-060-100E	LR-060-100E	LR
LR-060-100N	LR-060-100N	LR
LR-060-100W	LR-060-100W	LR
LR-060-25E	LR-060-25E	LR
LR-060-50E	LR-060-50E	LR
LR-060-50N	LR-060-50N	LR
LR-060-50W	LR-060-50W	LR
LR-060-75E	LR-060-75E	LR
LR-060-75N	LR-060-75N	LR
LR-060-75W	LR-060-75W	LR
LR-091-1	LR-091-1	LR
LR-091-2	LR-091-2	LR
LR-107	LR-107	LR
LR-124	LR-124	LR
LR-125	LR-125	LR
LR-125E	LR-125E	LR
LR-125E-S-2-DAVG	LR-125E-S-2-DAVG	LR
LR-126	LR-126	LR
LR-142-DAVG	LR-142-DAVG	LR
LR-144	LR-144	LR
LR-304	LR-304	LR
LR-305	LR-305	LR
LR-308	LR-308	LR
LR-309	LR-309	LR
LR-310-DAVG	LR-310-DAVG	LR
LR-311	LR-311	LR
LR-311-100E	LR-311-100E	LR
LR-311-100N	LR-311-100N	LR
LR-311-100S	LR-311-100S	LR
LR-311-100W	LR-311-100W	LR
LR-311-10S	LR-311-10S	LR
LR-311-10W	LR-311-10W	LR
LR-311-25S	LR-311-25S	LR

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
LR-311-25W	LR-311-25W	LR
LR-311-50N	LR-311-50N	LR
LR-311-50S	LR-311-50S	LR
LR-311-50W-DAVG	LR-311-50W-DAVG	LR
LR-311-75E	LR-311-75E	LR
LR-311-75N	LR-311-75N	LR
LR-311-75S	LR-311-75S	LR
LR-311-75W	LR-311-75W	LR
LR-311-S-2	LR-311-S-2	LR
LR-312	LR-312	LR
LR-313	LR-313	LR
LR-314	LR-314	LR
LR-316	LR-316	LR
LR-317	LR-317	LR
LR-318	LR-318	LR
LR-318-100E	LR-318-100E	LR
LR-318-100N	LR-318-100N	LR
LR-318-100S	LR-318-100S	LR
LR-318-100W	LR-318-100W	LR
LR-318-10E	LR-318-10E	LR
LR-318-10N	LR-318-10N	LR
LR-318-10S	LR-318-10S	LR
LR-318-10W	LR-318-10W	LR
LR-318-25E	LR-318-25E	LR
LR-318-25N	LR-318-25N	LR
LR-318-25S	LR-318-25S	LR
LR-318-25W	LR-318-25W	LR
LR-318-50E	LR-318-50E	LR
LR-318-50N	LR-318-50N	LR
LR-318-50S	LR-318-50S	LR
LR-318-50W	LR-318-50W	LR
LR-318-75E-DAVG	LR-318-75E-DAVG	LR
LR-318-75N	LR-318-75N	LR
LR-318-75S	LR-318-75S	LR
LR-318-75W	LR-318-75W	LR
LR-318-S-2	LR-318-S-2	LR
LR-319	LR-319	LR
LR-320	LR-320	LR
LR-321	LR-321	LR
LR-322	LR-322	LR
01-H404-SS[1]D1-005	H404-1	MISC

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18-SS-594-DAVG	18-SS-594-DAVG	18
RR-588	RR-588	RR-N
Golf Course Area 5 (0 to <=1 foot)		
LR-248	LR-248	LR
LR-249	LR-249	LR
LR-258	LR-258	LR
LR-259	LR-259	LR
LR-260	LR-260	LR
LR-261	LR-261	LR
RR-556	RR-556	LR
12-2-B-501-S-1	12-2-B-501-S-1	12
12-2-B-502-S-1-DAVG	12-2-B-502-S-1-DAVG	12
12-2-TP-505-S-1	12-2-TP-505-S-1	12
12-SS-401	12-SS-401	12
12-SS-403	12-SS-403	12
12-SS-405	12-SS-405	12
12-TP-501-S-1-DAVG	12-TP-501-S-1-DAVG	12
12-TP-502-S-1-DAVG	12-TP-502-S-1-DAVG	12
12-TP-503-S-1	12-TP-503-S-1	12
12-VS-1	12-VS-1	MISC
12-VS-3	12-VS-3	MISC
12-VS-4	12-VS-4	MISC
RR-560	RR-560	RR-N
RR-561	RR-561	RR-N
Golf Course Area 6 (0 to <=1 foot)		
18-TP-553-S-1	18-TP-553-S-1	18
18-TP-554-S-1	18-TP-554-S-1	18
18-TP-555-S-1-DAVG	18-TP-555-S-1-DAVG	18
18-TP-556-S-1	18-TP-556-S-1	18
18-TP-557-S-1	18-TP-557-S-1	18
18-TP-558-S-1	18-TP-558-S-1	18
18-VS-241	18-VS-241	18
18-VS-242	18-VS-242	18
18-VS-243	18-VS-243	18
18-VS-244	18-VS-244	18
18R-20	18R-20	18-REF
18R-21	18R-21	18-REF
18R-22	18R-22	18-REF
18R-23	18R-23	18-REF
18R-459	18R-459	18-REF
18R-467	18R-467	18-REF

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18R-468	18R-468	18-REF
18R-471	18R-471	18-REF
18R-472	18R-472	18-REF
18R-474-DAVG	18R-474-DAVG	18-REF
18R-474-S-2	18R-474-S-2	18-REF
LR-245-DAVG	LR-245-DAVG	LR
LR-256	LR-256	LR
LR-257	LR-257	LR
RR-537	RR-537	RR-N
RR-539	RR-539	RR-N
RR-540-DAVG	RR-540-DAVG	RR-N
18-MH-2	18-MH-2	18
18-MH-3	18-MH-3	18
18-MH-7	18-MH-7	18
18-SS-591	18-SS-591	18
18-SS-592	18-SS-592	18
18-SS-694	18-SS-694	18
18-SS-695	18-SS-695	18
RR-562	RR-562	RR-N
Golf Course Area 7 (0 to <=1 foot)		
18-TP-514-S-1-DAVG	18-TP-514-S-1-DAVG	18
18-TP-516-S-1	18-TP-516-S-1	18
18-TP-518-S-1	18-TP-518-S-1	18
18-TP-532-S-1	18-TP-532-S-1	18
18-TP-533-S-1-DAVG	18-TP-533-S-1-DAVG	18
18-TP-543-S-1	18-TP-543-S-1	18
18-TP-544-S-1	18-TP-544-S-1	18
18-TP-545-S-1	18-TP-545-S-1	18
18-TP-548-S-1	18-TP-548-S-1	18
18-TP-DEP,S-1	18-TP-DEP,S-1	18
18-TP-GS-25-S-1	18-TP-GS-25-S-1	18
18-TR-105N,S-1	18-TR-105N,S-1	18
18-TR-105S,S-3	18-TR-105S,S-3	18
18-TR-106E,S-3	18-TR-106E,S-3	18
18-TR-106W,S-1	18-TR-106W,S-1	18
18-TR-107S,S-3	18-TR-107S,S-3	18
18-VS-216	18-VS-216	18
18-VS-217	18-VS-217	18
18-VS-218	18-VS-218	18
18-VS-224-DAVG	18-VS-224-DAVG	18
18-VS-225	18-VS-225	18

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18-VS-226	18-VS-226	18
18-VS-227	18-VS-227	18
18-VS-233	18-VS-233	18
18-VS-234	18-VS-234	18
18-VS-235	18-VS-235	18
18-VS-236	18-VS-236	18
18R-10	18R-10	18-REF
18R-101	18R-101	18-REF
18R-103	18R-103	18-REF
18R-104	18R-104	18-REF
18R-105-DAVG	18R-105-DAVG	18-REF
18R-106	18R-106	18-REF
18R-107-100S	18R-107-100S	18-REF
18R-107-100W	18R-107-100W	18-REF
18R-107-125W	18R-107-125W	18-REF
18R-107-25E	18R-107-25E	18-REF
18R-107-25S	18R-107-25S	18-REF
18R-107-50E	18R-107-50E	18-REF
18R-107-50N-DAVG	18R-107-50N-DAVG	18-REF
18R-107-50S	18R-107-50S	18-REF
18R-107-50W	18R-107-50W	18-REF
18R-107-75S	18R-107-75S	18-REF
18R-107-75W	18R-107-75W	18-REF
18R-108	18R-108	18-REF
18R-109	18R-109	18-REF
18R-110	18R-110	18-REF
18R-111	18R-111	18-REF
18R-14	18R-14	18-REF
18R-18	18R-18	18-REF
18R-19	18R-19	18-REF
18R-448	18R-448	18-REF
18R-449	18R-449	18-REF
18R-457	18R-457	18-REF
18R-463	18R-463	18-REF
18R-464	18R-464	18-REF
RR-114	RR-114	RR-N
RR-115-DAVG	RR-115-DAVG	RR-N
RR-116	RR-116	RR-N
RR-117	RR-117	RR-N
RR-118	RR-118	RR-N
RR-533	RR-533	RR-N

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18-MH-4	18-MH-4	18
18-SS-562	18-SS-562	18
18-SS-563	18-SS-563	18
18-SS-564	18-SS-564	18
18-SS-565	18-SS-565	18
18-SS-578	18-SS-578	18
18-SS-580	18-SS-580	18
18-SS-581	18-SS-581	18
18-SS-584-2	18-SS-584-2	18
18-SS-585	18-SS-585	18
18-SS-586	18-SS-586	18
18-SS-587	18-SS-587	18
18-SS-588	18-SS-588	18
18-SS-625	18-SS-625	18
18-SS-627	18-SS-627	18
18-SS-628	18-SS-628	18
18-SS-629	18-SS-629	18
18-SS-668	18-SS-668	18
18-SS-683	18-SS-683	18
18-SS-685	18-SS-685	18
18-SS-686-DAVG	18-SS-686-DAVG	18
RR-563	RR-563	RR-N
RR-564	RR-564	RR-N
Golf Course Area 8 (0 to <=1 foot)		
18-SS-GS-68	18-SS-GS-68	18
18-SS-GS-69	18-SS-GS-69	18
18-SS-GS-71	18-SS-GS-71	18
18-SS-GS-73	18-SS-GS-73	18
18-SS-GS-74	18-SS-GS-74	18
18-SS-GS-75	18-SS-GS-75	18
18-SS-GS-76	18-SS-GS-76	18
18-SS-GS-79	18-SS-GS-79	18
18-SS-GS-80	18-SS-GS-80	18
18-TP-524-S-1	18-TP-524-S-1	18
18-TP-526-S-1	18-TP-526-S-1	18
18-TP-527-S-1-DAVG	18-TP-527-S-1-DAVG	18
18-TP-528-S-1	18-TP-528-S-1	18
18-TP-529-S-1	18-TP-529-S-1	18
18-TP-530-S-1	18-TP-530-S-1	18
18-TP-550-S-1	18-TP-550-S-1	18
18-TP-551-S-1	18-TP-551-S-1	18

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18-TP-552-S-1	18-TP-552-S-1	18
18-TP-GS-62-S-1	18-TP-GS-62-S-1	18
18-TP-GS-70-S-1	18-TP-GS-70-S-1	18
18-TP-GS-72-S-1	18-TP-GS-72-S-1	18
18-TR-102W,S-3	18-TR-102W,S-3	18
18-TR-109E,S-3	18-TR-109E,S-3	18
18-TR-109W,S-1	18-TR-109W,S-1	18
18-TR-110N,S-1	18-TR-110N,S-1	18
18-TR-110S,S-3	18-TR-110S,S-3	18
18-TR-111E,S-1	18-TR-111E,S-1	18
18-TR-111W,S-3	18-TR-111W,S-3	18
18-TR-112N,S-3	18-TR-112N,S-3	18
18-TR-112S,S-1	18-TR-112S,S-1	18
18-TR-113N,S-3	18-TR-113N,S-3	18
18-TR-114W,S-3	18-TR-114W,S-3	18
18-TR-115N,S-1	18-TR-115N,S-1	18
18-TR-115S,S-3	18-TR-115S,S-3	18
18-TR-116E,S-1	18-TR-116E,S-1	18
18-TR-116W,S-3	18-TR-116W,S-3	18
18-VS-249	18-VS-249	18
18-VS-250	18-VS-250	18
18-VS-251	18-VS-251	18
18-VS-252	18-VS-252	18
18-VS-257	18-VS-257	18
18-VS-258	18-VS-258	18
18-VS-259	18-VS-259	18
18-VS-260	18-VS-260	18
18R-107-75E	18R-107-75E	18-REF
18R-11	18R-11	18-REF
18R-112	18R-112	18-REF
18R-112-100E	18R-112-100E	18-REF
18R-112-100N	18R-112-100N	18-REF
18R-112-10E-DAVG	18R-112-10E-DAVG	18-REF
18R-112-10N	18R-112-10N	18-REF
18R-112-125N	18R-112-125N	18-REF
18R-112-25E	18R-112-25E	18-REF
18R-112-25N	18R-112-25N	18-REF
18R-112-50E	18R-112-50E	18-REF
18R-112-50N	18R-112-50N	18-REF
18R-112-75E	18R-112-75E	18-REF
18R-112-75N	18R-112-75N	18-REF

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18R-112-S-2	18R-112-S-2	18-REF
18R-113	18R-113	18-REF
18R-114	18R-114	18-REF
18R-115	18R-115	18-REF
18R-119	18R-119	18-REF
18R-12	18R-12	18-REF
18R-120-DAVG	18R-120-DAVG	18-REF
18R-121	18R-121	18-REF
18R-121-100N	18R-121-100N	18-REF
18R-121-100W-DAVG	18R-121-100W-DAVG	18-REF
18R-121-10N	18R-121-10N	18-REF
18R-121-10W	18R-121-10W	18-REF
18R-121-25N	18R-121-25N	18-REF
18R-121-25W	18R-121-25W	18-REF
18R-121-50N	18R-121-50N	18-REF
18R-121-50W	18R-121-50W	18-REF
18R-121-75N	18R-121-75N	18-REF
18R-121-75W	18R-121-75W	18-REF
18R-122	18R-122	18-REF
18R-123	18R-123	18-REF
18R-124	18R-124	18-REF
18R-125	18R-125	18-REF
18R-126	18R-126	18-REF
18R-127	18R-127	18-REF
18R-15	18R-15	18-REF
18R-15 6"-12"	18R-15 6"-12"	18-REF
18R-15-100N-DAVG	18R-15-100N-DAVG	18-REF
18R-15-10N	18R-15-10N	18-REF
18R-15-10W	18R-15-10W	18-REF
18R-15-25N	18R-15-25N	18-REF
18R-15-50N	18R-15-50N	18-REF
18R-15-75N	18R-15-75N	18-REF
18R-16	18R-16	18-REF
18R-432	18R-432	18-REF
18R-438	18R-438	18-REF
18R-439	18R-439	18-REF
18R-442	18R-442	18-REF
18R-451	18R-451	18-REF
18R-452	18R-452	18-REF
18R-452-S-2	18R-452-S-2	18-REF
18R-453	18R-453	18-REF

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
LR-106	LR-106	LR
LR-106-S-2	LR-106-S-2	LR
RR-121	RR-121	RR-N
RR-534	RR-534	RR-N
RR-535	RR-535	RR-N
18-MH-1	18-MH-1	18
18-MH-6	18-MH-6	18
18-SS-566	18-SS-566	18
18-SS-568	18-SS-568	18
18-SS-569	18-SS-569	18
18-SS-570	18-SS-570	18
18-SS-571	18-SS-571	18
18-SS-577	18-SS-577	18
18-SS-583-DAVG	18-SS-583-DAVG	18
18-SS-590	18-SS-590	18
18-SS-593	18-SS-593	18
18-SS-647	18-SS-647	18
18-SS-648	18-SS-648	18
18-SS-649	18-SS-649	18
18-SS-650	18-SS-650	18
18-SS-652	18-SS-652	18
18-SS-653	18-SS-653	18
18-SS-654	18-SS-654	18
18-SS-656	18-SS-656	18
18-SS-657	18-SS-657	18
18-SS-658	18-SS-658	18
18-SS-659	18-SS-659	18
18-SS-660	18-SS-660	18
18-SS-661	18-SS-661	18
18-SS-662	18-SS-662	18
18-SS-663-DAVG	18-SS-663-DAVG	18
18-SS-692-DAVG	18-SS-692-DAVG	18
18-SS-693	18-SS-693	18
18-SS-715	18-SS-715	18
18-SS-730	18-SS-730	18
18-SS-732	18-SS-732	18
18-SS-733-DAVG	18-SS-733-DAVG	18
18-SS-865	18-SS-865	18
18-SS-866	18-SS-866	18
18-SS-879	18-SS-879	18
18-SS-GS-34	18-SS-GS-34	18

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18-SS-GS-35	18-SS-GS-35	18
18-SS-GS-36	18-SS-GS-36	18
18-SS-GS-37	18-SS-GS-37	18
18-SS-GS-63	18-SS-GS-63	18
18-SS-GS-65	18-SS-GS-65	18
18-SS-GS-66	18-SS-GS-66	18
RR-566	RR-566	RR-N
RR-567	RR-567	RR-N
RR-567-A1	RR-567-A1	RR-N
RR-567-A2	RR-567-A2	RR-N
RR-567-B1	RR-567-B1	LR
RR-567-B2	RR-567-B2	LR
RR-567-S-2	RR-567-S-2	RR-N
Golf Course Area 9 (0 to <=1 foot)		
18-TP-41-S-1	18-TP-41-S-1	18
18-TP-501-S-1-DAVG	18-TP-501-S-1-DAVG	18 North
18-TP-503-S-1	18-TP-503-S-1	18 North
18-TP-505-S-1	18-TP-505-S-1	18 North
18-TP-506-S-1	18-TP-506-S-1	18 North
18-TP-507-S-1	18-TP-507-S-1	18 North
18-TP-508-S-1	18-TP-508-S-1	18 North
18-TP-509-S-1	18-TP-509-S-1	18
18-TP-512-S-1	18-TP-512-S-1	18
18-TP-513-S-1	18-TP-513-S-1	18
18-TP-53-S-1	18-TP-53-S-1	18
18-TP-547-S-1-DAVG	18-TP-547-S-1-DAVG	18 North
18-TP-549-S-1	18-TP-549-S-1	18
18-TP-559-S-1-DAVG	18-TP-559-S-1-DAVG	18 North
18-TP-GS-27-S-1	18-TP-GS-27-S-1	18
18-TP-GS-28-S-1	18-TP-GS-28-S-1	18
18-TP-GS-32-S-1	18-TP-GS-32-S-1	18
18-TP-GS-33-S-1	18-TP-GS-33-S-1	18
18-TP-GS-38-S-1	18-TP-GS-38-S-1	18
18-TP-GS-40-S-1	18-TP-GS-40-S-1	18
18-TP-GS-41-S-1	18-TP-GS-41-S-1	18
18-TP-GS-42-S-1	18-TP-GS-42-S-1	18
18-TP-GS-43-S-1	18-TP-GS-43-S-1	18
18-TP-GS-47-S-1	18-TP-GS-47-S-1	18
18-TP-GS-49-S-1	18-TP-GS-49-S-1	18
18-TP-GS-53-S-1	18-TP-GS-53-S-1	18
18-TP-GS-54-S-1	18-TP-GS-54-S-1	18

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18-TP-GS-59-S-1	18-TP-GS-59-S-1	18
18-TP-GS-81-S-1	18-TP-GS-81-S-1	18
18-TR-101N,S-3	18-TR-101N,S-3	18
18-TR-101S,S-1	18-TR-101S,S-1	18
18-TR-102E,S-1	18-TR-102E,S-1	18
18-TR-103S,S-1	18-TR-103S,S-1	18
18-VS-195	18-VS-195	1234
18-VS-196	18-VS-196	1234
18-VS-197	18-VS-197	1234
18-VS-198	18-VS-198	1234
18-VS-203	18-VS-203	1234
18-VS-204	18-VS-204	1234
18-VS-205	18-VS-205	1234
18-VS-208	18-VS-208	1234
18-VS-209	18-VS-209	1234
18-VS-210	18-VS-210	1234
18-VS-211	18-VS-211	1234
18R-02	18R-02	18-REF
18R-03	18R-03	18-REF
18R-06	18R-06	18-REF
18R-07	18R-07	18-REF
18R-402	18R-402	18-REF
18R-403	18R-403	18-REF
18R-407	18R-407	18-REF
18R-408	18R-408	18-REF
18R-412	18R-412	18-REF
18R-413	18R-413	18-REF
18R-414	18R-414	18-REF
18R-415	18R-415	18-REF
18R-416	18R-416	18-REF
18R-419	18R-419	18-REF
18R-420	18R-420	18-REF
18R-426	18R-426	18-REF
18R-428-DAVG	18R-428-DAVG	18-REF
RR-528	RR-528	RR-N
RR-528-S-2	RR-528-S-2	RR-N
RR-529	RR-529	RR-N
RR-531	RR-531	RR-N
1234-SS-501	1234-SS-501	1234
1234-SS-502	1234-SS-502	1234
1234-SS-503	1234-SS-503	1234

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
1234-SS-504	1234-SS-504	1234
1234-SS-505	1234-SS-505	1234
1234-SS-506	1234-SS-506	1234
1234-SS-507	1234-SS-507	1234
1234-SS-508	1234-SS-508	1234
1234-SS-509	1234-SS-509	1234
1234-SS-510	1234-SS-510	1234
1234-SS-511	1234-SS-511	1234
1234-SS-512	1234-SS-512	1234
1234-SS-513-DAVG	1234-SS-513-DAVG	1234
1234-SS-514-DAVG	1234-SS-514-DAVG	1234
1234-SS-515	1234-SS-515	1234
1234-TP-501-S-1	1234-TP-501-S-1	1234
1234-TP-502-S-1	1234-TP-502-S-1	1234
1234-TP-503-S-1	1234-TP-503-S-1	1234
1234-TP-504-S-1-DAVG	1234-TP-504-S-1-DAVG	1234
1234-TP-505-S-1	1234-TP-505-S-1	1234
1234-TP-506-S-1	1234-TP-506-S-1	1234
1234-TP-507-S-1	1234-TP-507-S-1	1234
1234-TP-508-S-1	1234-TP-508-S-1	1234
1234-TP-509-S-1	1234-TP-509-S-1	1234
1234-TP-511-S-1	1234-TP-511-S-1	1234
1234-TP-512-S-1	1234-TP-512-S-1	1234
1234-TP-513-S-1	1234-TP-513-S-1	1234
1234-TP-514-S-1	1234-TP-514-S-1	1234
1234-TP-515-S-1	1234-TP-515-S-1	1234
1234-TP-516-S-1-DAVG	1234-TP-516-S-1-DAVG	1234
1234-TP-518-S-1	1234-TP-518-S-1	1234
1234-TP-519-S-1	1234-TP-519-S-1	1234
1234-TP-520-S-1	1234-TP-520-S-1	1234
1234-TP-521-S-1	1234-TP-521-S-1	1234
1234-TP-522-S-1-DAVG	1234-TP-522-S-1-DAVG	1234
1234-TP-523-S-1	1234-TP-523-S-1	1234
1234-TP-524-S-1	1234-TP-524-S-1	1234
1234-TP-525-S-1	1234-TP-525-S-1	1234
1234-TP-526-S-1-DAVG	1234-TP-526-S-1-DAVG	1234
1234-TP-527-S-1	1234-TP-527-S-1	1234
18-SS-504	18-SS-504	18 North
18-SS-505	18-SS-505	18 North
18-SS-507	18-SS-507	18 North
18-SS-508	18-SS-508	18 North

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18-SS-509	18-SS-509	18 North
18-SS-521-DAVG	18-SS-521-DAVG	18 North
18-SS-522	18-SS-522	18 North
18-SS-523	18-SS-523	18 North
18-SS-524	18-SS-524	18 North
18-SS-525	18-SS-525	18 North
18-SS-527	18-SS-527	18 North
18-SS-528	18-SS-528	18 North
18-SS-539	18-SS-539	18 North
18-SS-540-DAVG	18-SS-540-DAVG	18 North
18-SS-541	18-SS-541	18 North
18-SS-542	18-SS-542	18 North
18-SS-543	18-SS-543	18 North
18-SS-614	18-SS-614	18
18-SS-624	18-SS-624	18
18-SS-639	18-SS-639	18
18-SS-640	18-SS-640	18
18-SS-644	18-SS-644	18
18-SS-645	18-SS-645	18
18-SS-646	18-SS-646	18
18-SS-666	18-SS-666	18 North
18-SS-670	18-SS-670	18 North
18-SS-687	18-SS-687	18 North
18-SS-688	18-SS-688	18 North
18-SS-689	18-SS-689	18
18-SS-690	18-SS-690	18 North
18-SS-696	18-SS-696	18 North
18-SS-697	18-SS-697	18 North
18-SS-698	18-SS-698	18 North
18-SS-705	18-SS-705	18 North
18-SS-706	18-SS-706	18 North
18-SS-707	18-SS-707	18 North
18-SS-708	18-SS-708	18 North
18-SS-709	18-SS-709	18 North
18-SS-716	18-SS-716	18
18-SS-725	18-SS-725	18
18-SS-726	18-SS-726	18
18-SS-727	18-SS-727	18
18-SS-729	18-SS-729	18
18-SS-835	18-SS-835	18 North
18-SS-836	18-SS-836	18 North

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18-SS-839	18-SS-839	18 North
18-SS-840	18-SS-840	18 North
18-SS-841	18-SS-841	18 North
18-SS-842	18-SS-842	18 North
18-SS-843-DAVG	18-SS-843-DAVG	18 North
18-SS-844	18-SS-844	18 North
18-SS-845	18-SS-845	18 North
18-SS-846	18-SS-846	18 North
18-SS-847	18-SS-847	18 North
18-SS-852	18-SS-852	18 North
18-SS-853	18-SS-853	18 North
18-SS-854	18-SS-854	18 North
18-SS-856	18-SS-856	18
18-SS-857	18-SS-857	18 North
18-SS-858	18-SS-858	18 North
18-SS-859	18-SS-859	18 North
18-SS-860-DAVG	18-SS-860-DAVG	18
18-SS-861	18-SS-861	18
18-SS-862	18-SS-862	18 North
18-SS-863	18-SS-863	18 North
18-SS-864	18-SS-864	18 North
18-SS-867	18-SS-867	18
18-SS-868	18-SS-868	18 North
18-SS-869	18-SS-869	18 North
18-SS-874	18-SS-874	18 North
18-SS-875-DAVG	18-SS-875-DAVG	18
18-SS-876	18-SS-876	18
18-SS-877	18-SS-877	18
18-SS-878	18-SS-878	18
18-SS-887	18-SS-887	18 North
18-SS-888	18-SS-888	18 North
18-SS-889	18-SS-889	18 North
18-SS-891	18-SS-891	18 North
18-SS-892	18-SS-892	18 North
18-SS-893	18-SS-893	18 North
18-SS-894	18-SS-894	18 North
18-SS-896	18-SS-896	18 North
18-SS-897	18-SS-897	18
18-SS-898	18-SS-898	18 North
18-SS-899	18-SS-899	18 North
18-SS-900	18-SS-900	18 North

Table B-3 – Golf Course Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
18-SS-901	18-SS-901	18 North
18-SS-902	18-SS-902	18 North
18-SS-903	18-SS-903	18 North
18-SS-904	18-SS-904	18 North
18-SS-905	18-SS-905	18 North
18-SS-906	18-SS-906	18 North
18-SS-909	18-SS-909	18 North
18-SS-910	18-SS-910	18 North
18-SS-917	18-SS-917	18 North
18-SS-918	18-SS-918	18 North
18-SS-919	18-SS-919	18 North
18-SS-927	18-SS-927	18 North
18-SS-GS-13	18-SS-GS-13	18
18-SS-GS-20	18-SS-GS-20	18
18-SS-GS-21	18-SS-GS-21	18
18-SS-GS-26	18-SS-GS-26	18
18-SS-GS-29	18-SS-GS-29	18
18-SS-GS-30	18-SS-GS-30	18
18-SS-GS-31	18-SS-GS-31	18
18-SS-GS-39	18-SS-GS-39	18
18-SS-GS-44	18-SS-GS-44	18
18-SS-GS-45	18-SS-GS-45	18
18-SS-GS-46	18-SS-GS-46	18
18-SS-GS-48	18-SS-GS-48	18
18-SS-GS-50	18-SS-GS-50	18
18-SS-GS-51	18-SS-GS-51	18
18-SS-GS-52	18-SS-GS-52	18
18-SS-GS-57	18-SS-GS-57	18
18-SS-GS-58	18-SS-GS-58	18
18-SS-GS-60	18-SS-GS-60	18
18-SS-GS-61	18-SS-GS-61	18
18-SS-GS-64	18-SS-GS-64	18

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
Golf Course Area 1 (1 to <=15 feet)		
25-B-501-S-4-DAVG	25-B-501-S-4-DAVG	25
25-TP-10,S-1	25-TP-10,S-1	25
25-TP-10,S-2	25-TP-10,S-2	25
25-TP-11,S-1	25-TP-11,S-1	25
25-TP-11,S-2	25-TP-11,S-2	25
25-TP-501-S-2-DAVG	25-TP-501-S-2-DAVG	25
25-TP-501-S-3	25-TP-501-S-3	25
25-TP-502-S-2	25-TP-502-S-2	25
25-TP-502-S-3	25-TP-502-S-3	25
25-TP-503-S-3	25-TP-503-S-3	25
25-TP-503-S-4	25-TP-503-S-4	25
25-TP-505-S-2	25-TP-505-S-2	25
25-TP-506-S-2	25-TP-506-S-2	25
25-TP-511-S-2	25-TP-511-S-2	25
25-TP-511-S-3	25-TP-511-S-3	25
25-TP-515-S-2	25-TP-515-S-2	25
25-TP-516-S-3	25-TP-516-S-3	25
25-TP-517-S-2	25-TP-517-S-2	25
25-TP-524-S-2	25-TP-524-S-2	25
25-TP-524-S-3	25-TP-524-S-3	25
25-TP-7,S-1	25-TP-7,S-1	25
25-TP-7,S-2	25-TP-7,S-2	25
25-TP-8,S-1	25-TP-8,S-1	25
25-TP-8,S-2	25-TP-8,S-2	25
25-TP-9,S-1	25-TP-9,S-1	25
25-TP-9,S-2	25-TP-9,S-2	25
26-TP-513-S-2	26-TP-513-S-2	26
26-TP-513-S-3	26-TP-513-S-3	26
26-TP-514-S-2	26-TP-514-S-2	26
26-TP-514-S-3	26-TP-514-S-3	26
26-TP-515-S-2	26-TP-515-S-2	26
26-TP-515-S-3	26-TP-515-S-3	26
26-TP-517-S-2	26-TP-517-S-2	26
26-TP-518-S-2	26-TP-518-S-2	26
26-TP-518-S-3	26-TP-518-S-3	26
26-TP-522-S-2	26-TP-522-S-2	26
36-TP-1-S-3	36-TP-1-S-3	36
36-TP-2-S-3	36-TP-2-S-3	36
36-TP-4-S-3	36-TP-4-S-3	36
36-TP-5-S-3	36-TP-5-S-3	36

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
36-TP-6-S-2	36-TP-6-S-2	36
36-TP-6-S-3	36-TP-6-S-3	36
39-B-1-S-6	39-B-1-S-6	39
39-B-1-S-7	39-B-1-S-7	39
5-TP-513-S-3	5-TP-513-S-3	5
Golf Course Area 2 (1 to <=15 feet)		
16-B-3,S-1	16-B-3,S-1	16
16-B-3,S-3	16-B-3,S-3	16
16-B-3,S-5-DAVG	16-B-3,S-5-DAVG	16
16-B-4,S-1	16-B-4,S-1	16
16-B-4,S-3	16-B-4,S-3	16
16-B-4,S-4-DAVG	16-B-4,S-4-DAVG	16
16-B-4,S-5	16-B-4,S-5	16
16-B-5,S-3	16-B-5,S-3	16
16-B-501-S-1B	16-B-501-S-1B	16
16-B-501-S-1C	16-B-501-S-1C	16
16-B-501-S-2A	16-B-501-S-2A	16
16-B-501-S-3	16-B-501-S-3	16
16-B-501-S-3A	16-B-501-S-3A	16
16-B-502-S-2	16-B-502-S-2	16
16-B-503-S-2	16-B-503-S-2	16
16-B-503-S-3	16-B-503-S-3	16
16-B-503-S-4	16-B-503-S-4	16
16-B-504-S-1A	16-B-504-S-1A	16
16-B-504-S-2	16-B-504-S-2	16
16-B-504-S-2A	16-B-504-S-2A	16
16-B-504-S-3	16-B-504-S-3	16
16-B-505-S-1C	16-B-505-S-1C	16
16-B-505-S-2	16-B-505-S-2	16
16-B-505-S-2A	16-B-505-S-2A	16
16-B-505-S-3	16-B-505-S-3	16
16-TP-10,S-2	16-TP-10,S-2	16
16-TP-11,S-2	16-TP-11,S-2	16
16-TP-12,S-2	16-TP-12,S-2	16
16-TP-14,S-2	16-TP-14,S-2	16
16-TP-16,S-2	16-TP-16,S-2	16
16-TP-3,S-2	16-TP-3,S-2	16
16-TP-501-S-2	16-TP-501-S-2	16
16-TP-501-S-3	16-TP-501-S-3	16
16-TP-502-S-2	16-TP-502-S-2	16
16-TP-502-S-3	16-TP-502-S-3	16

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
16-TP-503-S-2	16-TP-503-S-2	16
16-TP-503-S-3	16-TP-503-S-3	16
16-TP-504-S-2	16-TP-504-S-2	16
16-TP-504-S-3	16-TP-504-S-3	16
16-TP-505-S-2	16-TP-505-S-2	16
16-TP-505-S-3	16-TP-505-S-3	16
16-TP-507-S-2	16-TP-507-S-2	16
16-TP-507-S-3	16-TP-507-S-3	16
16-TP-508-S-2	16-TP-508-S-2	16
16-TP-508-S-3	16-TP-508-S-3	16
16-TP-509-S-2	16-TP-509-S-2	16
16-TP-509-S-3	16-TP-509-S-3	16
16-TP-6,S-2	16-TP-6,S-2	16
16-TP-7,S-2	16-TP-7,S-2	16
16-TP-8,S-2	16-TP-8,S-2	16
16-TP-9,S-2	16-TP-9,S-2	16
5-HA-513-S-2	5-HA-513-S-2	5
5-HA-514-S-2	5-HA-514-S-2	5
5-HA-515-S-2	5-HA-515-S-2	5
5-HA-516-S-2	5-HA-516-S-2	5
5-HA-517-S-2	5-HA-517-S-2	5
5-TP-511-S-3	5-TP-511-S-3	5
5-TP-512-S-3	5-TP-512-S-3	5
5D-TPS-13-S-3	5D-TPS-13-S-3	5D
5D-TPS-15-S-3	5D-TPS-15-S-3	5D
5D-TPS-16-S-3	5D-TPS-16-S-3	5D
5D-TPS-17-S-3	5D-TPS-17-S-3	5D
5D-TPS-19-S-3	5D-TPS-19-S-3	5D
5D-TPS-21-S-2-DAVG	5D-TPS-21-S-2-DAVG	5D
5D-TPS-21-S-3	5D-TPS-21-S-3	5D
5D-TPS-8-S-3	5D-TPS-8-S-3	5D
APE-TP-501-S-2	APE-TP-501-S-2	APE
APE-TP-502-S-3	APE-TP-502-S-3	APE
APG-TP-503-S-2	APG-TP-503-S-2	LR
APG-TP-504-S-2	APG-TP-504-S-2	LR
LR-020 1'-2'	LR-020 1'-2'	LR
LR-020-S-3	LR-020-S-3	LR
Golf Course Area 3 (1 to <=15 feet)		
38-B-501-S-2	38-B-501-S-2	38
38-B-501-S-3	38-B-501-S-3	38
38-HA-502-S-2	38-HA-502-S-2	38

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
38-HA-503-S-2	38-HA-503-S-2	38
Golf Course Area 4 (1 to <=15 feet)		
26-B-1,S-2	26-B-1,S-2	26
26-B-2,S-1	26-B-2,S-1	26
26-B-2,S-3	26-B-2,S-3	26
26-B-2,S-4-DAVG	26-B-2,S-4-DAVG	26
26-B-2,S-6	26-B-2,S-6	26
26-B-3,S-1	26-B-3,S-1	26
26-B-3,S-2	26-B-3,S-2	26
26-B-3,S-4	26-B-3,S-4	26
26-B-4,S-1	26-B-4,S-1	26
26-B-4,S-2	26-B-4,S-2	26
26-B-4,S-4	26-B-4,S-4	26
26-B-4,S-5-DAVG	26-B-4,S-5-DAVG	26
26-B-5,S-1	26-B-5,S-1	26
26-B-5,S-2	26-B-5,S-2	26
26-B-5,S-4	26-B-5,S-4	26
26-B-501-S-1A	26-B-501-S-1A	26
26-B-501-S-2-DAVG	26-B-501-S-2-DAVG	26
26-B-501-S-3	26-B-501-S-3	26
26-B-502-S-1A	26-B-502-S-1A	26
26-B-502-S-2	26-B-502-S-2	26
26-B-502-S-3	26-B-502-S-3	26
26-B-503-S-1A	26-B-503-S-1A	26
26-B-503-S-2A	26-B-503-S-2A	26
26-B-503-S-2C	26-B-503-S-2C	26
26-B-503-S-3	26-B-503-S-3	26
26-B-6,S-1	26-B-6,S-1	26
26-B-6,S-2	26-B-6,S-2	26
26-B-6,S-4	26-B-6,S-4	26
26-HA-501-S-2	26-HA-501-S-2	26
26-HA-503-S-2	26-HA-503-S-2	26
26-HA-504-S-2	26-HA-504-S-2	26
26-TP-501-S-2-DAVG	26-TP-501-S-2-DAVG	26
26-TP-501-S-3	26-TP-501-S-3	26
26-TP-502-S-2-DAVG	26-TP-502-S-2-DAVG	26
26-TP-502-S-3	26-TP-502-S-3	26
26-TP-503-S-2	26-TP-503-S-2	26
26-TP-503-S-3	26-TP-503-S-3	26
26-TP-504-S-2	26-TP-504-S-2	26
26-TP-504-S-3	26-TP-504-S-3	26

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
26-TP-505-S-2	26-TP-505-S-2	26
26-TP-505-S-3	26-TP-505-S-3	26
26-TP-506-S-2	26-TP-506-S-2	26
26-TP-506-S-3	26-TP-506-S-3	26
26-TP-507-S-2	26-TP-507-S-2	26
26-TP-507-S-3	26-TP-507-S-3	26
26-TP-510-S-2	26-TP-510-S-2	26
26-TP-510-S-3	26-TP-510-S-3	26
26-TP-511-S-2A	26-TP-511-S-2A	26
26-TP-511-S-3	26-TP-511-S-3	26
26-TP-516-S-2	26-TP-516-S-2	26
26-TP-519-S-2	26-TP-519-S-2	26
APF-HA-501-S-3	APF-HA-501-S-3	APF
APF-TP-501-S-2	APF-TP-501-S-2	APF
LR-060 1'-2'	LR-060 1'-2'	LR
LR-060-S-3	LR-060-S-3	LR
LR-125E-S-3	LR-125E-S-3	LR
LR-311-S-3	LR-311-S-3	LR
LR-318-S-3	LR-318-S-3	LR
Golf Course Area 5 (1 to <=15 feet)		
12-1-TP-502-S-2-DAVG	12-1-TP-502-S-2-DAVG	12
12-1-TP-503-S-2-DAVG	12-1-TP-503-S-2-DAVG	12
12-2-B-501-S-2-DAVG	12-2-B-501-S-2-DAVG	12
12-2-B-501-S-2A	12-2-B-501-S-2A	12
12-2-B-501-S-3A	12-2-B-501-S-3A	12
12-2-B-502-S-2-DAVG	12-2-B-502-S-2-DAVG	12
12-2-B-502-S-3	12-2-B-502-S-3	12
12-2-OBTP-504-S-2	12-2-OBTP-504-S-2	12
12-2-OBTP-505-S-2	12-2-OBTP-505-S-2	12
12-2-OBTP-505-S-3	12-2-OBTP-505-S-3	12
12-2-TP-10,S-1	12-2-TP-10,S-1	12
12-2-TP-10,S-2	12-2-TP-10,S-2	12
12-2-TP-501-S-2	12-2-TP-501-S-2	12
12-2-TP-501-S-3	12-2-TP-501-S-3	12
12-2-TP-502-S-2	12-2-TP-502-S-2	12
12-2-TP-503-S-2	12-2-TP-503-S-2	12
12-2-TP-503-S-3-DAVG	12-2-TP-503-S-3-DAVG	12
12-2-TP-503-S-4	12-2-TP-503-S-4	12
12-2-TP-504-S-2-DAVG	12-2-TP-504-S-2-DAVG	12
12-2-TP-505-S-2-DAVG	12-2-TP-505-S-2-DAVG	12
12-2-TP-505-S-3	12-2-TP-505-S-3	12

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
12-2-TP-506-S-2	12-2-TP-506-S-2	12
12-2-TP-9,S-1	12-2-TP-9,S-1	12
12-2-TP-9,S-2	12-2-TP-9,S-2	12
12-3-TP-3,S-1	12-3-TP-3,S-1	12
12-3-TP-3,S-2	12-3-TP-3,S-2	12
12-3-TP-501-S-2-DAVG	12-3-TP-501-S-2-DAVG	12
12-3-TP-501-S-3	12-3-TP-501-S-3	12
12-3-TP-502-S-2	12-3-TP-502-S-2	12
12-3-TP-502-S-3	12-3-TP-502-S-3	12
12-3-TP-503-S-2	12-3-TP-503-S-2	12
12-3-TP-503-S-3	12-3-TP-503-S-3	12
12-4-TP-501-S-2	12-4-TP-501-S-2	12
12-TP-501-S-2-DAVG	12-TP-501-S-2-DAVG	12
12-TP-501-S-3	12-TP-501-S-3	12
12-TP-502-S-2-DAVG	12-TP-502-S-2-DAVG	12
12-TP-502-S-3	12-TP-502-S-3	12
12-TP-503-S-2	12-TP-503-S-2	12
12-TP-503-S-3	12-TP-503-S-3	12
RR-559-S-3	RR-559-S-3	RR-N
Golf Course Area 6 (1 to <=15 feet)		
18-TP-553-S-2	18-TP-553-S-2	18
18-TP-554-S-2	18-TP-554-S-2	18
18-TP-554-S-3	18-TP-554-S-3	18
18-TP-555-S-2-DAVG	18-TP-555-S-2-DAVG	18
18-TP-555-S-3	18-TP-555-S-3	18
18-TP-556-S-2	18-TP-556-S-2	18
18-TP-556-S-3	18-TP-556-S-3	18
18-TP-557-S-2	18-TP-557-S-2	18
18-TP-557-S-3	18-TP-557-S-3	18
18-TP-558-S-3	18-TP-558-S-3	18
18-TP-558-S-4	18-TP-558-S-4	18
18R-474-S-3	18R-474-S-3	18-REF
RR-515 1'-2'	RR-515 1'-2'	RR-N
Golf Course Area 7 (1 to <=15 feet)		
18-TP-34,S-1	18-TP-34,S-1	18
18-TP-514-S-2	18-TP-514-S-2	18
18-TP-514-S-3	18-TP-514-S-3	18
18-TP-515-S-2	18-TP-515-S-2	18
18-TP-515-S-3	18-TP-515-S-3	18
18-TP-516-S-2	18-TP-516-S-2	18
18-TP-516-S-3	18-TP-516-S-3	18

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
18-TP-518-S-2	18-TP-518-S-2	18
18-TP-518-S-3	18-TP-518-S-3	18
18-TP-532-S-2	18-TP-532-S-2	18
18-TP-532-S-3	18-TP-532-S-3	18
18-TP-533-S-2-DAVG	18-TP-533-S-2-DAVG	18
18-TP-533-S-4	18-TP-533-S-4	18
18-TP-543-S-2	18-TP-543-S-2	18
18-TP-543-S-3	18-TP-543-S-3	18
18-TP-544-S-2	18-TP-544-S-2	18
18-TP-544-S-3	18-TP-544-S-3	18
18-TP-545-S-2	18-TP-545-S-2	18
18-TP-545-S-3	18-TP-545-S-3	18
18-TP-548-S-2	18-TP-548-S-2	18
18-TP-548-S-3	18-TP-548-S-3	18
18-TP-603-S-2-DAVG	18-TP-603-S-2-DAVG	18
18-TP-603-S-3	18-TP-603-S-3	18
18-TP-DEP,S-2	18-TP-DEP,S-2	18
18-TP-GS-24-S-2	18-TP-GS-24-S-2	18
18-TP-GS-25-S-2	18-TP-GS-25-S-2	18
18-TR-105N,S-2	18-TR-105N,S-2	18
18-TR-105S,S-4	18-TR-105S,S-4	18
18-TR-106E,S-4	18-TR-106E,S-4	18
18-TR-106W,S-2	18-TR-106W,S-2	18
18-TR-107S,S-4	18-TR-107S,S-4	18
18R-107-S-3	18R-107-S-3	18-REF
Golf Course Area 8 (1 to <=15 feet)		
18-TP-21,S-1	18-TP-21,S-1	18
18-TP-521-S-3	18-TP-521-S-3	18
18-TP-522-S-3	18-TP-522-S-3	18
18-TP-523-S-2	18-TP-523-S-2	18
18-TP-523-S-3	18-TP-523-S-3	18
18-TP-524-S-2	18-TP-524-S-2	18
18-TP-524-S-3	18-TP-524-S-3	18
18-TP-525-S-2	18-TP-525-S-2	18
18-TP-525-S-3	18-TP-525-S-3	18
18-TP-526-S-2	18-TP-526-S-2	18
18-TP-526-S-3	18-TP-526-S-3	18
18-TP-527-S-2-DAVG	18-TP-527-S-2-DAVG	18
18-TP-527-S-3	18-TP-527-S-3	18
18-TP-528-S-2	18-TP-528-S-2	18
18-TP-528-S-3	18-TP-528-S-3	18

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
18-TP-529-S-2	18-TP-529-S-2	18
18-TP-529-S-3	18-TP-529-S-3	18
18-TP-530-S-2	18-TP-530-S-2	18
18-TP-530-S-3	18-TP-530-S-3	18
18-TP-534-S-2	18-TP-534-S-2	18
18-TP-534-S-3	18-TP-534-S-3	18
18-TP-550-S-2	18-TP-550-S-2	18
18-TP-550-S-3	18-TP-550-S-3	18
18-TP-551-S-2	18-TP-551-S-2	18
18-TP-551-S-3	18-TP-551-S-3	18
18-TP-552-S-2	18-TP-552-S-2	18
18-TP-552-S-3	18-TP-552-S-3	18
18-TP-604-S-1	18-TP-604-S-1	18
18-TP-604-S-2	18-TP-604-S-2	18
18-TP-GS-62-S-2	18-TP-GS-62-S-2	18
18-TP-GS-70-S-2	18-TP-GS-70-S-2	18
18-TP-GS-72-S-2	18-TP-GS-72-S-2	18
18-TR-102W,S-4	18-TR-102W,S-4	18
18-TR-109E,S-4	18-TR-109E,S-4	18
18-TR-109W,S-2	18-TR-109W,S-2	18
18-TR-110N,S-2	18-TR-110N,S-2	18
18-TR-110S,S-4	18-TR-110S,S-4	18
18-TR-111E,S-2	18-TR-111E,S-2	18
18-TR-111W,S-4	18-TR-111W,S-4	18
18-TR-112N,S-4	18-TR-112N,S-4	18
18-TR-112S,S-2	18-TR-112S,S-2	18
18-TR-113N,S-4	18-TR-113N,S-4	18
18-TR-114-S-2	18-TR-114-S-2	18
18-TR-114W,S-4	18-TR-114W,S-4	18
18-TR-115N,S-2	18-TR-115N,S-2	18
18-TR-115S,S-4	18-TR-115S,S-4	18
18-TR-116E,S-2	18-TR-116E,S-2	18
18-TR-116W,S-4	18-TR-116W,S-4	18
18R-112-S-3	18R-112-S-3	18-REF
18R-15 1'-2'-DAVG	18R-15 1'-2'-DAVG	18-REF
18R-452-S-3	18R-452-S-3	18-REF
LR-106-S-3	LR-106-S-3	LR
RR-567-S-3	RR-567-S-3	RR-N
Golf Course Area 9 (1 to <=15 feet)		
1-TP-14,S-1	1-TP-14,S-1	1234
1-TP-15,S-1	1-TP-15,S-1	1234

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
1-TP-15,S-2	1-TP-15,S-2	1234
1-TP-2,S-1	1-TP-2,S-1	1234
1-TP-4,S-1	1-TP-4,S-1	1234
1-TP-6,S-1	1-TP-6,S-1	1234
1-TP-8,S-1	1-TP-8,S-1	1234
1234-TP-501-S-2	1234-TP-501-S-2	1234
1234-TP-501-S-3	1234-TP-501-S-3	1234
1234-TP-502-S-2	1234-TP-502-S-2	1234
1234-TP-502-S-3	1234-TP-502-S-3	1234
1234-TP-503-S-2	1234-TP-503-S-2	1234
1234-TP-503-S-3	1234-TP-503-S-3	1234
1234-TP-504-S-2	1234-TP-504-S-2	1234
1234-TP-504-S-3	1234-TP-504-S-3	1234
1234-TP-505-S-2	1234-TP-505-S-2	1234
1234-TP-505-S-3	1234-TP-505-S-3	1234
1234-TP-506-S-2	1234-TP-506-S-2	1234
1234-TP-506-S-3	1234-TP-506-S-3	1234
1234-TP-507-S-2	1234-TP-507-S-2	1234
1234-TP-507-S-3	1234-TP-507-S-3	1234
1234-TP-508-S-2	1234-TP-508-S-2	1234
1234-TP-508-S-3	1234-TP-508-S-3	1234
1234-TP-509-S-2	1234-TP-509-S-2	1234
1234-TP-509-S-3	1234-TP-509-S-3	1234
1234-TP-510-S-2-DAVG	1234-TP-510-S-2-DAVG	1234
1234-TP-510-S-3	1234-TP-510-S-3	1234
1234-TP-511-S-2	1234-TP-511-S-2	1234
1234-TP-511-S-3	1234-TP-511-S-3	1234
1234-TP-512-S-2	1234-TP-512-S-2	1234
1234-TP-512-S-3	1234-TP-512-S-3	1234
1234-TP-513-S-2	1234-TP-513-S-2	1234
1234-TP-513-S-3	1234-TP-513-S-3	1234
1234-TP-514-S-2	1234-TP-514-S-2	1234
1234-TP-514-S-3	1234-TP-514-S-3	1234
1234-TP-515-S-2	1234-TP-515-S-2	1234
1234-TP-515-S-3	1234-TP-515-S-3	1234
1234-TP-516-S-2	1234-TP-516-S-2	1234
1234-TP-516-S-3	1234-TP-516-S-3	1234
1234-TP-518-S-2	1234-TP-518-S-2	1234
1234-TP-518-S-3	1234-TP-518-S-3	1234
1234-TP-519-S-2	1234-TP-519-S-2	1234
1234-TP-519-S-3	1234-TP-519-S-3	1234

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
1234-TP-520-S-2	1234-TP-520-S-2	1234
1234-TP-520-S-3	1234-TP-520-S-3	1234
1234-TP-521-S-2	1234-TP-521-S-2	1234
1234-TP-521-S-3	1234-TP-521-S-3	1234
1234-TP-522-S-2-DAVG	1234-TP-522-S-2-DAVG	1234
1234-TP-522-S-3	1234-TP-522-S-3	1234
1234-TP-523-S-2	1234-TP-523-S-2	1234
1234-TP-523-S-3	1234-TP-523-S-3	1234
1234-TP-524-S-2	1234-TP-524-S-2	1234
1234-TP-524-S-3	1234-TP-524-S-3	1234
1234-TP-525-S-2	1234-TP-525-S-2	1234
1234-TP-525-S-3	1234-TP-525-S-3	1234
1234-TP-526-S-2-DAVG	1234-TP-526-S-2-DAVG	1234
1234-TP-526-S-3	1234-TP-526-S-3	1234
1234-TP-527-S-2	1234-TP-527-S-2	1234
1234-TP-527-S-3	1234-TP-527-S-3	1234
18-B-501-S-1	18-B-501-S-1	18
18-B-501-S-2	18-B-501-S-2	18
18-TP-501-S-2-DAVG	18-TP-501-S-2-DAVG	18 North
18-TP-501-S-3	18-TP-501-S-3	18 North
18-TP-503-S-2	18-TP-503-S-2	18 North
18-TP-503-S-3	18-TP-503-S-3	18 North
18-TP-505-S-2	18-TP-505-S-2	18 North
18-TP-505-S-3	18-TP-505-S-3	18 North
18-TP-506-S-2	18-TP-506-S-2	18 North
18-TP-506-S-3	18-TP-506-S-3	18 North
18-TP-507-S-2	18-TP-507-S-2	18 North
18-TP-507-S-3	18-TP-507-S-3	18 North
18-TP-508-S-2	18-TP-508-S-2	18 North
18-TP-508-S-3	18-TP-508-S-3	18 North
18-TP-509-S-2	18-TP-509-S-2	18
18-TP-509-S-3	18-TP-509-S-3	18
18-TP-510-S-2-DAVG	18-TP-510-S-2-DAVG	18
18-TP-510-S-3	18-TP-510-S-3	18
18-TP-512-S-2	18-TP-512-S-2	18
18-TP-512-S-3	18-TP-512-S-3	18
18-TP-513-S-2	18-TP-513-S-2	18
18-TP-513-S-3	18-TP-513-S-3	18
18-TP-547-S-2-DAVG	18-TP-547-S-2-DAVG	18 North
18-TP-547-S-3	18-TP-547-S-3	18 North
18-TP-549-S-2	18-TP-549-S-2	18

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
18-TP-549-S-3	18-TP-549-S-3	18
18-TP-559-S-2-DAVG	18-TP-559-S-2-DAVG	18 North
18-TP-559-S-3	18-TP-559-S-3	18 North
18-TP-600-S-1	18-TP-600-S-1	18
18-TP-600-S-2	18-TP-600-S-2	18
18-TP-601-S-2	18-TP-601-S-2	18
18-TP-601-S-3	18-TP-601-S-3	18
18-TP-602-S-2	18-TP-602-S-2	18
18-TP-602-S-3	18-TP-602-S-3	18
18-TP-GS-22-S-2	18-TP-GS-22-S-2	18
18-TP-GS-27-S-2	18-TP-GS-27-S-2	18
18-TP-GS-28-S-2	18-TP-GS-28-S-2	18
18-TP-GS-32-S-2	18-TP-GS-32-S-2	18
18-TP-GS-33-S-2	18-TP-GS-33-S-2	18
18-TP-GS-38-S-2	18-TP-GS-38-S-2	18
18-TP-GS-40-S-2	18-TP-GS-40-S-2	18
18-TP-GS-41-S-2	18-TP-GS-41-S-2	18
18-TP-GS-42-S-2	18-TP-GS-42-S-2	18
18-TP-GS-43-S-2	18-TP-GS-43-S-2	18
18-TP-GS-47-S-2	18-TP-GS-47-S-2	18
18-TP-GS-49-S-2	18-TP-GS-49-S-2	18
18-TP-GS-53-S-2	18-TP-GS-53-S-2	18
18-TP-GS-54-S-2	18-TP-GS-54-S-2	18
18-TP-GS-59-S-2	18-TP-GS-59-S-2	18
18-TP-GS-81-S-2	18-TP-GS-81-S-2	18
18-TR-101N,S-4	18-TR-101N,S-4	18
18-TR-101S,S-2	18-TR-101S,S-2	18
18-TR-102E,S-2	18-TR-102E,S-2	18
18-TR-103S,S-2	18-TR-103S,S-2	18
3-TP-1,S-1-DAVG	3-TP-1,S-1-DAVG	1234
3-TP-1,S-2	3-TP-1,S-2	1234
3-TP-2,S-1	3-TP-2,S-1	1234
3-TP-2,S-2	3-TP-2,S-2	1234
3-TP-3,S-1	3-TP-3,S-1	1234
3-TP-3,S-2	3-TP-3,S-2	1234
3-TP-4,S-1-DAVG	3-TP-4,S-1-DAVG	1234
3-TP-4,S-2	3-TP-4,S-2	1234
3-TP-5,S-1	3-TP-5,S-1	1234
3-TP-5,S-2-DAVG	3-TP-5,S-2-DAVG	1234
3-TP-6,S-1	3-TP-6,S-1	1234
3-TP-6,S-2	3-TP-6,S-2	1234

Table B-4 – Golf Course Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
RR-528-S-3	RR-528-S-3	RR-N

Table B-5 – Historical Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
Historical Area 1 (0 to <=1 foot)		
18-SS-517	18-SS-517	18 North
18-SS-884	18-SS-884	18 North
18-SS-885	18-SS-885	18 North
RR-530-A	RR-530-A	RR-N
RR-530-B	RR-530-B	LR
RR-530-C	RR-530-C	LR
Historical Area 2 (0 to <=1 foot)		
01-SM-SS-[R67C2]-D1-005	R67C2	MISC
01-SM-SS-[R67C3]-D1-005	R67C3	MISC
01-SM-SS-[R67C4]-D1-005	R67C4	MISC
01-SM-SS-[R68C2]-D1-005	R68C2	MISC
01-SM-SS-[R68C3]-D1-005	R68C3	MISC
01-SM-SS-[R68C4]-D1-005	R68C4	MISC
01-SM-SS-[R69C4]-D1-005	R69C4	MISC
BG-SS-4	BG-SS-4	LR
LR-195	LR-195	LR
Historical Area 3 (0 to <=1 foot)		
01-H404-SS[11]D1-005-DAVG	H404-11	MISC
01-H404-SS[2]D1-005	H404-2	MISC
01-H404-SS[3]D1-005	H404-3	MISC
01-H404-SS[5]D1-005	H404-5	MISC
01-H404-SS[7]D1-005	H404-7	MISC
01-H404-SS[8]D1-005	H404-8	MISC
01-H404-SS[9]D1-005	H404-9	MISC
19-VS-38	19-VS-38	MISC

Table B-6 – Industrial Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
Industrial Area (0 to <=1 foot)		
10-SS-401	10-SS-401	10
10-VS-2a	10-VS-2a	10
31-SS-403	31-SS-403	31-REF
31-SS-404	31-SS-404	31-REF
31-SS-501-DAVG	31-SS-501-DAVG	31-REF
31-SS-503	31-SS-503	31-REF
31-SS-504	31-SS-504	31-REF
31-SS-505	31-SS-505	31-REF
31-SS-506	31-SS-506	31-REF
31-SS-507	31-SS-507	31-REF
31-SS-509	31-SS-509	31-REF
31-SS-511	31-SS-511	31-REF
31-SS-512	31-SS-512	31-REF
31-SS-513	31-SS-513	31-REF
31-SS-518	31-SS-518	31-REF
31-SS-519	31-SS-519	31-REF
31-SS-520	31-SS-520	31-REF
31-SS-521	31-SS-521	31-REF
31-SS-522	31-SS-522	31-REF
31-SS-523	31-SS-523	31-REF
31-SS-524	31-SS-524	31-REF
31-SS-525	31-SS-525	31-REF
31-SS-526	31-SS-526	31-REF
31-SS-527-DAVG	31-SS-527-DAVG	31-REF
31-SS-528	31-SS-528	31-REF
31-SS-529	31-SS-529	31-REF
31-SS-530	31-SS-530	31-REF
31-SS-533	31-SS-533	31-REF
31-SS-535-DAVG	31-SS-535-DAVG	31-REF
31-SS-536	31-SS-536	31-REF
31-SS-600	31-SS-600	31
31-SS-601	31-SS-601	31
31-SS-602	31-SS-602	31
31-SS-603	31-SS-603	31
31-SS-606	31-SS-606	31
31-SS-608	31-SS-608	31
31-SS-609	31-SS-609	31
31-SS-610	31-SS-610	31
31-SS-614	31-SS-614	31
31-SS-621	31-SS-621	31

Table B-6 – Industrial Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
31-SS-624	31-SS-624	31
31-SS-626	31-SS-626	31
31-SS-627	31-SS-627	31
31-SS-628	31-SS-628	31
31-SS-629	31-SS-629	31
31-SS-631	31-SS-631	31
31-SS-632	31-SS-632	31
31-SS-635	31-SS-635	31
31-SS-639	31-SS-639	31
31-SS-640	31-SS-640	31
31-SS-644	31-SS-644	31
31-SS-645	31-SS-645	31
31-SS-646	31-SS-646	31
31-SS-649	31-SS-649	31
31-SS-650	31-SS-650	31
31-SS-651	31-SS-651	31
31-SS-658	31-SS-658	31
31-TP-503-S-1	31-TP-503-S-1	31-REF
31-TP-505-S-1-DAVG	31-TP-505-S-1-DAVG	31-REF
31-TP-506-S-1	31-TP-506-S-1	31-REF
31-TP-507-S-1	31-TP-507-S-1	31-REF
31-VS-107	31-VS-107	PARC_1_NOC
31-VS-136	31-VS-136	31
31-VS-144	31-VS-144	31
31-VS-149	31-VS-149	31
31-VS-161	31-VS-161	31
31-VS-211	31-VS-211	31
31-VS-212	31-VS-212	31
31-VS-419	31-VS-419	31
31-VS-420	31-VS-420	31
31-VS-422	31-VS-422	31
31-VS-424	31-VS-424	31
31-VS-425	31-VS-425	PARC_1_NOC
31-VS-427	31-VS-427	PARC_1_NOC
31-VS-428	31-VS-428	PARC_1_NOC
31-VS-430	31-VS-430	PARC_1_NOC
31-VS-431	31-VS-431	PARC_1_NOC
31-VS-439	31-VS-439	31
31-VS-440	31-VS-440	31
31-VS-441	31-VS-441	31
31-VS-442	31-VS-442	31

Table B-6 – Industrial Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
31-VS-446	31-VS-446	31
31-VS-508	31-VS-508	PARC_1_NOC
31-VS-509	31-VS-509	31
31-VS-510	31-VS-510	31
31-VS-529	31-VS-529	PARC_1_NOC
31-VS-533	31-VS-533	PARC_1_NOC
31-VS-536	31-VS-536	PARC_1_NOC
31-VS-566	31-VS-566	PARC_1_NOC
31-VS-567	31-VS-567	PARC_1_NOC
31-VS-577-DAVG	31-VS-577-DAVG	PARC_1_NOC
31-VS-580	31-VS-580	PARC_1_NOC
31-VS-581	31-VS-581	PARC_1_NOC
31-VS-582	31-VS-582	PARC_1_NOC
31-VS-584	31-VS-584	31
31-VS-585	31-VS-585	31
31-VS-591	31-VS-591	PARC_1_NOC
31-VS-592	31-VS-592	PARC_1_NOC
31-VS-595	31-VS-595	PARC_1_NOC
31-VS-596	31-VS-596	PARC_1_NOC
31-VS-597-DAVG	31-VS-597-DAVG	PARC_1_NOC
31-VS-600	31-VS-600	PARC_1_NOC
31-VS-601	31-VS-601	PARC_1_NOC
31-VS-607	31-VS-607	PARC_1_NOC
31-VS-631	31-VS-631	PARC_1_NOC
31-VS-634	31-VS-634	PARC_1_NOC
31-VS-635	31-VS-635	PARC_1_NOC
31-VS-642	31-VS-642	PARC_1_NOC
31-VS-643	31-VS-643	PARC_1_NOC
31-VS-644	31-VS-644	PARC_1_NOC
31-VS-650	31-VS-650	PARC_1_NOC
31-VS-651	31-VS-651	PARC_1_NOC
31-VS-653	31-VS-653	PARC_1_NOC
31-VS-656	31-VS-656	PARC_1_NOC
31-VS-658	31-VS-658	PARC_1_NOC
31-VS-662	31-VS-662	PARC_1_NOC
31-VS-670	31-VS-670	PARC_1_NOC
31-VS-679-DAVG	31-VS-679-DAVG	PARC_1_NOC
31-VS-682	31-VS-682	PARC_1_NOC
31-VS-684	31-VS-684	PARC_1_NOC
31-VS-700	31-VS-700	PARC_1_NOC
31-VS-701	31-VS-701	PARC_1_NOC

Table B-6 – Industrial Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
31-VS-702	31-VS-702	PARC_1_NOC
31-VS-703	31-VS-703	PARC_1_NOC
31-VS-704	31-VS-704	PARC_1_NOC
31-VS-705	31-VS-705	PARC_1_NOC
31-VS-706	31-VS-706	PARC_1_NOC
31-VS-707	31-VS-707	PARC_1_NOC
31-VS-708	31-VS-708	PARC_1_NOC
31-VS-709	31-VS-709	PARC_1_NOC
31-VS-710	31-VS-710	PARC_1_NOC
31-VS-711	31-VS-711	PARC_1_NOC
31-VS-712	31-VS-712	PARC_1_NOC
31-VS-76	31-VS-76	31
31-VS-77	31-VS-77	31
31-VS-88	31-VS-88	PARC_1_NOC
31-VS-94	31-VS-94	PARC_1_NOC
31-VS-95	31-VS-95	PARC_1_NOC
31-VS-96	31-VS-96	PARC_1_NOC
31-VS-98	31-VS-98	PARC_1_NOC
31-VS-99	31-VS-99	PARC_1_NOC
LR-053	LR-053	LR
LR-054	LR-054	LR
LR-055	LR-055	LR
LR-056	LR-056	LR
LR-057	LR-057	LR
LR-058	LR-058	LR
LR-069	LR-069	LR
LR-070-1	LR-070-1	LR
LR-070-2	LR-070-2	LR
LR-070S	LR-070S	31-REF
LR-071-1	LR-071-1	LR
LR-071-2	LR-071-2	LR
LR-071S	LR-071S	31-REF
LR-072	LR-072	LR
LR-073-1	LR-073-1	LR
LR-073-2	LR-073-2	LR
LR-086	LR-086	LR
LR-087	LR-087	LR
LR-088	LR-088	LR
LR-089	LR-089	LR
LR-102N	LR-102N	LR
LR-102S	LR-102S	LR

Table B-6 – Industrial Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
LR-102W	LR-102W	LR
LR-104A	LR-104A	LR
LR-121	LR-121	LR
LR-122	LR-122	LR
LR-123	LR-123	LR
RR-546-C	RR-546-C	LR
RR-593	RR-593	LR
RR-594	RR-594	RR-N

Table B-7 – Industrial Area Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
Industrial Area (1 to <= 15 feet)		
10-TP-501-S-2	10-TP-501-S-2	10
10-TP-501-S-3	10-TP-501-S-3	10
10-TP-503-S-2	10-TP-503-S-2	10
10-TP-503-S-3	10-TP-503-S-3	10
31-B-501-S-2	31-B-501-S-2	31
31-B-501-S-3	31-B-501-S-3	31
31-B-502-S-2	31-B-502-S-2	31
31-B-502-S-3	31-B-502-S-3	31
31-B-503-S-2	31-B-503-S-2	31-REF
31-B-503-S-3	31-B-503-S-3	31-REF
31-B-504-S-2	31-B-504-S-2	31-REF
31-B-504-S-3	31-B-504-S-3	31-REF
31-HA-501-S-3	31-HA-501-S-3	31-REF
31-HA-502-S-3	31-HA-502-S-3	31-REF
31-TP-10,S-2	31-TP-10,S-2	31
31-TP-11,S-2	31-TP-11,S-2	31
31-TP-12,S-2	31-TP-12,S-2	31
31-TP-13,S-2	31-TP-13,S-2	31
31-TP-14,S-2	31-TP-14,S-2	31
31-TP-15,S-2	31-TP-15,S-2	31
31-TP-16,S-2	31-TP-16,S-2	31
31-TP-17,S-2	31-TP-17,S-2	31-REF
31-TP-18,S-2	31-TP-18,S-2	31-REF
31-TP-19,S-1	31-TP-19,S-1	31-REF
31-TP-19,S-2	31-TP-19,S-2	31-REF
31-TP-21,S-1-DAVG	31-TP-21,S-1-DAVG	31-REF
31-TP-21,S-2	31-TP-21,S-2	31-REF
31-TP-501-S-2-DAVG	31-TP-501-S-2-DAVG	31
31-TP-501-S-3	31-TP-501-S-3	31
31-TP-502-S-2	31-TP-502-S-2	31
31-TP-502-S-3	31-TP-502-S-3	31
31-TP-503-S-2	31-TP-503-S-2	31-REF
31-TP-503-S-3	31-TP-503-S-3	31-REF
31-TP-504-S-2	31-TP-504-S-2	31
31-TP-504-S-3	31-TP-504-S-3	31
31-TP-505-S-2	31-TP-505-S-2	31-REF
31-TP-505-S-3	31-TP-505-S-3	31-REF
31-TP-506-S-2	31-TP-506-S-2	31-REF
31-TP-506-S-3	31-TP-506-S-3	31-REF

Table B-7 – Industrial Area Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
31-TP-507-S-2	31-TP-507-S-2	31-REF
31-TP-507-S-3	31-TP-507-S-3	31-REF
31-TP-508-S-2	31-TP-508-S-2	31-REF
31-TP-508-S-3	31-TP-508-S-3	31-REF
31-TP-7,S-2	31-TP-7,S-2	31-REF
31-TP-8,S-2	31-TP-8,S-2	31
31-TP-9,S-2	31-TP-9,S-2	31
LR-104 1'-2'	LR-104 1'-2'	RR-N
RR-595-S-3	RR-595-S-3	RR-N

Table B-8 – Open Space Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
Open Space Area 1 (0 to <= 1 Foot BGS)		
6-SS-501	6-SS-501	6
6-SS-502	6-SS-502	6
6-SS-503	6-SS-503	6
LR-013	LR-013	LR
Open Space Area 4 (0 to <= 1 Foot BGS)		
18-HA-501-S-1-DAVG	18-HA-501-S-1-DAVG	18
18-HA-502-S-1	18-HA-502-S-1	18
18-HA-503-S-1	18-HA-503-S-1	18
18-SS-731	18-SS-731	18
18-SS-GS-77	18-SS-GS-77	18
18-SS-GS-78	18-SS-GS-78	18
18R-443	18R-443	18-REF
18R-454	18R-454	18-REF
18R-460	18R-460	18-REF
18R-469	18R-469	18-REF
LR-139	LR-139	LR
LR-140	LR-140	LR
LR-141	LR-141	LR
LR-143	LR-143	LR
LR-155	LR-155	LR
LR-156	LR-156	LR
LR-183	LR-183	LR
LR-197	LR-197	LR
LR-214	LR-214	LR
LR-231	LR-231	LR
LR-232	LR-232	LR
LR-246	LR-246	LR
LR-247	LR-247	LR
Open Space Area NOC (0 to <= 1 Foot BGS)		
01-OS02-SS-[LR-68-1050E]-C1-000	LR-68-1050E	Creek
01-OS02-SS-[LR-68-1125E]-C1-000	LR-68-1125E	Creek
01-OS02-SS-[LR-68-1200E]-C1-000	LR-68-1200E	Creek
01-OS02-SS-[LR-68-1425E]-C1-000	LR-68-1425E	Creek
01-OS02-SS-[LR-68-1500E]-C1-000	LR-68-1500E	Creek
01-OS02-SS-[LR-68-150E]-C1-000	LR-68-150E	Creek
01-OS02-SS-[LR-68-150W]-C1-000	LR-68-150W	Creek
01-OS02-SS-[LR-68-1650E]-C1-000	LR-68-1650E	Creek
01-OS02-SS-[LR-68-1725E]-C1-000	LR-68-1725E	Creek
01-OS02-SS-[LR-68-225E]-C1-000	LR-68-225E	Creek
01-OS02-SS-[LR-68-225W]-C1-000	LR-68-225W	Creek

Table B-8 – Open Space Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
01-OS02-SS-[LR-68-300E]-C1-000	LR-68-300E	Creek
01-OS02-SS-[LR-68-300W]-C1-000	LR-68-300W	Creek
01-OS02-SS-[LR-68-375E]-C1-000	LR-68-375E	Creek
01-OS02-SS-[LR-68-375W]-C1-000	LR-68-375W	Creek
01-OS02-SS-[LR-68-450E]-C1-000	LR-68-450E	Creek
01-OS02-SS-[LR-68-450W]-C1-000	LR-68-450W	Creek
01-OS02-SS-[LR-68-675E]-C1-000	LR-68-675E	Creek
01-OS02-SS-[LR-68-750E]-C1-000	LR-68-750E	Creek
01-OS02-SS-[LR-68-825E]-C1-000	LR-68-825E	Creek
01-OS02-SS-[LR-68-900E]-C1-000	LR-68-900E	Creek
01-OS02-SS-[LR-68-975E]-C1-000	LR-68-975E	Creek
01-OS02-SS[LR-68-300W-TRANSECT]-C1-000	LR-68-300W-TRANSECT	Creek
01-OS02-SS[LR-68-600E-TRANSECT]-C1-000	LR-68-600E-TRANSECT	Creek
02-OS02-[LR-68-600E-2-TRANSECT]-D1-000	LR-68-600E-2-TRANSECT	Creek
02-OS02-[LR-68-600E-3-TRANSECT]-D1-000	LR-68-600E-3-TRANSECT	Creek
02-OS02-[LR-68-600E-4-TRANSECT]-D1-000	LR-68-600E-4-TRANSECT	Creek
02-OS02-[LR-68-600E-5-TRANSECT]-D1-000	LR-68-600E-5-TRANSECT	Creek
02-OS02-[LR-68-600E-6-TRANSECT]-D1-000	LR-68-600E-6-TRANSECT	Creek
31-SS-402	31-SS-402	Creek
31-SS-502	31-SS-502	Creek
31-TP-509-S-1	31-TP-509-S-1	Creek
31-VS-433	31-VS-433	Creek
31-VS-530	31-VS-530	Creek
LR-052	LR-052	Creek
LR-069W	LR-069W	Creek
LR-085	LR-085	Creek
LR-101	LR-101	Creek
LR-102	LR-102	Creek
LR-120	LR-120	Creek
LR-68-E125	LR-68-E125	Creek
LR-68-N125-DAVG	LR-68-N125-DAVG	Creek
LR-68-S125	LR-68-S125	Creek
LR-68-S175	LR-68-S175	Creek
LR-68-S275	LR-68-S275	Creek
LR-68-S375	LR-68-S375	Creek
LR-68-S475-DAVG	LR-68-S475-DAVG	Creek
LR-68-S575	LR-68-S575	Creek
LR-68-S675	LR-68-S675	Creek
LR-68-S775	LR-68-S775	Creek
LR-68-S875	LR-68-S875	Creek
LR-68-W25	LR-68-W25	Creek

Table B-8 – Open Space Area Samples <=1 Foot

Sample ID	Short Sample ID	RI Area
RR-592	RR-592	Creek
RR-596	RR-596	Creek
RR-596-S-2	RR-596-S-2	Creek
RR-597	RR-597	Creek
RR-598-DAVG	RR-598-DAVG	Creek
RR-599	RR-599	Creek
Open Space Area SOC (0 to <= 1 Foot BGS)		
38-VS-12	38-VS-12	MISC
38-VS-16	38-VS-16	MISC
38-VS-18	38-VS-18	MISC
38-VS-8	38-VS-8	MISC
LR-051	LR-051	LR
LR-100	LR-100	LR
LR-117	LR-117	LR
LR-117-S-2	LR-117-S-2	LR
LR-119	LR-119	LR
LR-135	LR-135	LR
LR-136	LR-136	LR
LR-137	LR-137	LR
LR-68-W125	LR-68-W125	MISC
RR-548-A2	RR-548-A2	RR-N
RR-548-B1	RR-548-B1	LR
RR-548-B2	RR-548-B2	LR
RR-555-B2	RR-555-B2	LR

Table B-9 – Open Space Area Samples >1 Foot and <=15 Feet

Sample ID	Short Sample ID	RI Area
Open Space Area 4 (1 to <=15 feet)		
18-HA-501-S-2	18-HA-501-S-2	18
18-HA-502-S-2	18-HA-502-S-2	18
18-HA-503-S-2	18-HA-503-S-2	18
Open Space Area NOC (1 to <=15 feet)		
31-TP-509-S-2	31-TP-509-S-2	Creek
31-TP-509-S-3	31-TP-509-S-3	Creek
RR-596-S-3	RR-596-S-3	Creek
Open Space Area SOC (1 to <=15 feet)		
LR-117-S-3	LR-117-S-3	LR

Appendix C – Letters and Other Documentation of Site-Specific Determinations by Ecology

C.1 Introduction

The purpose of this appendix is to document the letters and other documentation of site-specific determinations that have been provided by the Department of Ecology.

This appendix contains letters and other documentation organized as follows:

- C.2 Arsenic and Lead Soil Cleanup and Remediation Levels
- C.2.1 Cleanup Levels and Remediation Levels for the Former DuPont Works Site
- C.2.2 Residential Soil-Lead Cleanup Level and Remediation Level for Former DuPont Works Site
- C.2.3 Non-Residential Remediation Levels at the Former DuPont Works Site
- C.2.4 Soil Arsenic Non-Residential Remediation Levels
- C.2.5 Arsenic in Soil – Area Background Levels
- C.3 DNT Soil Cleanup Level Protective of Groundwater
- C.4 Mercury Cleanup Levels Summary and Mercury/Lead Leaching Study
- C.5 TNT Soil Cleanup Level Protective of Groundwater
- C.6 TPH Soil Cleanup Level Protective of Groundwater
- C.6.1 Review of TPH Soil Cleanup Level Protective of Groundwater
- C.6.2 TPH/PAH Cleanup Level Summary

C.2 Arsenic and Lead Soil Cleanup and Remediation Levels

C.2.1 Cleanup Levels and Remediation Levels for the Former DuPont Works Site

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

April 21, 2000

Dennis Clark
DuPont City Hall
303 Barksdale
DuPont WA 98327

Hello Dennis,

Re: Cleanup Standards and Remediation Levels for the Former DuPont Works Site

Thank you for spending time with me yesterday talking about land use and the cleanup site. I have enclosed a copy of three letters from Ecology to Weyerhaeuser and DuPont companies, per our discussion. The City of DuPont (former Mayor Shenkel) had received copies of these letters in the past.

Letter #1 (10/1/97) establishes a soil-lead cleanup standard for residential property at 450 parts per million (ppm). This cleanup standard is specific for the DuPont site and was developed using an EPA risk and exposure model and site-specific information. This cleanup standard was developed back when residential development was still being considered within Parcel 1.

Letter #2 (5/3/99) establishes soil-lead remediation levels for 4 different land use types:

1) golf course – 4,100 ppm
2) commercial – 2,100 ppm
3) Industrial – 1,000 ppm
4) Open space – 1,500 ppm

These remediation levels were developed using an EPA risk exposure model. The first three are based on adult worker exposure assumptions and the open space land use is based on an older child (7 to 18 years of age) exposure assumption. The soil-lead cleanup standard is still 450 ppm. That does not change. Any location where contaminants are left behind above the cleanup standard must be addressed through engineering and/or institutional controls, which includes deed restrictions.

Letter #3 (6/25/99) establishes soil-arsenic remediation levels for 3 different land use types:

1) golf course – 530 ppm
2) commercial – 60 ppm
3) industrial – 90 ppm
4) open space – to be determined

These remediation levels were developed using the standard Model Toxics Control Act risk formula and making adjustments to the exposure frequency parameter. Like the soil-lead remediation levels, the first three are for adult workers and the open space will be based on the older child exposure assumption. The open space soil-arsenic remediation level will probably be set at 32 ppm, the same average concentration identified in the twenty background soil samples collected outside the cleanup site boundary many years ago. The cleanup standard for soil-arsenic is 20 ppm, based on the Model Toxics Control Act Method A number. The likely source of the elevated area-wide arsenic concentrations is the former ASARCO smelter in Ruston.

If you have any questions about the enclosed letters or want more detail on how the numbers (remediation levels and cleanup standards) were developed, please give me a call and I will provide you with that information.

On another subject, yesterday we discussed the City's year 2000 comprehensive land use plan being developed and the proposed location of future residential development. You were aware of the existing deed restrictions covering Parcels 1 and 2 of the cleanup site, which precludes residential development, now and into the future. You mentioned that conditions might change allowing for residential development within the cleanup site. Those changes included further cleanup might be conducted in the future, Weyerhaeuser might change its mind on the restrictive covenant, new technologies might be developed for easier and cheaper cleanups, etc. While I heard what you were saying yesterday, I am not sure that identifying deed restricted property for future residential development is a wise decision. The companies (Weyerhaeuser and DuPont) have stated to me, numerous times, that they have no intention of every allowing residences within the cleanup site due to long-term liability concerns. If you need additional copies of the restrictive covenants, let me know. A copy was provided most recently to former Mayor Shenkel in a letter dated 11/15/99. They are also on file with the Pierce County Assessor's office.

One last item. Sometime in the not too distant future, I would like to set up a meeting with you and Mayor Krill and whoever else is necessary from the City and Ecology (and the companies if appropriate) to discuss the DuPont Works Environmental Impact Statement before the final version is released. Before having the meeting, I need more time to go through all the comments Ecology received on the draft and determine how we will address them. The responses to the comments will be contained in a Responsiveness Summary. I am hoping that the final EIS will be ready for release in about 6 weeks.

If you have any questions about this letter or the enclosures, please give me a telephone call at (360) 407-6262. I understand that City Hall staff are now "on line". I can also be contacted at the following e-mail address mblu461@ecy.wa.gov .

Sincerely,

Mike Blum

Mike Blum
Toxics Cleanup Program
Southwest Regional Office

Enclosures (3)

cc: Judy Krill, City of DuPont
Jim Odendahl, Weyerhaeuser Co
Jeff King, West Shores Corp.
Ron Buchanan, DuPont Co.
David Brentlinger, Weyerhaeuser Real Estate Co.
Ecology's Weyerhaeuser DuPont Project Team
Sue Mauermann, Ecology Regional

C.2.2 Residential Soil-Lead Cleanup Level and Remediation Level for Former DuPont Works Site

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

October 1, 1997

Mr. Vern Moore
Weyerhaeuser Company
PO Box 100
DuPont, WA 98327-0100

Mr. Jack Frazier
The DuPont Company
Barley Mill Plaza Bldg. 27-1162
PO Box 80027
Wilmington, DE 19880-0027

Re: Residential Soil-Lead Cleanup Standard for Former DuPont Works Site

Dear Vern and Jack:

This letter is in reply to Tim Bingman's August 25, 1997, letter to me regarding site-specific inputs to the Integrated Exposure Uptake BioKinetic (IEUBK) model for determining residential soil-lead cleanup levels. I will also summarize our recent discussions about soil-lead cleanup in the future residential areas of the former DuPont Works Site and provide you with a decision regarding a site-specific soil cleanup standard for lead. As you know, Ecology is adopting the use of the Environmental Protection Agency's IEUBK model as a basis for setting site-specific residential cleanup levels for the protection of children. The Model Toxics Control Act (MTCA) Science Advisory Board has also concurred in the use of the model for making site-specific decisions.

Over the past several years, the Ecology Team has reviewed numerous submissions from Weyerhaeuser and DuPont Companies related to the topic of soil-lead cleanup standards, most of which dealt with the development of site-specific inputs into the IEUBK model. The most recent discussions on this topic have dealt with the soil-to-dust transfer coefficient input to the model. The standard default value for the soil-to-dust transfer coefficient is seventy percent (70%). We all agreed that 70% may not be a reasonable value to use for the Site, however, we needed adequate site-specific justification to change the default value.

Ecology used the services of Dr. Terri Bowers of Gradient Corporation to review the current literature for information that could provide a value for the soil-to-dust transfer coefficient that would be appropriate for the former DuPont Works Site. Terri provided Ecology with a report dated February 12, 1997 entitled Estimating the Soil-to-Dust Transfer Coefficient, and a memo regarding the Review of Leadville and Sandy Soil-to-Dust Relationships, dated June 24, 1997. On July 11, 1997, after initial review by the Ecology Team, I sent those same materials to Dr. Greg Glass for peer review. Greg is knowledgeable about risk assessment and has familiarity with the issue of soil-to-dust transfer at other cleanup sites. Greg responded on August 12, 1997, to my July 11 letter, which included a list of questions needing his response.

Based on the work by Terri and Greg, it appears that the 70% default value for the soil-to-dust transfer coefficient is an overestimate for this parameter at the former DuPont Works Site. This conclusion is mostly based on the fact that 1) the new homes to be constructed at the Site will not contain lead-based paint, 2) leaded gasoline will not be used in motor vehicles in the future, and 3) the future roads in the area will not have been impacted by past leaded gasoline use. Both consultants provided similar ranges of soil-to-dust transfer coefficients that would be defensible for use at the Site.

As noted in Tim's letter, Terri recommended using a soil-to-dust transfer coefficient on the order of 15 to 45%. Greg's opinion was that the range was 15 to 50% "with relatively high confidence", or 20 to 45% "with somewhat lesser but still appreciable confidence." The Ecology Team has selected 45%, a value from the upper portion of the soil-to-dust transfer coefficient range, to account for uncertainties in the underlying data, and its application at this site. The Ecology Team then applied the 45% transfer coefficient along with a site-specific ground water lead level of 2.0 ug/l to the IEUBK model. Using these inputs, the Ecology Team determined the residential soil cleanup level that would be protective of 95% of the child population (0 to 84 months of age) at a blood-lead level of 10 ug/dl.

Using the input parameters noted above, the IEUBK model estimates a soil-lead cleanup value of 443 mg/kg as protective. The proposed future development of the residential areas of the Site includes removal of the lead-contaminated topsoil prior to home construction, followed by replacement with clean topsoil and sod after the new homes are constructed. Considering the proposed future conditions at the Site, and the accuracy of the soil-to-dust transfer coefficient estimate, Ecology approves a risk management concentration of 450 mg/kg as protective of human health in the future residential areas at the former DuPont Works Site.

The Ecology Team recognizes that agreement on this issue marks a significant milestone in the project. We look forward to resolving the remaining technical issues including a soil-lead cleanup standard for the non-residential areas of the Site. If you or any of your team have any questions regarding this letter, please give me a telephone call at (360) 407-6262.

Sincerely,

Mike Blum

Mike Blum
Site Manager
Toxics Cleanup Program

MB:td

cc: Distribution list

cc: Tim Bingman, DuPont Company
Terri Bowers, Gradient Corporation
Mary Burg, Ecology Toxics Cleanup Program Manager
Greg Glass, Greg Glass Consulting
Mark Jobson, Assistant Attorney General
Jeff King, DuPont Company
Roseanne Lorenzana, Environmental Protection Agency
Craig McCormack, Ecology Toxics Cleanup Program
Pamela Meitner, DuPont Company Legal Department
Ralph Palumbo, Summit Law Group
Willard Shenkel, City of DuPont
Jim White, Washington State Department of Health
Marian Wineman, Woodward Clyde Consultants
Ecology's Weyerhaeuser/DuPont Site Team

C.2.3 Non-Residential Remediation Levels at the Former DuPont Works Site

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

May 3, 1999

Mr. Vern Moore
Weyerhaeuser Company
Post Office Box 100
DuPont, WA 98327-0100

Mr. Izzy Zanikos
DuPont Specialty Chemicals
Barley Mill Plaza Building 27
Post Office Box 80027
Wilmington, DE 19880-0027

Dear Vern and Izzy:

Re: Non-Residential Remediation Levels at the Former DuPont Works Site

The Department of Ecology (Ecology) Team working on this project has made some decisions regarding remediation levels for lead in soil at the site. These remediation levels, formerly known as action levels, are for land uses other than residential. These remediation levels are levels at which we believe there is limited threat to human health and the environment based on assumed exposure scenarios and the implementation of various institutional controls and property deed restrictions. As a reminder, remediation levels are not synonymous with cleanup levels or cleanup standards.

I received Tim Bingman's letter of December 18, 1998 on the 21st of December. That letter proposed remediation levels for lead and arsenic in soils for the future golf course, industrial, commercial, and open-space land use areas. Remediation levels for arsenic in soil will be addressed in another letter in the near future.

First let me identify the site-specific soil-lead remediation levels to be established by Ecology and then explain how we arrived at those levels. Some levels are the same or slightly higher than what you proposed, while others have been reduced based on different exposure assumptions.

Table #1
Summary of Ecology-Derived Remediation Levels
For the Former DuPont Works Site

Future Land Use Area	Lead in Soil
Golf Course	4,100 ppm
Commercial	2,100 ppm
Industrial	1,000 ppm[†]
Open Space	1,500 ppm

[†] Use same soil-lead remediation level as in Parcel 2 as opposed to Adult Lead model value of 1,963 ppm.

Tim Bingman and I made a presentation to the Model Toxics Control Act Science Advisory Board in November 1998 regarding the use of EPA's Adult Lead model to develop soil-lead remediation levels at cleanup sites in Washington. They gave their approval to the use of the model and the model's guidance document. As proposed in Tim's December 1998 letter, Ecology concurs with the use of the region-specific baseline blood-lead level (Washington State) and blood-lead geometric standard deviation (Western U.S.); 1.36 micrograms per deciliter (ug/dl) and 1.81, respectively. Table #2 below outlines the specific input parameters to the Adult Lead Model equation and the values selected by Ecology as appropriate for the former DuPont Works site.

Table #2 - Adult Lead Model Input Variables

Description of Input Variables	Equation Variables	Units	Commercial Exposure Scenario	Golf Course Exposure Scenario	Industrial Exposure Scenario
95th Percentile PbB (Blood Lead) in Fetus	$PbB_{fetal,0.95}$	ug/dl	10	10	10
Fetal/Maternal PbB Ratio	$R_{fetal/maternal}$	----	0.9	0.9	0.9
Biokinetic Slope Factor	BKSF	ug/dl per ug/day	0.4	0.4	0.4
Geometric Standard Deviation PbB	$GSD_{i,adult}$	----	1.81	1.81	1.81
Baseline PbB	$PbB_{adult,0}$	ug/dl	1.36	1.36	1.36
Soil Ingestion Rate	IRs	g/day	**0.200**	0.100	0.050
Absorption Fraction	AFs	----	0.12	0.12	0.12
Exposure Frequency	EF	days/year	52	52	**219**
Averaging Time	AT	days/year	365	365	365
Remediation Levels	PbS	mg/kg	**2,067**	4,134	**1,963**

(The values in **bold** are different from those proposed by Weyerhaeuser and DuPont)

The Ecology Team considered the input variables proposed by the companies. The choice of input variables is a risk management decision and is based on best professional judgement, unless of course site-specific data is available. We decided that the above variables should be used for the following reasons:

1. The golf course cap is an engineered containment facility. As such, greater controls, both physical and institutional, can and will be implemented.

2. The commercial areas worked in by landscapers may not have the same protective measures as the golf course, nor will workers necessarily be aware that the areas they are working in are part of a hazardous waste site with possible residual soil contamination. Draft EPA Region 10 guidance recommends 200 mg/day as an adult soil ingestion rate for occupational exposures involving soil contact activities. The golf course worker will be better informed about the site being a hazardous waste containment facility, and as such, will be required to take better precautions to reduce exposure to (ingestion of) contaminated soils, as compared to commercial area landscape workers. That is why we have chosen 100 mg/day as the appropriate ingestion rate for the golf course worker versus the 200 mg/day recommended by EPA. To further reduce exposures, the companies have stated that the irrigation lines at the golf course will be located either in clean backfill or above the contaminated soil layer. This can be ensured through course design, which will occur with Ecology oversight.

3. The frequency of contact for the industrial land use scenario was changed to match the default value in the Adult Lead Model. The 40% value (146 days) from the Model Toxics Control Act soil/carcinogen risk formula is not appropriate for use in this model.

4. The exposure frequency for the golf course worker is set at 52 days per year. As noted in Tim's letter and the attached appendices, the Ecology Team agrees that an appropriate estimate for the exposure frequency is 36 days per year (possibly even less, depending upon site layout and engineering controls), however a minimum value of 52 days per year must be used to avoid "violating" the adult lead model assumptions (steady-state blood lead levels).

5. The industrial land use remediation level has been reduced from 1,963 to 1,000 ppm to match the Model Toxics Control Act Method A industrial cleanup value established for Parcel #2 in the 1997 Cleanup Action Plan, as recommended by the companies.

6. The Adult Lead Model is set to be protective of the fetus of a pregnant woman, the most susceptible sub-population. To be protective of an adult (non-pregnant worker), the remediation levels for each land use scenario would be considerably higher. The target blood lead level of 10 ug/dl was established to be protective of the fetus as well as very young children.

Next let me describe how the Ecology Team selected 1,500 ppm as the soil-lead remediation level for open space areas. The companies proposed a ratio approach based on using the results of the site-specific residential cleanup levels established for the site - 450 ppm. That level was determined using EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model and is based on young children up to 84 months old. The most frequently exposed population in the open space areas, which are the natural areas and not developed parks or ball fields, would most frequently be the "older child". The older child is somewhere between 7 and 18 years of age. There is no specific age at which the older child's biokinetics responds similarly to an adult, especially in terms of absorption of lead. Most researchers agree that the younger child absorbs lead more readily than the older child or the adult. So, how does one develop a remediation level when no soil-lead exposure model exists for the older child? As noted above, the companies proposed an "exposure ratioing" approach that results in a remediation level of 3,159 ppm. That level is based on a once a week exposure compared to daily exposure at the residential cleanup level of 450 ppm. [(7 days/week ÷ 1 day/week) * (450 ppm) = 3,150 ppm] (The difference between Ecology's (3,150 ppm) and the companies' (3,159 ppm) remediation level is the minor difference between the use of a 1 day per week ratio versus a 52 days per year ratio.) The goal of the IEUBK model is to protect 95% of the children from exceeding a blood lead level of 10 ug/dl. Exposure frequencies of 2 and 3 days per week result in remediation levels of 1575 ppm and 1050 ppm respectively.

Using the Adult Lead Model to develop remediation levels for the older child is another approach. Using the adult lead model with exposure frequencies of 1, 2, and 3 days per week results in remediation levels of 3512 ppm, 1756 ppm, and 1171 ppm respectively.

Under all scenarios, the maternal/fetal blood lead ratio was eliminated and the goal of protecting 95% of the older child population from exceeding 10 ug/dl blood lead level was retained. As a point of reference, the adult blood lead level goal ("not to exceed" value) is based on industrial exposures and is generally set at 25 to 30 ug/dl for males. The geometric standard deviation and baseline blood lead level input remained unchanged.

The two approaches yield ranges of approximately 1,050 to 3,150 ppm and 1,200 to 3,500 ppm. The site-specific residential cleanup level for lead in soil is 450 ppm. The value for open space proposed by the companies was 3,159 ppm. The upper bound is dependent on the assumed exposure scenario and the input parameters. The Ecology Team has set the soil-lead remediation level for the open space as 1,500 ppm based on consideration of the above criteria and best professional judgement regarding this risk management decision. As you know, most of the open space areas are relatively clean, with some isolated areas of elevated contaminant concentrations (e.g., hot spots). The Team carefully thought about exposure frequency and considered twice a week as appropriate, resulting in remediation levels of 1575 and 1750 ppm using the ratio approach and the adult lead model, respectively. In making this risk management decision, the Ecology Team also considered the older child transporting lead contamination back home on their shoes and clothes, which could create additional exposures to themselves and/or to other/younger children in the house.

One last issue. The Toxics Cleanup Program is currently in the midst of a major change to the Model Toxics Control Act. The program is also wrestling with some significant issues related to arsenic in soil. Those things will affect how we address arsenic remediation levels at the former DuPont Works site. Due to the above changes as well as ongoing discussions with the companies, the Ecology Team is addressing arsenic issues separate from lead. Site-specific arsenic remediation levels will be established in a letter that will follow in the near future.

In conclusion, the Ecology Team has spent considerable time considering your remediation levels proposal contained in Tim Bingman's December 1998 letter. We feel that the input variables chosen by Ecology are reasonable and protective. As stated earlier in this letter, we feel that the golf course cap/containment facility provides the best physical and institutional controls on future exposure to contaminated soils. As in the past, this project's cleanup Team (Weyerhaeuser, DuPont, and Ecology) is once again breaking new ground, this time with use of EPA's Adult Lead Model. These innovative approaches take more time to evaluate than following the well-worn path others have used. We are comfortable that the soil-lead remediation level decisions Ecology has made will stand up to public scrutiny, when we get to that point. There is adequate conservatism built into the assumptions used, while not being overly conservative.

If you have any questions regarding this letter or the calculations and risk management decisions regarding remediation levels, please give me a call at (360) 407-6262.

Sincerely,

Mike Blum

Mike Blum
Site Manager
Toxics Cleanup Program
Southwest Regional Office

cc: Tim Bingman, DuPont Company
Ralph Palumbo, Summit Law Group
Pamela Meitner, DuPont Company Legal Department
Mark Jobson, Assistant Attorney General
Jeff King, West Shores Corporation
Willard Shenkel, City of DuPont
Ecology's Weyerhaeuser/DuPont Site Team
David Jansen, Toxics Cleanup Program Section Supervisor

C.2.4 Arsenic Non-Residential Soil Remediation Levels

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

June 25, 1999

Mr. Vern Moore
Weyerhaeuser Company
P.O. Box 100
DuPont, WA 98327-0100

Mr. Izzy Zanikos
DuPont Specialty Chemicals
Barley Mill Plaza Building 27
P.O. Box 80027
Wilmington, DE 19880-0027

Dear Vern and Izzy:

Re: Soil Arsenic Non-Residential Remediation Levels

The Department of Ecology (Ecology) Team received Tim Bingman's letter dated June 1, 1999, regarding the development of non-residential remediation levels for arsenic in soil at the former DuPont Works cleanup site. Tim's letter was received on June 2nd. The letter incorporated the issues we had discussed during our May 25, 1999, meeting at the site as well as some issues related to open space land use areas that were not discussed that day. The Ecology Team (Dan Alexanian, Kelly Susewind, and myself) is in concurrence with the proposed remediation levels with the proviso that engineering controls will be used to limit exposure to golf course workers. The assumed exposed individual based on that particular land use is the basis for the associated remediation level, which are as follows:

PROPOSED LAND USE	POTENTIALLY EXPOSED INDIVIDUAL	REMEDIATION LEVEL
Commercial	Adult landscape worker	60 milligrams per kilogram (mg/kg) or parts per million
Golf Course	Adult golf course worker	530 mg/kg
Industrial	Adult worker	90 mg/kg

I have included the specific input variables as an attachment to this letter, which I copied directly from Tim's letter.

The open space land use areas do not have a proposed soil-arsenic remediation level. A "combination of engineering solutions" was proposed in Tim's letter that includes some soil removal and some in-place capping/containment. Ecology believes that the soil-arsenic remediation goal for the open space areas should be 32 mg/kg, which is the same as the area background for the site. In working towards that goal, Ecology also wants to ensure that the net environmental benefit of any proposed action is positive. We have talked numerous times about the issue of net environmental benefit of cleanup in open space areas.

That includes the impacts of either excavation and/or capping of contaminated soils versus leaving the contaminants in place and not disrupting the environment. Our teams have collectively reached a verbal understanding of generally what needs to occur and why. What is lacking is that reasoning written down in a more formal manner. Your request needs to be a "stand alone" document, like most of the past proposals you have submitted. When someone outside our respective team reads your request letter as well as Ecology's response, they should have a clear understanding of the issues and the reasoning behind your request and Ecology's response.

In general, as well as specifically in terms of the open space areas, a goal of Ecology and the companies is to safeguard water quality in Sequalitchew Creek, Old Fort Lake and Puget Sound. A couple protective measures includes limiting work on steep slopes and creating erosion problems as well as saving trees and habitat where possible - especially in the designated open spaces. As we have discussed, specific open space locations needing remediation will be made on a case by case basis. As discussed in Tim's letter, remediation of arsenic impacted soils along the narrow gauge railroad corridor, within the Sequalitchew Creek canyon open space area (Open Space #1), will be capped with gravel. That action will serve as both a physical barrier to exposure as well as creating part of the planned walking trail down the Sequalitchew Creek canyon to Puget Sound. Your request letter should discuss why other more permanent options are not feasible, such as excavation and off-site disposal or on-site treatment, and why those options may cause more harm than good.

I would like to point out a few things about the gravel capping approach for the narrow gauge railroad corridor mentioned in Tim's letter. There are some difficulties, or potential opportunities, depending on how one looks at it. In reviewing the existing narrow gauge sampling data within Open Space #1, it appears that there were four or five samples collected (RR-596, RR-597, RR-598, RR-599, and LR-68), all of which exceeded the area background arsenic concentration of 32 ppm. Therefore, that entire section of track would need to be covered with gravel. Tim's letter proposed a "six-inch thick layer of gravel extending five feet on either side of the railroad centerline". Why five feet? That proposal needs to be justified. The railroad corridor data from the site includes samples collected along the centerline and some samples 25 and 50 feet on either side of the centerline. Further "downstream" of Open Space #1, there were no samples collected along the narrow gauge railroad. That area is outside the consent decree boundary. When we established the boundary, it was based on soil-lead contamination. At that time, 1991, arsenic was not known to be a contaminant at the site. Do you have any information about whether that section of track was sprayed with arsenic-based herbicides in the past? I understand that there is a mitigation agreement between the City of DuPont (City) and Lone Star Northwest (Lonestar) regarding conversion of a portion of the railroad corridor to a trail along Sequalitchew Creek canyon. I have not yet seen or read that agreement, so I do not know the details. I understand that section of track/railroad corridor is to be covered with wood chips. Is there a possibility of working with the City and Lonestar to pave or gravel the entire railroad corridor down the canyon, thereby addressing both remediation concerns and gravel mining mitigation at the same time? Also, gravel would make a better (more permanent) path than wood chips.

A couple other final comments and questions. In Open Space Area #3, the buffer zone along the southern and eastern site perimeter, a 75-foot strip of vegetation will be left. Does the 75-foot border start at the fence line or the inside edge of the existing dirt road? If the existing dirt road is part of that open space, do you think vegetation will be planted or will it in be naturally re-vegetated? Capping in the open space areas will reduce the exposure potential by cutting off or reducing that exposure pathway. It does not however reduce the contaminant concentration remaining, as mistakenly stated in Tim's letter.

It is Ecology's desire to work with the companies to protect the open spaces and the ecological resources to the extent practicable. If you have any questions regarding this letter or what the Ecology Team is expecting regarding the open space areas and additional net environmental benefit evaluation, please give me a call at (360) 407-6262.

Sincerely,

Mike Blum

Mike Blum
Site Manager
Toxics Cleanup Program
Southwest Regional Office

MB:mf(1/tcp)
Attachment

cc: Mark Jobson, Assistant Attorney General
Pamela Meitner, DuPont Company Legal Department
Ralph Palumbo, Summit Law Group
Willard Shenkel, City of DuPont
Ronald Summers, Lone Star Northwest
Jeff King, West Shores Corporation
Marian Wineman, Woodward Clyde
Ecology's Weyerhaeuser/DuPont Site Team
David Jansen, Ecology

Attachment #1

Bases for Input Variables Used to Calculate Non-Residential Arsenic Remediation Levels

A description of the major inputs to the MTCA intake equation, as well as an explanation for values used in calculating arsenic remediation levels, is described below.

RISK – Represents the acceptable incremental carcinogenic risk level. In the case of all three land use scenarios, this value is 1×10^{-5}. The 1×10^{-5} value is codified for industrial settings in the MTCA at WAC 173-340-745 (4)(a)(iii)(B). The policy to use a value of 1×10^{-5} for the commercial areas (which is also applicable to the golf course area) was established by Pete Kmet in a memorandum dated February 14, 1995.

ABW – Describes the average body weight for the potentially exposed population under consideration. For the commercial, golf course and industrial areas, this would be an adult, with an average body weight of 70 kg.

LIFE – Represents the duration of a human lifetime over which the exposure is averaged. Per WAC 173-340-740 (3)(a)(iii)(B), the default value is 75 years.

UCF – This is a unit conversion factor of 1×10^{6} applied to calculate remediation levels in units of mg/kg.

CPF – This describes the carcinogenic potency factor for arsenic. The current value for arsenic in USEPA's IRIS database is 1.5 mg/kg/day^{-1}.

SIR – Represents the soil ingestion rate for exposure to site soils. Ecology has recommended a value of 200 mg/day for establishing remediation levels for the future commercial land use area. A value of 100 mg/day has been recommended by Ecology for use in the golf course area, in light of the training that golf course workers receive. The 50 mg/day value is the MTCA default for industrial exposure.

AB – Represents the gastrointestinal absorption rate. DuPont and Weyerhaeuser believe that current scientific evidence supports the value of 0.4 (40%) as specified for arsenic in the MTCA "Cleanup Levels and Risk Calculation" document. However, we understand that Ecology anticipates modification of this value as a matter of policy to 100% absorption in the near future. Hence, the updated value has been used in these calculations.

DUR – Describes the duration of exposure in years. The value of 20 years for industrial exposure is the MTCA default value. The value of 20 years for the commercial and golf course areas is specified in Pete Kmet's memorandum of February 14, 1995, and is appropriate, given that adults represent the potentially exposed population.

FOC – Represents the frequency of contact term. Frequency of contact, as used in the MTCA equation, is calculated from the exposure frequency for the commercial, industrial and golf course land use scenarios. The value of 52 days/year represents a once-per-week exposure in the commercial area. The 12 days/year value for the golf course worker is based on a combination of interviews of golf course managers describing the approximate frequency for subsurface soil exposure during maintenance activities, and the anticipated use of clean backfill material around irrigation main lines at the golf course. The 40% frequency of contact for the industrial areas (corresponding to an exposure frequency of 146 days/year) is the MTCA default for industrial exposure.

C.2.5 Arsenic in Soil – Area Background levels

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

March 11, 1996

Mr. Vern Moore
Weyerhaeuser Company
P.O. Box 100
DuPont, WA 98327-0100

Mr. Jack Frazier
The DuPont Company
DuPont Chemicals, B-12230
1007 Market Street
Wilmington, DE 19898

Dear Vern and Jack:

Re: Arsenic in Soil - Area Background Levels - 32 Parts Per Million

This letter is to confirm our recent discussions about arsenic and the area background soil concentration that has been determined for the former DuPont Works Site. The Ecology Team has reviewed the data submitted in the draft Remedial Investigation (RI) report dated December 22, 1994, as well as a separate but similar undated 6 page paper entitled Area Background Arsenic Levels, both prepared by Hart Crowser. The conclusion reached by Hart Crowser is that the area background concentration is 32 mg/kg; following the Model Toxic Control Act (MTCA) regulations and associated guidance. The Ecology Team concurs with the determination of 32 parts per millions (ppm) as the area background concentration for arsenic in soil.

So, what does that 32 ppm determination mean in terms of site cleanup decisions? Ecology will not require any soil cleanups to be more stringent than 32 ppm, irrespective of land use. Site-specific cleanup standards and action levels for arsenic in soil have not been determined for this Site. You and your consultant, Sciences International, Inc., are currently working on a proposal to reassess the toxicity of arsenic, which may affect soil-arsenic cleanup levels for this Site. As a point of reference, at this point in time, the arsenic cleanup standard for the Site would be 32 ppm for residential land use and 200 ppm for industrial land use. Cleanup standards for other land uses such as commercial, recreational, open space, etc., would fall somewhere in between 32 and 200 ppm.

It is interesting to note a couple points about natural background concentrations of arsenic in surficial soil throughout Washington State. Sampling conducted by the United States Geological Survey, under a project[1] through Ecology, found the following results:

Areas of the State	Arsenic (GFAA[2] Lab Method)	Arsenic (ICP[3] Lab Method)
Puget Sound Area	7.30 mg/kg	22.80 mg/kg
Western Washington	6.37 mg/kg	46.21 mg/kg
Statewide	6.99 mg/kg	41.81 mg/kg

[1] Ecology, Natural Background Soil Metals Concentrations in Washington State October 1994, publication #94-115
[2] Graphite Furnace Atomic Absorption (GFAA), EPA Methods 7060 & 7740
[3] Inductively Coupled Plasma (ICP) Atomic Emission Spectroscopy, EPA Methods 3050 & 6010

Mr. Vern Moore
Mr. Jack Frazier
March 11, 1996
Page 2

As shown above and noted in the 1994 Ecology report, using GFAA for arsenic analysis allows one to achieve lower detection limits than using ICP methods and is therefore more accurate at lower levels. ICP analysis can produce higher values for arsenic because of iron (iron acts as an interferant and is difficult to correct for when analyzing for arsenic using ICP Methods).

One last point that we all need to keep in mind. All future characterization and confirmation/verification analyses should use the same analytical methods that we have been using to date. We need to ensure all the data, past and future, is comparable. The original Quality Assurance Project Plan identified GFAA as the primary methodology for soil-metals analyses, with the exception of mercury.

If you have any questions regarding this letter and area background levels for arsenic in soil, please give me a call at (360) 407-6262.

Sincerely,

Dan Alexander for

Mike Blum
Site Manager
Toxics Cleanup Program
Southwest Regional Office

MB:jr

cc: Ecology's Weyerhaeuser/DuPont Site Team
Greg Glass, Greg Glass Consulting
David Jansen, Ecology
Ed Kenney, DuPont Toxics Citizen Oversight Project
Jeff King, DuPont Environmental Remediation Services
John Kreiter, DuPont Company Legal Department
Ralph Palumbo, Heller, Ehrman, White, & McAuliffe
Willard Schenkel, City of DuPont
Tom Skjervold, DuPont Toxics Citizen Oversight Project
Steve Thiele, Assistant Attorney General
Marian Wineman, Hart Crowser, Inc.

C.3 DNT Soil Cleanup Level Protective of Groundwater

RECEIVED JAN 1 9 1996

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

January 12, 1996

Mr. Vern Moore
Weyerhaeuser Company
P.O. Box 100
DuPont, WA 98327-0100

Mr. Jack Frazier
The DuPont Company
DuPont Chemicals, B-12230
1007 Market Street
Wilmington, DE 19898

Dear Vern and Jack:

Re: Acceptance of Two Issue Papers - 1) Determination of a DNT Soil Cleanup Level Protective of Groundwater, and 2) Impracticability of Groundwater Treatment

The Ecology Team reviewed the two latest drafts of the above mentioned documents for the Former DuPont Works Site as drafted by Hart Crowser. We find them to be acceptable and agree with the conclusions contained in those issue papers. No further rewrites are necessary nor should other changes be made to them prior to their incorporation as is into the final draft remedial investigation and feasibility study reports.

The Ecology Team is still reviewing numerous other issues and/or papers submitted or raised at previous meetings. Some of those issues are listed below. Of course, this is not an exhaustive list:

1) The paper entitled <u>Summary - Potential Leachability of Lead and Arsenic in Golf Course Use Areas</u>.
2) The question of leachability of Bunker C in Area 8 and whether the excavations can be backfilled.
3) Exposure units.
4) Arsenic background concentrations.
5) Arsenic cleanup standards and Sciences International, Inc., work.
6) MTCA Lead cleanup standards using the IEUBK model.
7) Site-specific lead bioavailability study.
8) Statistics
9) Ecological risk assessment and Greg Linder's work, just to name a few.

The Ecology Team is close to finalizing or making a decision on more than half of the above mentioned items.

If you have any questions regarding this letter, please give me a call at (360) 407-6262.

Sincerely,

Mike Blum

Mike Blum
Site Manager
Toxics Cleanup Program
Southwest Regional Office

MB:jr

cc: Ecology's Weyerhaeuser/DuPont Site Team
David Jansen, Ecology
Jeff King, DuPont Environmental Remediation Services
John Kreiter, DuPont Company Legal Department
Ralph Palumbo, Heller, Ehrman, White, & McAuliffe
Steve Thiele, Attorney General's Office
Marian Wineman, Hart Crowser, Inc.

**DETERMINATION OF A DNT SOIL CLEANUP LEVEL
PROTECTIVE OF GROUNDWATER
FORMER DUPONT WORKS SITE
DUPONT, WASHINGTON**

Conservative evaluations of Site conditions indicate that a soil cleanup level for dinitrotoluene (DNT) of 3 mg/kg provides a high level of protection to groundwater at the Former DuPont Works Site (Site), assuming a hypothetical drinking water exposure.

Soil Cleanup Level Determination

The DNT soil cleanup level for drinking water protection was calculated probabilistically using the following method with conservative input assumptions:

soil cleanup level (mg/kg) = drinking water screening level (mg/L) * DAF (unitless)* K_d (L/kg) (1)

where

- the MTCA drinking water screening level for DNT is 0.00013 mg/L;
- DAF is the dilution/attenuation factor, which, for this evaluation, considered only dilution occurring as a result of natural mixing of infiltration with groundwater flow in the upper ten feet of Site aquifers; and
- K_d is the Site-specific DNT soil:water desorption coefficient determined from toxicity characteristic leaching procedure (TCLP) testing.

Equation (1) was run as a Monte Carlo simulation using Crystal Ball software, a forecasting and risk analysis add-on to Excel software. In the Monte Carlo simulation, equation (1) was solved 5,000 times using input parameter values picked randomly from probability distributions for K_d and DAF developed from Site-specific and regional information. The soil cleanup level results determined from the 5,000 iterations were compiled automatically into a probability distribution for which percentiles were generated. The 5th percentile value of that distribution represents a conservative estimate of a DNT soil cleanup level protective of Site groundwater under a hypothetical drinking water exposure scenario, i.e., there is 95 percent probability that a 3 mg/kg DNT soil cleanup level is protective of Site groundwater.

Cleanup Level Determination Assumptions

Because the DNT drinking water screening level was set as a constant in equation (1), assumptions were required only for the desorption coefficient (K_d) and DAF in determining a Site-specific soil cleanup level for DNT. The assumptions follow, and supporting information is provided in Attachment A.

Desorption Coefficient (K_d) for DNT. A Site-specific DNT soil:water desorption coefficient (K_d) was developed from TCLP results for 27 samples of Site soils. Informal discussions with the Washington State Department of Ecology (Ecology - Charles San Juan, personal communication, August 1995) indicate that TCLP is an acceptable method for obtaining desorption coefficient (K_d) estimates for organic compounds like DNT. Statistical evaluation of the K_d values indicates that they are lognormally distributed with a geometric mean of 20 L/kg and geometric standard deviation of 4.0 L/kg (see Table 1). The geometric standard deviation was decreased, such that the K_d probability distribution in the Monte Carlo simulation was constrained within the range of Site-specific values determined from TCLP testing. Without the adjustment of standard deviation, the modeled distribution projected well outside the range of measured values. The resulting K_d probability distribution extends from 2 to 190 L/kg (refer to page A-5 in Attachment A [values are in natural logs]), which encompasses all but the single lowest and single highest measured values (0.2 and 248 L/kg, respectively; see Table 1). Figure 1 provides a comparison of the modeled and measured probability distributions for K_d for DNT at the Site.

Dilution/Attenuation Factor (DAF). A dilution/attenuation factor (DAF) represents the reduction in concentration occurring during transport from the bottom of the impacted soil, through the vadose zone, to a monitoring point within the aquifer. The DAF includes dilution (e.g., mixing and dispersion) and attenuation (e.g., sorption, reaction, and degradation) occurring both in the vadose zone and in the aquifer. Consistently low DNT concentrations detected in Site monitoring wells located downgradient of areas where high DNT soil concentrations existed prior to interim source removal may suggest a large DAF for DNT at the Site.

For this evaluation, the DAF was limited to reflect only the natural dilution occurring in the upper ten feet of Site aquifers (i.e., all other dilution/attenuation processes were not considered). A ten-foot thickness of aquifer was selected as a conservative assumption based on protecting a hypothetical drinking water exposure. Groundwater discharging at the sea level seeps is not a potential drinking water source because of salinity (per WAC 173-340-720-[1][a][ii][B]; refer to Hart Crowser, 1994), and the seeps are submerged daily by high tides. DNT was not detected in freshwater springs discharging to Sequalitchew Creek in four years of monitoring. Therefore, a drinking water exposure at the Site could only occur by constructing and operating a water supply well. In practice, a well would be installed as far below the water table as practical to provide for pump clearance and well losses, and to maximize available drawdown and thus well yield. A well completed deeper in the aquifer would draw water from a greater aquifer thickness, and thus allow greater mixing to occur. Considering dilution in only the upper ten feet of aquifer, corresponding to a small (ten-foot) well penetration, provides an additional conservative assumption in developing a DAF for the Site. Because this DAF considers only physical mixing of the infiltration water with groundwater in the aquifer, and does not include any chemical attenuation processes, it is applicable for all constituents at the Site.

The dilution factor represents the ratio of the groundwater flux (through a one-foot-wide by ten-feet-thick vertical cross sectional area of aquifer) to the infiltration flux (through a one-square-foot surface area). The assumptions used in estimating the aquifer flux and infiltration flux in the Monte Carlo simulation are listed below.

Infiltration flux was calculated as follows:

$$Q_i = (P - ET - RO) * A_{surface} * (\text{foot}/12 \text{ inches}) * (7.48 \text{ gal/ft}^3) * (\text{year}/525{,}600 \text{ min})$$

where

Q_i = infiltration flux in gpm;
P = precipitation in inches/yr;
ET = evapotranspiration in inches/yr;
RO = runoff in inches/yr;
$A_{surface}$ = surface area of 1 ft^2; and
The last three terms on the right side of the equation are units conversion factors as indicated.

- For the Monte Carlo simulation, precipitation was assigned a triangular distribution with minimum, most likely, and maximum values of 25.6, 37.8, and 50.0 inches per year, respectively, based on annual precipitation data from the Tacoma station. The measured annual values ranged from 24.9 to 46.9 inches per year. The average (37.8 in/yr) and standard deviation (6.1 in/yr) of the annual precipitation values were calculated, and the average value was used as the most likely value in the triangular distribution. The average plus and minus two standard deviations represented the maximum and minimum values, respectively, in the distribution (see page A-5 in Attachment A).

- Evapotranspiration was assigned a uniform distribution with minimum and maximum values of 19.9 and 20.1 inches per year, respectively, based on estimated evapotranspiration values from the Tacoma (19.9 inches/yr) and Puyallup (20.1 inches/yr) stations reported in Washington State University (1968) (see page A-5 in Attachment A).

- Runoff was assigned a uniform distribution within minimum and maximum values of 0 and 5.0 inches per year (see page A-6 in Attachment A). Although regional measurements of surface runoff were not obtained (data are rarely measured), Thorthwaite and Mather (1957) suggest 10 percent of precipitation as a reasonable estimate for many soils. Because of the permeable Site soils and limited observable runoff at the Site, runoff was assumed to range from 0 in/yr (most conservative assumption) to 10 percent (reasonable upper-bound value) of the maximum precipitation value (10 percent of 50 in/yr = 5.0 in/yr).

Groundwater flux in the aquifer was calculated using Darcy's Law of the form:

$$Q_{gw} = (K * i * A_{aquifer}) * (\text{foot}/30.48\ \text{cm}) * (60\ \text{sec/min.}) * (7.48\ \text{gal/ft}^3)$$

where

Q_{gw} = flux of groundwater in gpm within the upper 10 feet of aquifer;
K = aquifer hydraulic conductivity in cm/sec;
i = hydraulic gradient in ft/ft;
$A_{aquifer}$ = aquifer vertical cross sectional area in ft^2 normal to groundwater flow; and

The last three terms on the right side of the equation are units conversion factors as indicated.

For the dilution factor to be applicable across the Site, probability distributions for hydraulic parameters were developed to represent both the Water Table Aquifer and unconfined Sea Level Aquifer at the Site.

- Hydraulic conductivity (K) was assigned a lognormal distribution with geometric mean of 5×10^{-2} cm/sec and a standard deviation of 25 percent of the mean. The mean value provides a reasonable conservative estimate for representing both Site aquifers based on available data (Hart Crowser, 1994). Because the aquifer dilution factor will be most sensitive to uncertainty in K, a standard deviation of 25 percent of the mean value was selected to provide a relatively constrained, thus useful, range of groundwater fluxes while encompassing the reasonable range of expected values for K in both

Site aquifers (5×10^{-3} to 5×10^{-1} cm/sec; refer to page A-6 in Attachment A [values are in natural logs]).

- Hydraulic gradient (i) was assigned a triangular distribution with minimum, most likely, and maximum values of 0.005, 0.028 (midpoint of range), and 0.05 ft/ft, respectively. The range of gradient values encompasses values measured in both Site aquifers (Hart Crowser, 1994).

- Aquifer cross sectional area was set at 10 ft^2, which is a one-foot width of aquifer by the 10-foot thickness of aquifer considered in this evaluation.

This probabilistic evaluation indicates that there is a 95 percent probability that the aquifer dilution factor (representing a minimum DAF for all constituents at the Site) is at least 2,400 (5th percentile value; refer to the dilution factor forecast statistics on page A-4 of Attachment A).

Soil Cleanup Level Determination Results

The results of the Monte Carlo simulation run with the aforementioned input assumptions indicates there is a 95 percent probability that a DNT soil concentration of 3 mg/kg is protective of Site groundwater under a drinking water scenario. The mean value in the DNT soil cleanup level distribution was 59 mg/kg and the most likely value (mode) was 20 mg/kg. Attachment A provides supporting information for the soil cleanup level determination, including forecasts with statistical output (pages A-1 through A-4) and assumptions (pages A-5 and A-6).

Conclusion

There is a high probability that a DNT soil cleanup level of 3 mg/kg will be protective of Site groundwater assuming a hypothetical drinking water exposure. The 3 mg/kg cleanup level was determined from a probabilistic evaluation which incorporated Site-specific data and their inherent uncertainty, while maintaining a high level of conservatism (e.g., not considering any of the dilution or attenuation processes occurring in the thick vadose zone at the Site). Because Site groundwater will not be used for drinking water supply under future use of the Site, higher DNT concentrations than 3 mg/kg in soil would be protective of the highest beneficial use of Site groundwater, which is discharge to surface water.

REFERENCES

Hart Crowser, 1994. Draft Remedial Investigation/Feasibility Study, Former DuPont Works Site, Dupont, Washington. December 22, 1994.

Thorthwaite, C.W., and J.R. Mather, 1957. Instructions and Tables for Computing Potential Evapotranspiration for Water Balance. Publications in Climatology, v. 10, no. 3. Drexel Institute of Technology, Laboratory of Climatology. Centerton, NJ.

Washington State University, 1968. Washington Climate Data for King, Kitsap, Mason, and Pierce Counties. WSU Cooperative Extension Service, College of Agriculture. Prepared in cooperation with US Department of Agriculture. EM 2734.

DNTSOIL.rev

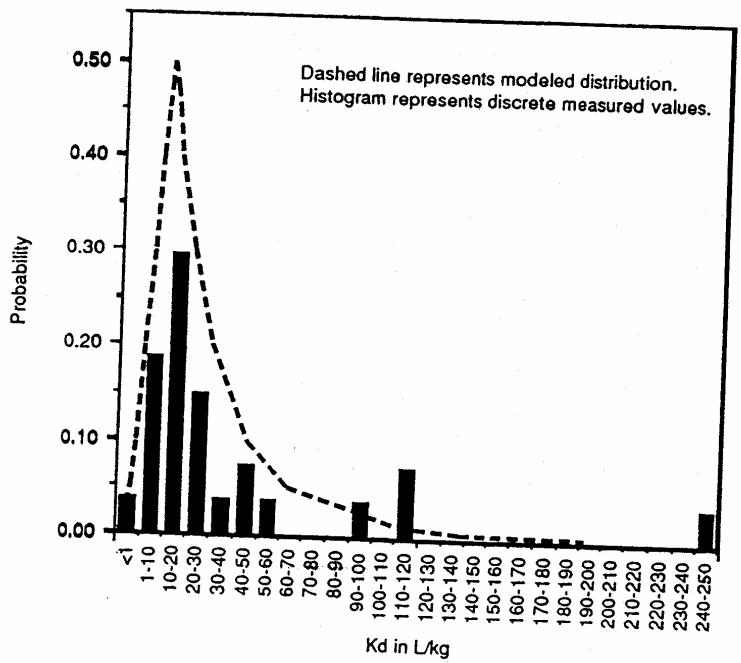
Table 1 - TCLP DNT Data and Desorption Coefficient (Kd) Estimates

SMPL-ID	Total DNT (1/2 U) Soil Concentration in mg/kg	Total DNT TCLP Leachate Concentration in mg/L	Desorption Coefficient (Kd) in L/kg
5D-DS-5	330	3.40	97
18-DS-SC-1	113	4.16	27
18-DS-SC-10	96	50	2
5D-DS-4	35	1.74	20
5D-DS-1	30	0.26	117
5D-DS-3	20.6	0.08	248
5-DH-TP-2-S-1	13.2	0.31	43
5D-TP-DS-6-S-3	10.8	44	0.2
18-DS-SC-11	8.7	1.32	7
5D-DS-2	8.6	0.57	15
5D-TP-DS-2-S-3	8.2	0.07	111
18-DS-SC-18	6.7	0.96	7
18-DS-SC-63	6.5	0.19	34
5D-TP-DS-6-S-2	6.2	0.53	12
18-DS-SC-5	6.1	0.13	46
18-DS-48	5.6	0.06	95
18-DS-SC-65	4.1	0.23	18
5D-TP-DS-6-S-4	3.4	0.25	14
5D-TP-DS-2-S-4	2.7	0.16	17
18-DS-SC-79	2.0	0.21	10
5D-TP-DS-3-S-3	1.5	0.06	25
18-DS-SC-68	1.3	0.15	9
18-DS-SC-28	0.3	0.01	24
5-DH-TP-2-S-2	0.07	0.001	52
5-DH-TP-3-S-1	0.04 U	0.002 U	20
5-DH-TP-4-S-1	0.03 U	0.002 U	19
5-DH-TP-1-S-1	0.02	0.002 U	10

No. of Samples:	27
Geometric Mean:	20 L/kg
Geometric Std. Dev:	4.0 L/kg

426101/DNTSOIL.xls

Comparison of Modeled and Measured Probability Distributions for Kd



HARTCROWSER
J-4261-01 10/95
Figure 1

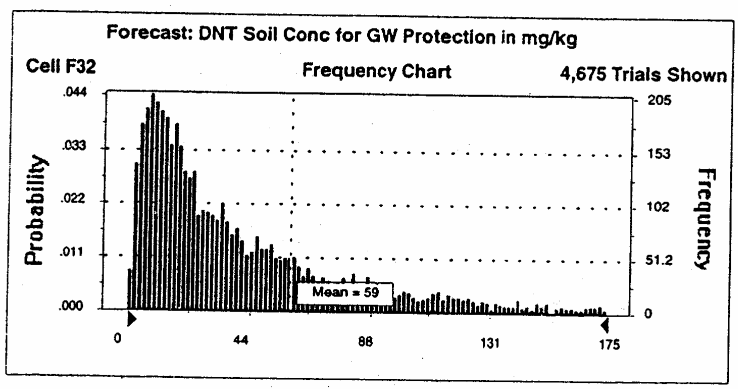
ATTACHMENT A
SUPPORTING INFORMATION FOR DNT SOIL CLEANUP LEVEL

Crystal Ball Report

Forecast: DNT Soil Conc for GW Protection in mg/kg **Cell: F32**

Summary:
- Display Range is from 0 to 175
- Entire Range is from 0 to 4011
- After 5,000 Trials, the Std. Error of the Mean is 2

Statistics:	Value
Trials	5000
Mean	59
Median (approx.)	30
Mode (approx.)	20
Standard Deviation	116
Variance	13444
Skewness	15.37
Kurtosis	430.59
Coeff. of Variability	1.97
Range Minimum	0
Range Maximum	4011
Range Width	4010
Mean Std. Error	1.64



Forecast: DNT Soil Conc for GW Protection in mg/kg (cont'd) **Cell: F32**

Percentiles:

Percentile	Value (approx.)
0%	0
5%	3
25%	13
50%	30
75%	65
95%	200
100%	4011

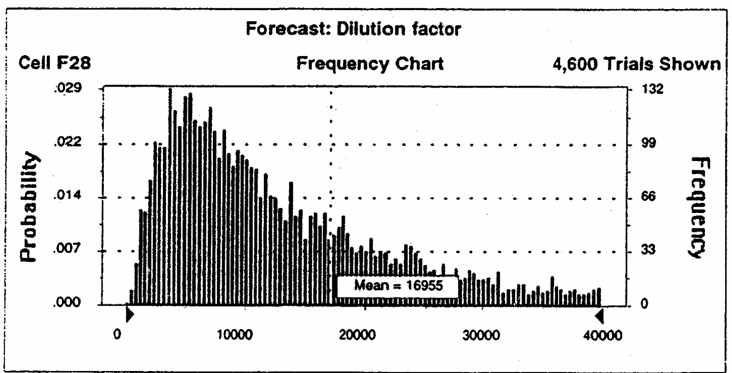
End of Forecast

Forecast: Dilution factor **Cell: F28**

Summary:

Display Range is from 0 to 40000
Entire Range is from 255 to 382050
After 5,000 Trials, the Std. Error of the Mean is 278

Statistics:	Value
Trials	5000
Mean	16955
Median (approx.)	11140
Mode (approx.)	5981
Standard Deviation	19652
Variance	386216865
Skewness	4.99
Kurtosis	54.30
Coeff. of Variability	1.16
Range Minimum	255
Range Maximum	382050
Range Width	381796
Mean Std. Error	277.93



Forecast: Dilution factor (cont'd) **Cell: F28**

Percentiles:

Percentile	Value (approx.)
0%	255
5%	2396
25%	6019
50%	11140
75%	20737
95%	49824
100%	382050

End of Forecast

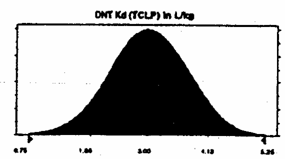
Assumptions

Assumption: DNT Kd (TCLP) in L/kg **Cell: F29**

Lognormal distribution with parameters:

Mean	3.00	(log space)
Standard Dev.	0.75	(log space)

Selected range is from -Infinity to +Infinity
Mean value in simulation was 26.73

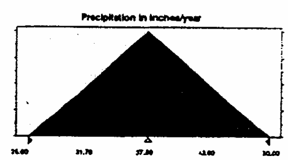


Assumption: Precipitation in Inches/year **Cell: F18**

Triangular distribution with parameters:

Minimum	25.60
Likeliest	37.80
Maximum	50.00

Selected range is from 25.60 to 50.00
Mean value in simulation was 37.72

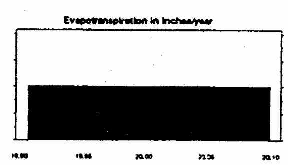


Assumption: Evapotranspiration in Inches/year **Cell: F19**

Uniform distribution with parameters:

Minimum	19.90
Maximum	20.10

Mean value in simulation was 20.00

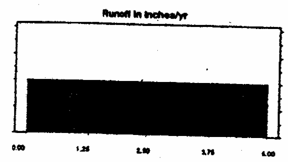


Assumption: Runoff in Inches/yr **Cell: F20**

Uniform distribution with parameters:

Minimum	0.00
Maximum	5.00

Mean value in simulation was 2.48

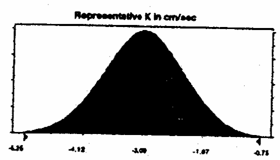


Assumption: Representative K in cm/sec **Cell: B18**

Lognormal distribution with parameters:

Mean	-3.00	(log space)
Standard Dev.	0.75	(log space)

Selected range is from -Infinity to +Infinity
Mean value in simulation was 0.07

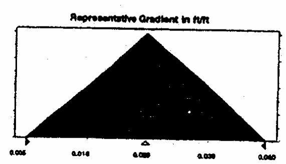


Assumption: Representative Gradient in ft/ft **Cell: B19**

Triangular distribution with parameters:

Minimum	0.005
Likeliest	0.028
Maximum	0.050

Selected range is from 0.005 to 0.050
Mean value in simulation was 0.028



End of Assumptions

C.4 Mercury Cleanup Levels Summary and Mercury/Lead Leaching Study

XXXXXXXXXXXXXXXXX
Director

Mercury

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

7272 Cleanwater Lane, LU-11 • Olympia, Washington 98504-6811 • (206) 753-2353

August 12, 1993

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Wilmington, Deleware 19898

Re: Mercury Cleanup Levels Summary and Mercury/Lead Leaching Study

Dear Vern, Linda, and Jack:

This letter transmits the Department of Ecology's (Ecology) comments on the above reports dated July 19, 1993. The Ecology team (Dan Alexanian, Kelly Susewind, and myself) reviewed them and our approval/comments follow.

MERCURY CLEANUP LEVELS SUMMARY:

The Mercury Cleanup Levels Summary report is hereby accepted and approved. The Ecology team agrees with the approaches taken to establish site specific cleanup levels for mercury in soil. Based upon the work conducted by Hart Crowser, the soil cleanup level for mercury is 24.0 mg/kg (equivalent to parts per million (ppm)). That concentration of mercury, which is the Model Toxics Control Act Method "B" soil cleanup level, is protective of human health and the environment, including ground water and surface water. It should be noted that 24 mg/kg is the individual cleanup level for mercury, which may be adjusted downward depending on cumulative site risks associated with multiple hazardous substances or exposure pathways.

We do have comments on a couple statements made in the summary report. The summary report states, "...mercury concentration below 24 mg/kg in site soils will not leach to ground water..." and "...ground water and surface water have not and will not be impacted." These statements are overly definitive in relation to reality. More appropriate would have been statements such as the following, "...mercury concentrations below 24 mg/kg in site soils will not leach to ground water at harmful levels..." and "...ground water and surface water have not and will not be adversely impacted." Over time, be it geologic time, the mercury will eventually leach to ground water or surface water.

P 4, p 4: Flow rate varied between columns due to variations in dry soil density (compactness), and therefore "K".

Page 5, Table 3: Correct the location of the comma in the second column, third row from the top; 8,190 instead of 81,90.

P 6, p 2: The statement that the metals concentration in the leachate was proportional to the initial soil concentration is "a little strong." A preferable statement would be: metals concentration in the leachate increased with increasing initial soil concentrations.

P 6, p 3: "COL-3 ran for approximately twice as long as COL-1 and nearly ~~six~~ 5 times as long as COL-5." In that same paragraph, it refers to other columns with similar soil concentrations. Were other samples with similar concentrations tested? If not, it would be preferable to say "K_d was greater, indicating less leaching" or " K_d was same order of magnitude indicating similar leaching" or some other statement to indicate that the increased contact time did not adversely affect the results.

P 7, Table 5: The table needs to be modified to include another column showing averages. In our connotation, partition coefficient implies some sort of equilibrium, which is better represented by an average. The averages would be: column #1 is 32,000 L/kg, column #2 is 61,000 L/kg, and column #3 is 41,000 L/kg.

P 7, p 1: In that paragraph, please include the TCLP value for lead.

P 8, p 1: What is the "bonding/binding energy values from leaching solution thermodynamics" that is mentioned in that paragraph?

P 8, p 2: "Soil samples were leached using a 1:20 solid to liquid ratio." Is that ratio based upon weight? If by weight, the column tests used an average of 10.98 pounds (4.99 kilograms (kgs)) of soil and 10.28 kgs of water, therefore approximately a 1:2 ratio. Since all column tests reached or approached the detection limit of 0.2 ug/L, it is not too surprising that diluting the leachate ten fold in the ELP tests resulted in mostly non-detects, even with the increased contact. A brief comparison of the solid to liquid ratio for both tests would seem appropriate for the report.

P 10, Table 7: Is sample #ELP-IS-1 a TCLP test sample rather than an extraction leaching procedure sample? It is footnoted in Table 6 that #ELP-IS-1 is a TCLP sample. In general, the Tables need to be "cleaned up" to clearly identify or separate ELP results from TCLP results.

P 10, p 1: The first sentence states that the ELP data ranged from 16,000 to 36,000 L/mg for mercury. It is difficult to call that a "range," especially since those are only two data points and they are duplicate tests. Also, "This is also consistent with observed results from the column testing, indicating that both mercury and lead are preferentially adsorbed to site soils." Please explain how the underlined part of that sentence relates to the rest of that paragraph.

P 10, p 3: It states that a ratio of average leachate concentrations to initial concentrations was used. On page 9, it states soil:water partition coefficients were calculated from leachate and final soil concentrations. Which is it? Also, how did you calculate the lead ELP value of 2.6×10^{-5}?

P 11, p 1: We calculated that column test contact times ranged from 2 to 6 hours, based on pore volumes. How did you calculate contact times to get a range from 4.5 to 22 hours?

Because of the importance of these two reports, we want to ensure that they are as accurate and error-free as possible. If you have any questions or would like to arrange a meeting to discuss our comments and your responses on the two reports, please give me a telephone call at (206) 586-0364.

Sincerely,

Mike Blum

Mike Blum
Site Manager
Toxics Cleanup Program

cc: Marian Wineman, Hart Crowser, Inc.
Ralph Palumbo, Heller, Ehrman, White, & McAuliffe
Charles Hunter, DuPont Company Legal Department
Jay Manning, Senior Assistant Attorney General
Ken Johnson, Weyerhaeuser Company
Bob Shedd, Weyerhaeuser Company
Jeff King, DuPont Environmental Remediation Services
William Gorgensen, City of DuPont
Ecology's Weyerhaeuser/DuPont Site Team
Megan White, Toxics Cleanup Program Section Supervisor

Admittedly, the mercury concentrations would be extremely low and the impact would probably be imperceptible, though the mercury will leach.

Also, in one of the footnotes, it states, "If mercury were leachable to groundwater it would have shown up in the groundwater sampling data since mercury sources have existed at the Site since the early 1900s." Mercury may have been used at the DuPont Works since the early 1900s, but when it was first released (spilled/discharged) into the environment and exposed to leaching and/or gravity is unknown.

MERCURY/LEAD LEACHING STUDY:

The Mercury/Lead Leaching Study report, as explained to me by Marian Wineman, is to be "viewed" as a reference document. Contained within that report is the backup information used or quoted in the Mercury Cleanup Levels Summary as well as information on lead leaching studies conducted at the same time as the mercury work. Currently, the lead leaching study results are not being used for purposes like the mercury data is. The Ecology team kept the above in mind while reviewing the report. Our detailed comments are as follows:

Page (P) 2, paragraph (p) 3: The text says the permeameter can accommodate 8-inch diameter samples up to 18 inches long. The schematic (Figure A-1) says a sample length of up to 12 inches. Which is it?

P 3, p 2: A hydraulic conductivity (K) of 3×10^{-5} cm/sec puts the recompacted sample in the silt range or the bottom of the silty sand range. In the Mercury Cleanup Levels Summary report (page V-2), it states that a K of 10^{-3} is at the lower end of the range of K estimates. It seems that the test material has an artificially low permeability. What potential effect (under estimated leachability? over estimated leachability?) does this decreased hydraulic conductivity have on the results? Does the over-compacted (lower permeability) sample increase contact times? Does it create preferential flow paths thereby decreasing contact time? A different effect? A couple other related issues (possible discrepancies or errors) were noted in the document.

> In that paragraph and Attachment B, it refers to COL-IS-5. Figure B-2 identifies the sample as COL-IS-5. On Table C-1, it refers to sample COL-IS-3 (with the same hydraulic conductivity as COL-IS-5) . Are the samples identified correctly or are they all really COL-IS-5?
>
> On Table C-1, shouldn't the ratio between before and after results be the same for "water content" and "saturation"?
>
> Is the hydraulic conductivity of sample COL-IS-5 actually 3×10^{-5}. That seems low for a sample containing 85% gravel and sands and only 16% silts and clays? It would be helpful to see the raw data sheets for computing hydraulic conductivity. Were hydraulic conductivities calculated for the other samples?

P 4, p 3: It states that the actual conditions for each column are summarized in Table 2. Table 2 only has a permeability number for Column #3 and none for columns 1 and 5. Are those permeabilities available?

P 4, Table 2: Columns 1 and 5 have the same dimensions but differ in weight by greater than 8%, therefore the density should also differ by 8%. Shouldn't the density for column 5 be 98 lb/ft^3 instead of 105? [18.48 / 19.99 (106) = 98 lb/ft^3.]

Also, on Table 2: The dry density for column 3 should be 117 rather than 116 lb/ft^3.

C.5 TNT Soil Cleanup Level Protective of Groundwater

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

January 11, 2001

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Weyerhaeuser Company
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Mr. Ron Buchanan
DuPont Specialty Chemicals
Barley Mill Plaza Building 27
Post Office Box 80027
Wilmington, DE 19880-0027

Re: Hot Spot Interim Action Report

Dear Jim and Ron:

The Ecology Team has reviewed the report entitled Hot Spot Interim Action Report dated October 4, 2000 and we have the following comments. I apologize for my delay in getting your our comments, as Dan Alexanian provided me with his comments a while ago.

1. Page 1, Section 1.1, Third paragraph: The Method C industrial soil cleanup level for trinitrotoluene (TNT) is identified in the report as 33 mg/kg. That level is the Method B concentration based on direct contact as a carcinogen. The Method C industrial cleanup levels are as follows:
Direct contact as a carcinogen - 4,380 mg/kg
Direct contact as a non-carcinogen - 1,750 mg/kg
Protective of groundwater as a carcinogen (100x the groundwater standard) - 2.92 mg/kg
Protective of groundwater as a non-carcinogen (100x the groundwater value)- 1.75 mg/kg
Based on protection of groundwater, the cleanup level would be 1.75 mg/kg, not 33 mg/kg. If you have some site-specific data on TNT and the leachability, that cleanup level might increase or decrease. It does look however, based on the existing sampling data, that TNT is not an issue anymore in the industrial area located north of Sequalitchew Creek. Prior sampling revealed higher TNT concentrations in Area 10 north of the creek.

2. Page 2, 2nd paragraph (and other locations in the report): "Sample 26-B-503-S-1 is located in a future Placement Area and was not removed because it will be covered with more than 15 feet of fill." The Ecology Team has some philosophical concerns about burying high levels of hazardous substances (25,000 mg/kg lead, for example), even when it is buried 15 feet or more and does not pose a threat to ground water. We should discuss this more in the near future. While it does comply with the Model Toxics Control Act regulations, it seems that if the material is easily accessible, it should be dealt with rather than just covering it over. If you continue with your proposal, you need to ensure that a minimum of 15 feet of fill is placed over those locations with "higher" contaminant concentration.

3. Page 17, Section A3: "In selected cases where the impacted soils are greater than 1.5 feet deep, the initial excavation was 10 feet by 10 feet." Why was 10 by 10 chosen rather than 50 by 50?

4. Pages 21 and 22, Section B7, the bullets: Please explain the statement "...therefore, no data were qualified." I appears from the various statements that there were problems in the lab with lead matrix spike recovery or control limits, but "no data were qualified". Only 2 of 17 bullets identified data that were qualified, though it appears that all the matrix spikes/blank spikes had problems.

5. General comment: It is hard to figure out how to compare original samples with post-excavation confirmational samples.

If you have any questions regarding the above comments, please give me a telephone call at (360) 407-6262.

Sincerely,

Mike Blum

Mike Blum
Site Manager
Toxics Cleanup Program

MB:dj

cc: Izzy Zanikos, DuPont Company
Marian Wineman, URS
Jeff King, West Shores Corporation
Brad Grimsted, Pioneer Technologies Corporation
Ecology's Weyerhaeuser/DuPont Site Team

C.6 TPH Soil Cleanup Level Protective of Groundwater

C.6.1 Review of TPH Soil Cleanup Level Protective of Groundwater

**REVIEW OF TPH SOIL CLEANUP LEVEL
PROTECTIVE OF GROUNDWATER
FORMER DUPONT WORKS SITE
DUPONT, WASHINGTON
FEBRUARY 12, 1996**

In recent discussions regarding residual Bunker C-derived TPH concentrations and backfilling of the Area 8 pipeline excavation (January 18, 1996, meeting), Ecology stated that they perceived inconsistencies in the TPH/PAH Cleanup Level Summary regarding a TPH concentration protective of Site groundwater (7,600 mg/kg vs. 11,000 mg/kg).

Response

There is evidence to support a Bunker C-derived TPH soil concentration of 30,000 mg/kg as protective of Site groundwater. The evidence is summarized below.

- Because the risk posed by Bunker C-derived TPH at the Site is associated with its cPAH content, a groundwater protection soil cleanup level for Bunker C-derived TPH was derived based on cPAH content in the TPH/PAH Cleanup Level Summary. In Appendix VI of that document, a Bunker C-derived TPH concentration of 7,600 mg/kg was determined by calculating a cPAH concentration protective of groundwater and back-calculating the corresponding TPH concentration from the TPH/cPAH regression (with 95% confidence; Appendix V of the TPH/PAH Cleanup Level Summary). A cPAH concentration of 12 mg/kg was initially calculated as protective of groundwater using the most stringent MTCA cPAH drinking water screening level (0.000012 mg/L), a conservative literature-derived value for cPAH partition coefficient (9,600 L/kg), and a conservative default dilution/attenuation factor (DAF) of 100.

  Applying the Site-specific DAF of 2,100 (refer to DNT Soil Cleanup Level Determination; October 1995) rather than a default DAF of 100 indicates that a cPAH concentration of 240 mg/kg is protective of Site groundwater. This corresponds to a Bunker C-derived TPH concentration above 30,000 mg/kg (as protective of Site groundwater). This value is consistent with preliminary findings from the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG). In the January 17, 1996, meeting of Ecology's Risk Assessment Forum TPH subcommittee, the TPHCWG presented example risk-based groundwater protection cleanup goals of 35,000 mg/kg for motor oil, and higher (soil saturation [e.g., 25 percent TPH]) for weathered motor oil which is more representative of Bunker C-derived TPH at the Site.

- Leachable TPH was not detected in TCLP testing of Site soil samples with Bunker C-derived TPH concentrations up to 11,000 mg/kg. Leachable TPH was detected (16 mg/L) in a sample of Site soil with 19,000 mg/kg TPH, as reported in Appendix VI of the TPH/PAH Cleanup Level Summary and the Area 8 Interim Status Memorandum. Applying the Site-specific DAF of 2,100 to this leachate concentration produces a resultant estimated groundwater concentration of only 0.008 mg/L, well below the MTCA groundwater screening level of 1 mg/L. Alternatively, a Bunker C-derived TPH groundwater protection soil cleanup level which represents a soil saturated with Bunker C-derived TPH is determined from these data by multiplying a TPH desorption coefficient (K_d) of 1,200 L/kg (19,000 mg/kg ÷ 16 mg/L) by the DAF of 2,100 (MTCA groundwater screening level is 1 mg/L). As stated above, the TPHCWG's preliminary findings likewise indicate that soils fully saturated with high molecular weight hydrocarbons (like Bunker C) pose no risk to groundwater.

- After decades of rainwater leaching of residual TPH in Site soils, detection of TPH and cPAHs has not been confirmed in Site groundwater.

Conclusion

Site-specific data, corroborated by the findings of the TPHCWG, indicate that Bunker C-derived TPH concentrations of 30,000 mg/kg in Site soils will not adversely impact Site groundwater. This value is higher than the previous determination because it includes a more realistic assessment of the substantial natural dilution/attenuation occurring at the Site (Site-specific DAF of 2,100 compared to a default of 100).

SG/rkb
tph.rpt

ECOLOGY MEETING
February 15, 1996

Attendees: Mike Blum, Dan Alexanian, Kelly Susewind, Vern Moore, Jeff King, Steve Germiat, Marian Wineman, Geneva Smith

Paraffin Investigation

The Weyerhaeuser/DuPont team reported they had conducted additional sampling in Areas 6, 12, and 38 in order to verify the presence of paraffin wax-derived TPH. A Paraffin Investigation report was presented to Ecology which outlined details of the soil sampling, analysis results, and exploration location maps.

Area 6, Crystallizer Drum Area

Oil was detected in the two surface soil samples that were taken. The results did not confirm paraffin as the source of TPH.

Area 12, Works Magazine Landfill

Fourteen confirmation soil samples were collected from RI and pre-RI sampling locations where elevated TPH and/or oil and grease were detected. It was determined that paraffin associated with waxed cardboard boxes most likely accounted for the majority of TPH detected during the RI sampling. Low concentrations of diesel were detected in three of the samples.

Mike Blum of Ecology stated that the samples taken from Unit 12-2 did not necessarily confirm that all the TPH was paraffin-based. Additional sampling might provide extra support.

Marian Wineman of the Weyerhaeuser/DuPont team stated there were many variabilities in Area 12 and paraffin was very patchy throughout the area, which could result in patch hits. Three monitoring wells in the location have not detected TPH. She also stated that the chromatogram for paraffin was nearly identical to the chromatograms from Area 12.

Area 38, Carton Production Area and Drywell

TPH concentrations above the MTCA screening level were detected in three RI samples in Area 38. Interim source removal was conducted in October 1995 and verification samples were taken. Paraffin was not detected in any of the samples. Oil and diesel were detected.

Path Forward:

> *Ecology will review Paraffin Report and decide whether or not additional sampling will be needed.*

Review of TPH Soil Cleanup Level Protective of Groundwater

Discussion on residual Bunker C-derived TPH concentrations and the backfilling of Area 8 pipeline excavation. The Weyerhaeuser/DuPont team responded to Ecology questions regarding inconsistencies in the TPH/PAH Cleanup Level Summary regarding a TPH concentration protective of Site groundwater. Steve Germiat of the Weyerhaeuser/DuPont team stated that site-specific data indicated that Bunker C-derived TPH concentrations of 30,000 mg/kg in Site soils would not adversely impact the groundwater.

Mike Blum of Ecology stated that Ecology did not necessarily agree with the 30,000 mg/kg number. He stated that in general, the TPH values were probably protective of groundwater using the DAF. There is concern about the PAH's since chrysene is showing up in some of the monitoring wells.

Dan Alexanian of Ecology stated that the proposed monitoring well would be down-gradient from Area 8 and could be used to monitor PAHs, as well as DNT. Mike Blum gave approval for Area 8 to be backfilled, but stated the PAH in groundwater still needed to be dealt with in determining TPH soil cleanup levels protective of groundwater. Dan Alexanian agreed with this on the condition that if necessary (after the PAC decision), the Weyerhaeuser/DuPont team would come back in and clean up locations which exceed the PAC's number.

Path Forward:

- *Area 8 to be backfilled.*
- *Ecology to review TPH/cPAH data with regards to establishing Site TPH soil cleanup levels.*
- *Weyerhaeuser/DuPont team to tabulate all sample concentrations exceeding MTCA screening levels at depths below 15 feet.*

Other Issues

Discussion on arsenic background number of 32 ppm. Ecology agrees with the work that has been done and with the 32 ppm number.

Path Forward:

- *Parcel 2 draft RI package to Ecology. (22 March 1996)*
- *W/D will initiate first draft of Parcel 2 CAP.*

Schedule for remainder of the Site was discussed. It could take more than two years for the PAC to come up with recommendations, for Ecology to put together some policies, and get changes made in the regulations. Mike Blum stated Ecology would like to begin making some decisions for this site.

Vern Moore stated that the golf course alternate plan would be submitted to the City of DuPont around the middle of March. It is grandfathered under the City's 1985 Comprehensive Plan. The Weyerhaeuser/DuPont team would like to see the Department of Ecology sponsor the EIS, lending more efficiency and speed to the project. The Weyerhaeuser/DuPont team gave Ecology a 2001 to 2002 estimate for completion of the cleanup.

Ecology will confirm with the Weyerhaeuser/DuPont team a date for a general meeting with everyone invited. (This has been confirmed for 3/19/96 8:30 am - 12 noon at DuPont field office).

C.6.2 TPH/PAH Cleanup Level Summary

file: Final Draft

DRAFT

TPH/PAH CLEANUP LEVEL SUMMARY

INTRODUCTION

The appropriate soil cleanup levels for total carcinogenic polycyclic aromatic hydrocarbons (cPAH) in each land use area at the Former DuPont Works Site (the "Site") are as follows:[1]

Land Use	cPAH
Residential	1 to 10 mg/kg
Open Space	5 to 50 mg/kg
Golf Course	20 to 220 mg/kg
Industrial	30 to 300 mg/kg

The appropriate soil cleanup levels for Bunker C fuel-derived total petroleum hydrocarbons (TPH) are 3,100 to 27,000 mg/kg.

TPH/cPAH cleanup levels for groundwater are not established because groundwater and surface water at the Site are in compliance with MTCA screening levels.

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[1] Soil cleanup levels apply to soils from 0 to 15 feet in depth. WAC 173-340-740(6)(c).

TPH AND cPAH DETECTED AT THE SITE

TPH and/or cPAH concentrations above MTCA screening levels were detected at 15 areas of the Site. Interim source removal actions have been conducted in eight of those areas. TPH and/or cPAH concentrations above MTCA screening levels remain only in two of these interim source removal areas: Area 5 (mixed petroleum products) and Area 8 (Bunker C fuel-derived TPH). An interim source removal action in Area 24 will be conducted in 1994, and verification data will determine whether TPH/cPAH concentrations above MTCA screening levels remain.

Six additional (non-source removal) areas contain TPH and/or cPAH concentrations above MTCA screening levels. Areas 7 and 16 contain Bunker C fuel-derived TPH. Area 26 contains mixed petroleum products. Areas 6, 12 and 38 contain non-hazardous paraffin-derived TPH. No toxic fraction is associated with paraffin-derived TPH, and no cPAHs were detected in any of these three areas. Accordingly, no further action based on petroleum constituent concentrations is proposed for the three areas with nonhazardous paraffin-derived petroleum constituents.

Appendix I summarizes TPH and cPAH concentrations in soil in each area of the Site that has had concentrations above MTCA screening levels, and provides information regarding the source of petroleum constituents for each area. Appendix II describes the TPH/cPAH composition of the Bunker C fuels present at the Site.

CLEANUP LEVELS FOR TPH/cPAH IN SOILS

1. Soil cleanup levels for cPAH. The MTCA Cleanup Regulation requires establishment of cleanup levels based on estimates of the reasonable exposures expected to occur under both current and future site use conditions. WAC 173-340-740(1)(a).

The City of Dupont 1985 Comprehensive Land Use Plan for the area South of Sequalitchew Creek will result in that area being used exclusively for residential, recreational and commercial uses. Recreational uses may include an 18-hole golf course (that will cover a significant portion of the area South of Sequalitchew Creek) and open space, or "green belts," along the Creek, in the kettle areas, and around Old Fort Lake. Commercial uses will cover the remaining areas that are not specifically developed as residential neighborhoods. The cPAH cleanup levels were developed for each planned residential and recreational land use area.[2] Cleanup levels were also developed for the industrial areas of the Site that are located North of Sequalitchew Creek.

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[2] Residential cleanup levels will apply in the commercial areas because many commercial areas will have mixed commercial and residential uses.

The cPAH cleanup levels for residential land use are derived using exposure assumptions that are representative of chronic exposures with children as the sensitive receptor population. (Note, however, that cPAH has not been detected above MTCA screening levels in areas currently planned for residential development.)

The cPAH cleanup levels for open space land use are derived using reasonable exposure assumptions representative of children in a recreational setting. Soils in the areas of the Site planned for open space uses will not be disturbed by activities typical in residential areas such as gardening and landscaping. Landscaping and vegetative ground cover will further reduce the availability of surface soils for direct contact. However, incidental soil ingestion by children has been considered in setting the cleanup levels for cPAH in open space areas.

The cPAH cleanup levels for golf course land use are derived using exposure assumptions appropriate to golf course maintenance workers. Golfers (and other persons with access to the golf course) would not be potentially exposed to residual constituents in native soils because the entire golf course area will be covered by 1 to 2 feet of topsoil and golf course turf grasses.[3]

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[3] Some golf course areas may also be covered by concrete or asphalt roads, parking lots, golf cart paths, and by structures such as a club house, maintenance and storage buildings, etc.

Thus, the only potentially exposed persons would be golf course workers (adults) who occasionally may come into contact with native soils during maintenance of the golf course. Exposure in these circumstances would be infrequent and of limited duration.

The cPAH cleanup levels for industrial land use are derived using exposure assumptions appropriate to protect an adult worker that might have daily contact with Site soils.

In accordance with WAC 173-340-708(3)(c), documentation for the use of Site-specific exposure scenarios is provided in Appendix III.

2. Soil cleanup levels for TPH. The risk presented by the Bunker C fuel constituents detected at the Site is attributable to its cPAH components. See Appendix IV. Accordingly, correlation analyses were performed to assess the statistical relationship between cPAH and TPH concentrations, and to establish TPH cleanup levels for Bunker C fuel-derived TPH detected in Areas 7, 8 and 16.[4] See WAC 173-340-702(6) (Ecology "**shall** consider new scientific information when establishing cleanup levels for individual sites").

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[4] No TPH cleanup level is established for Areas 5 and 26 that have mixed petroleum products because cleanup of metals contamination in those areas will also cleanup soils with petroleum constituents. Verification testing will be done in those areas to confirm that no TPH concentrations remain above MTCA screening levels.

The results indicate that cleanup levels of 3,100 to 27,000 mg/kg for Bunker C fuel-derived TPH will correspond to the residential cleanup goal of 1 to 10 mg/kg for cPAH. Appendix V explains the analysis used to establish TPH cleanup levels. See also, WAC 173-340-740(3)(ii)(B).

TPH/cPAH CONCENTRATIONS IN SITE GROUNDWATER AND SURFACE WATER DO NOT POSE A RISK TO HUMAN HEALTH

TPH/cPAH cleanup levels are not established for groundwater because TPH/cPAH concentrations are not present above MTCA screening levels in groundwater or surface water at the Site. Appendix VI sets forth TPH/cPAH concentrations detected in Site groundwater and surface water during RI sampling.

- TPH was not detected in any groundwater or surface water sample collected during the four rounds of RI water sampling;
- no groundwater samples had detections of any noncarcinogenic PAH above the MTCA drinking water screening levels;
- no groundwater sample had detections of total cPAH above the MTCA screening level, except a single unconfirmed detection in one well that is not considered representative of groundwater quality;

- no TPH or noncarcinogenic PAHs were detected above MTCA screening levels in any surface water samples; and
- no cPAH were detected in any surface water sample, except a single detection which was the result of elevated sample turbidity and which is not representative of surface water quality at the Site.

<u>TPH/PAH CONCENTRATIONS IN SITE SOILS, GROUNDWATER AND SURFACE WATER ARE PROTECTIVE OF ECOLOGICAL RECEPTORS</u>

A quantitative ecological risk assessment was performed to estimate the potential risk posed by TPH/cPAH in soils at the Site. <u>See</u> Appendix VII.

The results of the ecological risk assessment indicate that cPAH concentrations in soil below 30 mg/kg are protective of ecological receptors at the Site. No cPAH-related ecological risks would be present in the residential areas of the Site at the TPH cleanup levels ranging from 1 to 10 mg/kg. cPAH concentrations in the open space areas of the Site are less than 30 mg/kg. Finally, there will be no risk to ecological receptors in the golf course area because the topsoil cover, golf course turf grasses and golf course maintenance will minimize small mammal exposure to the underlying subsurface soils.

The risk to ecological receptors from exposure to Bunker C fuel-related TPH is attributable to its cPAH components. The cPAH concentration of 30 mg/kg determined to be protective of ecological resources corresponds to a TPH soil concentration of 76,000 mg/kg. Thus, at the cleanup levels established for TPH (3,100 to 27,000 mg/kg), Site soils will not present a risk to ecological receptors.

CONCLUSION

The following soil cleanup levels for cPAH/TPH are established based on land use:

1. For residential land use, the appropriate cPAH cleanup level is 1 to 10 mg/kg;

2. For open space land use, the appropriate cPAH cleanup level is 5 to 50 mg/kg;

3. For golf course land use, the appropriate cPAH cleanup level is 20 to 220 mg/kg;

4. For industrial land use, the appropriate cPAH cleanup level is 30 to 300 mg/kg.

5. For soils that contain Bunker C fuel-derived TPH, the appropriate cleanup level is 3,100 to 27,000 mg/kg.

The cPAH/PAH cleanup levels set forth above are protective of ecological receptors. No groundwater risk is present at the Site because TPH/cPAH concentrations in groundwater are well below MTCA screening levels.

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LIST OF TECHNICAL APPENDICES

TPH/PAH CLEANUP LEVEL SUMMARY

APPENDIX I
SUMMARY OF TPH/PAH IN SOILS

Total petroleum hydrocarbons (TPH) have been detected in soil samples collected from 15 areas of the Site. Based on historical records and chemical fingerprinting (chromatogram) analyses, the primary source of the TPH on the Site is Bunker C fuel. However, a few Site areas have TPH detections associated with sources other than Bunker C fuel, including mixed petroleum types (gasoline, kerosene, and diesel formerly occurred in former UST locations) and paraffin.

Because MTCA allows for the evaluation of the toxic fraction of TPH (WAC 173-340-730[3][ii][B]), TPH-containing soils were also analyzed for polycyclic aromatic hydrocarbons (PAHs) and/or benzene, toluene, ethylbenzene, or xylenes (BTEX) depending on the petroleum type.

Of the 15 areas where TPH has been detected, interim source removal has been conducted in eight areas, and interim source removal is planned for a ninth area (Area 24, Main Powerhouse) in 1994. Ecology has reviewed verification sampling data for three of these areas and has determined that No Further Action (NFA) is needed in these areas.

Interim Source Removal Areas Approved by Ecology for No Further Action

- **Area 20—Underground Storage Tanks.** Four underground storage tanks which formerly contained kerosene, diesel, or gasoline, have been removed and the associated petroleum-containing soils overexcavated (Hart Crowser, 1991);

- **Area 38—Box Production Area Underground Storage Tank.** Diesel and/or Bunker C were identified in one underground storage tank, which has been removed, and the associated petroleum-containing soils overexcavated (Hart Crowser, 1993); and

- **Area 39—Laboratory Underground Storage Tank.** Gasoline was identified in one underground storage tank, which has been removed, and the associated petroleum-containing soils overexcavated (Hart Crowser, 1993).

These three areas, which have been approved by Ecology for NFA, will not be addressed further. Area 24, the Main Powerhouse, is scheduled for interim source removal during 1994.

The remaining eleven areas are addressed below according to the petroleum type identified in each area.

Bunker C-Derived TPH

Analysis of Bunker C-Derived TPH

Fourteen soil and product samples from the Area 8 pipeline were analyzed for fuel identification (EPA Method 8015 Modified) or volatile organic compounds (EPA Method 8240). Bunker C was identified in eight of these samples. No BTEX was detected in any of the samples where Bunker C was identified.

Based on these results, it was determined that BTEX was not representative of the toxic fraction of Bunker C-derived TPH (WAC 173-340-740[3][ii][B]).

Carcinogenic PAHs (cPAHs) were detected in each area with elevated concentrations of Bunker C-derived TPH. Non-carcinogenic PAHs were not detected at the Site above MTCA screening levels, and therefore will not be addressed further.

Areas where Bunker C occurs include Areas 7, 8, 16, and 24. The appropriate cleanup level for TPH in these areas was determined on the basis of a correlation evaluation of the TPH and corresponding total cPAH concentration (toxic fraction per WAC 173-340-740[3][ii][B]) and future land use, as described in Appendix V.

Additional discussion of Bunker C-derived TPH in Areas 7, 8, and 16 is provided below. Area 24 is not discussed because interim source removal is planned for later in 1994.

Interim Source Removal of Bunker C-Derived TPH in Area 8

The objective of the Area 8 interim source removal was to excavate soils containing total cPAH concentrations above 1 mg/kg to a depth of 15 feet (WAC 173-340-740[6][c]).

Post-removal TPH concentrations in the upper 15 feet of soil ranged from not detected (ND) to 200 mg/kg. Post-removal cPAH concentrations in samples in the upper 15 feet of soil were all below detection limits. Post-removal TPH concentrations of soil at depths greater than 15 feet ranged from not detected to 11,000 mg/kg. Post-removal total cPAH concentrations of soil at depths greater than 15 feet ranged from not detected to 4.4 mg/kg. Based on the total cPAH/TPH correlation and considerations of TPH leachability, all targets associated with cPAH and groundwater protection have been achieved by the interim source removal. The cPAH/TPH correlation evaluation is discussed in Appendix V. TPH leachability is discussed in Appendix VI. Table I-1 summarizes TPH/cPAH concentrations in Area 8.

Table I-1 - TPH and cPAH Concentrations in Area 8 Following Interim Source Removal

Area	Range of Concentrations in mg/kg	Detection Frequency	Arithmetic Mean in mg/kg	95 Percent UCL in mg/kg
TPH				
8 (< 15 ft)	ND to 200	6/17	40	200
8 (all depths)	ND to 11,000	32/48	1,300	11,000
Total cPAH				
8 (< 15 ft)	ND	0/6	ND	ND
8 (all depths)	ND to 4.4	2/13	0.4	4.4

ND: Not detected. TPH detection limit of 21 mg/kg; cPAH detection limit of 0.06 mg/kg.

Bunker C-Derived TPH in Areas 7 and 16 (Non-Interim Source Removal Areas)

A surficial layer of Bunker C residue is present in portions of the bottoms of the Area 7 and Area 16 kettles (Hart Crowser, 1992a). Fuel identification analyses performed on samples of the residue from each of these areas confirm that weathered and unweathered Bunker C residue is present in each area, and the residues in each area are similar (refer to Appendix II). Table I-2 presents TPH and cPAH data for Areas 7 and 16.

Table I-2 - TPH and cPAH Concentrations in Areas 7 and 16 (Bunker C-Derived TPH)

Area[1]	Range of Concentrations in mg/kg	Detection Frequency	Arithmetic Mean in mg/kg	95 Percent UCL in mg/kg
TPH				
7	ND to 10,000	15/29	960	10,000
16	ND to 2,500	29/51	310	2,200
Total cPAH				
7	ND to 2.9	5/7	0.8	2.9
16	ND to 17.9	8/19	1.5	17.9

ND: Not detected. TPH detection limit of 21 mg/kg; cPAH detection limit of 0.06 mg/kg.

[1] Concentrations are summarized for samples above 15 feet because, where sampled, no detections of TPH or cPAH occurred below 15 feet in these areas with the exception of one sample with 28 ppm TPH in Area 16.

Mixed Petroleum-Derived TPH

Analysis of Mixed Petroleum-Derived TPH

BTEX was detected in soils formerly associated with USTs, which have been removed during interim source removal in Areas 20, 38, and 39. Ecology has determined that NFA is required in these areas (see above).

Areas found to contain mixed petroleum products are Areas 5, 19, 35, 26, 40, and one subunit of Area 12, Area 12-2. These areas are discussed below, with the exception of subunit Area 12-2 which is discussed in the ***Non-Hazardous Paraffin-Derived TPH*** section below.

Interim Source Removal Areas - Mixed Petroleum-Derived TPH

Area 5. Area 5 formerly contained debris deposited and partially buried on the western slope of the Area 16 kettle. The area has been used since at least the 1940s for disposal of non-burnable materials. Prior to debris removal activities in the area, the debris included a variety of containers including drums, demolition debris, and general refuse. The majority of the drums removed were apparently empty and non-hazardous. However, 85 drums contained mixed petroleum products (oil, tar, grease, and asphalt), which contributed to elevated TPH concentrations in this area.

Area 5 interim source removal was based on excavating soils with elevated concentrations of DNT, metals, TPH, and PAHs. Following the interim source removal, verification soil samples collected from the area contained TPH concentrations ranging from not detected to 1,900 mg/kg. Verification data for cPAHs indicated concentrations ranging from 0.3 to 2.4 mg/kg.

The mixed petroleum products detected in Area 5 are associated with concentrations of other constituents above MTCA screening levels, mainly lead and arsenic. Cleanup of soils for lead and arsenic will remove all TPH-containing soils above the MTCA screening level, therefore, it is unnecessary to establish cleanup levels for TPH in this area.

Area 19. Petroleum-containing soil from the area around the Oil House was excavated and removed. Verification soil sample results indicated concentrations in samples ranging from below detection limits to 29 mg/kg, well below the MTCA screening level. Therefore, TPH will not be addressed further in this area.

Area 35. Three drums containing a solidified tar-like substance were removed. Verification soil sample results indicated TPH concentrations were below detection limits. Therefore, TPH will not be addressed further in this area.

Area 40. Soils from a drywell at the Press House in Area 40, which previously contained TPH and PAH concentrations above screening levels, were excavated during interim source removal. Verification soil sample results indicated that concentrations of TPH were below detection limits. Therefore, TPH will not be addressed further in this area.

Table I-3 provides TPH and cPAH data for interim source removal Areas 5, 19, 35, and 40.

Table I-3 - TPH and cPAH Concentrations in Mixed Petroleum-Derived TPH Areas Following Interim Source Removal

Area(1)	Range of Concentrations in mg/kg	Detection Frequency	Arithmetic Mean in mg/kg	95 Percent UCL in mg/kg
TPH				
5	ND to 1,900	45/85	130	330
19	ND to 70	2/13	19	70
35	ND	0/3	ND	ND
40	ND	0/2	ND	ND
Total cPAH				
5	0.33 to 2.4	8/8	1.3	2.4
19	0.28	1/1	—	—

ND: Not detected. TPH detection limits of 20 to 50 mg/kg; cPAH detection limit of 0.06 mg/kg.

(1) Concentrations are summarized for samples above 15 feet because, where sampled, no detections of TPH or cPAH occurred below 15 feet in these areas.

Mixed Petroleum-Derived TPH in Area 26 (Non-Interim Source Removal Area)

Area 26 (Unit 26A) Kettle. Area 26 includes the facilities used for reconstruction of spent acids returning from the nitroglycerin production area. One of the two kettles (Unit 26A) located south of the recovery facilities reportedly received liquid discharge from several sources, including the vehicle maintenance and truck wash facility. TPH concentrations above the MTCA direct contact screening level were detected in surface soil samples collected from several locations on the northern portion of the kettle floor, and are a mixture of petroleum products derived from the vehicle maintenance facility (Table I-4). Fuel fingerprint analysis (EPA Method 8015 Modified) identified the substance as heavy oil. The results are distinctly different from Area 7 and Area 16 (kettles) fuel identification results, which indicated Bunker C. No Bunker C residue is evident in the Unit 26A kettle.

Soil samples, which contained TPH above MTCA screening levels, also contained concentrations of other constituents, mainly lead. Cleanup of soils for lead will remove TPH-containing soils above the MTCA screening level, therefore, it is unnecessary to establish cleanup levels for TPH in this area.

Table I-4 - TPH and cPAH Concentrations in Area 26 (Mixed Petroleum-Derived TPH)

Area[1]	Range of concentrations in mg/kg	Detection Frequency	Arithmetic Mean in mg/kg	95 Percent UCL in mg/kg
		TPH		
26	ND to 5,600	15/47	380	810
		Total cPAH		
26	ND to 37.0	9/11	4.1	37.0

ND: Not detected. TPH detection limit of 21 mg/kg; cPAH detection limit of 0.06 mg/kg.

(1) Concentrations are summarized for samples above 15 feet because, where sampled, no detections of TPH or cPAH occurred below 15 feet in these areas.

Non-Hazardous Paraffin-Derived TPH

Analysis of Paraffin-Derived TPH

Paraffin wax is a white, semi-translucent, flammable, odorless solid (Clayton and Clayton, 1982). It is a mixture of solid, high molecular weight (C-30 to C-40 range) hydrocarbons, primarily alkanes derived from petroleum sources (Sax, 1987). Paraffin is insoluble in water and is soluble in organic solvents and oils (Sax, 1987). Paraffin wax is used for coating paper and food containers, medicinal agents, candles, sealant, and chewing gum base. Paraffin wax is biologically inert for the Site exposure routes (RTECS, 1994).

The TPH analysis (EPA Method 418.1) does not distinguish between paraffins and other petroleum-derived products; however, historical Site use and field observations conducted during the RI confirm that only waxes and paraffins are present in Areas 6, 12, and 38. Historical information indicates that paraffin was used as a protective coating on boxes and cartons used to pack and ship Site products. Paraffin-containing drums or paraffin-coated boxes were found in each of these three areas. In addition, no cPAHs were detected in any of these three areas. Since cPAHs were not detected in soil samples collected from the three areas (Areas 6, 12, and 38) and there is no toxic fraction associated with the paraffin-derived TPH, the TPH will not be addressed further in these areas.

Area 6. Area 6 was used for disposal of defective 55-gallon ammonium nitrate drums used at the ammonium nitrate plant. A total of 1,600 drums were removed from this area during interim source removal. Except for seven drums, the drums were empty. The non-empty drums contained residual ammonia salts and paraffin, as identified by field screening analysis. Soil samples above the MTCA screening level were confined to surface samples (0 to 1 foot in depth). The soil TPH detections in this area are associated with residue from the paraffin-containing drums. No other potential TPH sources were identified in the historical records or field observations for this area.

Area 12. Wastes related to explosives packaging activities in the Works Magazine were buried in shallow excavations in several areas of the Works Magazine landfill. Waste materials buried include explosives packaging, auto shop wastes, empty ammonium nitrate drums, and residual monomethylamine nitrate (MMAN). Five of seven Area 12 landfill units contain elevated TPH concentrations. The highest concentrations of TPH were detected in samples from locations containing paraffin-coated cardboard, residual MMAN, and mixed solid waste. Mixed solid waste found in Area 12 consisted of various materials, including metal strapping, miscellaneous plastic bags, foam rubber, wood debris, cloth, and rubber hose. The TPH detections are associated with the paraffin coating on the cardboard packaging.

cPAHs were not detected in any of the 22 soil samples analyzed for Area 12. Of the landfill units with elevated TPH, autobody parts and waste oil were observed in only one (Unit 12-2) of the five units with elevated TPH concentrations during the excavation of test pits. All soil samples in this unit containing elevated TPH concentrations also contained residual MMAN concentrations above MTCA screening levels. Cleanup of soils for MMAN will remove TPH-containing soils above the MTCA screening level, therefore, it is unnecessary to establish cleanup levels for TPH in this unit of Area 12.

Area 38. Area 38 encompasses the buildings used for production and labeling of boxes and cartons used to package and ship products from the Site. Packaging materials were originally wooden boxes, which, over time, were replaced by paraffin-coated cardboard cartons. Both cardboard printing and paraffin coating activities occurred in this area. Water and/or solvents used to clean printing equipment in the box factory drained through a wooden trough from the building into a drywell located approximately 15 feet south of the box factory. TPH concentrations above the MTCA screening level were detected in the three soil samples collected from the trough (two samples) and drywell (one sample). No cPAHs were detected in these samples although four of the ten samples had detection limits greater than 1 mg/kg due to sample matrix interference. Benzene and xylene, associated with historical use of solvents for cleaning printing equipment, were detected at concentrations well below MTCA screening levels in the surficial sample collected within the drywell. No BTEX were detected in deeper samples from the drywell.

A UST (containing diesel and/or Bunker C) was removed approximately 15 feet from the drywell in Area 38. All soils containing TPH above MTCA screening levels were removed in association with the UST removal (Hart Crowser, 1992b).

Residual paraffin was likely washed down the trough to the drywell from in the box factory, therefore the source of the TPH detected in Area 38 (limited to the trough and drywell) is most likely the paraffin. Because the analytical method for TPH (EPA Method 418.1) does not detect BTEX, and the detected TPH concentration (1,400 mg/kg) in the surficial sample from the drywell was substantially higher than the detected total BTEX concentration (1.9 mg/kg) in that sample, the TPH does not appear to be associated with the BTEX.

Regardless, all elevated TPH concentrations detected at the trough and drywell were limited to samples collected from 0 to 1.5 foot and were associated with concentrations of other constituents above MTCA screening levels, including arsenic, mercury, and lead. These other constituents were also detected at greater depths (2 to 4 feet) than TPH at these locations. Cleanup of soils for lead, arsenic, and mercury will remove all TPH-containing soils above the MTCA screening level, therefore, it is unnecessary to establish cleanup levels for TPH in this area.

Table I-5 provides data on Paraffin-Derived TPH concentrations in Areas 6, 12, and 38.

Table I-5 - TPH Data for Areas 6, 12, and 38 (Paraffin-Derived TPH)

Area[(1)]	Range of Concentrations in mg/kg	Detection Frequency	Arithmetic Mean in mg/kg	95 Percent UCL in mg/kg
TPH				
6	ND to 1,900	6/9	450	1,900
12	ND to 36,000	14/43	1,500	9,400
38	ND to 1,400	15/19	180	950

ND: Not detected. TPH detection limit of 20 mg/kg.
(1) Concentrations are summarized for samples above 15 feet because, where sampled, no detections of TPH or cPAH occurred below 15 feet in these areas.

Conclusions

TPH and cPAHs detected in several Site areas are associated with three different sources. The primary Site petroleum source, Bunker C, is confined to four areas (7, 8, 16, and 24) which have either undergone interim source removal or will be addressed subsequently. Mixed petroleum types were identified in five areas (5, 19, 26, 35, and 40) and one Area subunit (Unit 12-2). Interim source removal has been conducted in Areas 19, 35, and 40. Further action to address other constituents in Areas 5, 12-2, and 26 will concurrently address the remaining TPH concentrations above screening levels. Additionally, no further action, based on TPH concentrations, is proposed for the three areas with non-hazardous paraffin-derived TPH and no detected cPAHs (Areas 6, 12, and 38).

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APPENDIX II
BUNKER C TPH/PAH COMPOSITION

As summarized in Appendix I, TPH on the Site has been detected in several forms. The composition of TPH determines its mobility and its potential to impact groundwater, as well as its toxicity. Bunker C fuel, associated primarily with the powerhouse and pipeline, is the predominant form of TPH on site (Appendix I). Bunker C and paraffin tend to adsorb tightly to soils and are not mobile. In support of this, TPH has not been detected in site groundwater (Appendix VI).

TPH composition also determines toxicity (Appendix IV). The toxicity of Bunker C, composed of heavier hydrocarbons, is associated primarily with cPAHs. No toxic fraction has been identified for paraffin. Because Bunker C is the predominant form of TPH found on site, its composition and how its composition effects mobility and toxicity is discussed in this Appendix.

Bunker C - Derived TPH

In general, Bunker C fuels, or heavy fuel oils, consist of a wide variety of formulations. The primary components of Bunker fuels are naphthenes, asphaltenes, saturated hydrocarbons, and aromatic hydrocarbons. Naphthenes, or cycloparaffins, are saturated cycloalkanes consisting primarily of 3 carbon-ring (cyclopropane), 4 carbon-ring (cyclobutane), 5 carbon-ring (cyclopentane), and 6 carbon-ring (cyclohexane) compounds. These ring structures may have a variety of saturated side chains. Asphaltenes are the heavier petroleum component of Bunker C and consist of primarily saturated longer chain compounds. Saturated hydrocarbons are represented by the long chain alkane compounds. Finally, the aromatics are primarily composed of PAHs. cPAHs have been determined to be the toxic fraction of Bunker C fuels.

Different formulations of Bunker C fuel oil are composed of varying concentrations of each of these components. A study by Bobra and Callaghan (1990) demonstrated the degree of variation in Bunker C compositions:

Component	% Content
Naphthenes	45
Asphaltenes	6 to 14
Saturates	15 to 24
Aromatics	25 to 55

Chromatograms of Bunker C product show that as much as 70 percent of its composition is hydrocarbons in the C-20 or higher range (refer to Figures II-1 and II-2).

Bunker C has been found in two forms on the Site. A viscous product is present in two areas (the Powerhouse - Area 24 and the Bunker C pipeline - Area 8), while a hardened tar-like residue was found at the bottom of Area 7 and Area 16 kettles.

Soils in Area 8, which contain elevated concentrations of Bunker C, have been removed to achieve the cPAH screening level of 1.0 mg/kg throughout the upper 15 feet of soil. Area 24 is scheduled for further action in 1994.

Kettle area soils are typically visibly stained and may have a hardened residue resulting from weathering of residual Bunker C. GC-FID fuel identification scans were performed on samples of the viscous and tar-like materials collected from these areas. Analysis of the chromatograms for these samples indicate that the viscous product from Areas 8 and 24 is unweathered Bunker C, and the hardened product from Areas 7 and 16 is weathered Bunker C. Weathered products typically do not show lighter-end hydrocarbons that show up in the unweathered samples. Lighter-end hydrocarbons have a greater tendency than heavier compounds to volatilize, degrade, or mobilize when exposed to the environment. Chromatograms for one weathered sample (16-SS-502) and one unweathered sample (16-SS-503) are included on Figures II-1 and II-2, respectively.

The limited mobility of weathered Bunker C was confirmed by subsurface explorations in Areas 7 and 16. TPH detections in explorations within the kettles correspond to a distribution of a thin layer (typically 1 to 6 inches) of hydrocarbons across the bottom of the kettles. Data from Area 7 subsurface explorations indicate that elevated TPH concentrations are vertically bounded to the upper 3 feet of material. Elevated TPH concentrations in Area 16 are vertically bounded to the upper 1 foot of material.

Bunker C product from the pipeline (Area 8) exhibits greater mobility than the weathered product. The practice of heating the fuel prior to pumping it through the pipeline may have increased mobility of Bunker C from the pipeline. Leakage from pipeline joints over time, pressurizing the pipe to improve transport, and the large volumes of product transported, all contributed to the mobilization of Bunker C in this area. Bunker C product from the pipeline was detected up to 35 feet below the ground surface. However, the pipeline has not been used since the mid-1960s. Interim source removal in Area 8 has further controlled the TPH source in this area and also achieved cPAH screening levels. Based on soil leachability testing (TCLP) performed on soil samples collected from Area 8 (Appendix VI), residual TPH present in this area at the conclusion of interim source removal is not a possible TPH source to groundwater.

Bunker C-Derived cPAH

Locations where TPH was detected were evaluated for PAH composition. Soil samples from Area 8 analyzed for PAHs indicate the presence of 12 of 16 PAHs analyzed. Characterization of PAHs was performed on 52 soil samples from Area 8 with cPAHs detected in 31 of the 52 samples.

Site-wide soil testing demonstrated that the seven cPAHs were present in different areas. Chrysene is the predominant cPAH appearing in 40 out of 121 soil samples tested for PAHs, with a maximum concentration of 14 mg/kg. However, chrysene is the least potent cPAH, exhibiting a relative potency of 0.1 percent that of benzo(a)pyrene (BAP; EPA, 1993) (Appendix IV). Benzo(b)fluoranthene and BAP were the second and third most frequently detected cPAHs, appearing in 27/121 and 24/121 soil samples, respectively. The concentrations of these compounds were lower than chrysene, with maximum concentrations of only 7.0 mg/kg for benzo(b)fluoranthene and 4.8 mg/kg for BAP. Benzo(b)fluoranthene exhibits a relative potency 10 percent that of BAP. Table II-1 summarizes the relative detection frequencies of cPAHs.

Table II-1 - Concentrations and Occurrence of Individual cPAHs

cPAH[1]	Detection Frequency	Maximum Concentration in mg/kg
Benzo(a)anthracene	22/121	8.6
Benzo(a)pyrene	24/121	4.8
Benzo(b)fluoranthene	27/121	7.0
Benzo(k)fluoranthene	17/121	2.3
Chrysene	40/121	14.0
Dibenzo(a,h)anthracene	8/121	0.5
Indeno(1,2,3-c,d)pyrene	19/121	1.6
Total cPAHs	48/121	37.0

Note:

(1) These seven PAHs are considered probable human carcinogens by EPA (IRIS, 1994).

Conclusions

Bunker C detected on the Site was found in two forms, a viscous product associated with the powerhouse and pipeline, and weathered Bunker C found in the Area 7 and Area 16 kettles. Interim source removal has removed the majority of Bunker C product associated with the pipeline. Weathered Bunker C was confined to surficial soils in Areas 7 and 16.

Based on soil leachability testing, residual TPH is low mobility and does not represent a TPH source to groundwater.

Although all seven cPAHs were detected in various site samples with elevated Bunker C, chrysene, one of the least potent of the cPAHs, exhibiting a potency of 0.1 percent of that of BAP, was the predominant cPAH detected on the Site.

Thus, the Bunker C at the Site is comprised of predominantly less mobile and less toxic cPAHs (Appendix IV).

References for Appendix II

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Attachments:
Figure II-1 - Chromatogram for Sample 16-SS-502
Figure II-2 - Chromatogram for Sample 16-SS-503
Figure II-3 - Chromatogram for Sample 7-SS-507
Figure II-4 - Chromatogram for Sample 7-SS-508

tph\tph2.new

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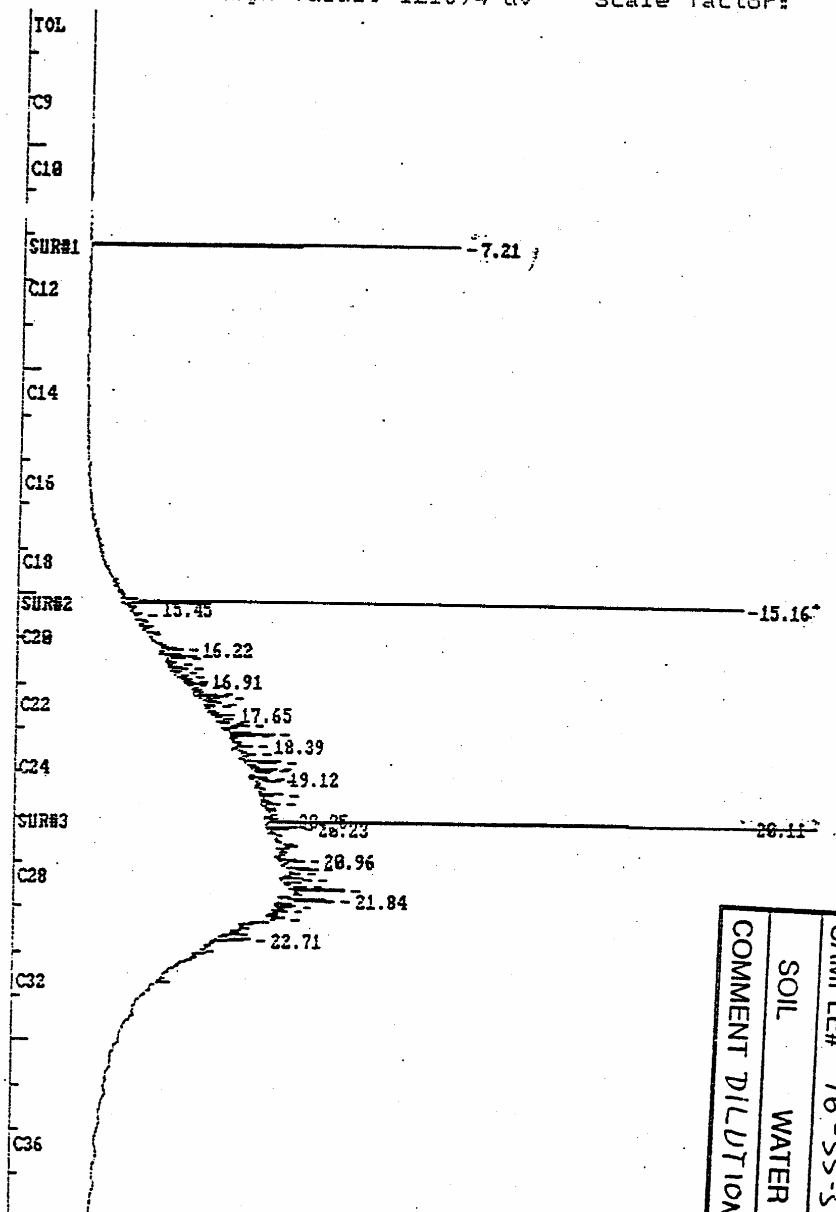

HART CROWSER LABORATORY
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SAMPLE# 16-SS-S02
SOIL WATER Product
COMMENT DILUTION 1:100

Figure II-1

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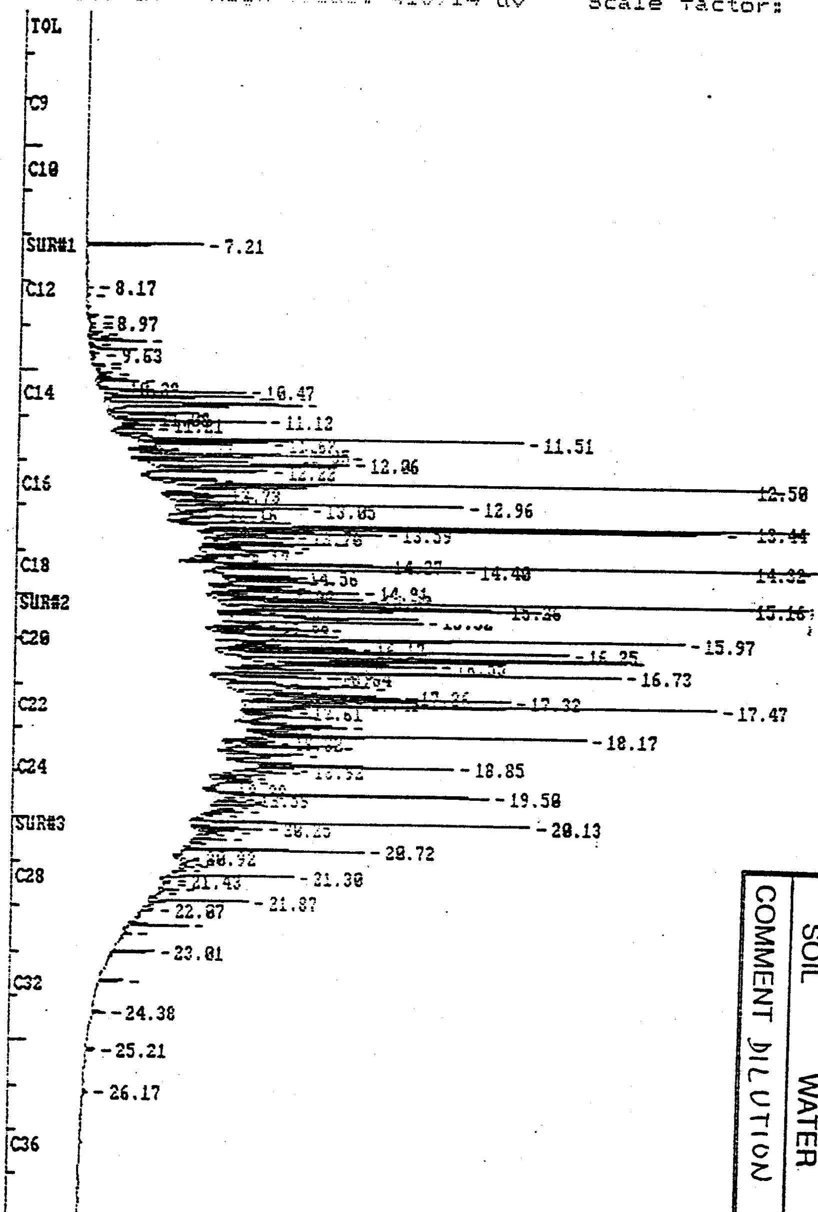

HART CROWSER LABORATORY
JOB# 3534-00
SAMPLE# 16-SS-S03
SOIL WATER Product
COMMENT DILUTION 1:100

Figure II-2

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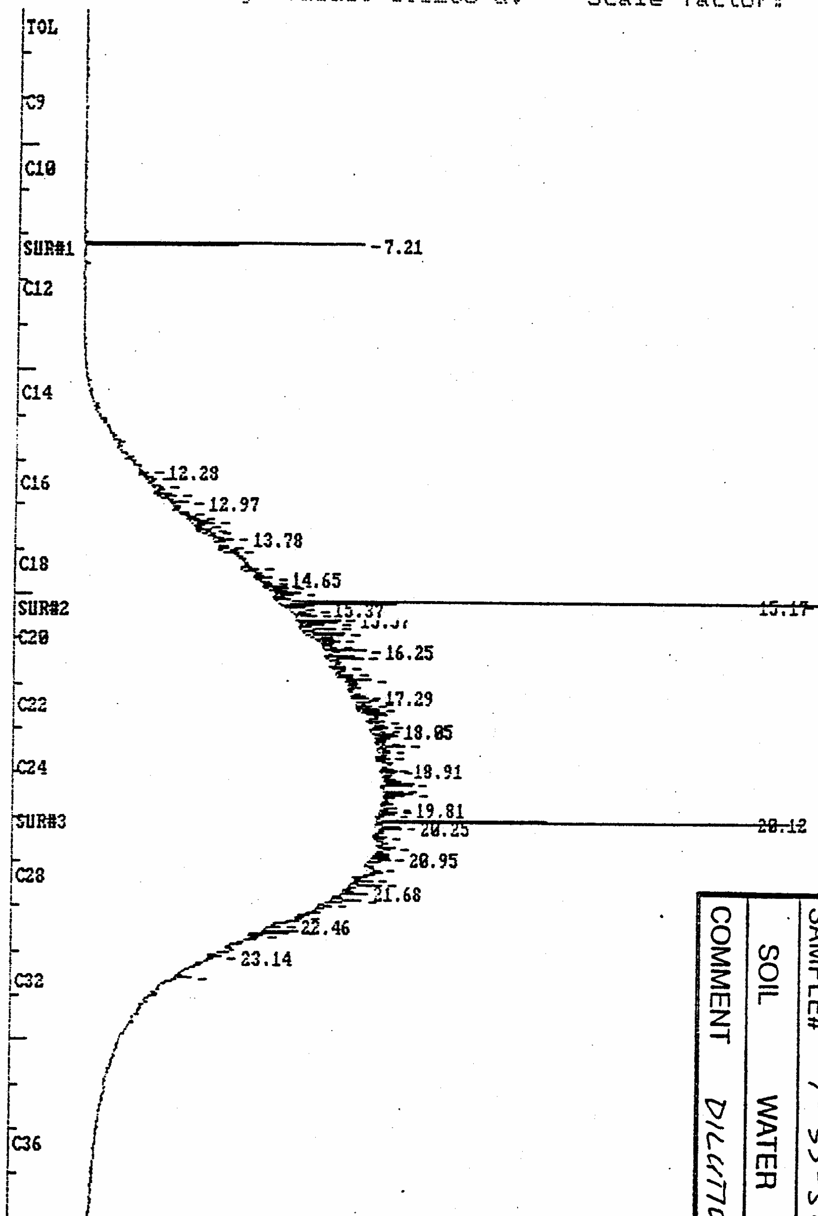

HART CROWSER LABORATORY
JOB# 3534-00
SAMPLE# 7-SS-S07
SOIL WATER product
COMMENT DILUTION 1:100

Figure II-3

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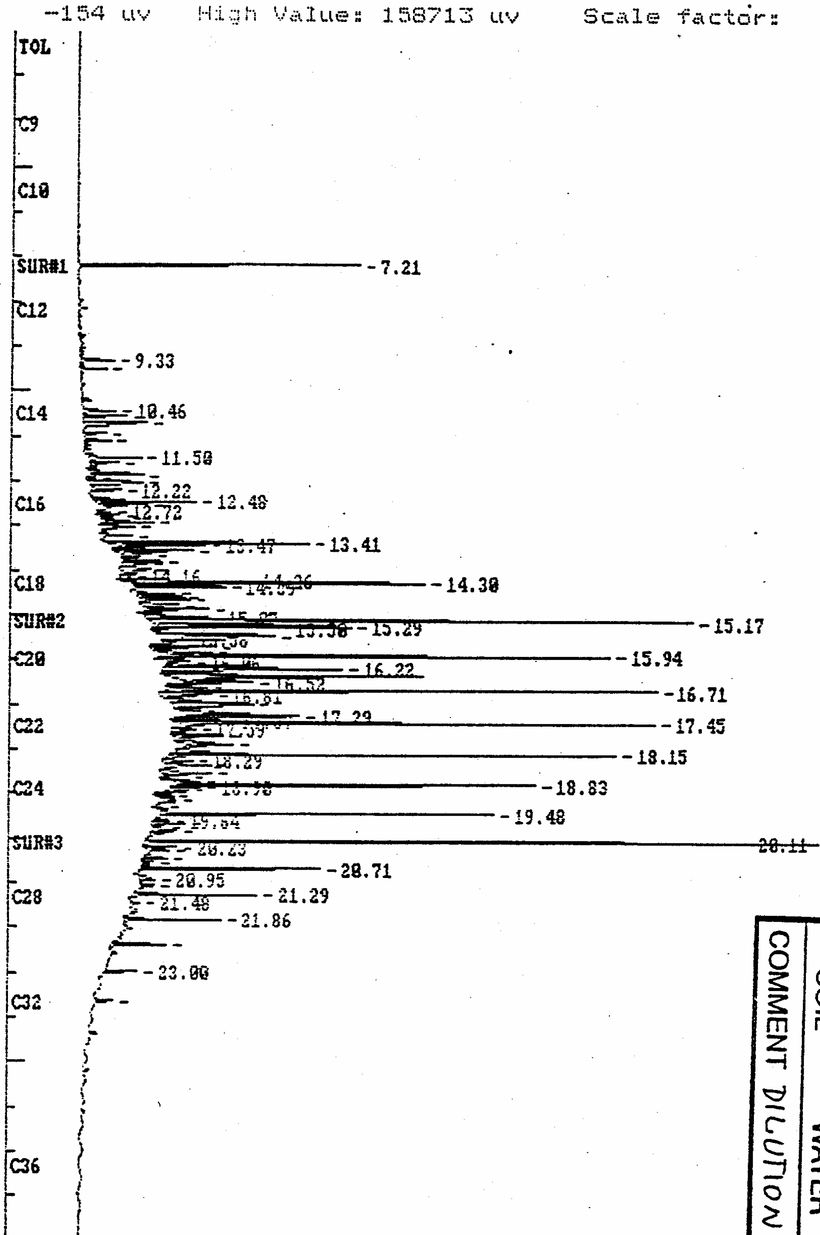


HART CROWSER LABORATORY
JOB# 3534-00
SAMPLE# 7-SS-508
SOIL WATER Product
COMMENT DILUTION 1:100

Figure II-4

APPENDIX III
DEVELOPMENT OF cPAH SOIL CLEANUP LEVELS FOR DESIGNATED LAND USES AT THE SITE

Soils with residual TPH/cPAH are contained within areas where the future land use may be either residential or recreational (although TPH/cPAH has not been detected in the zoned industrial areas of the Site, an industrial cleanup level has been developed in this appendix). This appendix describes the rationale and procedures used to develop cleanup levels for cPAH that will be protective of human health for these land uses.

Basis for Exposure Assumptions

Land Use. Following Site development, the non-industrial areas will include residential and recreational use areas. Recreational land use will include both a golf course and open space.

cPAH cleanup levels were generated for an industrial scenario and three exposure scenarios: golf course, open space, and residential. Note, however, that current development plans do not include residential areas where cPAH has been detected. Different exposure assumptions are applied in each scenario to account for the most likely individuals and activities producing the potential for exposure.

During golf course development, residual constituents in soil will be covered by one to two feet of topsoil in order to support course turf against the extremely rapid drainage of the native soils (Cummock, 1993; D'Aboy, 1993; Griswold, 1993). The only potential for exposure to the subsoils beneath the turf and imported topsoil would be infrequent activities requiring maintenance workers to dig through the barrier into the subsoils. Golfers and other visitors (e.g., trespassers) would not have contact with the subsoils. The cPAH cleanup level for golf course land use is derived from assumptions appropriate to a golf course maintenance worker.

In open space or green belt areas, residual soils may be available for direct contact, but not through activities typically associated with soil contact such as gardening, landscaping, or incidental ingestion by very young children (i.e., children less than six years old, who are typically assumed to incur the greatest levels of intake through soil contact, will be less likely to roam unattended through open space areas). Older children may represent the most likely, potentially exposed subpopulation, since they may roam through open space areas more freely than younger children. The DNT cleanup level for open space land use is intended to protect all children visiting open space areas, so the cleanup level was calculated using parameters for a younger (0-6 year old) child in a recreational setting. This will be conservative for the older child.

The cPAH cleanup level for residential land use is intended to protect the younger (0-6 year old) child as a sensitive receptor, so the cleanup level was calculated using parameters typical for a child resident. Note again that cPAH has not been detected in areas currently planned for residential development.

The cPAH cleanup level for industrial land use is intended to protect an adult worker assumed to have regular and frequent (daily, occupational) contact with Site soils.

Ranges in risk-based cleanup levels. Recent risk assessment policy guidance (EPA 1992a) recommends development of risk ranges to describe potential risks from constituents at hazardous waste sites, and to inform risk management decisions for those sites. Risk ranges describe and account for uncertainty in risk assessment methods, and provide perspective on the upper-bound estimates of risk conventionally presented in risk assessments. Risk management is considered appropriate when predicted carcinogenic risks are in the range between one-in-one-million (10^{-6}) and one-in-ten-thousand (10^{-4}). In general, management of risks below the one-in-one-million threshold is unwarranted, whereas abatement of risks above the one-in-ten-thousand level is (usually) considered unnecessary.

Similarly, risk-based cleanup levels may be derived by rearranging equations used to estimate risk, and solving the equations for the concentration term associated with a pre-specified risk threshold (e.g., one-in-one-million). The concentration term is then regarded as the cleanup level associated with that threshold. Cleanup levels derived from rearranged risk algorithms are subject to the same types and degrees of uncertainty that apply to estimates of risk. Therefore, it is appropriate to generate a range of cleanup levels for consideration in the risk management process. The ranges of cleanup levels established in this document are based on a risk threshold between 10^{-6} and 10^{-5} for residential, open space, and golf course land use, and 10^{-5} and 10^{-4} for industrial land use.

Derivation of the Cleanup Levels

Soil cleanup levels for BAP are based on protection against potential carcinogenic effects. The carcinogenic potential of cPAH is conservatively represented by benzo(a)pyrene (BAP), the most potent cPAH (see below).

Two exposure routes are considered in the development of cleanup levels for cPAH: soil ingestion and dermal contact with soil. The cleanup levels are calculated using equation 1. This equation is developed from exposure equations provided in Exhibits 6-14 and 6-15 in RAGS (EPA, 1989) by simultaneously solving the equations for the concentration in soil.

$$CS = \frac{Risk \times BW \times AT}{CPF \times CF \times FI \times EF \times ED \times \left[(IR \times ABS_i) + (SA \times AF \times ABS_d) \right]} \quad (1)$$

Tables 1 and 2 define the parameters in equation 1, and provide the values and references used for each land use. Values are based on estimates of central tendency for most parameters such that exposure, averaged over a lifetime, will produce an incrementally increased risk of cancer equal to the risk management threshold given as the "risk" parameter.

Table 1: Parameters Used to Calculate Cleanup Levels.

			ECT							
PARAMETER	DESCRIPTION		RES	a	OS	b	GC	c	IND	d
Risk	Acceptable risk level (unitless)	e	← 1E-5 to 1E-6 →						1E-4 to 1E-5	
BW	Body weight (kg)	f	15		15		70		70	
AT	Averaging time – carcinogens (days)	f	25550		25550		25550		25550	
CF	Conversion factor (mg/kg)	g	1E-6		1E-6		1E-6		1E-6	
FI	Freqency of intake (percent)	h	100		100		100		100	
EF	Exposure frequency (days/year)		275	i	52	j	36	k	250	f
ED	Exposure duration (years)		3	l	3	l	9	m	9	m
IR	Soil ingestion rate (mg/day)		63	n	63	n	26	o	26	o
SA	Skin surface area (cm2)	p	800		800		2000		2000	
AF	Soil to skin adherence factor (mg/cm2)	p	0.2		0.2		0.2		0.2	

NOTES

a. RES represents residential land use. The most exposed individual is a child.
b. OS represents open space land use. The most exposed individual is a child.
c. GC represents golf course land use. The most exposed individual is an adult.
d. IND represents industrial land use. The most exposed individual is an adult.
e. Two iterations were completed for RES, OS and GC: one at a risk threshold of 10^-5, and one at 10^-6. For IND, iterations were at 10^-4 and 10^-5.
f. From EPA 1991a.
g. Converts kg soil to mg soil.
h. Set at the maximum value to be conservative.
i. From EPA Region X, 1991.
j. ASARCO. 1993.
k. Cupit, 1993; D'Aboy, 1993; McCarthy, 1993.
l. Use 3 as the mid-point of a 0-6 year uniform distribution.
m. From RAGS (EPA, 1989).
n. Thompson and Burmaster 1991.
o. From D.O.E. 1993.
p. From EPA 1992b.

Table 2: cPAH-specific Parameters Used to Calculate Cleanup Levels.

PARAMETER	DESCRIPTION	cPAH	
CPF	Cancer potency factor (mg/kg-day)^-1	7.30	a
ABSi	Gastrointestinal absorption factor (percent)	100	
ABSd	Dermal absorption factor (percent)	2.3	b

NOTES a. From Huether (1993).
b. EPA Region 10, February, 1991 as cited in Eagle Harbor Revised Risk Assessment, 1991.

The U.S. EPA has acknowledged the use of certain average exposure assumptions in managing potential risks from carcinogens (EPA, 1991b). The basis of this recommendation is that protection against carcinogenic effects relies on a model of long-term exposure. Long-term exposure is best approximated using average values rather than extreme values, since the latter have "no consistent relationship" with long-term exposure. In order to account for uncertainty in some exposure parameters, upper-bound values are used for these parameters to assure a conservative approach to human health protection. Several sources of uncertainty for which conservatism is maintained are discussed below.

cPAH Potency. The carcinogenic potency of cPAH as a class is conservatively represented by the toxicity of benzo(a)pyrene (BAP). However, of the seven PAHs considered to be carcinogenic, BAP is the most potent. One cPAH is as potent as BAP; the other five are substantially less potent (10 to 1,000 times less potent). Because of this, toxicity equivalence factors (TEFs) may be applied in risk assessments when specific cPAHs are identified (EPA 1993).

The carcinogenic potency factor for BAP was used to develop cleanup levels at the Site. However, the predominant cPAH at the Site is chrysene, which is one-thousand times less potent than BAP. Therefore, use of the BAP potency factor is very conservative.

Fractional Intake from Specific Source Areas. The FI term as provided in Risk Assessment Guidance for Superfund (RAGS; EPA 1989) accounts for the fractional amount of soil that may be ingested on a daily basis from different sources. As applied in the Site risk assessment, the FI term describes the frequency of soil contact by an individual at the golf course or open space areas (FI in residential and industrial scenarios was assumed to be 100 %). The term accounts for the fact that only a portion of the surface area designated for golf course and open space use overlies Site areas with residual constituents in the soil. Furthermore, exposure at the golf course will be limited to maintenance workers, who occasionally may be required to excavate soils to a depth penetrating the 1-2 foot barrier of amended topsoil that will overlie native soils. This barrier will prevent exposure to individuals walking over the golf course.

In the Site risk assessment, exposure to subsurface soils at the golf course or surface soils in open space areas was assumed to be random, occurring with a frequency of contact equal to the percentage of total land use surface area represented by a given Site area (e.g., the surface area of Area 16 equals 2% of the total, planned open space area; therefore, the probability of contacting surface soils in Area 16 during an open space visit is assumed to be 2%).

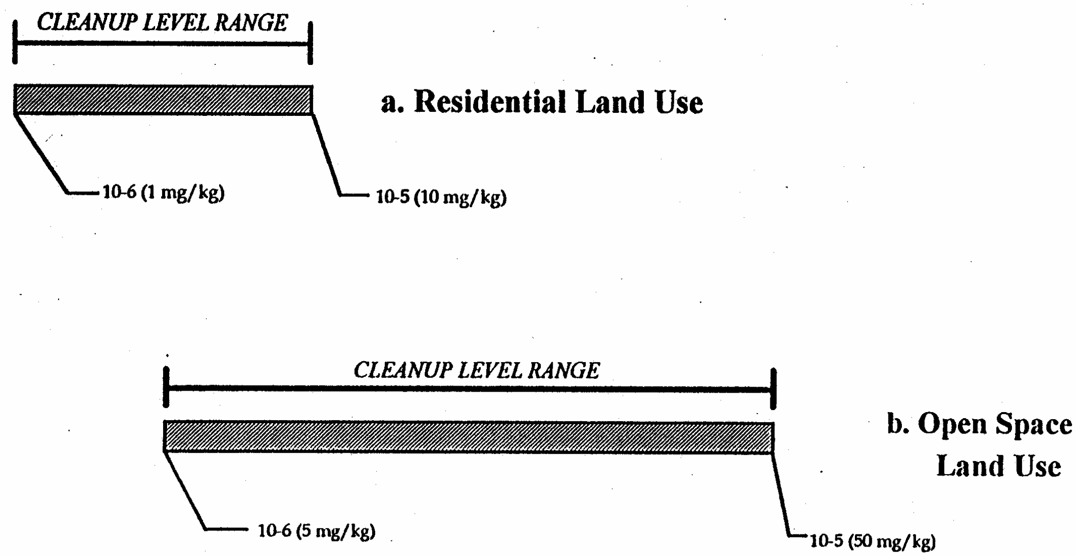
However, to derive cleanup levels for the Site, FI is assumed equal to 100% for both the open space and golf course scenarios. This is conservative, since it is highly unlikely that an individual will visit the same location (or all locations) during each visit, or that each excavation by a golf course worker will occur in the same place.

Using the parameters provided in the tables, the following cPAH cleanup level ranges are calculated for each land use:

- 1-10 mg/kg for residential land use;
- 5-50 mg/kg for open space land use;
- 20-220 mg/kg for golf course land use; and
- 30-300 mg/kg for industrial land use.

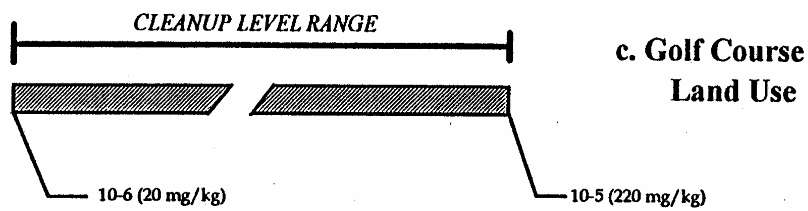
The ranges for residential, open space and golf course land use correspond to a risk threshold range between 10^{-6} and 10^{-5}; the range for industrial land use corresponds to a risk threshold range between 10^{-5} and 10^{-4}. These ranges are depicted graphically in Figure 1.

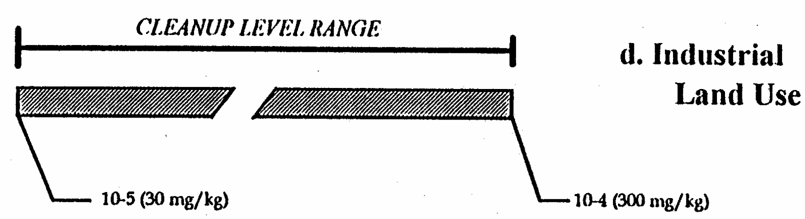
FIGURE 1: CLEANUP LEVEL RANGES FOR cPAH[1]



[1]Scaling is relative.

FIGURE 1: CLEANUP LEVEL RANGES FOR cPAH (continued)





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APPENDIX IV
HUMAN HEALTH TOXICITY OF TPH/PAHS

Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) are the most toxic component of Bunker C petroleum hydrocarbons. The MTCA regulation states that the cleanup level for TPH can be based upon the toxic fraction of the petroleum compound (WAC 173-340-740 (3)(a)(ii)(B)). As summarized in Appendix II, the most commonly detected cPAH was chrysene, one of the least potent of the cPAHs. Few studies are available concerning the toxicity of specific petroleum products; therefore, the following literature has been reviewed and relevant information compiled in the following section.

Bunker C Toxicity

Acute Toxicity. The American Petroleum Institute (API) commissioned Elars Bioresearch to study the acute toxicity of a variety of fuel petroleums (Beck et al., 1984). Four types of Bunker C fuel oils were studied. They were identified by specific gravity (sp) and sulfur content (%S): sp 0.99/2.7%S; sp 0.95/0.8%S; sp 0.92/0.2%S; and sp 1.04/1.2%S. Tests were performed to determine acute dermal and oral toxicity. Oral exposure to the Bunker C fuels with specific gravities of less than 1.0 demonstrated little toxicity with no increase in mortality associated with dosages up to 25 ml/kg body weight. The final Bunker C fuel, sp 1.04/1.2 %S, however, demonstrated measurable toxicity with an oral LD_{50} of 5 ml/kg body weight. Similar results were reported concerning dermal toxicity. These experiments illustrate the variability of toxicity associated with different formulations of Bunker C.

Acute Toxicity of Bunker C Components. Bunker C fuel oil is composed primarily of naphthenes, asphaltenes, saturated hydrocarbons, and aromatics (PAHs) (see Appendix II). cPAHs, the toxic component of Bunker C fuel oil, will be addressed separately.

Saturates, i.e., the saturated hydrocarbon chains with 9 or more carbons, have relatively little toxicity data. None of the long-chain (C-15 or greater) hydrocarbons are believed to be teratogenic, mutagenic, or carcinogenic (Clayton and Clayton, 1982). Extremely long chain compounds such as N-Pentadecane (C-15), 1-Octadecanol (C-18), and 1-Eicosanol (C-20) are considered relatively non-toxic with LD_{50}s greater than 15,000 mg/kg.

Asphaltenes also are considered to be relatively non-toxic. The International Agency for Research on Cancer (IARC) has evaluated the data for asphaltenes and determined the data to be insufficient to classify these compounds as carcinogens (IARC, 1989). These compounds have also not been found to be mutagenic in mouse skin models (HSDB, 1994). In general, these compounds have little or no toxicity associated with them, even among road workers who used asphalt as a chewing-gum material (HSDB, 1994).

As with the other Bunker C components, naphthenes have very limited acute toxicity data. These data suggest that naphthenes are relatively non-toxic as well. Toxicity data on cyclopropanes, cyclobutanes, and cyclopentanes describe these compounds to only be toxic as simple asphixiants, although there is some evidence that cyclopropane may be carcinogenic (Lewis, 1992). Cyclohexane and ethylcyclohexane were demonstrated to have LD_{50}s of 30,000 and 64,000 mg/kg, respectively. These data suggest that the longer chain naphthenes will be relatively non-toxic compared with other components of Bunker C.

Carcinogenicity. The IARC has reviewed information concerning the carcinogenicity of a variety of petroleum fuels (IARC, 1989). Bunker C has not been demonstrated to be mutagenic in either bacterial or whole cell models. Bunker C has both positive and negative results in tumorigenic studies. Human epidemiology data are hard to interpret because of mixed exposures. As a result, the IARC has given Bunker C fuel a Group 2B ranking, possible human carcinogen. No ranking by the EPA is available at this time.

Bingham et al. (1980) linked the carcinogenicity of Bunker C with the fuel's PAH content. C3H mice were given dermal applications of 20 mg Bunker C twice weekly for an unspecified period of time (at least 59 weeks). Bunker C fuel containing 0.01 percent benzo(a)pyrene resulted in 2 out of 19 mice developing tumors over 59 weeks. In mice treated with Bunker C fuel containing 0.16 percent benzo(a)pyrene, 21 out of 25 developed tumors over 59 weeks (of which 12 were malignant). This study indicates that the carcinogenicity of Bunker C is largely dependent upon the PAH content of the particular fuel.

cPAH Toxicity

Carcinogenicity. Chrysene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and benzo(a)pyrene have all been determined to be complete carcinogens in animals by multiple routes of exposure. These seven cPAHs have been classified by the EPA as Group B2, probable human carcinogens (IRIS, 1994).

Benzo(a)pyrene is typically used as the representative PAH based on the availability of data. Neal and Rigdon (1967) reported a dose-related incidence of forestomach tumors in mice orally exposed to benzo(a)pyrene. An additional study by Brune et al. (1981) also demonstrated a dose-related incidence of tumors in sprague-Dawley rats. Slope factors for benzo(a)pyrene have been calculated using both a linear multi-stage model of carcinogenesis and a two-stage model. Four slopes, from 4.5 to 11.7, have been calculated. The EPA has presently established an oral carcinogenic slope factor of 7.3 $(mg/kg\text{-}day)^{-1}$ based on the geometric mean of these four previous slope factors (IRIS, 1994).

Relative Potencies of cPAHs. Benzo(a)pyrene (BAP) has been determined to be one of the most potent carcinogens of the cPAHs (EPA, 1986). Clement Associates (1988) used the two-staged carcinogenic model to develop potency estimates for various cPAHs that have demonstrated lesser carcinogenic potential than BAP. Quantitative risk estimates for mixtures of PAHs have often assumed that all cPAHs are as toxic as BAP, and that the carcinogenic effect of the mixture can be estimated by the sum of the effects of each individual cPAH. However, it has been documented that five of the seven cPAHs are less carcinogenic in animal studies than BAP (the toxicity of dibenzo(a,h)anthracene is assumed to be equal to BAP). Thus, assuming all cPAHs to be as toxic as BAP can result in an overestimation of risk (EPA, 1993a).

In 1993, based on the EPA's Office of Health and Environmental Assessment (OHEA) review of the Clement Associates (1988) report, OHEA issued provisional guidance for quantitative risk assessment of PAHs (EPA, 1993a), which is considered interim guidance. However, a recent memorandum originating from EPA Region 10 (EPA, 1993b) indicates that all the EPA regions agree that the new PAH policy would be formally adopted by EPA in the near future and that all the regions would use the policy as interim guidance for risk assessment of PAH compounds. Included in this guidance is an order of magnitude ranking of relative potency values for the individual PAHs that are recommended in order to provide a consistent approach in risk assessment.

Assessment of the risk of mixtures. using the relative potency approach, involves the following steps:

- Analytical determination of cPAHs;
- Multiplication of sample concentrations by their relative potencies to express concentration in terms of BAP equivalents, or relative potency concentrations (RPC);

- Summation of the RPCs to obtain total BAP equivalents in the sample;
- Determination of human exposure (expressed in terms of BAP equivalents); and
- Combining exposure with cancer potency information on BAP to estimate the cancer risk associated with exposure to the PAH mixture.

Table IV-1 summarizes the relative potencies for cPAHs (as presented in EPA, 1993a) detected at the Site.

Table IV-1 - Relative Potencies for cPAHs

cPAH	Relative Potency Factors
Benzo(a)Anthracene	0.1
Benzo(a)Pyrene	1.0
Benzo(b)Fluoranthene	0.1
Benzo(k)Fluoranthene	0.01
Chrysene	0.001
Dibenzo(a,h)Anthracene	1.0
Indeno(1,2,3c,d)Pyrene	0.1

As discussed in Appendix II, chrysene—the least potent of the seven cPAHs—is also the most prevalent cPAH at the Site. Therefore, sample cPAH results from Areas 7, 8, and 16 were normalized to total BAP equivalents using RPFs in order to more accurately reflect the relative potency of the cPAHs associated with the Bunker C detected on the Site. Normalized cPAH results were used to derive a cleanup level for TPH based on a correlation between TPH and cPAH concentrations (Appendix V).

Conclusions

The toxic fraction of the Bunker C product on Site is related to cPAHs. Much of the remaining content of Bunker C fuels is relatively non-toxic because it is composed of non-aromatic straight chain hydrocarbons. Because chrysene is the most prevalent but least potent of the cPAHs present at the site, it is appropriate to use EPA's interim relative potency factors to estimate the potential cancer risk associated with exposure to these substances at the Site.

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APPENDIX V
BUNKER C TPH CLEANUP LEVEL

In order to determine a cleanup level for Bunker C TPH detected on the Site, and recognizing that the risk posed by Bunker C is largely attributable to its cPAH components, correlation analyses were performed to assess the statistical relationship between cPAH and TPH concentrations. A correlation analysis was performed to determine an appropriate Site-wide cleanup level for Bunker C-derived TPH.

Regression Analysis to Determine Site-Wide Bunker C TPH Cleanup Level

An evaluation of the correlation between TPH and cPAHs was performed on samples collected from areas known to contain elevated concentrations of Bunker C. Regression analysis was performed on data collected from Areas 7, 8, and 16 combined. Data were combined from all Bunker C areas because: 1) there was limited cPAH data for area-specific correlations; 2) no significant differences were observed between area-specific correlations; and 3) the same product has been demonstrated to occur in all three areas (see Appendix II).

Cumulative total cPAH concentrations were assessed in the regression analyses. Sample cPAH results were normalized to total BAP equivalents in order to more accurately reflect the potency of individual cPAHs (see Appendix IV). The TPH concentrations associated with normalized cPAH concentrations of 1.0 and 10.0 mg/kg, the range of acceptable residential cleanup levels based on the toxicity of BAP, were calculated for the 95 percent upper confidence level.

Based on the regression analysis ($r^2=0.52$), normalized total cPAH concentrations of 1.0 and 10.0 mg/kg are equivalent to TPH residential cleanup levels of 3,100 to 27,000 mg/kg at the 95 percent confidence level (see Figure V-1).

Conclusions

Results indicate that cleanup levels of 3,100 to 27,000 mg/kg for Bunker C-derived TPH will achieve the cleanup goal of 1.0 to 10.0 mg/kg for cPAHs (residential land use) in Areas 7, 8, and 16. Normalized cPAH data accurately reflect the toxicity associated with the cPAHs detected on Site (see Appendix IV) and represent an accurate method for deriving a Bunker C cleanup level.

Attachments:

Figure V-1	Correlation Between cPAHs and TPH-418.1 Bunker C Areas 7, 8, and 16

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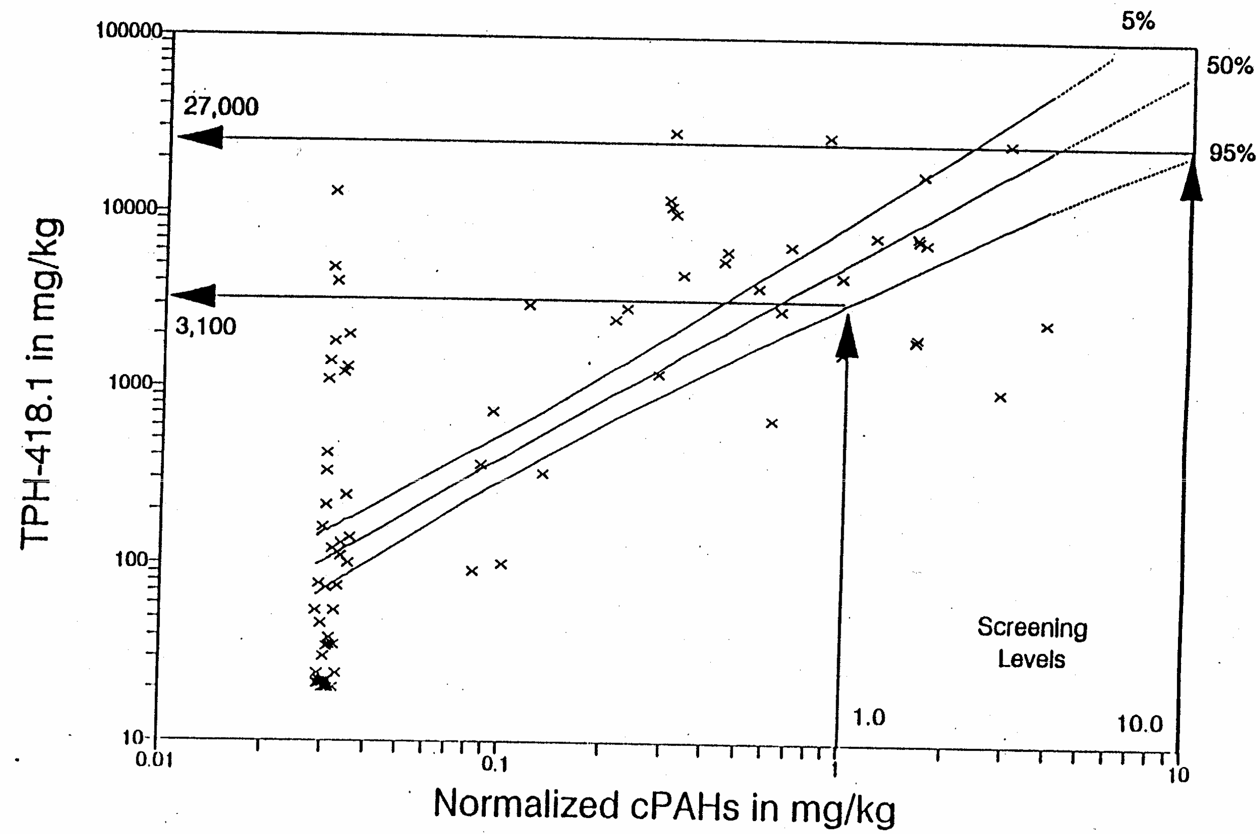
Correlation Between cPAHs and TPH-418.1

Bunker C Areas 7, 8, and 16



APPENDIX VI
GROUNDWATER, SURFACE WATER, AND LEACHABILITY DATA FOR TPH AND cPAHs

Groundwater Data

TPH Data for Groundwater. Total petroleum hydrocarbons (TPH; WTPH 418.1 analysis) have not been detected in any groundwater sample collected during the four rounds of RI groundwater sampling. The TPH data for groundwater are presented in Table VI-1.

Non-Carcinogenic PAH Data for Groundwater. Of the 129 groundwater samples collected during four rounds of RI groundwater sampling, no sample had confirmed detections of any PAH above the MTCA drinking water screening levels for non-carcinogenic (e.g., chronic toxicity) effects.

cPAH Data for Groundwater. One of the 129 groundwater samples collected during four rounds of RI groundwater sampling had an unconfirmed detection of total cPAHs above the 0.0001 mg/L MTCA screening level for total cPAHs (Table VI-2). During the September 1992 sampling round, one of two samples collected from monitoring well MW-8 had a reported total cPAH concentration of 0.0016 mg/L. However, this result was not confirmed by the field duplicate sample collected concurrently from MW-8, which had only a single cPAH (chrysene) detected at the detection limit (0.00001 mg/L). The discrepancy in results between this set of duplicate samples suggests possible sample contamination during sample handling in the field or laboratory. This is further supported by the lack of cPAH detections in groundwater samples or field duplicates from MW-8 in any of the other groundwater sampling rounds, either before or after the September 1992 sampling round. Detected total cPAH concentrations also have not exceeded the 0.0001 mg/L screening level in any other groundwater samples collected during the RI. Based on these data, the single unconfirmed detection of cPAHs in MW-8 above the screening level is not considered representative of groundwater quality at this location or elsewhere at the Site.

Chrysene has been detected inconsistently in groundwater samples from 11 monitoring wells (excluding the September 1992 sample from MW-8) at concentrations marginally above the MTCA Method B screening level of 0.000012 mg/L (Table VI-2). As discussed in Appendix IV, the individual cPAH screening levels are based on benzo(a)pyrene toxicity. Because benzo(a)pyrene is a more potent carcinogen than chrysene (by three orders of magnitude), the individual cPAH screening level is highly conservative for chrysene, which is the least potent of the seven cPAHs.

The chrysene detections occur infrequently in different monitoring wells, including well MW-14 located along the eastern (hydraulically upgradient) edge of the Site. The detected concentrations are very low, ranging from 0.00002 to 0.0001 mg/L, with an average of 0.00003 mg/L relative to the detection limit of 0.00001 mg/L. Furthermore, chrysene is not detected consistently at a given well over time (detected in only one of the 11 wells in more than one of the four sampling rounds). Statistical testing (a Fisher's Exact Test) indicates that the proportion of chrysene detections in on-site monitoring wells (16/129) is not significantly different (at $p = 0.05$; 95% confidence level) than the proportion of detections in background wells (0/12).

Benzo(b)fluoranthene and dibenzo(a,h)anthracene were also each detected in one groundwater sample (other than the September 1992 sample from MW-8) at concentrations marginally above the individual cPAH screening level (Table VI-2).

It should be noted that the RI analyses' very low-level detection limits for individual cPAHs in water (0.00001 mg/L) are essentially the same as the screening level for individual cPAHs (0.000012 mg/L). As a result, almost any detection of an individual cPAH in groundwater is above the screening level. Furthermore, the individual cPAH screening levels are below practical quantitation limits (PQLs) of 0.0002 to 0.002 mg/L as defined by Ecology (Ecology, 1993).

In any event, all samples in which an individual cPAH was detected (other than the September 1992 sample from MW-8), had a total cPAH concentration at or below the 0.0001 mg/L screening level for total cPAHs.

The screening levels for individual cPAHs are highly conservative since they are based on benzo(a)pyrene toxicity (discussed in Appendix IV). Chrysene, not benzo(a)pyrene, is the only cPAH detected in more than one groundwater sample collected from the Site (excluding anomalous September 1992 sample from MW-8). Because a screening level based on chrysene toxicity would be 0.012 mg/L (0.000012 mg/L/0.001 Relative Potency Factor [RPF]; refer to Appendix IV), the MTCA drinking water screening level for total cPAHs (0.0001 mg/L) is protective of human health and the environment at the Site.

Surface Water Data

TPH and ncPAH Data for Surface Water. No TPH or non-carcinogenic PAHs were detected above MTCA screening levels in any of the four rounds of RI surface water sampling.

cPAH Data for Surface Water. cPAHs were detected at a concentration above the most stringent surface water screening level in one surface water sample; however, the data indicate that the single exceedence was the result of elevated sample turbidity created during sampling.

In the December 1992 sampling round, low concentrations of cPAHs were detected in the surface water sample from sampling location SW-1 near the mouth of Sequalitchew Creek (Table VI-2). Six of seven individual cPAH concentrations (0.00006 to 0.00023 mg/L) were above MTCA screening levels (0.000031 mg/L based on benzo(a)pyrene toxicity). Because seasonally low water conditions occurred at SW-1 during the December 1992 sampling round, greater than usual sediment was stirred up during sampling, resulting in elevated total suspended solids (TSS) in the sample. The TSS value in this sample was 160 mg/L, an order of magnitude higher than all other TSS values measured from the SW-1 location. Because cPAHs have relatively low solubilities, the low level cPAH detections are likely related to the higher levels of particulate matter (TSS) in the sample.

No cPAHs were detected in any other surface water sample from the four rounds of sampling, indicating that the single detection is not representative of surface water quality at the Site.

Leachability Data

The lack of petroleum compounds (TPH and PAH) detected in groundwater or surface water is consistent with the low degree of leachability measured during toxicity characteristics leaching procedure (TCLP) testing for these compounds in Site soils.

Nine soil samples collected from Area 8 (Bunker C-derived) were tested for TPH leachability using the TCLP test (EPA Methods 1311/418.1). The TPH concentrations in the nine soil samples submitted for TCLP analysis ranged from 800 to 19,000 mg/kg. In addition, one of the samples was tested for TCLP PAHs. The TCLP test employs a much more rigorous leaching procedure than would be representative of natural site conditions (e.g., leaching due to rainwater infiltration). As a result, the TCLP results are conservative since they overestimate leachability relative to actual site conditions. The TCLP TPH and PAH results are summarized in Table VI-3.

Leachable total petroleum hydrocarbons (TPH), under the rigorous TCLP procedure, were not detected in samples with TPH concentrations up to 11,000 mg/kg. The only detected leachable TPH (16 mg/L) of the nine samples tested occurred in the sample containing the highest TPH concentration of 19,000 mg/kg. No leachable cPAHs were detected in the Area 8 soil sample containing 6,900 mg/kg TPH.

Literature-derived values for cPAH partition coefficients provide additional support that residual hydrocarbon concentrations at the Site are protective of groundwater. Table VI-4 provides literature values for log K_{oc} (normalized organic carbon partition coefficient) for the cPAH compounds and an average measured organic carbon content for Site soils (fractional organic carbon content, f_{oc}). The soil:water partition coefficients (K_d values) for cPAHs were estimated by the expression $K_d = K_{oc} \times f_{oc}$. The estimated cPAH K_d values range from 9,600 to 1,205,000 (Table VI-4). Using the lowest estimated K_d value of 9,600 L/kg, a cPAH soil screening level for protection of groundwater (based on the conservative benzo(a)pyrene screening level) can be calculated as follows:

Soil conc. (mg/kg) = groundwater screening level (mg/L) x K_d (L/kg) x DAF
= (0.000012 mg/L) (9,600 L/kg) (100)
= 12 mg/kg

As discussed in the lead cleanup summary, EPA determined during its development of the TCLP regulations (55 FR 11803) that a dilution/ attenuation factor (DAF) of 100 is appropriate for the full range of constituents in the TCLP list, many of which are more mobile in the subsurface than cPAHs.

A total cPAH concentration of 12 mg/kg corresponds to a Bunker C-derived TPH concentration of 7,600 mg/kg (with 95% confidence; refer to Appendix V for TPH/cPAH regression analysis). This calculated TPH concentration is consistent with the fact that no leachable cPAHs were detected in a sample with 6,900 mg/kg Bunker C-derived TPH. This evaluation, with the TCLP data, supports 7,600 mg/kg TPH (Bunker C-derived) as protective of groundwater at the Site. All areas with Bunker C TPH sources have average concentrations (arithmetic mean and 95% UCL) below 7,600 mg/kg (refer to Tables I-1 and I-2 in Appendix I).

No areas of the Site have an average (arithmetic mean) cPAH concentration above 12 mg/kg. In fact, only two of 111 samples collected from the Site have detected cPAH concentrations above 12 mg/kg (one from Area 16 and one from Area 26). Because of the numbers of PAH samples and proportions of detections, the 95% UCL for cPAHs in these areas default to the maximum concentration according to MTCA statistical guidance (18 mg/kg in Area 16, and 37 mg/kg in Area 26; Table I-3 in Appendix I). Groundwater quality data from monitoring wells located immediately downgradient of Area 16 (MW-2, MW-3, and MW-5) and

Area 26 (MW-6) indicate no adverse impact to groundwater from TPH or cPAHs in these areas. Furthermore, cPAH results from samples collected below a depth of 1 foot in Area 16 (results provided in RI Deliverable I; Hart Crowser, 1992) indicate that the cPAHs, like the TPH, is limited to surficial soils impacted by Bunker C residue, i.e., there has been negligible vertical transport of cPAHs.

Although current MTCA guidance requires a single maximum sample result to represent average cPAH concentrations in Areas 16 and 26, all available data indicate that cPAHs in these areas, or in any area of the Site, do not pose a risk to groundwater or surface water.

Conclusions

Historical (pre-interim source removal) TPH and cPAH concentrations in soil have not adversely impacted groundwater or surface water at the Site. Evaluation of site-specific TCLP data and cPAH partition coefficients (K_d) supports a TPH concentration for Bunker C-derived petroleum concentrations of 7,600 mg/kg for protection of groundwater. Following interim source removal, no average concentrations of Bunker C-derived TPH are above 7,600 mg/kg. Furthermore, cPAH concentrations in soil do not pose a risk to groundwater or surface water. Therefore, remaining soils will not adversely impact groundwater or surface water quality at the Site in the future.

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Attachments:

Table VI-1 - Total Petroleum Hydrocarbon (TPH) Concentrations in mg/L in Groundwater and Surface Water

Table VI-2 - Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Table VI-3 - Summary of Soil Petroleum Hydrocarbon Leachability Data

Table VI-4 - Estimated Partition Coefficients (K_d) for cPAHs

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Table VI-1 - Total Petroleum Hydrocarbon (TPH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Location	TPH 418.1 in mg/L
Groundwater		
MW-1-12-92	MW-1	ND
MW-1-3-92	MW-1	ND
MW-1-6-92	MW-1	ND
MW-1-9-92	MW-1	ND
MW-2-12-92	MW-2	ND
MW-2-3-92	MW-2	ND
MW-2-6-92	MW-2	NDE
MW-2-9-92	MW-2	ND
MW-3-12-92	MW-3	ND
MW-3-3-92	MW-3	ND
MW-3-6-92	MW-3	NDE
MW-3-9-92	MW-3	ND
MW-4-12-92	MW-4	ND
MW-4-3-92	MW-4	ND
MW-4-6-92	MW-4	ND
MW-4-9-92	MW-4	ND
MW-5-12-92	MW-5	NDE
MW-5-3-92	MW-5	ND
MW-5-6-92	MW-5	ND
MW-5-9-92	MW-5	ND
MW-6-12-92	MW-6	ND
MW-6-3-92	MW-6	ND
MW-6-6-92	MW-6	ND
MW-6-9-92	MW-6	ND
MW-7-12-92	MW-7	ND
MW-7-3-92	MW-7	ND
MW-7-6-92	MW-7	NDE
MW-7-9-92	MW-7	ND
MW-8-12-92	MW-8	ND
MW-8-3-92	MW-8	ND
MW-8-6-92	MW-8	NDE
MW-8-9-92	MW-8	ND
MW-9-12-92	MW-9	ND
MW-9-3-92	MW-9	ND
MW-9-6-92	MW-9	NDE
MW-9-9-92	MW-9	ND
MW-11-12-92	MW-11	ND
MW-11-3-92	MW-11	ND
MW-11-6-92	MW-11	NDE
MW-11-9-92	MW-11	ND
MW-12-12-92	MW-12	ND
MW-12-3-92	MW-12	ND
MW-12-6-92	MW-12	NDE
MW-12-9-92	MW-12	ND
MW-13-12-92	MW-13	ND
MW-13-3-92	MW-13	ND
MW-13-6-92	MW-13	NDE
MW-13-9-92	MW-13	ND
MW-14-12-92	MW-14	ND
MW-14-3-92	MW-14	ND
MW-14-6-92	MW-14	ND

Table VI-1 - Total Petroleum Hydrocarbon (TPH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Location	TPH 418.1 in mg/L
MW-14-9-92	MW-14	ND
MW-15-1-93	MW-15	ND
MW-15-12-92	MW-15	ND
MW-15-3-92	MW-15	ND
MW-16-12-92	MW-16	ND
MW-16-3-92	MW-16	ND
MW-16-6-92	MW-16	NDE
MW-16-9-92	MW-16	ND
MW-17-12-92	MW-17	ND
MW-17-3-92	MW-17	ND
MW-17-6-92	MW-17	ND
MW-17-9-92	MW-17	ND
MW-18-12-92	MW-18	ND
MW-18-3-92	MW-18	ND
MW-18-6-92	MW-18	NDE
MW-18-9-92	MW-18	ND
MW-19-12-92	MW-19	ND
MW-19-3-92	MW-19	ND
MW-19-6-92	MW-19	NDE
MW-19-9-92	MW-19	ND
MW-20-12-92	MW-20	ND
MW-20-3-92	MW-20	ND
MW-20-6-92	MW-20	ND
MW-20-9-92	MW-20	ND
MW-21-12-92	MW-21	ND
MW-21-3-92	MW-21	ND
MW-21-6-92	MW-21	ND
MW-21-9-92	MW-21	ND
MW-22-12-92	MW-22	ND
MW-22-3-92	MW-22	ND
MW-22-6-92	MW-22	NDE
MW-22-9-92	MW-22	ND
MW-23-12-92	MW-23	ND
MW-23-3-92	MW-23	ND
MW-23-6-92	MW-23	NDE
MW-23-9-92	MW-23	ND
MW-24-12-92	MW-24	ND
MW-24-3-92	MW-24	ND
MW-24-6-92	MW-24	NDE
MW-24-9-92	MW-24	ND
MW-25-1-93	MW-25	ND
MW-25-12-92	MW-25	ND
MW-25-7-92	MW-25	ND
MW-25-9-92	MW-25	ND
MW-26-1-93	MW-26	ND
MW-26-12-92	MW-26	ND
MW-26-7-92	MW-26	ND
MW-26-9-92	MW-26	ND
MW-27-3-92	MW-27	ND
SEEP-1-12-92	SEEP-1	ND
SEEP-1-3-92	SEEP-1	ND
SEEP-1-6-92	SEEP-1	ND

Table VI-1 – Total Petroleum Hydrocarbon (TPH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Location	TPH 418.1 in mg/L
SEEP-1-9-92	SEEP-1	ND
SEEP-2-12-92	SEEP-2	ND
SEEP-2-3-92	SEEP-2	ND
SEEP-2-6-92	SEEP-2	ND
SEEP-2-9-92	SEEP-2	ND
SPR-3-12-92	SPR-3	ND
SPR-3-3-92	SPR-3	ND
SPR-3-9-92	SPR-3	ND
SPR-4-12-92	SPR-4	ND
SPR-4-3-92	SPR-4	ND
SPR-4-6-92	SPR-4	ND
SPR-4-9-92	SPR-4	ND
83-93-3-92	83-93	ND
83-94-3-92	83-94	ND
Surface Water		
SW-1-12-92	SW-1	ND
SW-1-3-92	SW-1	ND
SW-1-6-92	SW-1	ND
SW-2-12-92	SW-2	ND
SW-2-3-92	SW-2	ND
SW-2-6-92	SW-2	ND
SW-2-9-92	SW-2	ND
SW-3-12-92	SW-3	ND
SW-3-3-92	SW-3	ND
SW-3-6-92	SW-3	ND
SW-3-9-92	SW-3	ND
SW-4-3-92	SW-4	ND
SW-4-6-92	SW-4	ND
SW-5-12-92	SW-5	ND
SW-5-3-92	SW-5	ND
SW-5-6-92	SW-5	ND
SW-5-9-92	SW-5	ND
SW-6-12-92	SW-6	ND
SW-6-3-92	SW-6	ND
SW-6-6-92	SW-6	ND
SW-6-9-92	SW-6	ND
SW-7-12-92	SW-7	ND
SW-7-3-92	SW-7	ND
SW-7-6-92	SW-7	ND
SW-7-9-92	SW-7	ND

Notes:

ND Not detected at detection limit of 1 mg/L.

NDE Not detected at estimated detection limit of 1 mg/L. Sample MW-5-12-92 not detected at estimated detection limit of 3 mg/L.

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Table VI-2 - Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Benzo(a)-Anthracene	Benzo(a)-Pyrene	Benzo(b)-Fluoranthene	Benzo(k)-Fluoranthene	Chrysene	Dibenzo-(a,h)Antracene	Indeno-(1,2,3-c,d)-Pyrene	Total cPAHs (a)
Groundwater								
7-B-503	NDE	NDE	NDE	NDE	NDE	NDE	NDE	
MW-1-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-1-3-92	ND	ND	ND	ND	ND	0.000015	ND	0.000015
MW-1-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-1-9-92	ND	ND	ND	ND	0.0001	ND	ND	0.0001
MW-2-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-2-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-2-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-2-9-92	NDE	NDE	NDE	NDE	NDE	NDE	NDE	
MW-3-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-3-3-92	ND	ND	0.000025	ND	ND	ND	ND	0.000025
MW-3-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-3-9-92	ND	ND	0.00001	ND	ND	ND	ND	0.00001
MW-4-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-4-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-4-6-92	ND	ND	ND	ND	0.00002	ND	ND	0.00002
MW-4-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-5-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-5-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-5-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-5-9-92	ND	ND	ND	ND	0.00003	ND	ND	0.00003
MW-6-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-6-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-6-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-6-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-7-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-7-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-7-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-7-9-92	ND	ND	ND	ND	0.00001 J	ND	ND	0.00001
MW-8-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-8-3-92	ND	ND	ND	ND	ND	ND	ND	

Table VI-2 – Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Benzo(a)-Anthracene	Benzo(a)-Pyrene	Benzo(b)-Fluoranthene	Benzo(k)-Fluoranthene	Chrysene	Dibenzo-(a,h)Antracene	Indeno-(1,2,3-c,d)-Pyrene	Total cPAHs (a)
MW-8-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-8-9-92	0.00016	0.00008	0.00028	0.00025	0.00045	ND	0.00034	0.00156
MW-9-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-9-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-9-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-9-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-11-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-11-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-11-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-11-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-12-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-12-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-12-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-12-9-92	ND	ND	ND	ND	0.00002	ND	ND	0.00002
MW-13-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-13-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-13-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-13-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-14-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-14-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-14-6-92	ND	ND	ND	ND	0.00002	ND	ND	0.00002
MW-14-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-15-1-93	ND	ND	ND	ND	0.00003	ND	ND	0.00003
MW-15-12-92	NDE	NDE	NDE	NDE	NDE	NDE	NDE	
MW-15-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-15-7-92	NDE	NDE	NDE	NDE	NDE	NDE	NDE	
MW-16-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-16-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-16-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-16-9-92	ND	ND	ND	ND	0.00002	ND	ND	0.00002
MW-17-12-92	ND	ND	ND	ND	0.00004	ND	ND	0.00004
MW-17-3-92	ND	ND	ND	ND	ND	ND	ND	

Table VI-2 – Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Benzo(a)-Anthracene	Benzo(a)-Pyrene	Benzo(b)-Fluoranthene	Benzo(k)-Fluoranthene	Chrysene	Dibenzo-(a,h)Antracene	Indeno-(1,2,3-c,d)-Pyrene	Total cPAHs (a)
MW-17-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-17-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-18-12-92	ND	ND	ND	ND	0.00007	ND	ND	0.00007
MW-18-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-18-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-18-9-92	NDE	NDE	NDE	NDE	NDE	NDE	NDE	
MW-19-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-19-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-19-6-92	ND	ND	ND	ND	0.00002	ND	ND	0.00002
MW-19-9-92	ND	ND	ND	ND	0.00001	ND	ND	0.00001
MW-20-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-20-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-20-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-20-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-21-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-21-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-21-6-92	ND	ND	ND	ND	0.00001	ND	ND	0.00001
MW-21-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-22-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-22-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-22-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-22-9-92	ND	ND	ND	ND	0.00001	ND	ND	0.00001
MW-23-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-23-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-23-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-23-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-24-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-24-3-92	ND	ND	ND	ND	ND	ND	ND	
MW-24-6-92	ND	ND	ND	ND	ND	ND	ND	
MW-24-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-25-1-93	NDE	NDE	NDE	NDE	NDE	NDE	NDE	
MW-25-12-92	ND	ND	ND	ND	ND	ND	ND	

Table VI-2 – Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Benzo(a)-Anthracene	Benzo(a)-Pyrene	Benzo(b)-Fluoranthene	Benzo(k)-Fluoranthene	Chrysene	Dibenzo-(a,h)Antracene	Indeno-(1,2,3-c,d)-Pyrene	Total cPAHs (a)
MW-25-7-92	ND	ND	ND	ND	ND	ND	ND	
MW-25-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-26-1-93	ND	ND	ND	ND	0.00002	ND	ND	0.00002
MW-26-12-92	ND	ND	ND	ND	ND	ND	ND	
MW-26-7-92	ND	ND	ND	ND	ND	ND	ND	
MW-26-9-92	ND	ND	ND	ND	ND	ND	ND	
MW-27-3-92	ND	ND	ND	ND	ND	ND	ND	
SEEP-1-12-92	ND	ND	ND	ND	ND	ND	ND	
SEEP-1-3-92	ND	ND	ND	ND	ND	ND	ND	
SEEP-1-6-92	ND	ND	ND	ND	ND	ND	ND	
SEEP-1-9-92	ND	ND	ND	ND	ND	ND	ND	
SEEP-2-12-92	ND	ND	ND	ND	ND	ND	ND	
SEEP-2-3-92	ND	ND	ND	ND	ND	ND	ND	
SEEP-2-6-92	ND	ND	ND	ND	ND	ND	ND	
SEEP-2-9-92	ND	ND	ND	ND	ND	ND	ND	
SPR-3-12-92	ND	ND	ND	ND	ND	ND	ND	
SPR-3-3-92	ND	ND	ND	ND	ND	ND	ND	
SPR-3-9-92	ND	ND	ND	ND	ND	ND	ND	
SPR-4-12-92	ND	ND	ND	ND	ND	ND	ND	
SPR-4-3-92	ND	ND	ND	ND	ND	ND	ND	
SPR-4-6-92	ND	ND	ND	ND	ND	ND	ND	
SPR-4-9-92	ND	ND	ND	ND	ND	ND	ND	

Table VI-2 – Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Benzo(a)-Anthracene	Benzo(a)-Pyrene	Benzo(b)-Fluoranthene	Benzo(k)-Fluoranthene	Chrysene	Dibenzo-(a,h)Antracene	Indeno-(1,2,3-c,d)-Pyrene	Total cPAHs (a)
Surface Water								
SW-1-12-92	0.00009	0.00009	0.00017	0.00006 J	0.00023	ND	0.00007	0.00071
SW-1-3-92	ND	ND	ND	ND	ND	ND	ND	
SW-1-6-92	ND	ND	ND	ND	ND	ND	ND	
SW-2-12-92	ND	ND	ND	ND	ND	ND	ND	
SW-2-3-92	ND	ND	ND	ND	ND	ND	ND	
SW-2-6-92	ND	ND	ND	ND	ND	ND	ND	
SW-2-9-92	ND	ND	ND	ND	ND	ND	ND	
SW-3-12-92	ND	ND	ND	ND	ND	ND	ND	
SW-3-3-92	ND	ND	ND	ND	ND	ND	ND	
SW-3-6-92	ND	ND	ND	ND	ND	ND	ND	
SW-3-9-92	ND	ND	ND	ND	ND	ND	ND	
SW-4-3-92	ND	ND	ND	ND	ND	ND	ND	
SW-4-6-92	ND	ND	ND	ND	ND	ND	ND	
SW-5-12-92	ND	ND	ND	ND	ND	ND	ND	
SW-5-3-92	ND	ND	ND	ND	ND	ND	ND	
SW-5-6-92	ND	ND	ND	ND	ND	ND	ND	
SW-5-9-92	ND	ND	ND	ND	ND	ND	ND	
SW-6-12-92	ND	ND	ND	ND	ND	ND	ND	
SW-6-3-92	ND	ND	ND	ND	ND	ND	ND	
SW-6-6-92	ND	ND	ND	ND	ND	ND	ND	
SW-6-9-92	ND	ND	ND	ND	ND	ND	ND	
SW-7-12-92	ND	ND	ND	ND	ND	ND	ND	
SW-7-3-92	ND	ND	ND	ND	ND	ND	ND	
SW-7-6-92	ND	ND	ND	ND	ND	ND	ND	
SW-7-9-92	ND	ND	ND	ND	ND	ND	ND	

Notes:
ND Not detected (cPAH detection limits ranging from 0.00001 to 0.00005 mg/L; ncPAH detection limits ranging from 0.00001 to 0.00002 mg/L).
NDE Not detected (estimated cPAH detection limits ranging from 0.00001 to 0.00005 mg/L; estimated ncPAH detection limits ranging from 0.00001 to 0.00002 mg/L).
J Estimated value.
(a) Total represents the sum of detected values only.

Table VI-2 – Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Acenaph-thene	Acenaph-thylene	Anthra-cene	Benzo (g,h,i) Perylene	Fluoran-thene	Fluorene	Naph-thalene	Phenan-threne	Pyrene	Total ncPAHs (a)
Groundwater										
7-B-503	NDE	NDE	NDE	0.00006 J	NDE	NDE	NDE	0.00031 J	NDE	0.00037
MW-1-12-92	ND	ND	ND	ND	ND	ND	ND	0.00003	ND	0.00003
MW-1-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-1-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-1-9-92	ND	ND	0.00006	ND	ND	0.0011	0.0016	0.00041	ND	0.00317
MW-2-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-2-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-2-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-2-9-92	NDE	NDE	NDE	NDE	NDE	NDE	NDE	NDE	NDE	
MW-3-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-3-3-92	ND	ND	ND	ND	ND	ND	ND	0.00002	ND	0.00002
MW-3-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-3-9-92	ND	ND	ND	ND	ND	ND	ND	0.00003	ND	0.00003
MW-4-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-4-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-4-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-4-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-5-12-92	ND	ND	ND	ND	ND	ND	ND	0.00004	ND	0.00004
MW-5-3-92	ND	ND	ND	ND	ND	ND	ND	0.000015	ND	0.000015
MW-5-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-5-9-92	ND	ND	ND	ND	ND	ND	0.00033	0.00013	ND	0.00046
MW-6-12-92	ND	ND	ND	ND	ND	ND	ND	0.00004	ND	0.00004
MW-6-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-6-6-92	ND	ND	ND	ND	ND	ND	ND	0.00003	ND	0.00003
MW-6-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-7-12-92	ND	ND	ND	ND	ND	ND	ND	0.00004	ND	0.00004
MW-7-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-7-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-7-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-8-12-92	ND	ND	ND	ND	ND	ND	ND	0.00005	ND	0.00005
MW-8-3-92	ND	ND	ND	ND	ND	ND	ND	0.000015	ND	0.000015

Table VI-2 – Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Acenaph-thene	Acenaph-thylene	Anthra-cene	Benzo (g,h,i) Perylene	Fluoran-thene	Fluorene	Naph-thalene	Phenan-threne	Pyrene	Total ncPAHs (a)
MW-8-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-8-9-92	ND	ND	ND	0.00018	0.00015	ND	0.00016	0.00008	0.00014	0.00071
MW-9-12-92	ND	ND	ND	ND	ND	ND	ND	0.00004	ND	0.00004
MW-9-3-92	ND	ND	ND	ND	ND	ND	ND	0.000025	ND	0.000025
MW-9-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-9-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-11-12-92	ND	ND	ND	ND	ND	ND	ND	0.00005	ND	0.00005
MW-11-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-11-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-11-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-12-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-12-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-12-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-12-9-92	ND	ND	ND	ND	ND	ND	ND	0.00008	ND	0.00008
MW-13-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-13-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-13-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-13-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-14-12-92	ND	ND	ND	ND	ND	ND	ND	0.00006	ND	0.00006
MW-14-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-14-6-92	ND	ND	ND	ND	ND	ND	ND	0.00001	ND	0.00001
MW-14-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-15-1-93	ND	ND	ND	ND	0.00002	ND	ND	0.00003	ND	0.00005
MW-15-12-92	NDE	NDE	NDE	NDE	0.00004 J	NDE	NDE	0.00008 J	0.00005 J	0.00017
MW-15-3-92	ND	ND	ND	ND	ND	ND	ND	0.00005	ND	0.00005
MW-15-7-92	NDE	NDE	NDE	NDE	0.00011 J	NDE	NDE	0.00003 J	NDE	0.00014
MW-16-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-16-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-16-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-16-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-17-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-17-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Table VI-2 – Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Acenaph-thene	Acenaph-thylene	Anthra-cene	Benzo (g,h,i) Perylene	Fluoran-thene	Fluorene	Naph-thalene	Phenan-threne	Pyrene	Total ncPAHs (a)
MW-17-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-17-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-18-12-92	ND	ND	ND	ND	0.00004	ND	ND	0.00009	ND	0.00013
MW-18-3-92	ND	ND	ND	ND	ND	ND	ND	0.00002	ND	0.00002
MW-18-6-92	ND	ND	ND	ND	ND	ND	ND	0.00005	ND	0.00005
MW-18-9-92	NDE	NDE	NDE	NDE	NDE	NDE	NDE	NDE	NDE	
MW-19-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-19-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-19-6-92	ND	ND	ND	ND	ND	ND	ND	0.00004	ND	0.00004
MW-19-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-20-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-20-3-92	ND	ND	ND	ND	ND	ND	ND	0.000022	ND	0.000022
MW-20-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-20-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-21-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-21-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-21-6-92	ND	ND	ND	ND	ND	ND	ND	0.00001	ND	0.00001
MW-21-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-22-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-22-3-92	ND	ND	ND	ND	0.00007	ND	ND	0.000035	ND	0.000105
MW-22-6-92	ND	ND	ND	ND	ND	ND	ND	0.00002	ND	0.00002
MW-22-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-23-12-92	ND	ND	ND	ND	ND	ND	ND	0.00005	ND	0.00005
MW-23-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-23-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-23-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-24-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-24-3-92	ND	ND	ND	ND	ND	ND	ND	0.00003	ND	0.00003
MW-24-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-24-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-25-1-93	NDE	NDE	NDE	NDE	NDE	NDE	NDE	0.00002 J	NDE	0.00002
MW-25-12-92	ND	ND	ND	ND	ND	ND	ND	0.00006	ND	0.00006

Table VI-2 - Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Acenaph-thene	Acenaph-thylene	Anthra-cene	Benzo (g,h,i) Perylene	Fluoran-thene	Fluorene	Naph-thalene	Phenan-threne	Pyrene	Total ncPAHs (a)
MW-25-7-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-25-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-26-1-93	ND	ND	ND	ND	ND	ND	ND	0.00003	ND	0.00003
MW-26-12-92	ND	ND	ND	ND	ND	ND	ND	0.00006	ND	0.00006
MW-26-7-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-26-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
MW-27-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SEEP-1-12-92	ND	ND	ND	ND	ND	ND	ND	0.00002	ND	0.00002
SEEP-1-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SEEP-1-6-92	ND	ND	ND	ND	ND	ND	ND	0.00004	ND	0.00004
SEEP-1-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SEEP-2-12-92	ND	ND	ND	ND	ND	ND	ND	0.00002	ND	0.00002
SEEP-2-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SEEP-2-6-92	ND	ND	ND	ND	ND	ND	ND	0.00003	ND	0.00003
SEEP-2-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SPR-3-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SPR-3-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SPR-3-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SPR-4-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SPR-4-3-92	ND	ND	ND	ND	ND	ND	ND	0.000015	ND	0.000015
SPR-4-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SPR-4-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Table VI-2 – Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in mg/L in Groundwater and Surface Water

Sample ID	Acenaph-thene	Acenaph-thylene	Anthra-cene	Benzo (g,h,i) Perylene	Fluoran-thene	Fluorene	Naph-thalene	Phenan-threne	Pyrene	Total ncPAHs (a)
Surface Water										
SW-1-12-92	ND	ND	0.00003	0.00014	0.00038	ND	ND	ND	0.00016 J	0.00071
SW-1-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-1-6-92	ND	ND	ND	ND	ND	ND	ND	0.00004	ND	0.00004
SW-2-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-2-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-2-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-2-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-3-12-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-3-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-3-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-3-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-4-3-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-4-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-5-12-92	ND	ND	ND	ND	ND	ND	ND	0.00005	ND	0.00005
SW-5-3-92	ND	ND	ND	ND	ND	ND	ND	0.00002	ND	0.00002
SW-5-6-92	ND	ND	ND	ND	ND	ND	ND	0.00004	ND	0.00004
SW-5-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-6-12-92	ND	ND	ND	ND	ND	ND	ND	0.00005	ND	0.00005
SW-6-3-92	ND	ND	ND	ND	ND	ND	ND	0.000025	ND	0.000025
SW-6-6-92	ND	ND	ND	ND	ND	ND	ND	0.00002	ND	0.00002
SW-6-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-7-12-92	ND	ND	ND	ND	ND	ND	ND	0.00003	ND	0.00003
SW-7-3-92	ND	ND	ND	ND	ND	ND	ND	0.00002	ND	0.00002
SW-7-6-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	
SW-7-9-92	ND	ND	ND	ND	ND	ND	ND	ND	ND	

Notes:
- ND — Not detected (cPAH detection limits ranging from 0.00001 to 0.00005 mg/L; ncPAH detection limits ranging from 0.00001 to 0.00002 mg/L).
- NDE — Not detected (estimated cPAH detection limits ranging from 0.00001 to 0.00005 mg/L; estimated ncPAH detection limits ranging from 0.00001 to 0.00002 mg/L).
- J — Estimated value.
- (a) — Total represents the sum of detected values only.

Table VI-3 – Summary of Soil Petroleum Hydrocarbon Leachability Data

Sample ID:	8-VS-SC-224	8-VS-SC-112	8-VS-SC-152	8-VS-SC-170
Station No:	2+82	12+90	8+93	7+12
Sampling Date:	6/10/93	6/07/93	6/08/93	6/08/93 (3)
Sample Depth in Feet:	15	15	15	15
TPH 418.1 in mg/kg (ppm)	6,900 (2)	5,400	2,340 (1)	6,000 (2)
TCLP TPH 418.1 in mg/L (ppm)	ND	ND	ND	ND
TCLP cPAHs in mg/L (ppm)				
Benzo(a)anthracene	ND	NA	NA	NA
Benzo(a)pyrene	ND	NA	NA	NA
Benzo(b)fluoranthene	ND	NA	NA	NA
Benzo(k)fluoranthene	ND	NA	NA	NA
Chrysene	ND	NA	NA	NA
Dibenzo(a,h)anthracene	ND	NA	NA	NA
Indeno(1,2,3,c,d)pyrene	ND	NA	NA	NA
Total cPAHs (a)	ND	—	—	—
Total cPAHs (b)	0.004	—	—	—
TCLP ncPAHs in mg/L (ppm)				
Acenaphthene	ND	NA	NA	NA
Acenaphthylene	ND	NA	NA	NA
Anthracene	ND	NA	NA	NA
Benzo(g,h,i)perylene	ND	NA	NA	NA
Fluoranthene	ND	NA	NA	NA
Fluorene	ND	NA	NA	NA
Naphthalene	ND	NA	NA	NA
Phenanthrene	ND	NA	NA	NA
Pyrene	ND	NA	NA	NA
Total ncPAHs (b)	0.015	—	—	—

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Notes:

ND Not detected (cPAH detection limits ranging from 0.001 to 0.0021 mg/L; ncPAH detection limits ranging from 0.0005 to 0.005 mg/L; TCLP TPH 418.1 not detected at detection limit of 1 mg/L).

NA Not analyzed.

(a) Total represents the sum of detected values only.

(b) Total includes one-half the detection limit of non-detected compounds.

(1) TPH Screening in mg/kg dry weight.

(2) TPH Screening in mg/kg wet weight.

(3) Sample location was excavated during subsequent source removal.

Table VI-3 – Summary of Soil Petroleum Hydrocarbon Leachability Data

Sample ID:	8-VS-SC-208	8-VS-SC-296A	8-VS-SC-297A	8-VS-59	8-VS-81
Station No:	3+73	10+74	6+88	2+00	10+74
Sampling Date:	6/09/93	7/2/93 (3)	7/2/93 (3)	7/12/93	7/28/93
Sample Depth in Feet:	15	15	15	15	20
TPH 418.1 in mg/kg (ppm)	819 (1)	19,000	9,500	7,200	11,000
TCLP TPH 418.1 in mg/L (ppm)	ND	16	ND	ND	ND
TCLP cPAHs in mg/L (ppm)					
Benzo(a)anthracene	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA
Dibenzo(a,h)anthracene	NA	NA	NA	NA	NA
Indeno(1,2,3,c,d)pyrene	NA	NA	NA	NA	NA
Total cPAHs (a)	—	—	—	—	—
Total cPAHs (b)	—	—	—	—	—
TCLP ncPAHs in mg/L (ppm)					
Acenaphthene	NA	NA	NA	NA	NA
Acenaphthylene	NA	NA	NA	NA	NA
Anthracene	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	NA	NA	NA
Fluorene	NA	NA	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA
Pyrene	NA	NA	NA	NA	NA
Total ncPAHs (b)	—	—	—	—	—

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Notes:

ND Not detected (cPAH detection limits ranging from 0.001 to 0.0021 mg/L; ncPAH detection limits ranging from 0.0005 to 0.005 mg/L; TCLP TPH 418.1 not detected at detection limit of 1 mg/L).

NA Not analyzed.

(a) Total represents the sum of detected values only.

(b) Total includes one-half the detection limit of non-detected compounds.

(1) TPH Screening in mg/kg dry weight.

(2) TPH Screening in mg/kg wet weight.

(3) Sample location was excavated during subsequent source removal.

Table VI-4 - Estimated Partition Coefficients (Kd) for cPAHs

cPAH Compound	log Koc (a)	Koc	Average foc (b)	Estimated Kd (c)
Chrysene	5.39	245,000	0.039	9,600
Benzo(b)fluoranthene	5.74	550,000	0.039	21,500
Benzo(a)anthracene	6.14	1,380,000	0.039	53,800
Dibenzo(a,h)anthracene	6.22	1,660,000	0.039	64,700
Benzo(a)pyrene	5.6 to 6.29	398,000 to 1,950,000	0.039	15,500 to 76,100
Benzo(k)fluoranthene	6.64	4,365,000	0.039	170,200
Ideno(1,2,3-cd)pyrene	7.49	30,903,000	0.039	1,205,200

Notes:
(a) Literature data from Montgomery and Welkom, 1991.
(b) Average fractional organic carbon value from large-volume soil samples used for treatability studies.
(c) Kd = Koc * foc

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APPENDIX VII
POTENTIAL ECOLOGICAL RISK OF TPH/cPAH

A quantitative ecological risk assessment was performed to estimate the potential risk posed by TPH/cPAH in soils at the Site to ecological receptors.

cPAHs

The ecological risk assessment for cPAHs used conservative models to approximate plant and animal uptake of cPAHs to derive potential doses for indicator species and evaluate risk. These methods are briefly summarized below.

Soil total cPAH concentrations were used as model inputs, and different exposure scenarios were simulated using a weighted statistical model. Soil cPAH concentrations were first normalized to benzo(a)pyrene equivalents (Appendix IV). Exposure concentrations for smaller animals were determined by calculating the upper confidence limit on the arithmetic mean (95% UCL) for individual areas of concern. Exposure concentrations for higher trophic animals were modeled by calculating the area weighted average for normalized cPAHs from sections of the Former DuPont Works Site and from the Site as a whole. The 95% UCL was then calculated for each weighted average. The area weighted approach provides a quantitative method for estimating cPAH exposure from animal foraging behavior.

The indicator species selected for the risk assessment included the Townsend Vole, Blacktail Deer, Red Fox, Red-tailed Hawk, and the Mallard Duck. Tasca et al. (1989) developed equations and assumptions to estimate daily intake of food, water, and incidentally ingested soil. The Department of Agriculture (DOA, 1985) catalogued the ranges and behaviors of indicator species. Plant uptake factors were derived from algorithms developed by Travis and Arms (1988) using benzo(a)pyrene as the modeled compound.

Based on this approach, daily chemical intakes of cPAHs were calculated for individual indicator species. These daily chemical intakes were compared against a laboratory No Observable Adverse Effects Level (NOAEL) for benzo(a)pyrene reported by Neal and Rigdon (1967). A hazard quotient was calculated for each indicator species by dividing the daily cPAH uptake by the reported NOAEL.

Results of this risk assessment indicate that higher trophic mammals such as foxes and deer have hazard quotients less than 0.1 and therefore are not at risk of cPAH toxicity. Avian species have hazard quotients below 1.0, demonstrating that Site conditions do not impact these species. Finally, smaller animals were demonstrated not to have any potential risks associated with cPAHs. Hazard quotients for cPAHs in voles ranged from less than 0.1 to a maximum of 1.2 in Area 26. The assumed cPAH exposure concentration in soil at Area 26 was 37 mg/kg (Appendix I). The results of the ecological risk assessment indicate that cPAH concentrations in individual areas below approximately 30 mg/kg (37 mg/kg/1.2) are protective of ecological receptors at the Site. This level is greater than the acceptable range of human health based cleanup levels established for total cPAHs of 1.0 to 10.0 mg/kg; therefore, cleanup based on human health risk would also be protective of ecological receptors on the Site.

TPH

Bunker C fuels are the primary petroleum constituent on the Site. Limited toxicity data are available for Bunker C in mammalian species. Recognizing that the risk posed by Bunker C is largely attributable to its cPAH components, the risk to ecological receptors from exposure to Bunker C-derived TPH was evaluated based on normalized cPAH concentrations.

The results of the ecological risk assessment indicate that cPAH concentrations in individual areas below approximately 30 mg/kg are protective of ecological receptors at the Site. This level corresponds to a TPH concentration of 76,000 mg/kg based on the regression analysis of the combined Bunker C-impacted areas (Appendix V). This level is greater than the range of cleanup levels established for the Site of 3,100 and 27,000 mg/kg, and therefore cleanup based on human health risk would be protective of ecological receptors on the Site.

Conclusions

Results of the ecological risk assessment indicate that a cPAH concentration of 30 mg/kg would be protective of ecological receptors on the Site. This level corresponds to a TPH concentration of 76,000 mg/kg, much greater than the range of cleanup levels for the Site of 3,100 and 27,000 mg/kg based on human health risk. Therefore cleanup to these levels would also be protective of ecological receptors on Site.

References for Appendix VII

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DOA, 1985. Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington. U.S. Department of Agriculture. Forest Service, Pacific Northwest Region, Portland, OR, R6-F&WL-192-1985. June 1985.

Neal, J. and R.H. Rigdon, 1967. Gastric Tumors in Mice Fed Benzo(a)pyrene: A Quantitative Study. Tex. Rep. Biol. Med. 25: 553-557.

Tasca, J.J, M.F. Saunders, and R.S. Prann, 1989. Terrestrial food-chain model for risk assessment, pp. 111-116. In: Superfund '89, Hazardous Materials Control Research Institute's Tenth National Conference and Exhibition, Washington, D.C.

Travis, C. and A.D. Arms, 1988. Bioconcentration of Organics in Beef, Milk, and Vegetation. Environmental Science and Technology, 22(3): 271-273.

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Appendix D – Toxicity Information for Select Constituents

D.1 Monomethyl Amine Nitrate – Monomethylamine

D.1.1 Derivation of Oral Reference Dose

Monomethylamine nitrate (MMAN) was produced by DuPont for use as a sensitizer with water gel explosive formulations. There are no other industrial applications for MMAN. MMAN readily dissociates in water to monomethylamine (MMA) and nitrate, and is not expected to be persistent in the environment. Current analytical methods do not distinguish MMAN from MMA.

EPA has not published toxicity information or toxicity values (e.g., RfD) for MMAN or MMA. MMAN/MMA are not considered carcinogens by EPA. Chronic studies of the toxicological effects of MMA were not found in the current literature. Evidence from occupational studies have shown no long-lasting health effects when workers were exposed to MMAN via inhalation and dermal contact (ACGIH, 1988).

In the absence of human or animal toxicity dose-response studies, the RfD in the draft final RA was derived using an alternative approach. MMA is a natural ingredient in many foods including vegetables (e.g., average concentration in several different types of vegetables was 21.95 ppm) and seafood (Neurath et al., 1977). The RfD was derived based on the amount of MMA an individual consumes daily via ingestion of vegetables. It is assumed that consuming MMA in the diet does not result in any adverse health effects.

The RfD represents the amount of MMA that the average adult and child consumes daily as part of their normal diet (i.e., vegetables only) and then the dose is determined by dividing these values by the child and adult body weights, respectively. These doses are conservative approximations of the average doses of MMA in the diet because (1) the vegetables considered represent a small part of the American diet which contains other sources of MMA (e.g., seafood), (2) the ingestion rate of vegetables used was a U.S. population average which may underestimate the intake of vegetables and MMA by some groups such as vegetarians, and (3) the measurements of MMA in uncooked vegetables are underestimates of the amount consumed because cooking and canning increase MMA content of foods (Lin et al.,1983).

The derived oral RfD is 0.0175 mg/kg-day for a child and 0.0081 mg/kg-day for an adult. The RfD for the adult is lower (i.e., more protective when used in a risk evaluation) than the RfD for the child because the average adult eats less MMA each day per kilogram of body weight. These RfDs are adequate (protective) for evaluating potential risks associated with human exposure to MMAN or MMA. The lower, more protective RfD (i.e., 0.0081) was selected for the Dupont Works Site and approved by Ecology (PIONEER, 1997).

D.1.2 References

ACGIH (American Conference of Governmental and Industrial Hygienists). 1988. Documentation of the Threshold Limit Values and Biological Exposure Indies. Cincinnati, Ohio. American Conference of Governmental and Industrial Hygienists.

Neurath , G. B. et al. 1977. Primary and secondary amines in the human environment. Food and Cosmetic Toxicology. 15:275-282.

Lin, J.K., Lee, Y.J., and H.W. Chang. 1983. High concentrations of dimethylamine and methylamine in squid and octopus and their implications in tumor etiology. Food and Chemical Toxicology. 21(2):143-149.

PIONEER (PIONEER Technologies Corporation). 1997. Letter from Brad Grimsted to Mike Blum.

D.2 Toxicity Profile for Arsenic

D.2.1 Introduction

Arsenic is a naturally occurring element that is widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. It is released into the air by volcanoes, the weathering of arsenic-containing minerals and ores, and by commercial or industrial processes (EPA, 2002a). Arsenic is persistent and does not breakdown in the environment. It can only change its form. Once it is released into the air, it will settle to the ground or be washed out of the air by rain. Once in soil, arsenic can be taken up and converted to organic arsenic by plants and animals.

The primary commercial use of inorganic arsenic is as a wood preservative, while organic arsenic compounds are typically used in pesticides (ATSDR, 2001). At the Site, arsenic is most likely present due to its use as a pesticide to control vegetation along the narrow gauge railroad. Speciation of arsenic at the Site has shown it to be present primarily in the inorganic form.

D.2.2 Health Effects

Inorganic arsenic compounds are generally more toxic to humans than organic arsenic compounds. Breathing high levels of inorganic arsenic can cause a sore throat or irritated lungs. Inhalation of lower levels of arsenic over a long time can cause darkening of the skin and appearance of small "corns" or "warts" on the body (ATSDR, 2001). Inhalation of arsenic has also been associated with development of lung cancer (EPA, 2002a).

Ingestion of high levels of inorganic arsenic can cause death, while ingestion of lower levels can cause nausea, vomiting, anemia, abnormal heart rhythm, and circulatory system damage (ATSDR, 2001). Ingestion of inorganic arsenic has been linked to a form of skin cancer and also to bladder, liver, and lung cancer (EPA, 1994). The World Health Organization, the Department of Health and Human Services, and the EPA have determined that inorganic arsenic is a human carcinogen (ATSDR, 2001).

D.2.3 Basis for Toxicity Values Used in the Risk Assessment

Toxicity values for both cancer and non-cancer health effects were used in the RA to calculate remediation levels. The value used to calculate a remediation level based on non-cancer health effects was an oral reference dose (RfD) of 0.0003 mg/kg-day, based on the observance of hyperpigmentation, ketatosis, and possible vascular complications in people exposed to inorganic arsenic in drinking water. The value used to calculate a cleanup levels and remediation levels based on cancer risk was a cancer potency factor (CPF) of 1.5 $(mg/kg\text{-}day)^{-1}$, based on the occurrence of skin cancer in humans exposed to inorganic arsenic in drinking water (EPA, 2002b).

D.2.4 References

ATSDR (Agency for Toxic Substances and Disease Registry). 2001. ToxFAQs for Arsenic, July, 2001.

EPA (United States Environmental Protection Agency). 2002a. Hazard Summary for Arsenic and Compounds. Unified Air Toxics Website. Office of Air Quality Planning & Standards.

EPA (United States Environmental Protection Agency). 2002b. EPA's Integrated Risk Information System Database, 1st Quarter Update, 2002.

D.3 Toxicity Profile for Lead

D.3.1 Introduction

Lead is a naturally occurring metal found in small amounts in the earth's crust. Lead is also present due to human activities such as burning fossil fuels, mining, and manufacturing. Manufacturing uses of lead include the production of batteries, ammunition, metal products, and devices used to shield x-rays (ATSDR, 2001).

Lead does not breakdown in the environment. It can only change its form. When lead is released to the air, it may travel long distances before it settles out and sticks to soil particles.

Because of health concerns, the lead content in gasoline, paints, ceramic products, caulking, and pipe solder has been dramatically reduced or eliminated in recent years (ATSDR, 2001).

Human exposure to lead occurs through a combination of inhalation and oral exposure, with the oral route generally contributing a greater proportion of the dose for the general population. The effects associated with exposure to lead are the same regardless of the route of exposure (inhalation and oral) (EPA, 2002).

D.3.2 Health Effects

Lead effects almost every organ and system in the body. The most sensitive system is the central nervous system, particularly in children, where slow cognitive development and delayed growth have been noted following chronic exposure (EPA, 2002). Lead also damages kidneys and the reproductive system. At high levels, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect memory. Lead may also cause anemia.

Although there is evidence that lead can cause cancer in laboratory animals, there is inadequate evidence to clearly determine that it causes cancer in humans (ATSDR, 2001).

D.3.3 Basis for Toxicity Evaluation in the Risk Assessment

The EPA has chosen to evaluate potential adverse health effects of lead using a physiologically-based model that takes into account lead consumption through diet and environmental sources such as air, soil, and water. The model used for establishing lead remediation levels in non-residential areas like the DuPont Site is the Adult Lead Model (EPA, 1996). This model estimates fetal blood lead concentrations in women exposed to lead in soil. A developing fetus is considered the most sensitive receptor associated with adult exposure to lead. The soil cleanup levels and remediation levels presented in the RA for lead were based on limiting the fetal blood lead level to 10 ug/dl.

D.3.4 References

ATSDR (Agency for Toxic Substances and Disease Registry). 2001. ToxFAQs for Lead, Updated June 11, 2001.

EPA (United States Environmental Protection Agency). 1996. Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated With Exposures to Lead in Soil. Technical Review Workgroup for Lead. Adult Risk Assessment Committee.

EPA (United States Environmental Protection Agency). 2002. Hazard Summary for Lead and Compounds. Unified Air Toxics Website. Office of Air Quality Planning & Standards.

D.4 Toxicity Profile for Mercury

D.4.1 Introduction

Mercury is a naturally occurring metal found in the environment. Mercury enters the environment as the result of the normal breakdown of minerals in rocks and soil from exposure to wind and water. Human activities have also resulted in the release of mercury to the environment. Most of the mercury released from human activities comes from the burning of fossil fuels, mining, smelting, and from solid waste incineration (ATSDR, 1999). Mercury can exist in three general forms: as metallic mercury, inorganic mercury, and organic mercury.

Mercury is persistent and does not breakdown in the environment. Once it is released into the air, mercury will settle to the ground or be washed out of the air by rain. Once in soil, mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts". Alternatively, mercury deposited on the soil may be taken up by microorganisms and converted to organic mercury (ATSDR, 1999). Metallic mercury is not typically found in the environment.

Exposure to organic mercury is generally only of concern when consumption of fish and other aquatic organisms is considered likely, due to the ability of methyl mercury to concentrate in animal tissues. At the DuPont Site, potential exposure to mercury is through direct contact with soil. Therefore, the focus of this toxicity profile is on the health effects associated with inorganic mercury.

D.4.2 Health Effects

In general, exposure to inorganic mercury is less harmful than exposure to the other forms of mercury because inorganic mercury is less able to reach the brain. Inhalation of inorganic mercury is not associated with adverse health effects. However, ingestion of high levels of inorganic mercury can permanently damage the brain, kidneys, and developing fetuses. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory loss (ATSDR, 2001).

Although there is evidence that inorganic mercury can cause cancer in laboratory animals, there is inadequate evidence to clearly determine that it causes cancer in humans (ATSDR, 2001).

D.4.3 Basis for Toxicity Value Used in the Risk Assessment

The toxicity value used to calculate cleanup and remediation levels based on non-cancer health effects was an oral reference dose (RfD) of 0.0003 mg/kg-day. This value was calculated from a study showing immune system effects in rats fed inorganic mercury in their diet (EPA, 2002).

D.4.4 References

ATSDR (Agency for Toxic Substances and Disease Registry). 1999. Toxicological Profile for Mercury. U.S. Dept of Health and Human Services.

ATSDR (Agency for Toxic Substances and Disease Registry). 2001. ToxFAQs for Mercury, Updated June 11, 2001.

EPA (United States Environmental Protection Agency). 2002. EPA's Integrated Risk Information System Database, 1st Quarter Update, 2002.

D.5 Toxicity Profile for 2,4,6-Trinitrotoluene (TNT)

D.5.1 Introduction

2,3,6-Trinitrotoluene (TNT) is a yellow, odorless solid that does not occur naturally in the environment. It is an explosive used in military shells, bombs, grenades, for industrial uses, and in underwater blasting. TNT enters the environment resulting from manufacturing activities, processing and destruction of bombs, and the recycling of explosives (ATSDR, 2001). Once in the environment, it is rapidly broken down by sunlight. It can also be broken down by microorganisms, but this is a much slower process. TNT can accumulate in small amounts in fish and plants, but potential exposure to humans at the DuPont Site is through accidental ingestion of soil.

D.5.2 Health Effects

Workers who were exposed to high airborne levels of TNT during production of explosives experienced health effects such as anemia and abnormal liver function. Other effects seen in humans include skin irritation after prolonged skin contact, and cataract development after more than one year of exposure (ATSDR, 2001).

Although there is evidence that TNT can cause cancer in laboratory animals, there is inadequate evidence to clearly determine that it causes cancer in humans (ATSDR, 2001).

D.5.3 D.5.3 Basis for Toxicity Values Used in the Risk Assessment

Toxicity values for both cancer and non-cancer health effects were used in the RA to calculate remediation levels. The value used to calculate cleanup levels and remediation levels based on non-cancer health effects was an oral reference dose (RfD) of 0.0005 mg/kg-day, based on the observance of liver effects in dogs exposed to TNT in their diet. The value used to calculate a remediation level based on cancer risk was a cancer potency factor (CPF) of 0.03 $(\text{mg/kg-day})^{-1}$, based on the occurrence of bladder tumors in rats exposed to TNT in their diet (EPA, 2002).

D.5.4 References

ATSDR (Agency for Toxic Substances and Disease Registry). 2001. ToxFAQs for 2,4,6-Trinitrotoluene (TNT), Updated June 11, 2001.

EPA (United States Environmental Protection Agency). 2002. EPA's Integrated Risk Information System Database, 1st Quarter Update, 2002.

D.6 Toxicity Profile for Total Petroleum Hydrocarbons (TPH)–as Bunker C Fuel

D.6.1 Introduction

Total petroleum hydrocarbons (TPH) is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil. Crude oil is used to make petroleum products. These products contain so many individual compounds that it is not practical to quantify each one. Instead, identification is made by performing chemical analysis of a category of TPH, as defined by weight of product. Some compounds that may be found in TPH are hexane, jet fuels, mineral oils, benzene, toluene, xylenes, naphthalene, and fluorine, as well as other petroleum products and gasoline components. However, it is likely that any given sample of TPH will only contain a subset of these compounds (ATSDR, 2001).

TPH may enter the environment through accidental spills, from industrial releases, or as byproducts from commercial or private uses. Once in the environment, certain fractions of TPH may be broken down by microorganisms, while other fractions may move into soil where they may persist for a long time (ATSDR, 2001).

The TPH product used at the DuPont Site was Bunker C fuel. Therefore, the discussion of health effects will pertain to those associated with exposure to this TPH product.

D.6.2 Health Effects

Human contact with Bunker C fuel has been associated with skin irritation. In addition, ingestion can cause nausea, vomiting, diarrhea, and central nervous system effects such as restlessness (U.S. Oil & Refining Co., 1998).

Bunker C Fuel may also contain some polycyclic aromatic hydrocarbons (PAHs), that have been shown to cause skin cancer in laboratory animals, however, there is inadequate evidence to clearly determine that they cause cancer in humans.

D.6.3 Derivation of a Bunker C Cleanup Level

Recognizing that the risk posed by Bunker C is largely attributable to its carcinogenic polycyclic aromatic hydrocarbon (cPAH) components, a Site-specific correlation analyses were performed to assess the statistical relationship between cPAH and TPH concentrations. Thus the Bunker C cleanup level is based on the cPAH toxicity values. See Appendix C for details on how this information was used to derive the cleanup level.

D.6.4 References

ATSDR (Agency for Toxic Substances and Disease Registry). 2001. ToxFAQs for Total Petroleum Hydrocarbons (TPH), Updated June 11, 2001.

U.S. Oil & Refining Company. 1998. Material Safety Data Sheet for Bunker C. Revised August 8, 1998.

Appendix E – Soil Cleanup Level and Remediation Level Calculations

E.1 Introduction

This appendix presents the calculations that were performed to develop the cleanup levels and remediation levels presented in Chapter 3. The equations used to calculate soil cleanup and remediation levels were obtained from the WAC 173-340-745. The EPA has chosen to evaluate the potential health effects of lead using a physiologically based model and the model equations and inputs are discussed in Chapter 3 of the RA.

The equations, inputs, and resulting cleanup or remediation levels are presented in the following tables:

- Table E-1 – Commercial Land Use Soil Remediation Levels.
- Table E-2 – Golf Course Land Use Soil Remediation Levels.
- Table E-3 – Historical Land Use Soil Remediation Levels.
- Table E-4 – Industrial Land Use Soil Cleanup Levels.
- Table E-5 – Open Space Land Use Soil Remediation Levels.

Table E-1 – Commercial Land Use Soil Remediation Levels

Constituent	RfD	CPF	ABW	Atn	Atc	UCF	SIR	AB1	EF	ED	Target HQ	Target Risk	Remediation Level (Noncarcinogenic) (mg/kg)	Remediation Level (Carcinogenic) (mg/kg)
Monomethylamine Nitrate	0.0081	NTV	70	7,300		1.0E+06	200	100%	52	20	1		19,900	NTV
Nitroglycerine	NTV	0.014	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	6,580
2,4,6-Trinitrotoluene	0.0005	0.03	70	7,300	27,375	1.0E+06	200	100%	52	20	1	1.0E-05	1,230	3,071
Aluminum	1	NTV	70	7,300		1.0E+06	200	100%	52	20	1		2,457,000	NTV
Arsenic (inorganic)	0.0003	1.5	70	7,300	27,375	1.0E+06	200	100%	52	20	1	1.0E-05	737	61
Copper	0.037	NTV	70	7,300		1.0E+06	200	100%	52	20	1		90,900	NTV
Mercury	0.0003	NTV	70	7,300		1.0E+06	200	100%	52	20	1		737	NTV
Benzo(a)anthracene	NTV	0.73	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	126
Benzo(a)pyrene	NTV	7.3	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	12
Benzo(b)fluoranthene	NTV	0.73	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	126
Benzo(k)fluoranthene	NTV	0.073	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	1,262
Chrysene	NTV	0.0073	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	12,620
Dibenz(a,h)anthracene	NTV	7.3	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	12
Indeno(1,2,3-cd)pyrene	NTV	0.73	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	126
Aldrin	3E-05	17	70	7,300	27,375	1.0E+06	200	100%	52	20	1	1.0E-05	73	5

Equation Input Values:

Input	Definition	Units
RfD	Noncancer Reference Dose	(mg/kg-day)
CPF	Cancer Potency Factor	(mg/kg-day)-1
ABW	Average Body Weight	(kg)
Atn	Averaging Time for Noncarcinogenic Effects	(days)
Atc	Averaging Time for Carcinogenic Effects	(days)
UCF	Unit Conversion Factor	(unitless)
SIR	Soil Ingestion Rate	(mg/day)
AB1	Gastrointestinal Absorption Rate	(unitless)
EF	Exposure Frequency	(days/year)
ED	Exposure Duration	(years)
Target HQ	Target Hazard Quotient for Noncarcinogenic Health Effects	(unitless)
Target Risk	Target Cancer Risk for Carcinogenic Health Effects	(unitless)

Equations:

Noncarcinogenic Soil Remediation Level (mg/kg):

$$\frac{RfD \times ABW \times UCF \times HQ \times AT_n}{SIR \times AB1 \times EF \times ED}$$

Carcinogenic Soil Remediation Level:

$$\frac{Risk \times ABW \times UCF \times AT_c}{CPF \times ASIR \times B1 \times EF \times ED}$$

Notes:
NTV = No Toxicity Value. Not toxicity value was available from the sources presented in Chapter 3. Therefore, a remediation level could not be calculated.

Table E-2 – Golf Course Land Use Soil Remediation Levels

Constituent	RfD	CPF	ABW	Atn	Atc	UCF	SIR	AB1	EF	ED	Target HQ	Target Risk	Remediation Level (Noncarcinogenic) (mg/kg)	Remediation Level (Carcinogenic) (mg/kg)
Monomethylamine Nitrate	0.0081	NTV	70	7,300		1.0E+06	200	100%	52	20	1		19,900	NTV
Nitroglycerine	NTV	0.014	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	6,580
2,4,6-Trinitrotoluene	0.0005	0.03	70	7,300	27,375	1.0E+06	200	100%	52	20	1	1.0E-05	1,230	3,071
Aluminum	1	NTV	70	7,300		1.0E+06	200	100%	52	20	1		2,457,000	NTV
Arsenic (inorganic)	0.0003	1.5	70	7,300	27,375	1.0E+06	200	100%	52	20	1	1.0E-05	737	61
Copper	0.037	NTV	70	7,300		1.0E+06	200	100%	52	20	1		90,900	NTV
Mercury	0.0003	NTV	70	7,300		1.0E+06	200	100%	52	20	1		737	NTV
Benzo(a)anthracene	NTV	0.73	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	126
Benzo(a)pyrene	NTV	7.3	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	12
Benzo(b)fluoranthene	NTV	0.73	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	126
Benzo(k)fluoranthene	NTV	0.073	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	1,262
Chrysene	NTV	0.0073	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	12,620
Dibenz(a,h)anthracene	NTV	7.3	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	12
Indeno(1,2,3-cd)pyrene	NTV	0.73	70		27,375	1.0E+06	200	100%	52	20		1.0E-05	NTV	126
Aldrin	3E-05	17	70	7,300	27,375	1.0E+06	200	100%	52	20	1	1.0E-05	73	5

Equation Input Values:

Input	Definition	Units
RfD	Noncancer Reference Dose	(mg/kg-day)
CPF	Cancer Potency Factor	(mg/kg-day)-1
ABW	Average Body Weight	(kg)
Atn	Averaging Time for Noncarcinogenic Effects	(days)
Atc	Averaging Time for Carcinogenic Effects	(days)
UCF	Unit Conversion Factor	(unitless)
SIR	Soil Ingestion Rate	(mg/day)
AB1	Gastrointestinal Absorption Rate	(unitless)
EF	Exposure Frequency	(days/year)
ED	Exposure Duration	(years)
Target HQ	Target Hazard Quotient for Noncarcinogenic Health Effects	(unitless)
Target Risk	Target Cancer Risk for Carcinogenic Health Effects	(unitless)

Equations:

Noncarcinogenic Soil Remediation Level (mg/kg):

$$\frac{RfD \times ABW \times UCF \times HQ \times AT_n}{SIR \times AB1 \times EF \times ED}$$

Carcinogenic Soil Remediation Level:

$$\frac{Risk \times ABW \times UCF \times AT_c}{CPF \times ASIR \times B1 \times EF \times ED}$$

Notes:
NTV = No Toxicity Value. Not toxicity value was available from the sources presented in Chapter 3. Therefore, a remediation level could not be calculated.

Table E-3 – Historical Land Use Soil Remediation Levels

Constituent	RfD	CPF	ABW	Atn	Atc	UCF	SIR	AB1	EF	ED	Target HQ	Target Risk	Remediation Level (Noncarcinogenic) (mg/kg)	Remediation Level (Carcinogenic) (mg/kg)
Monomethylamine Nitrate	0.0081	NTV	47	4,380		1.0E+06	200	100%	104	12	1		6,681	NTV
Nitroglycerine	NTV	0.014	47	NTV	2,7375	1.0E+06	200	100%	104	12		1.0E-06	NTV	368
2,4,6-Trinitrotoluene	0.0005	0.03	47	4,380	2,7375	1.0E+06	200	100%	104	12	1	1.0E-06	412	172
Aluminum	1	NTV	47	4,380		1.0E+06	200	100%	104	12	1		825,000	NTV
Arsenic (inorganic)	0.0003	1.5	47	4,380	27,375	1.0E+06	200	100%	104	12	1	1.0E-06	247	3
Copper	0.037	NTV	47	4,380		1.0E+06	200	100%	104	12	1		30,516	NTV
Mercury	0.0003	NTV	47	4,380		1.0E+06	200	100%	104	12	1		247	NTV
Benzo(a)anthracene	NTV	0.73	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	7
Benzo(a)pyrene	NTV	7.3	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	0.71
Benzo(b)fluoranthene	NTV	0.73	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	7
Benzo(k)fluoranthene	NTV	0.073	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	70
Chrysene	NTV	0.0073	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	706
Dibenz(a,h)anthracene	NTV	7.3	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	0.71
Indeno(1,2,3-cd)pyrene	NTV	0.73	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	7
Aldrin	0.00003	17	47	4,380	27,375	1.0E+06	200	100%	104	12	1	1.0E-06	24	0.30

Equation Input Values:

Input	Definition	Units
RfD	Noncancer Reference Dose	(mg/kg-day)
CPF	Cancer Potency Factor	(mg/kg-day)-1
ABW	Average Body Weight	(kg)
Atn	Averaging Time for Noncarcinogenic Effects	(days)
Atc	Averaging Time for Carcinogenic Effects	(days)
UCF	Unit Conversion Factor	(unitless)
SIR	Soil Ingestion Rate	(mg/day)
AB1	Gastrointestinal Absorption Rate	(unitless)
EF	Exposure Frequency	(days/year)
ED	Exposure Duration	(years)
Target HQ	Target Hazard Quotient for Noncarcinogenic Health Effects	(unitless)
Target Risk	Target Cancer Risk for Carcinogenic Health Effects	(unitless)

Equations:

Noncarcinogenic Soil Remediation Level (mg/kg):

$$\frac{RfD \times ABW \times UCF \times HQ \times AT_n}{SIR \times AB1 \times EF \times ED}$$

Carcinogenic Soil Remediation Level:

$$\frac{Risk \times ABW \times UCF \times AT_c}{CPF \times ASIR \times B1 \times EF \times ED}$$

Notes:
NTV = No Toxicity Value. Not toxicity value was available from the sources presented in Chapter 3. Therefore, a remediation level could not be calculated.

Table E-4 – Industrial Land Use Soil Cleanup Levels

Constituent	RfD	CPF	ABW	Atn	Atc	UCF	SIR	AB1	EF	ED	Target HQ	Target Risk	Remediation Level (Noncarcinogenic) (mg/kg)	Remediation Level (Carcinogenic) (mg/kg)
Monomethylamine Nitrate	0.0081	NTV	70	7,300		1.0E+06	50	100%	145	20	1		28,546	NTV
Nitroglycerine	NTV	0.014	70		27,375	1.0E+06	50	100%	145	20		1.0E-05	NTV	9,440
2,4,6-Trinitrotoluene	0.0005	0.03	70	7,300	27,375	1.0E+06	50	100%	145	20	1	1.0E-05	1,762	4,405
Aluminum	1	NTV	70	7,300		1.0E+06	50	100%	145	20	1		3,524,137	NTV
Arsenic (inorganic)	0.0003	1.5	70	7,300	27,375	1.0E+06	50	100%	145	20	1	1.0E-05	1,057	88
Copper	0.037	NTV	70	7,300		1.0E+06	50	100%	145	20	1		130,393	NTV
Mercury	0.0003	NTV	70	7,300		1.0E+06	50	100%	145	20	1		1,057	NTV
Benzo(a)anthracene	NTV	0.73	70		27,375	1.0E+06	50	100%	145	20		1.0E-05	NTV	181
Benzo(a)pyrene	NTV	7.3	70		27,375	1.0E+06	50	100%	145	20		1.0E-05	NTV	18
Benzo(b)fluoranthene	NTV	0.73	70		27,375	1.0E+06	50	100%	145	20		1.0E-05	NTV	181
Benzo(k)fluoranthene	NTV	0.073	70		27,375	1.0E+06	50	100%	145	20		1.0E-05	NTV	1,810
Chrysene	NTV	0.0073	70		27,375	1.0E+06	50	100%	145	20		1.0E-05	NTV	18,103
Dibenz(a,h)anthracene	NTV	7.3	70		27,375	1.0E+06	50	100%	145	20		1.0E-05	NTV	18
Indeno(1,2,3-cd)pyrene	NTV	0.73	70		27,375	1.0E+06	50	100%	145	20		1.0E-05	NTV	181
Aldrin	0.00003	17	70	7,300	27,375	1.0E+06	50	100%	145	20	1	1.0E-05	105	7

Equation Input Values:

Input	Definition	Units
RfD	Noncancer Reference Dose	(mg/kg-day)
CPF	Cancer Potency Factor	(mg/kg-day)-1
ABW	Average Body Weight	(kg)
Atn	Averaging Time for Noncarcinogenic Effects	(days)
Atc	Averaging Time for Carcinogenic Effects	(days)
UCF	Unit Conversion Factor	(unitless)
SIR	Soil Ingestion Rate	(mg/day)
AB1	Gastrointestinal Absorption Rate	(unitless)
EF	Exposure Frequency	(days/year)
ED	Exposure Duration	(years)
Target HQ	Target Hazard Quotient for Noncarcinogenic Health Effects	(unitless)
Target Risk	Target Cancer Risk for Carcinogenic Health Effects	(unitless)

Equations:

Noncarcinogenic Soil Remediation Level (mg/kg):

$$\frac{RfD \times ABW \times UCF \times HQ \times AT_n}{SIR \times AB1 \times EF \times ED}$$

Carcinogenic Soil Remediation Level:

$$\frac{Risk \times ABW \times UCF \times AT_c}{CPF \times ASIR \times B1 \times EF \times ED}$$

Notes:
NTV = No Toxicity Value. Not toxicity value was available from the sources presented in Chapter 3. Therefore, a remediation level could not be calculated.

Table E-5 – Open Space Land Use Soil Remediation Levels

Constituent	RfD	CPF	ABW	Atn	Atc	UCF	SIR	AB1	EF	ED	Target HQ	Target Risk	Remediation Level (Noncarcinogenic) (mg/kg)	Remediation Level (Carcinogenic) (mg/kg)
Monomethylamine Nitrate	0.0081	NTV	47	4,380		1.0E+06	200	100%	104	12	1		6,681	NTV
Nitroglycerine	NTV	0.014	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	368
2,4,6-Trinitrotoluene	0.0005	0.03	47	4,380	27,375	1.0E+06	200	100%	104	12	1	1.0E-06	412	172
Aluminum	1	NTV	47	4,380		1.0E+06	200	100%	104	12	1		824,759	NTV
Arsenic (inorganic)	0.0003	1.5	47	4,380	27,375	1.0E+06	200	100%	104	12	1	1.0E-06	247	3
Copper	0.037	NTV	47	4,380		1.0E+06	200	100%	104	12	1		30,516	NTV
Mercury	0.0003	NTV	47	4,380		1.0E+06	200	100%	104	12	1		247	NTV
Benzo(a)anthracene	NTV	0.73	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	7
Benzo(a)pyrene	NTV	7.3	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	0.71
Benzo(b)fluoranthene	NTV	0.73	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	7
Benzo(k)fluoranthene	NTV	0.073	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	70
Chrysene	NTV	0.0073	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	706
Dibenz(a,h)anthracene	NTV	7.3	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	0.71
Indeno(1,2,3-cd)pyrene	NTV	0.73	47		27,375	1.0E+06	200	100%	104	12		1.0E-06	NTV	7
Aldrin	0.00003	17	47	4,380	27,375	1.0E+06	200	100%	104	12	1	1.0E-06	24	0.30

Equation Input Values:

Input	Defiinition	Units
RfD	Noncancer Reference Dose	(mg/kg-day)
CPF	Cancer Potency Factor	(mg/kg-day)-1
ABW	Average Body Weight	(kg)
Atn	Averaging Time for Noncarcinogenic Effects	(days)
Atc	Averaging Time for Carcinogenic Effects	(days)
UCF	Unit Conversion Factor	(unitless)
SIR	Soil Ingestion Rate	(mg/day)
AB1	Gastrointestinal Absorption Rate	(unitless)
EF	Exposure Frequency	(days/year)
ED	Exposure Duration	(years)
Target HQ	Target Hazard Quotient for Noncarcinogenic Health Effects	unitless)
Target Risk	Target Cancer Risk for Carcinogenic Health Effects	(unitless)

Equations:

Noncarcinogenic Soil Remediation Level (mg/kg):

$$\frac{RfD \times ABW \times UCF \times HQ \times AT_n}{SIR \times AB1 \times EF \times ED}$$

Carcinogenic Soil Remediation Level:

$$\frac{Risk \times ABW \times UCF \times AT_c}{CPF \times ASIR \times B1 \times EF \times ED}$$

Notes:
NTV = No Toxicity Value. Not toxicity value was available from the sources presented in Chapter 3. Therefore, a remediation level could not be calculated.

Appendix F – Summary Statistics and Comparison to Standards

F.1 Introduction

This Appendix presents the summary statistics that were calculated for each EU as well as the comparison between of the resulting exposure point concentrations and the cleanup levels and remediation levels which are described in Chapter 3.

F.2 Summary Statistics For Each Evaluation Unit

The summary statistics for each EU are presented in Tables F-1 through F-48 as follows:

Table F-1 – Commercial Evaluation Unit 1 (0 to <=1 foot)
Table F-2 – Commercial Evaluation Unit 1 (>1 to <=15 feet)
Table F-3 – Commercial Evaluation Unit 2 (0 to <=1 foot)
Table F-4 – Commercial Evaluation Unit 2 (>1 to <=15 feet)
Table F-5 – Commercial Evaluation Unit 3 (0 to <=1 foot)
Table F-6 – Commercial Evaluation Unit 3 (>1 to <=15 feet)
Table F-7 – Commercial Evaluation Unit 4 (0 to <=1 foot)
Table F-8 – Commercial Evaluation Unit 4 (>1 to <=15 feet)
Table F-9 – Commercial Evaluation Unit 5 (0 to <=1 foot)
Table F-10 – Commercial Evaluation Unit 5 (>1 to <=15 feet)
Table F-11 – Commercial Evaluation Unit 6 (0 to <=1 foot)
Table F-12 – Commercial Evaluation Unit 6 (>1 to <=15 feet)
Table F-13 – Commercial Evaluation Unit 7 (0 to <=1 foot)
Table F-14 – Commercial Evaluation Unit 7 (>1 to <=15 feet)
Table F-15 – Commercial Evaluation Unit 8 (0 to <=1 foot)
Table F-16 – Commercial Evaluation Unit 8 (>1 to <=15 feet)
Table F-17 – Commercial Evaluation Unit 9 (0 to <=1 foot)
Table F-18 – Commercial Evaluation Unit 9 (>1 to <=15 feet)
Table F-19 – Golf Course Evaluation Unit 1 (0 to <=1 foot)
Table F-20 – Golf Course Evaluation Unit 1 (>1 to <=15 feet)
Table F-21 – Golf Course Evaluation Unit 2 (0 to <=1 foot)
Table F-22 – Golf Course Evaluation Unit 2 (>1 to <=15 feet)
Table F-23 – Golf Course Evaluation Unit 3 (0 to <=1 foot)
Table F-24 – Golf Course Evaluation Unit 3 (>1 to <=15 feet)
Table F-25 – Golf Course Evaluation Unit 4 (0 to <=1 foot)
Table F-26 – Golf Course Evaluation Unit 4 (>1 to <=15 feet)
Table F-27 – Golf Course Evaluation Unit 5 (0 to <=1 foot)
Table F-28 – Golf Course Evaluation Unit 5 (>1 to <=15 feet)
Table F-29 – Golf Course Evaluation Unit 6 (0 to <=1 foot)
Table F-30 – Golf Course Evaluation Unit 6 (>1 to <=15 feet)
Table F-31 – Golf Course Evaluation Unit 7 (0 to <=1 foot)
Table F-32 – Golf Course Evaluation Unit 7 (>1 to <=15 feet)
Table F-33 – Golf Course Evaluation Unit 8 (0 to <=1 foot)
Table F-34 – Golf Course Evaluation Unit 8 (>1 to <=15 feet)
Table F-35 – Golf Course Evaluation Unit 9 (0 to <=1 foot)
Table F-36 – Golf Course Evaluation Unit 9 (>1 to <=15 feet)
Table F-37 – Historical Evaluation Unit 1 (0 to <=1 foot)
Table F-38 – Historical Evaluation Unit 2 (0 to <=1 foot)
Table F-39 – Historical Evaluation Unit 3 (0 to <=1 foot)
Table F-40 – Industrial Evaluation Unit 1 (0 to <=1 foot)
Table F-41 – Industrial Evaluation Unit 1 (>1 to <=15 feet)
Table F-42 – Open Space Evaluation Unit 1 (0 to <=1 foot)
Table F-43 – Open Space Evaluation Unit 2 (0 to <=1 foot)
Table F-44 – Open Space Evaluation Unit 2 (>1 to <=15 feet)
Table F-45 – Open Space Evaluation Unit 3 (0 to <=1 foot)
Table F-46 – Open Space Evaluation Unit 3 (>1 to <=15 feet)
Table F-47 – Open Space Evaluation Unit 4 (0 to <=1 foot)
Table F-48 – Open Space Evaluation Unit 4 (>1 to <=15 feet)

F.3 Statistical Formulas Used To Calculate the Summary Statistics

This section presents the statistical formulas that were used to calculate the summary statistics presented in Tables F-1 through F-48.

F.3.1 Geometric Mean

Returns the mean value of the natural logarithm transformed values. The geometric mean is calculated as follows:

$$\hat{m} = e\left(\bar{y} + \frac{s_y^2}{2}\right)$$

F.3.2 Logarithmic Upper Confidence Limit for the Mean

Returns the one-sided natural logarithm upper confidence limit on the mean. The upper confidence limit on the lognormal mean is calculated as follows:

$$UL_{1-a} = e\left(\bar{y} + 0.5 s_y^2 + \frac{s_y H_{1-a}}{\sqrt{n-1}} \right)$$

Values of the H statistic not found in the lookup table were calculated using 4-Point Lagrangian Interpolation. Lagrangian interpolation is calculated as follows:

$$y_i = \sum_{i=0}^{n} \frac{II_n(X)}{(X - X_{i)} II'(X_i)} y_i, \quad i = 0,1,\cdots n,$$

$$II(x) = (X - X_o)(X - X_1)\cdots(X - X_n)$$

$$II'(X) = \frac{d}{d_x} II_n(X)$$

F.3.3 Mean (arithmetic)

Returns the arithmetic mean of the values. The mean is calculated as follows:

$$\overline{X} = \sum \frac{X_i}{n}$$

F.3.4 Median

Returns the median value of the distribution. The median is the value that divides a distribution exactly in half. The median is also referred to as the 50th percentile. The median is calculated as follows:

1. Order data from lowest to highest to obtain sample order statistics.

   $$X_{[1]} \le X_{[2]} \le . \cdots \le X_{[n]}$$

2. If n is odd the sample median is the $\frac{(n+1)}{2} th$ value.
3. If n is even the sample median is the average of the $\frac{n}{2} th$ and the $\frac{(n+2)}{2} th$ values.

F.3.5 Maximum Detected Value

Returns the maximum detected value in the distribution.

F.3.6 Maximum Non-Detected Value

Returns the maximum non-detected value in the distribution.

F.3.7 Minimum Detected Value

Returns the minimum detected value in the distribution.

F.3.8 Minimum Non-Detected Value

Returns the minimum non-detected value in the distribution.

F.3.9 Mode

Returns the most frequently occurring score in the distribution.

F.3.10 Sample Standard Deviation

The standard deviation returns the deviation of the sample distribution. The sample standard deviation is calculated as follows:

$$s = \sqrt{\frac{SS}{n-1}}$$

Where,

s	=	Sample standard deviation
SS	=	Sum of Squared deviations
n	=	Number of scores in the sample

The sum of squared deviations is calculated using the following formula:

$$SS = \sum X_i^{\,2} - \frac{(\sum X_i)^2}{N}$$

F.3.11 Upper Confidence Limit for the Mean

Returns the one-sided upper confidence limit on the mean using the following formula. The t-statistic is used to estimate the location of the mean in a sample distribution when the population standard deviation (s) and the population mean (μ) are unknown. The t-statistic is calculated as follows:

$$\mu = \overline{X} \pm t s_{\bar{x}}$$

The standard error of a distribution of sample means is calculated as follows.

$$s_{\overline{X}} = \frac{s}{\sqrt{n}}$$

How well the sample standard deviation (s) estimates the population standard deviation depends mainly on sample size, which is described in terms of degrees of freedom. The degrees of freedom describes the number of scores in a sample that are free to vary. The degrees of freedom is calculated as follows.

$$df = n - 1$$

F.3.12 Distribution Tests

Shapiro and Wilk Test (W Test)

The W statistic tests the null hypothesis (H_o) that the data have been drawn from a normal distribution. The alternative (H_1) is that the underlying population is not normally distributed. This test is applicable when the sample size is ≤ 50. The W statistic is calculated as follows:

1. Compute the denominator of the W test statistic

$$d = \sum_{i=1}^{n} (X_i - \overline{X})^2$$

2. Order data from lowest to highest to obtain sample order statistics.

$$X_{[1]} \le X_{[2]} \le \cdots \le X_{[n]}$$

Where,

$X_{[1]}$	=	Lowest score

$X_{[n]}$ = Highest score

3. Compute K.

$K = \frac{n}{2}$ if n is even

$K = \frac{n-1}{2}$ if n is odd

4. Get coefficients for a_i from a lookup table based on the K value.

5. Compute W statistic

$$W = \frac{1}{d}\left[\sum_{i=1}^{K} a_i\left(X_{[n-i+1]} - X_{[i]}\right)\right]^2$$

6. Reject H_o at the α significance level (an α of 0.05 was used) if W is less than the quantile provided in the lookup table.

Note: To test the Null Hypothesis

H_o: The population has a lognormal distribution

versus

H_1: The population does not have a lognormal distribution

The W Test can also be used to test the null hypothesis (H_o) that the data have been drawn from a lognormal distribution by using $Y_i = \ln X_i$ in place of X_i in the calculations.

D'Agostino's Test

The D statistic is a compliment to the W Test in that it also tests the null hypothesis of normality or lognormality. However the D statistic is applicable to sample sizes between 50 and 1,000. The D statistic is calculated as follows:

1. Order data from lowest to highest to obtain sample order statistics.

$$X_{[1]} \leq X_{[2]} \leq \cdots \leq X_{[n]}$$

Where,

$X_{[1]}$ = Lowest score

$X_{[n]}$ = Highest score

2. Compute the D statistic.

$$D = \frac{\sum_{i=1}^{n}\left[i - \frac{1}{2}(n+1)\right]X_{[i]}}{n^2 S}$$

Where,

$$S = \left[\frac{1}{n} \sum_{i=1}^{n} \left(X_i - \overline{X} \right)^2 \right]^{\frac{1}{2}}$$

3. Transform D to the Y statistic by performing the following computation.

$$Y = \frac{D - 0.28209479}{0.02998598 \div \sqrt{n}}$$

4. Reject at the α significance level (an α of 0.05 was used) the null hypothesis that the data were drawn from a normal distribution if Y is less than $\frac{\alpha}{2}$ quantile or greater than the $1-\frac{\alpha}{2}$ quantile distribution of Y. The quantiles are obtained from a lookup table.

Values of quantities of the y statistic not found in the lookup table are calculated using linear interpolation. Linear interpolation is performed as follows:

$$fp = (1-p)\, f_o + p f_1,$$

$$p = \frac{(X - X_o)}{(X_1 - X_o)}$$

Note: The Y statistic can also be used to test the null hypothesis of a lognormal population by using $Y_i = \ln X_i$ in place of X_i in the calculations.

F.4 Comparison to Standards

The MTCA RME concentrations that are presented in Tables F-1 through F-48 were compared to land use specific cleanup levels and remediation levels. Only constituents of concern that were evaluated in Chapter 4 of the RA were compared to the cleanup levels and remediation levels. Tables F-49 through F-53 present the EU and constituent-specific evaluation of the MTCA RME concentrations to the cleanup levels and remediation levels as well as an evaluation of the MTCA three-fold criteria. The tables are organized as follows:

- Table F-49 – Comparison of Commercial EUs to Soil Cleanup Levels and Remediation Levels
- Table F-50 – Comparison of Golf Course EUs to Soil Cleanup Levels and Remediation Levels
- Table F-51 – Comparison of Historical EUs to Soil Cleanup Levels and Remediation Levels
- Table F-52 – Comparison of Industrial EU to Soil Cleanup Levels and Remediation Levels
- Table F-53 – Comparison of Open Space EUs to Soil Cleanup Levels and Remediation Levels

Table F-1 - Commercial Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Nitroglycerine	mg/kg	3	33.33	0.24	8.50	1.10	1.10	1.82	1.10	
Metals (Total)										
Arsenic (inorganic)	mg/kg	58	100.00			1.70	370.00	34.62	18.00	
Copper	mg/kg	10	100.00			2.20	37.00	15.81	11.50	
Lead (and compounds) (inorganic)	mg/kg	74	95.95	5.00	6.40	7.40	3300.00	266.02	130.00	
Mercury (inorganic)	mg/kg	11	63.64	0.08	0.11	0.10	3.20	1.11	0.32	
PAHs										
Benzo(a)Pyrene	mg/kg	4	75.00	0.02	0.02	0.07	1.10	0.47	0.39	
Benzo(b)Fluoranthene	mg/kg	4	75.00	0.02	0.02	0.06	0.79	0.36	0.31	
Benzo(g,h,i)Perylene	mg/kg	4	100.00			0.08	4.90	2.31	2.13	
Benzo(k)Fluoranthene	mg/kg	4	25.00	0.02	0.37	0.03	0.03	0.08	0.06	
Chrysene	mg/kg	4	75.00	0.18	0.18	0.10	0.70	0.25	0.11	
Phenanthrene	mg/kg	4	25.00	0.01	0.19	0.03	0.03	0.04	0.04	
TPH - 418										
TPH (418.1)	mg/kg	14	57.14	20.00	20.00	24.00	10000.00	1826.00	62.00	10.00

Table F-1 - Commercial Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Nitroglycerine	mg/kg	2.16	2.84	1.10	0.82	5.46	434018116032	Normal/Lognormal
Metals (Total)								
Arsenic (inorganic)	mg/kg	61.22	40.09	46.05	17.58	48.16	46.05	Lognormal
Copper	mg/kg	12.28	18.54	37.00	11.29	22.93	43.29	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	470.00	303.11	451.12	117.23	357.31	451.12	Unknown
Mercury (inorganic)	mg/kg	1.34	1.39	3.20	0.33	1.84	33.01	Unknown
PAHs								
Benzo(a)Pyrene	mg/kg	0.52	0.67	1.10	0.16	1.09	69392546.79	Normal/Lognormal
Benzo(b)Fluoranthene	mg/kg	0.38	0.50	0.79	0.13	0.80	4990707.82	Normal/Lognormal
Benzo(g,h,i)Perylene	mg/kg	2.55	3.28	4.90	0.70	5.31	304566161.71	Normal/Lognormal
Benzo(k)Fluoranthene	mg/kg	0.08	0.11	0.03	0.05	0.17	50.14	Normal/Lognormal
Chrysene	mg/kg	0.30	0.37	0.70	0.17	0.60	9.58	Lognormal
Phenanthrene	mg/kg	0.04	0.06	0.03	0.03	0.09	25.34	Normal/Lognormal
TPH - 418								
TPH (418.1)	mg/kg	3246.25	2428.11	10000.00	122.40	3362.51	871054.56	Unknown

Table F-2 - Commercial Evaluation Unit 1 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Monomethylamine Nitrate	mg/kg	7	0.00	5.20	5.90			2.76	2.75	
Nitroglycerine	mg/kg	11	0.00	0.21	0.23			0.11	0.11	0.11
Trinitrotoluene, 2,4,6-	mg/kg	17	0.00	0.003	0.006			0.002	0.002	0.002
Arsenic (inorganic)	mg/kg	14	100.00			0.94	21.00	5.56	2.65	
Copper	mg/kg	8	100.00			0.96	47.00	11.70	9.05	
Lead (and compounds) (inorganic)	mg/kg	54	79.63	4.20	10.00	5.80	1300.00	103.36	37.50	
Mercury (inorganic)	mg/kg	12	25.00	0.08	0.11	0.13	0.93	0.14	0.05	
Aldrin	mg/kg	1	0.00	2.39	2.39			1.20	1.20	
Benzo(a)Anthracene	mg/kg	6	0.00	0.02	0.37			0.07	0.05	
Benzo(a)Pyrene	mg/kg	6	0.00	0.02	0.37			0.07	0.05	
Benzo(b)Fluoranthene	mg/kg	6	0.00	0.02	0.37			0.07	0.05	
Benzo(g,h,i)Perylene	mg/kg	6	0.00	0.02	0.37			0.07	0.05	
Benzo(k)Fluoranthene	mg/kg	6	0.00	0.02	0.37			0.07	0.05	
Chrysene	mg/kg	6	16.67	0.02	0.37	0.02	0.02	0.07	0.06	
Dibenz(a,h)anthracene	mg/kg	6	0.00	0.04	0.37			0.07	0.06	
Indeno(1,2,3-cd)pyrene	mg/kg	6	0.00	0.02	0.37			0.07	0.05	
Methylnaphthalene, 2-	mg/kg	3	0.00	0.18	0.37			0.12	0.10	
Phenanthrene	mg/kg	6	0.00	0.009	0.37			0.06	0.05	
Motor Oil	mg/kg	1	100.00			3000.00	3000.00	3000.00	3000.00	
TPH (418.1)	mg/kg	19	36.84	20.00	22.00	30.00	1800.00	126.08	10.00	10.00
Oil And Grease	mg/kg	14	35.71	20.00	27.00	26.00	630.00	106.75	10.00	10.00

Table F-2 - Commercial Evaluation Unit 1 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Geometric Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Monomethylamine Nitrate	mg/kg	0.11	2.79		2.76	2.84	2.84	Normal/Lognormal
Nitroglycerine	mg/kg	0.003	0.11		0.11	0.11	0.11	Unknown
Trinitrotoluene, 2,4,6-	mg/kg	0.0003	0.002		0.002	0.002	0.002	Unknown
Arsenic (inorganic)	mg/kg	6.30	6.73	10.53	3.58	8.54	10.53	Lognormal
Copper	mg/kg	14.75	15.40	47.00	6.74	21.58	67.84	Lognormal
Lead (and compounds) (inorganic)	mg/kg	210.43	122.86	236.79	30.20	151.59	236.79	Lognormal
Mercury (inorganic)	mg/kg	0.25	0.19	0.24	0.07	0.27	0.24	Unknown
Aldrin	mg/kg				1.20			Unknown
Benzo(a)Anthracene	mg/kg	0.07	0.09		0.03	0.12	2.95	Normal/Lognormal
Benzo(a)Pyrene	mg/kg	0.07	0.09		0.03	0.12	2.95	Normal/Lognormal
Benzo(b)Fluoranthene	mg/kg	0.07	0.09		0.03	0.12	2.95	Normal/Lognormal
Benzo(g,h,i)Perylene	mg/kg	0.07	0.09		0.03	0.12	2.95	Normal/Lognormal
Benzo(k)Fluoranthene	mg/kg	0.07	0.09		0.03	0.12	2.95	Normal/Lognormal
Chrysene	mg/kg	0.07	0.09	0.02	0.04	0.13	1.54	Normal/Lognormal
Dibenz(a,h)anthracene	mg/kg	0.07	0.09		0.05	0.13	0.54	Normal/Lognormal
Indeno(1,2,3-cd)pyrene	mg/kg	0.07	0.09		0.03	0.12	2.95	Normal/Lognormal
Methylnaphthalene, 2-	mg/kg	0.05	0.15		0.12	0.21	0.56	Normal/Lognormal
Phenanthrene	mg/kg	0.07	0.09		0.02	0.12	28.29	Normal
Motor Oil	mg/kg			3000.00	3000.00			Unknown
TPH (418.1)	mg/kg	408.88	190.62	178.62	23.08	288.73	178.62	Unknown
Oil And Grease	mg/kg	210.17	145.73	417.52	26.36	206.23	417.52	Unknown

Table F-3 - Commercial Evaluation Unit2 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Arsenic (inorganic)	mg/kg	165	98.18	2.00	2.50	1.60	120.00	32.57	30.00	
Copper	mg/kg	2	100.00			14.00	42.00	28.00	28.00	
Lead (and compounds) (inorganic)	mg/kg	150	100.00			4.40	330.00	55.07	38.00	
Mercury (inorganic)	mg/kg	2	50.00	0.08	0.08	0.50	0.50	0.27	0.27	
TPH (418.1)	mg/kg	1	0.00	21.00	21.00			10.50	10.50	

Table F-3 - Commercial Evaluation Unit2 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Geometric Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Arsenic (inorganic)	mg/kg	21.04	33.68	40.51	25.24	35.28	40.51	Unknown
Copper	mg/kg	19.80	42.00	42.00	24.25	116.40	522469290.24	Unknown
Lead (and compounds) (inorganic)	mg/kg	52.06	57.95	64.36	38.46	62.12	64.36	Lognormal
Mercury (inorganic)	mg/kg	0.32	0.50	0.50	0.14	1.72	.11346667365	Unknown
TPH (418.1)	mg/kg				10.50			Unknown

Table F-4 - Commercial Evaluation Unit 2 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Arsenic (inorganic)	mg/kg	4	100.00			1.20	3.60	2.03	1.65	
Copper	mg/kg	4	100.00			13.00	18.00	14.75	14.00	13.00
Lead (and compounds) (inorgan	mg/kg	4	75.00	5.30	5.30	16.00	39.00	19.41	18.00	
Mercury (inorganic)	mg/kg	4	0.00	0.08	0.10			0.04	0.04	
TPH (418.1)	mg/kg	4	50.00	22.00	22.00	39.00	140.00	50.25	25.00	11.00

Table F-4 - Commercial Evaluation Unit 2 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Geometric Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Arsenic (inorganic)	mg/kg	1.08	2.44	3.60	1.85	3.29	5.44	Normal/Lognormal
Copper	mg/kg	2.36	15.65	18.00	14.62	17.53	18.23	Normal/Lognormal
Lead (and compounds) (inorgan	mg/kg	15.02	25.16	39.00	13.49	37.08	4079.32	Normal/Lognormal
Mercury (inorganic)	mg/kg	0.004	0.05		0.04	0.05	0.05	Normal/Lognormal
TPH (418.1)	mg/kg	61.27	73.69	140.00	28.51	122.34	17175.50	Normal/Lognormal

Table F-5 - Commercial Evaluation Unit 3 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	59	100.00			7.00	350.00	40.44	21.00	
Copper	mg/kg	2	100.00			16.00	66.00	41.00	41.00	
Lead (and compounds) (inorganic)	mg/kg	33	96.97	7.00	7.00	20.00	3800.00	367.86	140.00	
Mercury (inorganic)	mg/kg	2	50.00	0.11	0.11	0.36	0.36	0.21	0.21	
PAHs										
Benzo(a)Pyrene	mg/kg	1	100.00			0.10	0.10	0.10	0.10	
Benzo(b)Fluoranthene	mg/kg	1	100.00			0.14	0.14	0.14	0.14	
Benzo(g,h,i)Perylene	mg/kg	1	100.00			0.09	0.09	0.09	0.09	
Benzo(k)Fluoranthene	mg/kg	1	100.00			0.04	0.04	0.04	0.04	
Chrysene	mg/kg	1	100.00			0.12	0.12	0.12	0.12	
Indeno(1,2,3-cd)pyrene	mg/kg	1	100.00			0.07	0.07	0.07	0.07	
Phenanthrene	mg/kg	1	100.00			0.09	0.09	0.09	0.09	
TPH - 418										
TPH (418.1)	mg/kg	1	100.00			450.00	450.00	450.00	450.00	

Table F-5 - Commercial Evaluation Unit 3 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	51.71	45.03	48.36	26.90	51.78	48.36	Lognormal
Copper	mg/kg	35.36	66.00	66.00	32.50	198.85	630645422379	Unknown
Lead (and compounds) (inorganic)	mg/kg	682.54	449.01	852.32	142.12	569.49	852.32	Lognormal
Mercury (inorganic)	mg/kg	0.22	0.36	0.36	0.14	1.17	.70757628715	Unknown
PAHs								
Benzo(a)Pyrene	mg/kg			0.10	0.10			Unknown
Benzo(b)Fluoranthene	mg/kg			0.14	0.14			Unknown
Benzo(g,h,i)Perylene	mg/kg			0.09	0.09			Unknown
Benzo(k)Fluoranthene	mg/kg			0.04	0.04			Unknown
Chrysene	mg/kg			0.12	0.12			Unknown
Indeno(1,2,3-cd)pyrene	mg/kg			0.07	0.07			Unknown
Phenanthrene	mg/kg			0.09	0.09			Unknown
TPH - 418								
TPH (418.1)	mg/kg			450.00	450.00			Unknown

Table F-6 - Commercial Evaluation Unit 3 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Aluminum	mg/kg	2	100.00			12000.00	13000.00	12500.00	12500.00	
Arsenic (inorganic)	mg/kg	4	100.00			2.00	3.38	2.82	2.95	
Copper	mg/kg	3	100.00			4.80	21.90	12.57	11.00	
Lead (and compounds) (inorganic)	mg/kg	3	66.67	5.10	5.10	6.50	11.00	6.68	6.50	
TPH - 418										
TPH (418.1)	mg/kg	3	33.33	21.00	21.00	42.00	42.00	21.00	10.50	10.50

Table F-6 - Commercial Evaluation Unit 3 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Aluminum	mg/kg	707.11	13000.00	13000.00	12490.00	15657.00	15289.30	Unknown
Arsenic (inorganic)	mg/kg	0.65	3.07	3.38	2.76	3.58	4.11	Normal/Lognormal
Copper	mg/kg	8.66	16.65	21.90	10.50	27.16	2874.69	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	4.23	8.68	11.00	5.67	13.81	1165.96	Normal/Lognormal
TPH - 418								
TPH (418.1)	mg/kg	18.19	29.57	42.00	16.67	51.66	8429.19	Unknown

Table F-7 Commercial Evaluation Unit4 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	64	100.00			3.30	390.00	50.02	41.50	
Copper	mg/kg	1	100.00			22.00	22.00	22.00	22.00	
Lead (and compounds) (inorganic)	mg/kg	33	100.00			4.70	450.00	86.17	59.00	

Table F-7 Commercial Evaluation Unit4 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	50.34	54.29	61.68	37.95	60.54	61.68	Unknown
Copper	mg/kg			22.00	22.00			Unknown
Lead (and compounds) (inorganic)	mg/kg	100.33	98.10	131.85	53.35	115.81	131.85	Lognormal

Table F-8 - Commercial Evaluation Unit 4 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	2	100.00			6.30	28.00	17.15	17.15	

Table F-8 - Commercial Evaluation Unit 4 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	15.34	28.00	28.00	13.28	85.66	567342019392	Unknown

Table F-9 - Commercial Evaluation Unit 5 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Aluminum	mg/kg	2	100.00			17000.00	24000.00	20500.00	20500.00	
Arsenic (inorganic)	mg/kg	208	100.00			4.50	370.00	48.28	35.50	
Copper	mg/kg	4	100.00			16.00	21.00	19.00	19.50	
Lead (and compounds) (inorganic)	mg/kg	164	99.39	6.60	6.60	9.20	410.00	75.06	57.00	
TPH - 418										
TPH (418.1)	mg/kg	3	33.33	20.00	26.00	39.00	39.00	20.67	13.00	

Table F-9 - Commercial Evaluation Unit 5 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Aluminum	mg/kg	4949.75	24000.00	24000.00	20199.01	42599.00	88067.88	Unknown
Arsenic (inorganic)	mg/kg	50.32	50.65	52.00	35.63	54.07	52.00	Unknown
Copper	mg/kg	2.16	19.83	21.00	18.90	21.54	22.22	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	63.05	78.39	86.41	56.29	83.22	86.41	Lognormal
TPH - 418								
TPH (418.1)	mg/kg	15.95	28.18	39.00	17.18	47.55	2719.34	Normal/Lognormal

Table F-10 - Commercial Evaluation Unit 5 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Monomethylamine Nitrate	mg/kg	31	22.58	5.10	6.90	0.04	30000.00	1182.04	2.70	
Metals (Total)										
Aluminum	mg/kg	6	100.00			8000.00	16000.00	11133.33	10950.00	
Arsenic (inorganic)	mg/kg	8	100.00			1.70	45.00	12.60	4.70	
Copper	mg/kg	6	100.00			11.00	29.00	18.00	14.00	
Lead (and compounds) (inorganic)	mg/kg	14	85.71	5.00	5.40	9.40	115.00	23.19	16.50	
PAHs										
Phenanthrene	mg/kg	11	9.09	0.009	0.71	0.08	0.08	0.05	0.004	0.004
TPH - 418										
TPH (418.1)	mg/kg	18	50.00	20.00	22.00	26.00	36000.00	2469.81	18.50	
TPH - 8015										
Oil And Grease	mg/kg	7	85.71	22.00	22.00	39.00	20000.00	3840.00	500.00	

Table F-10 - Commercial Evaluation Unit 5 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Monomethylamine Nitrate	mg/kg	5410.06	1845.69	3146.00	4.44	2830.97	3146.00	Unknown
Metals (Total)								
Aluminum	mg/kg	2881.43	11988.53	14208.77	10841.76	13503.66	14208.77	Normal/Lognormal
Arsenic (inorganic)	mg/kg	15.29	16.44	45.00	6.50	22.84	92.54	Lognormal
Copper	mg/kg	7.87	20.34	28.50	16.72	24.48	28.50	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	27.84	28.35	50.14	15.09	36.36	50.14	Lognormal
PAHs								
Phenanthrene	mg/kg	0.11	0.08	0.08	0.01	0.11	0.46	Unknown
TPH - 418								
TPH (418.1)	mg/kg	8422.03	3837.53	36000.00	81.89	5923.87	78899.36	Unknown
TPH - 8015								
Oil And Grease	mg/kg	7315.91	5825.38	20000.00	486.95	9212.70	179309500.29	Lognormal

Table F-11 - Commercial Evaluation Unit6 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	26	100.00			2.00	85.00	31.55	33.50	
Lead (and compounds) (inorganic)	mg/kg	5	80.00	5.00	5.00	38.00	287.00	103.50	85.00	

Table F-11 - Commercial Evaluation Unit6 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	20.59	34.31	56.65	23.18	38.45	56.65	Normal
Lead (and compounds) (inorganic)	mg/kg	110.12	139.99	287.00	47.56	208.50	481722.54	Normal/Lognormal

Table F-12 - Commercial Evaluation Unit 6 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Nitroglycerine	mg/kg	1	0.00	0.21	0.21			0.11	0.11	
Trinitrotoluene, 2,4,6-	mg/kg	1	0.00	0.003	0.003			0.002	0.002	
Arsenic (inorganic)	mg/kg	1	100.00			5.80	5.80	5.80	5.80	
Copper	mg/kg	1	100.00			8.40	8.40	8.40	8.40	
Lead (and compounds) (inorganic)	mg/kg	2	0.00	5.20	5.40			2.65	2.65	
Mercury (inorganic)	mg/kg	1	0.00	0.08	0.08			0.04	0.04	

Table F-12 - Commercial Evaluation Unit 6 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Geometric Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Nitroglycerine	mg/kg				0.11			Unknown
Trinitrotoluene, 2,4,6-	mg/kg				0.002			Unknown
Arsenic (inorganic)	mg/kg			5.80	5.80			Unknown
Copper	mg/kg			8.40	8.40			Unknown
Lead (and compounds) (inorganic)	mg/kg	0.07	2.70		2.65	2.97	2.90	Unknown
Mercury (inorganic)	mg/kg				0.04			Unknown

Table F-13 - Commercial Evaluation Unit 7 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Monomethylamine Nitrate	mg/kg	8	0.00	5.80	7.70			3.17	3.05	2.90
Nitroglycerine	mg/kg	10	0.00	0.21	0.31			0.12	0.12	
Trinitrotoluene, 2,4,6-	mg/kg	12	25.00	0.003	0.04	0.01	0.21	0.04	0.004	
Aluminum	mg/kg	1	100.00			16000.00	16000.00	16000.00	16000.00	
Arsenic (inorganic)	mg/kg	42	100.00			2.60	160.00	38.41	29.50	
Copper	mg/kg	1	100.00			21.00	21.00	21.00	21.00	
Lead (and compounds) (inorganic)	mg/kg	78	92.31	5.00	6.60	5.70	960.00	85.85	46.50	2.50
Mercury (inorganic)	mg/kg	1	0.00	0.09	0.09			0.04	0.04	
Benzo(a)Anthracene	mg/kg	1	0.00	0.20	0.20			0.10	0.10	
Benzo(a)Pyrene	mg/kg	1	0.00	0.20	0.20			0.10	0.10	
Benzo(b)Fluoranthene	mg/kg	1	0.00	0.20	0.20			0.10	0.10	
Benzo(g,h,i)Perylene	mg/kg	1	0.00	0.20	0.20			0.10	0.10	
Benzo(k)Fluoranthene	mg/kg	1	0.00	0.20	0.20			0.10	0.10	
Chrysene	mg/kg	1	0.00	0.20	0.20			0.10	0.10	
Dibenz(a,h)anthracene	mg/kg	1	0.00	0.20	0.20			0.10	0.10	
Indeno(1,2,3-cd)pyrene	mg/kg	1	0.00	0.20	0.20			0.10	0.10	
Methylnaphthalene, 2-	mg/kg	1	0.00	0.20	0.20			0.10	0.10	
Phenanthrene	mg/kg	1	0.00	0.20	0.20			0.10	0.10	

Table F-13 - Commercial Evaluation Unit 7 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Geometric Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Monomethylamine Nitrate	mg/kg	0.35	3.26		3.15	3.40	3.41	Unknown
Nitroglycerine	mg/kg	0.02	0.13		0.12	0.13	0.13	Normal/Lognormal
Trinitrotoluene, 2,4,6-	mg/kg	0.07	0.05	0.21	0.008	0.08	0.35	Unknown
Aluminum	mg/kg			16000.00	16000.00			Unknown
Arsenic (inorganic)	mg/kg	31.98	41.77	54.49	27.73	46.72	54.49	Lognormal
Copper	mg/kg			21.00	21.00			Unknown
Lead (and compounds) (inorganic)	mg/kg	140.39	96.64	133.50	40.91	112.41	133.50	Lognormal
Mercury (inorganic)	mg/kg				0.04			Unknown
Benzo(a)Anthracene	mg/kg				0.10			Unknown
Benzo(a)Pyrene	mg/kg				0.10			Unknown
Benzo(b)Fluoranthene	mg/kg				0.10			Unknown
Benzo(g,h,i)Perylene	mg/kg				0.10			Unknown
Benzo(k)Fluoranthene	mg/kg				0.10			Unknown
Chrysene	mg/kg				0.10			Unknown
Dibenz(a,h)anthracene	mg/kg				0.10			Unknown
Indeno(1,2,3-cd)pyrene	mg/kg				0.10			Unknown
Methylnaphthalene, 2-	mg/kg				0.10			Unknown
Phenanthrene	mg/kg				0.10			Unknown

Table F-14 - Commercial Evaluation Unit 7 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Monomethylamine Nitrate	mg/kg	16	12.50	0.03	5.70	1.40	2.90	2.32	2.70	0.02
Nitroglycerine	mg/kg	20	5.00	0.19	0.57	0.35	0.35	0.13	0.11	
Trinitrotoluene, 2,4,6-	mg/kg	22	36.36	0.003	0.08	0.01	42.00	2.62	0.002	0.002
Aluminum	mg/kg	6	100.00			7000.00	16000.00	12166.67	12500.00	
Arsenic (inorganic)	mg/kg	21	100.00			1.00	8.40	2.72	2.30	
Copper	mg/kg	18	100.00			7.00	24000.00	1347.39	15.00	
Lead (and compounds) (inorganic)	mg/kg	44	40.91	4.90	5.50	5.50	2900.00	174.79	2.75	2.50
Mercury (inorganic)	mg/kg	18	0.00	0.08	0.11			0.05	0.05	
Benzo(a)Anthracene	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Benzo(a)Pyrene	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Benzo(b)Fluoranthene	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Benzo(g,h,i)Perylene	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Benzo(k)Fluoranthene	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Chrysene	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Dibenz(a,h)anthracene	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Indeno(1,2,3-cd)pyrene	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Methylnaphthalene, 2-	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Phenanthrene	mg/kg	1	0.00	0.18	0.18			0.09	0.09	
Oil And Grease	mg/kg	4	75.00	20.00	20.00	30.00	93.00	46.00	40.50	

Table F-14 - Commercial Evaluation Unit 7 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Geometric Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Monomethylamine Nitrate	mg/kg	0.96	2.48	2.90	1.37	2.74	41.64	Unknown
Nitroglycerine	mg/kg	0.07	0.14	0.15	0.12	0.15	0.15	Unknown
Trinitrotoluene, 2,4,6-	mg/kg	9.36	3.99	42.00	0.01	6.05	53.47	Unknown
Aluminum	mg/kg	3060.50	13075.01	16000.00	11793.53	14684.30	16284.76	Normal/Lognormal
Arsenic (inorganic)	mg/kg	1.67	2.97	3.40	2.38	3.35	3.40	Lognormal
Copper	mg/kg	5653.35	2265.49	551.87	21.82	3665.96	551.87	Unknown
Lead (and compounds) (inorganic)	mg/kg	568.44	233.15	281.37	10.34	319.10	281.37	Unknown
Mercury (inorganic)	mg/kg	0.005	0.05		0.05	0.05	0.05	Normal/Lognormal
Benzo(a)Anthracene	mg/kg				0.09			Unknown
Benzo(a)Pyrene	mg/kg				0.09			Unknown
Benzo(b)Fluoranthene	mg/kg				0.09			Unknown
Benzo(g,h,i)Perylene	mg/kg				0.09			Unknown
Benzo(k)Fluoranthene	mg/kg				0.09			Unknown
Chrysene	mg/kg				0.09			Unknown
Dibenz(a,h)anthracene	mg/kg				0.09			Unknown
Indeno(1,2,3-cd)pyrene	mg/kg				0.09			Unknown
Methylnaphthalene, 2-	mg/kg				0.09			Unknown
Phenanthrene	mg/kg				0.09			Unknown
Oil And Grease	mg/kg	35.52	59.59	93.00	34.54	87.79	1722.91	Normal/Lognormal

Table F-15 - Commercial Evaluation Unit 8 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	27	100.00			4.20	120.00	50.19	46.00	
Lead (and compounds) (inorganic)	mg/kg	5	100.00			19.00	402.00	140.80	62.00	

Table F-15 - Commercial Evaluation Unit 8 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	25.49	53.55	72.35	42.10	58.56	72.35	Normal
Lead (and compounds) (inorganic)	mg/kg	156.49	192.66	402.00	83.92	290.00	4512.94	Normal/Lognormal

Table F-16 - Commercial Evaluation Unit 8 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	1	100.00			6.00	6.00	6.00	6.00	

Table F-16 - Commercial Evaluation Unit 8 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg			6.00	6.00			Unknown

Table F-17 - Commercial Evaluation Unit 9 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	219	99.54	2.40	2.40	3.00	160.00	31.69	26.00	
Lead (and compounds) (inorganic)	mg/kg	202	100.00			7.60	190.00	46.21	38.00	

Table F-17 - Commercial Evaluation Unit 9 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	22.58	32.72	35.68	25.10	34.22	35.68	Unknown
Lead (and compounds) (inorganic)	mg/kg	30.19	47.65	50.79	37.87	49.73	50.79	Lognormal

Table F-18 - Commercial Evaluation Unit 9 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	1	100.00			13.00	13.00	13.00	13.00	

Table F-18 - Commercial Evaluation Unit 9 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg			13.00	13.00			Unknown

Table F-19 - Golf Course Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Trinitrotoluene, 2,4,6-	mg/kg	1	0.00	0.006	0.006			0.003	0.003	
Metals (Total)										
Arsenic (inorganic)	mg/kg	46	97.83	2.10	2.10	2.70	370.00	39.56	21.50	
Copper	mg/kg	3	100.00			6.60	96.00	38.20	12.00	
Lead (and compounds) (inorganic)	mg/kg	63	92.06	5.00	6.20	7.10	3100.00	373.51	89.00	2.50
Mercury (inorganic)	mg/kg	19	78.95	0.10	0.11	0.14	3.10	0.65	0.44	0.05

Table F-19 - Golf Course Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Trinitrotoluene, 2,4,6-	mg/kg				0.003			Unknown
Metals (Total)								
Arsenic (inorganic)	mg/kg	66.05	46.19	63.23	18.12	55.95	63.23	Lognormal
Copper	mg/kg	50.13	61.82	96.00	19.66	122.71	4433702904.5	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	625.66	427.03	1162.44	93.40	505.22	1162.44	Lognormal
Mercury (inorganic)	mg/kg	0.77	0.77	1.89	0.33	0.96	1.89	Lognormal

Table F-20 - Golf Course Evaluation Unit 1 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Nitroglycerine	mg/kg	10	0.00	0.21	0.23			0.11	0.11	0.11
Trinitrotoluene, 2,4,6-	mg/kg	8	0.00	0.003	0.004			0.002	0.002	
Arsenic (inorganic)	mg/kg	14	100.00			1.50	110.00	17.86	3.70	
Copper	mg/kg	10	90.00	0.27	0.27	6.50	43.00	13.50	10.65	
Lead (and compounds) (inorganic)	mg/kg	39	71.79	4.70	5.80	7.10	4000.00	276.41	31.00	
Mercury (inorganic)	mg/kg	16	50.00	0.08	0.10	0.12	2.60	0.35	0.09	
TPH (418.1)	mg/kg	2	50.00	20.00	20.00	40.00	40.00	25.00	25.00	

Table F-20 - Golf Course Evaluation Unit 1 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Geometric Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Nitroglycerine	mg/kg	0.003	0.11		0.11	0.11	0.11	Unknown
Trinitrotoluene, 2,4,6-	mg/kg	0.00007	0.002		0.002	0.002	0.002	Normal/Lognormal
Arsenic (inorganic)	mg/kg	32.16	23.82	51.81	6.19	33.08	51.81	Unknown
Copper	mg/kg	11.94	16.16	43.00	7.88	20.42	234.17	Unknown
Lead (and compounds) (inorganic)	mg/kg	732.47	356.52	1344.44	33.30	475.45	1344.44	Unknown
Mercury (inorganic)	mg/kg	0.64	0.46	1.02	0.14	0.63	1.02	Unknown
TPH (418.1)	mg/kg	21.21	40.00	40.00	20.00	119.71	113637142058	Unknown

Table F-21 - Golf Course Evaluation Unit 2 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Monomethylamine Nitrate	mg/kg	5	0.00	5.40	6.30			2.91	2.90	
Nitroglycerine	mg/kg	6	0.00	0.21	0.24			0.11	0.12	
Trinitrotoluene, 2,4,6-	mg/kg	13	0.00	0.003	0.18			0.01	0.008	0.002
Metals (Total)										
Aluminum	mg/kg	2	100.00			7700.00	18000.00	12850.00	12850.00	
Arsenic (inorganic)	mg/kg	58	100.00			1.90	490.00	54.96	24.00	
Copper	mg/kg	6	100.00			12.00	98.30	46.27	38.50	
Lead (and compounds) (inorganic)	mg/kg	49	85.71	5.20	6.20	5.80	1500.00	161.62	34.00	
Mercury (inorganic)	mg/kg	20	70.00	0.08	0.11	0.16	100.00	10.84	0.25	
Organochlorine Pesticides										
Aldrin	mg/kg	4	0.00	0.005	0.006			0.003	0.003	
PAHs										
Benzo(a)Anthracene	mg/kg	15	26.67	0.02	0.19	0.10	3.40	0.33	0.010	0.009
Benzo(a)Pyrene	mg/kg	15	26.67	0.02	0.19	0.10	2.80	0.32	0.010	0.009
Benzo(b)Fluoranthene	mg/kg	15	20.00	0.02	0.19	0.77	3.70	0.36	0.010	0.010
Benzo(g,h,i)Perylene	mg/kg	15	46.67	0.02	0.02	0.02	1.60	0.20	0.01	0.010
Benzo(k)Fluoranthene	mg/kg	15	20.00	0.02	0.19	0.30	1.70	0.17	0.010	0.010
Chrysene	mg/kg	15	53.33	0.02	0.02	0.02	4.50	0.45	0.02	0.010
Dibenz(a,h)anthracene	mg/kg	15	13.33	0.04	0.37	0.44	0.51	0.10	0.02	0.02
Indeno(1,2,3-cd)pyrene	mg/kg	15	26.67	0.02	0.19	0.04	1.60	0.17	0.010	0.009
Methylnaphthalene, 2-	mg/kg	2	0.00	0.19	0.79			0.25	0.25	
Phenanthrene	mg/kg	15	26.67	0.009	0.09	0.06	1.10	0.10	0.005	
TPH - 418										
TPH (418.1)	mg/kg	31	54.84	22.00	25.00	31.00	2800.00	479.98	35.00	11.00

Table F-21 - Golf Course Evaluation Unit 2 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Monomethylamine Nitrate	mg/kg	0.16	2.96		2.91	3.07	3.08	Normal/Lognormal
Nitroglycerine	mg/kg	0.005	0.12		0.11	0.12	0.12	Unknown
Trinitrotoluene, 2,4,6-	mg/kg	0.02	0.02		0.006	0.02	0.04	Lognormal
Metals (Total)								
Aluminum	mg/kg	7283.20	18000.00	18000.00	11772.85	45367.10	242577934.05	Unknown
Arsenic (inorganic)	mg/kg	98.18	63.73	81.23	22.89	76.66	81.23	Lognormal
Copper	mg/kg	33.74	56.28	98.30	35.81	74.02	180.50	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	322.11	192.96	419.99	42.37	239.11	419.99	Lognormal
Mercury (inorganic)	mg/kg	26.16	14.87	100.00	0.49	20.96	211.86	Unknown
Organochlorine Pesticides								
Aldrin	mg/kg	0.0002	0.003		0.003	0.003	0.003	Normal/Lognormal
PAHs								
Benzo(a)Anthracene	mg/kg	0.88	0.49	3.23	0.03	0.73	3.23	Unknown
Benzo(a)Pyrene	mg/kg	0.75	0.45	2.80	0.03	0.66	3.57	Unknown
Benzo(b)Fluoranthene	mg/kg	0.96	0.53	3.48	0.03	0.80	3.48	Unknown
Benzo(g,h,i)Perylene	mg/kg	0.43	0.28	1.37	0.04	0.40	1.37	Unknown
Benzo(k)Fluoranthene	mg/kg	0.44	0.25	0.77	0.02	0.37	0.77	Unknown
Chrysene	mg/kg	1.17	0.66	4.50	0.04	0.98	4.86	Unknown
Dibenz(a,h)anthracene	mg/kg	0.16	0.12	0.23	0.04	0.17	0.23	Unknown
Indeno(1,2,3-cd)pyrene	mg/kg	0.42	0.25	0.86	0.03	0.36	0.86	Unknown
Methylnaphthalene, 2-	mg/kg	0.21	0.40		0.19	1.19	518550114788	Unknown
Phenanthrene	mg/kg	0.28	0.15	0.48	0.01	0.23	0.48	Unknown
TPH - 418								
TPH (418.1)	mg/kg	859.03	585.36	2404.03	64.68	741.81	2404.03	Unknown

Table F-22 - Golf Course Evaluation Unit 2 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Monomethylamine Nitrate	mg/kg	16	6.25	0.03	6.00	0.04	0.04	1.58	2.63	0.02
Trinitrotoluene, 2,4,6-	mg/kg	22	4.55	0.003	0.04	0.06	0.06	0.005	0.002	0.002
Metals (Total)										
Arsenic (inorganic)	mg/kg	24	100.00			1.60	436.00	86.76	15.30	
Copper	mg/kg	15	93.33	8.90	8.90	3.60	69.00	16.80	15.00	
Lead (and compounds) (inorganic)	mg/kg	56	80.36	5.00	5.70	6.10	920.00	172.99	69.50	2.50
Mercury (inorganic)	mg/kg	21	47.62	0.08	0.10	0.40	9.80	1.16	0.05	
PAHs										
Benzo(b)Fluoranthene	mg/kg	6	16.67	0.02	0.18	0.02	0.02	0.02	0.01	0.010
Benzo(g,h,i)Perylene	mg/kg	6	16.67	0.02	0.18	0.02	0.02	0.03	0.010	
Chrysene	mg/kg	6	16.67	0.02	0.18	0.03	0.03	0.03	0.01	0.010
TPH - 418										
TPH (418.1)	mg/kg	33	54.55	20.00	25.00	14.00	360.00	58.09	25.00	10.00
TPH - 8015										
Oil And Grease	mg/kg	16	68.75	20.00	20.00	22.00	2200.00	330.19	30.00	10.00

Table F-22 - Golf Course Evaluation Unit 2 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Monomethylamine Nitrate	mg/kg	1.43	1.83	0.04	0.30	2.21	423.25	Unknown
Trinitrotoluene, 2,4,6-	mg/kg	0.01	0.007	0.006	0.002	0.01	0.006	Unknown
Metals (Total)								
Arsenic (inorganic)	mg/kg	123.27	104.00	436.00	19.21	129.89	803.00	Unknown
Copper	mg/kg	15.47	19.57	26.16	13.02	23.84	26.16	Lognormal
Lead (and compounds) (inorganic)	mg/kg	237.31	194.58	756.72	46.62	226.39	756.72	Lognormal
Mercury (inorganic)	mg/kg	2.28	1.50	7.80	0.23	2.02	7.80	Unknown
PAHs								
Benzo(b)Fluoranthene	mg/kg	0.03	0.03	0.02	0.02	0.05	0.10	Unknown
Benzo(g,h,i)Perylene	mg/kg	0.03	0.03	0.02	0.02	0.05	0.12	Unknown
Chrysene	mg/kg	0.03	0.04	0.03	0.02	0.05	0.12	Unknown
TPH - 418								
TPH (418.1)	mg/kg	76.95	67.24	96.75	29.51	80.82	96.75	Unknown
TPH - 8015								
Oil And Grease	mg/kg	637.79	440.37	2200.00	57.08	609.70	2597.59	Unknown

Table F-23 - Golf Course Evaluation Unit 3 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Aluminum	mg/kg	8	100.00			9200.00	23000.00	14900.00	14000.00	
Arsenic (inorganic)	mg/kg	63	100.00			2.00	970.00	95.18	47.00	
Copper	mg/kg	8	100.00			17.00	72.00	38.75	36.50	
Lead (and compounds) (inorganic)	mg/kg	47	100.00			8.50	1200.00	117.48	63.00	
Mercury (inorganic)	mg/kg	17	94.12	0.13	0.13	0.13	11.00	1.78	0.28	
PAHs										
Benzo(a)Anthracene	mg/kg	1	100.00			0.07	0.07	0.07	0.07	
Benzo(a)Pyrene	mg/kg	1	100.00			0.09	0.09	0.09	0.09	
Benzo(b)Fluoranthene	mg/kg	1	100.00			0.13	0.13	0.13	0.13	
Benzo(g,h,i)Perylene	mg/kg	1	100.00			0.08	0.08	0.08	0.08	
Benzo(k)Fluoranthene	mg/kg	1	100.00			0.08	0.08	0.08	0.08	
Chrysene	mg/kg	1	100.00			0.14	0.14	0.14	0.14	
Indeno(1,2,3-cd)pyrene	mg/kg	1	100.00			0.07	0.07	0.07	0.07	
Phenanthrene	mg/kg	1	100.00			0.08	0.08	0.08	0.08	
TPH - 418										
TPH (418.1)	mg/kg	8	62.50	22.00	26.00	29.00	89.00	46.56	41.50	

Table F-23 - Golf Course Evaluation Unit 3 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Aluminum	mg/kg	4080.62	15925.77	18316.91	14442.01	17633.95	18316.91	Normal/Lognormal
Arsenic (inorganic)	mg/kg	145.42	107.62	132.35	50.23	125.79	132.35	Lognormal
Copper	mg/kg	19.44	43.64	63.87	34.48	51.77	63.87	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	189.11	136.26	147.87	68.49	163.93	147.87	Lognormal
Mercury (inorganic)	mg/kg	3.16	2.31	6.15	0.54	3.12	6.15	Unknown
PAHs								
Benzo(a)Anthracene	mg/kg			0.07	0.07			Unknown
Benzo(a)Pyrene	mg/kg			0.09	0.09			Unknown
Benzo(b)Fluoranthene	mg/kg			0.13	0.13			Unknown
Benzo(g,h,i)Perylene	mg/kg			0.08	0.08			Unknown
Benzo(k)Fluoranthene	mg/kg			0.08	0.08			Unknown
Chrysene	mg/kg			0.14	0.14			Unknown
Indeno(1,2,3-cd)pyrene	mg/kg			0.07	0.07			Unknown
Phenanthrene	mg/kg			0.08	0.08			Unknown
TPH - 418								
TPH (418.1)	mg/kg	34.63	55.27	89.00	33.42	69.76	163.76	Normal/Lognormal

Table F-24 - Golf Course Evaluation Unit 3 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Aluminum	mg/kg	1	100.00			6100.00	6100.00	6100.00	6100.00	
Arsenic (inorganic)	mg/kg	3	100.00			2.60	4.90	3.87	4.10	
Copper	mg/kg	1	100.00			330.00	330.00	330.00	330.00	
Lead (and compounds) (inorganic)	mg/kg	3	33.33	6.20	6.20	31.00	31.00	12.40	3.10	3.10
Mercury (inorganic)	mg/kg	3	33.33	0.11	0.11	0.87	0.87	0.33	0.06	0.06
TPH - 418										
TPH (418.1)	mg/kg	1	100.00			44.00	44.00	44.00	44.00	

Table F-24 - Golf Course Evaluation Unit 3 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Aluminum	mg/kg			6100.00	6100.00			Unknown
Arsenic (inorganic)	mg/kg	1.17	4.42	4.90	3.74	5.84	10.86	Normal/Lognormal
Copper	mg/kg			330.00	330.00			Unknown
Lead (and compounds) (inorganic)	mg/kg	16.11	19.99	31.00	6.68	39.56	199241106.45	Unknown
Mercury (inorganic)	mg/kg	0.47	0.55	0.87	0.14	1.12	7764156598.2	Unknown
TPH - 418								
TPH (418.1)	mg/kg			44.00	44.00			Unknown

Table F-25 - Golf Course Evaluation Unit 4 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	123	100.00			0.92	360.00	65.98	36.00	
Copper	mg/kg	8	100.00			16.00	190.00	64.75	27.00	16.00
Lead (and compounds) (inorganic)	mg/kg	59	96.61	5.70	6.50	6.90	25000.00	829.41	78.00	
Mercury (inorganic)	mg/kg	10	70.00	0.09	13.00	0.34	8.80	2.49	0.74	
PAHs										
Benzo(a)Anthracene	mg/kg	11	36.36	0.02	0.27	0.02	8.60	0.89	0.02	
Benzo(a)Pyrene	mg/kg	11	27.27	0.02	0.27	0.03	5.60	0.56	0.03	
Benzo(b)Fluoranthene	mg/kg	11	72.73	0.02	0.18	0.02	7.00	0.76	0.08	
Benzo(g,h,i)Perylene	mg/kg	11	54.55	0.02	0.18	0.17	4.40	0.82	0.17	
Benzo(k)Fluoranthene	mg/kg	11	18.18	0.02	0.27	0.20	2.60	0.28	0.01	
Chrysene	mg/kg	11	81.82	0.02	0.18	0.02	14.00	1.54	0.09	
Dibenz(a,h)anthracene	mg/kg	11	18.18	0.04	0.56	0.05	0.31	0.11	0.03	
Indeno(1,2,3-cd)pyrene	mg/kg	11	27.27	0.02	0.27	0.03	0.38	0.09	0.03	
Phenanthrene	mg/kg	11	63.64	0.010	0.09	0.01	7.10	0.78	0.05	
TPH - 418										
TPH (418.1)	mg/kg	19	57.89	20.00	20.00	35.00	5600.00	874.37	58.00	10.00
TPH - 8015										
Oil And Grease	mg/kg	2	100.00			240.00	250.00	245.00	245.00	

Table F-25 - Golf Course Evaluation Unit 4 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	77.49	70.71	86.27	37.03	77.57	86.27	Lognormal
Copper	mg/kg	72.58	82.99	190.00	38.87	113.38	265.87	Unknown
Lead (and compounds) (inorganic)	mg/kg	3293.56	1121.41	1300.09	110.17	1551.48	1300.09	Lognormal
Mercury (inorganic)	mg/kg	3.11	3.18	8.80	0.81	4.29	117.28	Lognormal
PAHs								
Benzo(a)Anthracene	mg/kg	2.57	1.43	8.60	0.05	2.30	34.09	Unknown
Benzo(a)Pyrene	mg/kg	1.67	0.91	5.60	0.05	1.47	6.54	Unknown
Benzo(b)Fluoranthene	mg/kg	2.08	1.20	7.00	0.09	1.90	16.52	Lognormal
Benzo(g,h,i)Perylene	mg/kg	1.41	1.12	4.40	0.14	1.59	159.09	Lognormal
Benzo(k)Fluoranthene	mg/kg	0.77	0.44	2.60	0.03	0.70	3.32	Unknown
Chrysene	mg/kg	4.16	2.42	14.00	0.14	3.81	50.83	Lognormal
Dibenz(a,h)anthracene	mg/kg	0.12	0.13	0.31	0.06	0.17	0.41	Unknown
Indeno(1,2,3-cd)pyrene	mg/kg	0.12	0.12	0.38	0.04	0.16	0.62	Lognormal
Phenanthrene	mg/kg	2.12	1.23	7.10	0.05	1.94	64.43	Lognormal
TPH - 418								
TPH (418.1)	mg/kg	1494.79	1110.30	5600.00	112.86	1469.00	40229.30	Unknown
TPH - 8015								
Oil And Grease	mg/kg	7.07	250.00	250.00	244.95	276.57	270.38	Unknown

Table F-26 - Golf Course Evaluation Unit 4 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	14	100.00			1.50	100.00	14.07	3.60	
Copper	mg/kg	8	100.00			4.10	22.00	13.14	11.50	
Lead (and compounds) (inorganic)	mg/kg	53	81.13	5.00	6.00	6.40	2500.00	358.84	160.00	
Mercury (inorganic)	mg/kg	8	37.50	0.07	0.09	0.50	6.70	1.15	0.04	
TPH - 418										
TPH (418.1)	mg/kg	20	10.00	20.00	22.00	51.00	520.00	37.60	10.00	10.00
TPH - 8015										
Oil And Grease	mg/kg	12	41.67	20.00	20.00	35.00	94.00	31.42	10.00	10.00

Table F-26 - Golf Course Evaluation Unit 4 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	27.08	19.09	34.49	5.40	26.89	34.49	Unknown
Copper	mg/kg	6.40	14.75	22.00	11.65	17.43	22.62	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	534.21	408.82	2500.00	82.16	482.42	2792.68	Lognormal
Mercury (inorganic)	mg/kg	2.32	1.73	6.70	0.17	2.71	234.15	Unknown
TPH - 418								
TPH (418.1)	mg/kg	113.91	55.12	35.23	13.28	81.64	35.23	Unknown
TPH - 8015								
Oil And Grease	mg/kg	29.52	37.36	70.91	20.85	46.72	70.91	Unknown

Table F-27 - Golf Course Evaluation Unit 5 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Aluminum	mg/kg	5	100.00			9400.00	22000.00	16280.00	18000.00	
Arsenic (inorganic)	mg/kg	20	100.00			2.00	190.00	28.61	13.50	
Copper	mg/kg	5	100.00			11.00	21.00	14.60	14.00	
Lead (and compounds) (inorganic)	mg/kg	10	60.00	5.80	6.50	12.00	308.00	41.32	12.50	
Mercury (inorganic)	mg/kg	5	20.00	0.09	0.11	0.01	0.01	0.04	0.05	

Table F-27 - Golf Course Evaluation Unit 5 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Aluminum	mg/kg	5365.82	18058.15	22000.00	15495.55	21396.09	26280.59	Normal/Lognormal
Arsenic (inorganic)	mg/kg	45.76	35.65	66.01	12.68	46.30	66.01	Lognormal
Copper	mg/kg	3.78	15.85	19.21	14.25	18.21	19.21	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	94.26	62.27	255.99	11.40	95.95	255.99	Lognormal
Mercury (inorganic)	mg/kg	0.02	0.05	0.01	0.04	0.06	0.13	Normal

Table F-28 - Golf Course Evaluation Unit 5 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Monomethylamine Nitrate	mg/kg	36	22.22	5.10	8.80	0.05	1000.00	53.01	2.70	
Metals (Total)										
Aluminum	mg/kg	13	100.00			6200.00	18000.00	11461.54	10000.00	
Arsenic (inorganic)	mg/kg	14	100.00			0.99	18.00	4.91	1.85	
Copper	mg/kg	13	100.00			11.00	24.00	15.08	15.00	
Lead (and compounds) (inorganic)	mg/kg	19	68.42	5.00	5.80	6.20	48.00	17.99	11.00	
Mercury (inorganic)	mg/kg	13	15.38	0.08	0.10	0.12	0.17	0.06	0.05	
PAHs										
Phenanthrene	mg/kg	12	8.33	0.009	0.18	0.08	0.08	0.02	0.005	
TPH - 418										
TPH (418.1)	mg/kg	17	23.53	20.00	23.00	160.00	10000.00	1288.06	10.50	10.50
TPH - 8015										
Oil And Grease	mg/kg	6	100.00			36.00	19000.00	3554.83	510.00	

Table F-28 - Golf Course Evaluation Unit 5 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Monomethylamine Nitrate	mg/kg	179.30	73.42	64.57	4.49	103.72	64.57	Unknown
Metals (Total)								
Aluminum	mg/kg	3235.36	12085.18	13483.74	11038.43	13060.58	13483.74	Normal/Lognormal
Arsenic (inorganic)	mg/kg	6.30	6.07	10.22	2.72	7.89	10.22	Unknown
Copper	mg/kg	3.48	15.75	16.90	14.75	16.79	16.90	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	15.70	20.47	43.15	10.83	24.24	43.15	Unknown
Mercury (inorganic)	mg/kg	0.04	0.07	0.08	0.05	0.08	0.08	Unknown
PAHs								
Phenanthrene	mg/kg	0.04	0.03	0.08	0.010	0.04	0.09	Unknown
TPH - 418								
TPH (418.1)	mg/kg	3301.35	1840.54	10000.00	37.21	2686.07	23041.50	Unknown
TPH - 8015								
Oil And Grease	mg/kg	7582.42	5805.27	19000.00	426.25	9792.29	69109801.12	Lognormal

Table F-29 - Golf Course Evaluation Unit 6 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Trinitrotoluene, 2,4,6-	mg/kg	2	50.00	0.003	0.003	0.02	0.02	0.01	0.01	
Metals (Total)										
Arsenic (inorganic)	mg/kg	25	100.00			3.30	280.00	70.74	38.00	
Lead (and compounds) (inorganic)	mg/kg	15	93.33	5.00	5.00	3.10	264.00	58.17	31.00	
PAHs										
Benzo(a)Anthracene	mg/kg	2	100.00			0.03	0.05	0.04	0.04	
Benzo(a)Pyrene	mg/kg	2	100.00			0.04	0.05	0.05	0.05	
Benzo(b)Fluoranthene	mg/kg	2	100.00			0.02	0.03	0.03	0.03	
Benzo(g,h,i)Perylene	mg/kg	2	50.00	0.02	0.02	0.06	0.06	0.04	0.04	
Chrysene	mg/kg	2	50.00	0.02	0.02	0.09	0.09	0.05	0.05	
Indeno(1,2,3-cd)pyrene	mg/kg	2	50.00	0.02	0.02	0.03	0.03	0.02	0.02	
Phenanthrene	mg/kg	2	100.00			0.02	0.04	0.03	0.03	
TPH - 418										
TPH (418.1)	mg/kg	2	50.00	29.00	29.00	84.00	84.00	49.25	49.25	

Table F-29 - Golf Course Evaluation Unit 6 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Trinitrotoluene, 2,4,6-	mg/kg	0.01	0.02	0.02	0.006	0.08	.12244255176	Unknown
Metals (Total)								
Arsenic (inorganic)	mg/kg	78.49	81.49	137.23	41.00	97.60	137.23	Lognormal
Lead (and compounds) (inorganic)	mg/kg	72.00	71.04	256.63	27.08	90.91	256.63	Lognormal
PAHs								
Benzo(a)Anthracene	mg/kg	0.01	0.05	0.05	0.04	0.10	0.88	Unknown
Benzo(a)Pyrene	mg/kg	0.004	0.05	0.05	0.04	0.06	0.06	Unknown
Benzo(b)Fluoranthene	mg/kg	0.003	0.03	0.03	0.02	0.04	0.04	Unknown
Benzo(g,h,i)Perylene	mg/kg	0.04	0.06	0.06	0.03	0.20	265175581486	Unknown
Chrysene	mg/kg	0.06	0.09	0.09	0.03	0.30	.78070058351	Unknown
Indeno(1,2,3-cd)pyrene	mg/kg	0.02	0.03	0.03	0.02	0.09	1772904.80	Unknown
Phenanthrene	mg/kg	0.01	0.04	0.04	0.03	0.09	16.62	Unknown
TPH - 418								
TPH (418.1)	mg/kg	49.14	84.00	84.00	34.90	268.66	.31734001616	Unknown

Table F-30 - Golf Course Evaluation Unit 6 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	8	100.00			2.25	47.00	11.38	4.31	
Copper	mg/kg	6	100.00			14.80	66.30	26.48	18.90	
Lead (and compounds) (inorganic)	mg/kg	11	45.45	5.00	5.60	6.00	260.00	45.17	2.80	2.50
PAHs										
Benzo(a)Anthracene	mg/kg	1	100.00			0.09	0.09	0.09	0.09	
Benzo(a)Pyrene	mg/kg	1	100.00			0.11	0.11	0.11	0.11	
Benzo(b)Fluoranthene	mg/kg	1	100.00			0.08	0.08	0.08	0.08	
Benzo(k)Fluoranthene	mg/kg	1	100.00			0.05	0.05	0.05	0.05	
Chrysene	mg/kg	1	100.00			0.15	0.15	0.15	0.15	
Dibenz(a,h)anthracene	mg/kg	1	100.00			0.12	0.12	0.12	0.12	
Phenanthrene	mg/kg	1	100.00			0.14	0.14	0.14	0.14	

Table F-30 - Golf Course Evaluation Unit 6 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	15.48	15.27	44.88	6.38	21.75	44.88	Lognormal
Copper	mg/kg	19.78	32.35	52.41	22.62	42.75	52.41	Unknown
Lead (and compounds) (inorganic)	mg/kg	85.46	63.21	260.00	9.00	91.86	614.66	Unknown
PAHs								
Benzo(a)Anthracene	mg/kg			0.09	0.09			Unknown
Benzo(a)Pyrene	mg/kg			0.11	0.11			Unknown
Benzo(b)Fluoranthene	mg/kg			0.08	0.08			Unknown
Benzo(k)Fluoranthene	mg/kg			0.05	0.05			Unknown
Chrysene	mg/kg			0.15	0.15			Unknown
Dibenz(a,h)anthracene	mg/kg			0.12	0.12			Unknown
Phenanthrene	mg/kg			0.14	0.14			Unknown

Table F-31 - Golf Course Evaluation Unit 7 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Trinitrotoluene, 2,4,6-	mg/kg	9	11.11	0.003	0.04	0.15	0.15	0.02	0.009	
Metals (Total)										
Arsenic (inorganic)	mg/kg	50	100.00			7.40	350.00	88.76	59.50	
Lead (and compounds) (inorganic)	mg/kg	37	100.00			6.85	1900.00	98.58	38.00	

Table F-31 - Golf Course Evaluation Unit 7 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Trinitrotoluene, 2,4,6-	mg/kg	0.05	0.04	0.15	0.009	0.05	0.18	Lognormal
Metals (Total)								
Arsenic (inorganic)	mg/kg	86.42	97.08	133.45	55.54	109.34	133.45	Lognormal
Lead (and compounds) (inorganic)	mg/kg	307.10	133.06	99.33	40.56	184.25	99.33	Unknown

Table F-32 - Golf Course Evaluation Unit 7 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Trinitrotoluene, 2,4,6-	mg/kg	10	20.00	0.003	0.33	0.004	0.07	0.03	0.003	
Metals (Total)										
Arsenic (inorganic)	mg/kg	8	100.00			1.80	15.00	5.87	4.43	
Copper	mg/kg	7	100.00			12.00	61.80	23.61	16.50	
Lead (and compounds) (inorganic)	mg/kg	21	28.57	5.00	5.90	5.00	290.00	33.10	2.55	2.50

Table F-32 - Golf Course Evaluation Unit 7 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Trinitrotoluene, 2,4,6-	mg/kg	0.05	0.04	0.07	0.006	0.06	0.32	Unknown
Metals (Total)								
Arsenic (inorganic)	mg/kg	4.42	6.98	12.72	4.68	8.84	12.72	Normal/Lognormal
Copper	mg/kg	17.82	28.45	43.74	19.89	36.70	43.74	Lognormal
Lead (and compounds) (inorganic)	mg/kg	80.47	45.17	65.30	5.81	63.39	65.30	Unknown

Table F-33 - Golf Course Evaluation Unit 8 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Trinitrotoluene, 2,4,6-	mg/kg	11	36.36	0.007	0.04	0.005	0.64	0.07	0.02	
Metals (Total)										
Arsenic (inorganic)	mg/kg	79	100.00			3.00	520.00	80.66	43.00	
Copper	mg/kg	2	100.00			18.40	26.00	22.20	22.20	
Lead (and compounds) (inorganic)	mg/kg	35	88.57	5.00	6.60	8.30	290.00	51.99	33.00	2.50
Mercury (inorganic)	mg/kg	2	50.00	0.13	0.13	0.09	0.09	0.08	0.08	
PAHs										
Benzo(a)Anthracene	mg/kg	2	50.00	0.02	0.02	0.03	0.03	0.02	0.02	
Benzo(a)Pyrene	mg/kg	2	50.00	0.02	0.02	0.03	0.03	0.02	0.02	
Chrysene	mg/kg	2	100.00			0.02	0.10	0.06	0.06	
Phenanthrene	mg/kg	2	50.00	0.009	0.009	0.03	0.03	0.02	0.02	
TPH - 418										
TPH (418.1)	mg/kg	2	100.00			47.00	52.00	49.50	49.50	

Table F-33 - Golf Course Evaluation Unit 8 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Trinitrotoluene, 2,4,6-	mg/kg	0.19	0.11	0.28	0.01	0.17	0.28	Unknown
Metals (Total)								
Arsenic (inorganic)	mg/kg	106.41	88.79	119.62	40.77	100.66	119.62	Lognormal
Copper	mg/kg	5.37	26.00	26.00	21.87	46.19	96.04	Unknown
Lead (and compounds) (inorganic)	mg/kg	61.66	59.10	106.24	26.93	69.67	106.24	Lognormal
Mercury (inorganic)	mg/kg	0.02	0.09	0.09	0.08	0.16	0.29	Unknown
PAHs								
Benzo(a)Anthracene	mg/kg	0.01	0.03	0.03	0.02	0.07	103230.01	Unknown
Benzo(a)Pyrene	mg/kg	0.01	0.03	0.03	0.02	0.07	103230.01	Unknown
Chrysene	mg/kg	0.05	0.10	0.10	0.05	0.30	159594229770	Unknown
Phenanthrene	mg/kg	0.02	0.03	0.03	0.01	0.11	.33679937728	Unknown
TPH - 418								
TPH (418.1)	mg/kg	3.54	52.00	52.00	49.44	65.29	64.29	Unknown

Table F-34 - Golf Course Evaluation Unit 8 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Trinitrotoluene, 2,4,6-	mg/kg	12	33.33	0.003	0.33	0.005	0.03	0.02	0.005	0.002
Metals (Total)										
Arsenic (inorganic)	mg/kg	11	100.00			3.20	11.00	5.41	4.38	
Copper	mg/kg	6	100.00			14.50	28.50	19.43	18.30	
Lead (and compounds) (inorganic)	mg/kg	27	22.22	5.00	5.70	5.00	60.00	5.68	2.50	2.50

Table F-34 - Golf Course Evaluation Unit 8 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Trinitrotoluene, 2,4,6-	mg/kg	0.05	0.03	0.03	0.007	0.05	0.17	Unknown
Metals (Total)								
Arsenic (inorganic)	mg/kg	2.73	5.99	7.22	4.92	6.90	7.22	Lognormal
Copper	mg/kg	4.81	20.86	24.12	19.00	23.39	24.12	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	11.21	7.16	6.15	3.47	9.36	6.15	Unknown

Table F-35 - Golf Course Evaluation Unit 9 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Nitroglycerine	mg/kg	11	9.09	0.21	0.25	0.24	0.24	0.13	0.12	
Trinitrotoluene, 2,4,6-	mg/kg	20	20.00	0.006	0.18	0.009	0.40	0.05	0.02	
Metals (Total)										
Arsenic (inorganic)	mg/kg	32	100.00			1.90	400.00	37.45	12.50	
Lead (and compounds) (inorganic)	mg/kg	149	95.97	5.00	6.10	6.00	2700.00	258.62	94.00	2.50

Table F-35 - Golf Course Evaluation Unit 9 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Nitroglycerine	mg/kg	0.04	0.14	0.15	0.12	0.15	0.15	Unknown
Trinitrotoluene, 2,4,6-	mg/kg	0.09	0.06	0.12	0.02	0.08	0.12	Lognormal
Metals (Total)								
Arsenic (inorganic)	mg/kg	73.46	46.32	59.95	15.89	59.49	59.95	Lognormal
Lead (and compounds) (inorganic)	mg/kg	447.16	283.42	427.21	91.63	319.36	427.21	Lognormal

Table F-36 - Golf Course Evaluation Unit 9 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Nitroglycerine	mg/kg	77	1.30	0.18	0.36	3.70	3.70	0.15	0.11	0.09
Trinitrotoluene, 2,4,6-	mg/kg	77	5.19	0.003	0.16	0.03	2.40	0.05	0.002	0.002
Metals (Total)										
Arsenic (inorganic)	mg/kg	11	100.00			1.80	40.00	6.19	3.12	
Copper	mg/kg	10	100.00			3.10	29.10	16.22	15.75	
Lead (and compounds) (inorganic)	mg/kg	59	28.81	5.00	5.50	4.00	330.00	17.04	2.50	2.50
PAHs										
Benzo(b)Fluoranthene	mg/kg	1	100.00			0.06	0.06	0.06	0.06	
Chrysene	mg/kg	1	100.00			0.04	0.04	0.04	0.04	

Table F-36 - Golf Course Evaluation Unit 9 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Nitroglycerine	mg/kg	0.41	0.18	0.13	0.11	0.23	0.13	Unknown
Trinitrotoluene, 2,4,6-	mg/kg	0.29	0.07	0.01	0.003	0.11	0.01	Unknown
Metals (Total)								
Arsenic (inorganic)	mg/kg	11.23	8.56	10.23	3.48	12.32	10.23	Unknown
Copper	mg/kg	6.84	17.74	27.71	14.36	20.18	27.71	Normal
Lead (and compounds) (inorganic)	mg/kg	46.27	21.14	17.31	5.15	27.19	17.31	Unknown
PAHs								
Benzo(b)Fluoranthene	mg/kg			0.06	0.06			Unknown
Chrysene	mg/kg			0.04	0.04			Unknown

Table F-37 - Historical Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	3	100.00			5.50	68.00	44.83	61.00	
Lead (and compounds) (inorganic)	mg/kg	3	100.00			38.00	190.00	90.67	44.00	

Table F-37 - Historical Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	34.24	60.97	68.00	28.36	102.56	10009991140.	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	86.08	131.22	190.00	68.23	235.78	150738.75	Normal/Lognormal

Table F-38 - Historical Evaluation Unit 2 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Aluminum	mg/kg	1	100.00			15000.00	15000.00	15000.00	15000.00	
Arsenic (inorganic)	mg/kg	8	100.00			6.00	73.00	44.88	49.50	
Lead (and compounds) (inorganic)	mg/kg	8	100.00			4.70	280.00	78.09	35.50	
Organochlorine Pesticides										
Aldrin	mg/kg	1	100.00			0.60	0.60	0.60	0.60	
TPH - 8015										
Oil And Grease	mg/kg	1	100.00			120.00	120.00	120.00	120.00	

Table F-38 - Historical Evaluation Unit 2 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Aluminum	mg/kg			15000.00	15000.00			Unknown
Arsenic (inorganic)	mg/kg	20.77	50.10	73.00	37.33	58.79	123.38	Normal
Lead (and compounds) (inorganic)	mg/kg	94.29	101.79	280.00	39.85	141.26	784.88	Lognormal
Organochlorine Pesticides								
Aldrin	mg/kg			0.60	0.60			Unknown
TPH - 8015								
Oil And Grease	mg/kg			120.00	120.00			Unknown

Table F-39 - Historical Evaluation Unit 3 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	8	100.00			5.40	150.00	29.58	13.00	
Lead (and compounds) (inorganic)	mg/kg	8	100.00			13.00	450.00	151.25	124.00	

Table F-39 - Historical Evaluation Unit 3 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	49.04	41.91	109.62	15.15	62.44	109.62	Lognormal
Lead (and compounds) (inorganic)	mg/kg	151.93	189.44	450.00	82.70	253.04	1587.03	Normal/Lognormal

Table F-40 - Industrial Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	134	98.51	2.00	4.60	3.40	180.00	40.79	31.00	
Lead (and compounds) (inorganic)	mg/kg	144	97.92	2.80	6.80	3.10	2000.00	126.33	49.50	

Table F-40 - Industrial Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	33.37	42.74	52.35	28.01	45.56	52.35	Lognormal
Lead (and compounds) (inorganic)	mg/kg	241.10	139.93	168.79	51.46	159.64	168.79	Lognormal

Table F-41 - Industrial Evaluation Unit 1 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Explosives										
Trinitrotoluene, 2,4,6-	mg/kg	38	7.89	0.003	0.07	0.004	0.21	0.02	0.002	0.002
Metals (Total)										
Aluminum	mg/kg	5	100.00			7500.00	14000.00	10900.00	11000.00	
Arsenic (inorganic)	mg/kg	17	100.00			1.70	71.00	8.18	2.80	1.70
Copper	mg/kg	15	100.00			9.90	220.00	31.06	17.00	
Lead (and compounds) (inorganic)	mg/kg	45	66.67	4.90	5.80	5.70	1500.00	59.54	9.00	
Mercury (inorganic)	mg/kg	15	26.67	0.07	0.09	0.09	0.24	0.07	0.04	
PAHs										
Benzo(a)Anthracene	mg/kg	15	6.67	0.02	0.18	0.23	0.23	0.05	0.009	0.009
Benzo(a)Pyrene	mg/kg	15	6.67	0.02	0.18	0.22	0.22	0.04	0.009	0.009
Benzo(b)Fluoranthene	mg/kg	15	6.67	0.02	0.18	0.15	0.15	0.04	0.009	0.009
Benzo(g,h,i)Perylene	mg/kg	16	6.25	0.02	0.18	0.10	0.10	0.04	0.009	0.009
Benzo(k)Fluoranthene	mg/kg	15	6.67	0.02	0.18	0.17	0.17	0.04	0.009	0.009
Chrysene	mg/kg	16	6.25	0.02	0.28	0.36	0.36	0.06	0.009	0.009
Dibenz(a,h)anthracene	mg/kg	16	6.25	0.04	0.18	0.05	0.05	0.04	0.02	0.02
Indeno(1,2,3-cd)pyrene	mg/kg	16	6.25	0.01	0.18	0.14	0.14	0.04	0.009	
Phenanthrene	mg/kg	16	12.50	0.009	0.18	0.009	0.20	0.04	0.005	0.004
TPH - 418										
TPH (418.1)	mg/kg	12	8.33	20.00	20.00	200.00	200.00	25.83	10.00	10.00

Table F-41 - Industrial Evaluation Unit 1 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Explosives								
Trinitrotoluene, 2,4,6-	mg/kg	0.04	0.02	0.05	0.006	0.03	0.05	Unknown
Metals (Total)								
Aluminum	mg/kg	2408.32	11698.08	14000.00	10674.63	13196.23	14271.02	Normal/Lognormal
Arsenic (inorganic)	mg/kg	16.97	11.02	12.25	3.69	15.36	12.25	Unknown
Copper	mg/kg	52.53	40.45	40.53	20.03	54.95	40.53	Unknown
Lead (and compounds) (inorganic)	mg/kg	226.77	82.56	59.51	10.45	116.46	59.51	Unknown
Mercury (inorganic)	mg/kg	0.06	0.08	0.10	0.06	0.10	0.10	Unknown
PAHs								
Benzo(a)Anthracene	mg/kg	0.06	0.06	0.12	0.02	0.07	0.12	Unknown
Benzo(a)Pyrene	mg/kg	0.06	0.05	0.12	0.02	0.07	0.12	Unknown
Benzo(b)Fluoranthene	mg/kg	0.05	0.05	0.09	0.02	0.06	0.09	Unknown
Benzo(g,h,i)Perylene	mg/kg	0.04	0.04	0.08	0.02	0.05	0.08	Unknown
Benzo(k)Fluoranthene	mg/kg	0.05	0.05	0.10	0.02	0.06	0.10	Unknown
Chrysene	mg/kg	0.09	0.07	0.18	0.02	0.10	0.18	Unknown
Dibenz(a,h)anthracene	mg/kg	0.03	0.04	0.05	0.03	0.05	0.06	Unknown
Indeno(1,2,3-cd)pyrene	mg/kg	0.04	0.04	0.09	0.02	0.06	0.09	Unknown
Phenanthrene	mg/kg	0.06	0.05	0.20	0.01	0.07	0.20	Unknown
TPH - 418								
TPH (418.1)	mg/kg	54.85	36.87	37.50	12.84	54.27	37.50	Unknown

Table F-42- Open Space Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	4	100.00			5.80	10.00	8.33	8.75	
Copper	mg/kg	3	100.00			50.00	100.00	81.00	93.00	
Lead (and compounds) (inorganic)	mg/kg	3	100.00			180.00	410.00	330.00	400.00	
Mercury (inorganic)	mg/kg	3	100.00			0.34	1.20	0.74	0.68	
TPH - 418										
TPH (418.1)	mg/kg	3	100.00			230.00	1900.00	1276.67	1700.00	

Table F-42 - Open Space Evaluation Unit 1 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	1.81	9.02	10.00	8.16	10.45	11.97	Normal/Lognormal
Copper	mg/kg	27.07	93.76	100.00	77.47	126.64	319.66	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	130.00	391.25	410.00	309.06	549.16	2583.36	Normal/Lognormal
Mercury (inorganic)	mg/kg	0.43	0.94	1.20	0.65	1.47	31.31	Normal/Lognormal
TPH - 418								
TPH (418.1)	mg/kg	911.94	1706.30	1900.00	905.68	2814.07	845688660.71	Normal/Lognormal

Table F-43 - Open Space Evaluation Unit 2 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	45	100.00			6.30	440.00	141.72	110.00	
Lead (and compounds) (inorganic)	mg/kg	50	96.00	5.00	5.90	6.30	12000.00	494.14	35.50	

Table F-43 - Open Space Evaluation Unit 2 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	135.82	155.50	295.89	72.69	175.81	295.89	Unknown
Lead (and compounds) (inorganic)	mg/kg	1765.99	664.21	756.78	55.09	914.71	756.78	Unknown

Table F-44 - Open Space Evaluation Unit 2 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	3	100.00			2.30	120.00	41.63	2.60	
Copper	mg/kg	2	100.00			11.00	14.00	12.50	12.50	

Table F-44 - Open Space Evaluation Unit 2 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	67.87	73.61	120.00	8.95	156.05	.22346841182	Lognormal
Copper	mg/kg	2.12	14.00	14.00	12.41	21.97	27.95	Unknown

Table F-45 - Open Space Evaluation Unit 3 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	16	100.00			4.30	110.00	31.56	22.00	
Lead (and compounds) (inorganic)	mg/kg	6	100.00			20.00	38.00	29.17	30.00	

Table F-45 - Open Space Evaluation Unit 3 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	29.59	36.67	59.57	21.69	44.52	59.57	Lognormal
Lead (and compounds) (inorganic)	mg/kg	7.08	31.27	37.51	28.41	34.99	37.51	Normal/Lognormal

Table F-46 - Open Space Evaluation Unit 3 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	1	100.00			3.80	3.80	3.80	3.80	

Table F-46 - Open Space Evaluation Unit 3 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg			3.80	3.80			Unknown

Table F-47 - Open Space Evaluation Unit 4 (0 to <=1 foot)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Arsenic (inorganic)	mg/kg	17	100.00			9.50	59.00	27.62	25.00	
Lead (and compounds) (inorganic)	mg/kg	7	85.71	5.00	5.00	46.00	101.00	62.21	72.00	

Table F-47 - Open Space Evaluation Unit 4 (0 to <=1 foot)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Arsenic (inorganic)	mg/kg	12.03	29.63	35.50	25.10	32.71	35.50	Normal/Lognormal
Lead (and compounds) (inorganic)	mg/kg	31.84	70.85	101.00	43.42	85.59	1067.07	Normal

Table F-48 - Open Space Evaluation Unit 4 (>1 to <= 15 feet)

Constituent	Units	Number of Samples Analyzed	Frequency of Detection	Minimum Non-Detected Value	Maximum Non-Detected Value	Minimum Detected Value	Maximum Detected Value	Mean	Median	Mode
Metals (Total)										
Lead (and compounds) (inorganic)	mg/kg	3	66.67	5.00	5.00	5.80	22.00	10.10	5.80	

Table F-48 - Open Space Evaluation Unit 4 (>1 to <= 15 feet)

Constituent	Units	Standard Deviation	Alternate	RME	Log Mean	95% UCL	Log 95% UCL	Distribution Test 5% Significance Level
Metals (Total)								
Lead (and compounds) (inorganic)	mg/kg	10.44	15.02	22.00	6.83	27.70	826294.51	Normal/Lognormal

Table F-49 – Comparison of Commercial EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin[(1)]	MTCA UCL Criterion[(2)]	MTCA 2X Criterion[(3)]	COPC
Commercial 1 (0 to <=1 foot)									
Arsenic (inorganic)	58	100	46	60	DW Commercial	10	0.80	6.20	Yes
Benzo(a)Pyrene	4	75	1	13	DW Commercial	0	0.09	0.09	No
Benzo(b)Fluoranthene	4	75	1	126	DW Commercial	0	0.01	0.01	No
Benzo(g,h,i)Perylene	4	100	5	No STD		--	--	--	No
Benzo(k)Fluoranthene	4	25	0	1,260	DW Commercial	0	0.00	0.00	No
Chrysene	4	75	1	12,600	DW Commercial	0	0.00	0.00	No
Copper	10	100	37	90,900	DW Commercial	0	0.00	0.00	No
Lead (and compounds) (inorganic)	74	96	451	118	DW Commercial	60	3.80	28.00	Yes
Mercury (inorganic)	11	64	3	24	DW Commercial	0	0.10	0.10	No
Nitroglycerine	3	33	1	6,580	DW Commercial	0	0.00	0.00	No
Phenanthrene	4	25	0	No STD		--	--	--	No
TPH (418.1)	14	57	10,000	7,600	DW Commercial	7	1.30	1.30	Yes
Commercial 1 (1 to <=15 feet)									
Arsenic (inorganic)	14	100	11	60	DW Commercial	0	0.20	0.40	No
Chrysene	6	17	0	12,600	DW Commercial	0	0.00	0.00	No
Copper	8	100	47	90,900	DW Commercial	0	0.00	0.00	No
Lead (and compounds) (inorganic)	54	80	237	118	DW Commercial	19	2.00	11.00	Yes
Mercury (inorganic)	12	25	0	24	DW Commercial	0	0.01	0.04	No
Motor Oil	1	100	3,000	2,000	DW Commercial	100	1.50	1.50	Yes
Oil And Grease	14	36	418	2,000	DW Commercial	0	0.20	0.30	No
TPH (418.1)	19	37	179	7,600	DW Commercial	0	0.02	0.20	No
Commercial 2 (0 to <=1 foot)									
Arsenic (inorganic)	165	98	41	60	DW Commercial	9	0.70	2.00	No
Copper	2	100	42	90,900	DW Commercial	0	0.00	0.00	No
Lead (and compounds) (inorganic)	150	100	64	118	DW Commercial	11	0.50	2.80	Yes
Mercury (inorganic)	2	50	1	24	DW Commercial	0	0.02	0.02	No

Table F-49 – Comparison of Commercial EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin(1)	MTCA UCL Criterion(2)	MTCA 2X Criterion(3)	COPC
Commercial 2 (1 to <=15 feet)									
Arsenic (inorganic)	4	100	4	60	DW Commercial	0	0.06	0.06	No
Copper	4	100	18	90,900	DW Commercial	0	0.00	0.00	No
Lead (and compounds) (inorgan	4	75	39	118	DW Commercial	0	0.30	0.30	No
TPH (418.1)	4	50	140	7,600	DW Commercial	0	0.02	0.02	No
Commercial 3 (0 to <=1 foot)									
Arsenic (inorganic)	59	100	48	60	DW Commercial	15	0.80	5.80	Yes
Benzo(a)Pyrene	1	100	0	13	DW Commercial	0	0.01	0.01	No
Benzo(b)Fluoranthene	1	100	0	126	DW Commercial	0	0.00	0.00	No
Benzo(g,h,i)Perylene	1	100	0	No STD		--	--	--	No
Benzo(k)Fluoranthene	1	100	0	1,260	DW Commercial	0	0.00	0.00	No
Chrysene	1	100	0	12,600	DW Commercial	0	0.00	0.00	No
Copper	2	100	66	90,900	DW Commercial	0	0.00	0.00	No
Indeno(1,2,3-cd)pyrene	1	100	0	126	DW Commercial	0	0.00	0.00	No
Lead (and compounds) (inorganic)	33	97	852	118	DW Commercial	58	7.20	32.20	Yes
Mercury (inorganic)	2	50	0	24	DW Commercial	0	0.02	0.02	No
Phenanthrene	1	100	0	No STD		--	--	--	No
TPH (418.1)	1	100	450	7,600	DW Commercial	0	0.06	0.06	No
Commercial 3 (1 to <=15 feet)									
Aluminum	2	100	13,000	1,000,000	DW Commercial	0	0.01	0.01	No
Arsenic (inorganic)	4	100	3	60	DW Commercial	0	0.06	0.06	No
Copper	3	100	22	90,900	DW Commercial	0	0.00	0.00	No
Lead (and compounds) (inorganic)	3	67	11	118	DW Commercial	0	0.09	0.09	No
TPH (418.1)	3	33	42	7,600	DW Commercial	0	0.01	0.01	No
Commercial 4 (0 to <=1 foot)									
Arsenic (inorganic)	64	100	62	60	DW Commercial	25	1.00	6.50	Yes
Copper	1	100	22	90,900	DW Commercial	0	0.00	0.00	No

Table F-49 – Comparison of Commercial EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin(1)	MTCA UCL Criterion(2)	MTCA 2X Criterion(3)	COPC
Lead (and compounds) (inorganic)	33	100	132	118	DW Commercial	18	1.10	3.80	Yes
Commercial 4 (1 to <=15 feet)									
Arsenic (inorganic)	2	100	28	60	DW Commercial	0	0.50	0.50	No
Commercial 5 (0 to <=1 foot)									
Aluminum	2	100	24,000	1,000,000	DW Commercial	0	0.02	0.02	No
Arsenic (inorganic)	208	100	52	60	DW Commercial	20	0.90	6.20	Yes
Copper	4	100	21	90,900	DW Commercial	0	0.00	0.00	No
Lead (and compounds) (inorganic)	164	99	86	118	DW Commercial	17	0.70	3.50	Yes
TPH (418.1)	3	33	39	7,600	DW Commercial	0	0.01	0.01	No
Commercial 5 (1 to <=15 feet)									
Aluminum	6	100	14,209	1,000,000	DW Commercial	0	0.01	0.02	No
Arsenic (inorganic)	8	100	45	60	DW Commercial	0	0.80	0.80	No
Copper	6	100	29	90,900	DW Commercial	0	0.00	0.00	No
Lead (and compounds) (inorganic)	14	86	50	118	DW Commercial	0	0.40	1.00	No
Monomethylamine Nitrate	31	23	3,146	19,900	DW Commercial	3	0.20	1.50	No
Oil And Grease	7	86	20,000	2,000	DW Commercial	29	10.00	10.00	Yes
Phenanthrene	11	9	0	No STD		--	--	--	No
TPH (418.1)	18	50	36,000	7,600	DW Commercial	6	4.70	4.70	Yes
Commercial 6 (0 to <=1 foot)									
Arsenic (inorganic)	26	100	57	60	DW Commercial	8	0.90	1.40	No
Lead (and compounds) (inorganic)	5	80	287	118	DW Commercial	20	2.40	2.40	Yes
Commercial 6 (1 to <=15 feet)									
Arsenic (inorganic)	1	100	6	60	DW Commercial	0	0.10	0.10	No
Copper	1	100	8	90,900	DW Commercial	0	0.00	0.00	No
Commercial 7 (0 to <=1 foot)									
Aluminum	1	100	16,000	1,000,000	DW Commercial	0	0.02	0.02	No
Arsenic (inorganic)	42	100	54	60	DW Commercial	21	0.90	2.70	Yes

Table F-49 – Comparison of Commercial EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin(1)	MTCA UCL Criterion(2)	MTCA 2X Criterion(3)	COPC
Copper	1	100	21	90,900	DW Commercial	0	0.00	0.00	No
Lead (and compounds) (inorganic)	78	92	134	118	DW Commercial	17	1.10	8.10	Yes
Trinitrotoluene, 2,4,6-	12	25	0	2	DW Commercial	0	0.10	0.10	No
Commercial 7 (1 to <=15 feet)									
Aluminum	6	100	16,000	1,000,000	DW Commercial	0	0.02	0.02	No
Arsenic (inorganic)	21	100	3	60	DW Commercial	0	0.06	0.10	No
Copper	18	100	552	90,900	DW Commercial	0	0.01	0.30	No
Lead (and compounds) (inorganic)	44	41	281	118	DW Commercial	16	2.40	24.60	Yes
Monomethylamine Nitrate	16	13	3	19,900	DW Commercial	0	0.00	0.00	No
Nitroglycerine	20	5	0	6,580	DW Commercial	0	0.00	0.00	No
Oil And Grease	4	75	93	2,000	DW Commercial	0	0.05	0.05	No
Trinitrotoluene, 2,4,6-	22	36	42	2	DW Commercial	9	24.00	24.00	Yes
Commercial 8 (0 to <=1 foot)									
Arsenic (inorganic)	27	100	72	60	DW Commercial	26	1.20	2.00	Yes
Lead (and compounds) (inorganic)	5	100	402	118	DW Commercial	40	3.40	3.40	Yes
Commercial 8 (1 to <=15 feet)									
Arsenic (inorganic)	1	100	6	60	DW Commercial	0	0.10	0.10	No
Commercial 9 (0 to <=1 foot)									
Arsenic (inorganic)	219	100	36	60	DW Commercial	10	0.60	2.70	Yes
Lead (and compounds) (inorganic)	202	100	51	118	DW Commercial	4	0.40	1.60	No
Commercial 9 (1 to <=15 feet)									
Arsenic (inorganic)	1	100	13	60	DW Commercial	0	0.20	0.20	No

Notes:
(1)Frequency of Exceedence of Standard. A value > 10 triggers MTCA COPC = Yes.
(2)Ratio of RME concentration to Standard. A value > 1 triggers MTCA COPC = Yes.
(3)Ratio of MAX concentration to Standard. A value > 2 triggers MTCA COPC = Yes.

Table F-50 – Comparison of Golf Course EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin(1)	MTCA UCL Criterion(2)	MTCA 2X Criterion(3)	COPC
Golf Course 1 (0 to <=1 foot)									
Arsenic (inorganic)	46	98	63	60	DW Golf Course	15	1.10	6.20	Yes
Copper	3	100	96	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	63	92	1,162	118	DW Golf Course	44	9.90	26.30	Yes
Mercury (inorganic)	19	79	2	24	DW Golf Course	0	0.08	0.10	No
Golf Course 1 (1 to <=15 feet)									
Arsenic (inorganic)	14	100	52	60	DW Golf Course	14	0.90	1.80	Yes
Copper	10	90	43	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	39	72	1,344	118	DW Golf Course	26	11.40	33.90	Yes
Mercury (inorganic)	16	50	1	24	DW Golf Course	0	0.04	0.10	No
TPH (418.1)	2	50	40	7,600	DW Golf Course	0	0.01	0.01	No
Golf Course 2 (0 to <=1 foot)									
Aluminum	2	100	18,000	1,000,000	DW Golf Course	0	0.02	0.02	No
Arsenic (inorganic)	58	100	81	60	DW Golf Course	21	1.40	8.20	Yes
Benzo(a)Anthracene	15	27	3	126	DW Golf Course	0	0.03	0.03	No
Benzo(a)Pyrene	15	27	3	13	DW Golf Course	0	0.20	0.20	No
Benzo(b)Fluoranthene	15	20	3	126	DW Golf Course	0	0.03	0.03	No
Benzo(g,h,i)Perylene	15	47	1	No STD		--	--	--	No
Benzo(k)Fluoranthene	15	20	1	1,260	DW Golf Course	0	0.00	0.00	No
Chrysene	15	53	5	12,600	DW Golf Course	0	0.00	0.00	No
Copper	6	100	98	90,900	DW Golf Course	0	0.00	0.00	No
Dibenz(a,h)anthracene	15	13	0	13	DW Golf Course	0	0.02	0.04	No
Indeno(1,2,3-cd)pyrene	15	27	1	126	DW Golf Course	0	0.01	0.01	No
Lead (and compounds) (inorganic)	49	86	420	118	DW Golf Course	33	3.60	12.70	Yes
Mercury (inorganic)	20	70	100	24	DW Golf Course	15	4.20	4.20	Yes
Phenanthrene	15	27	0	No STD		--	--	--	No
TPH (418.1)	31	55	2,404	7,600	DW Golf Course	0	0.30	0.40	No
Golf Course 2 (1 to <=15 feet)									
Arsenic (inorganic)	24	100	436	60	DW Golf Course	33	7.30	7.30	Yes

Table F-50 – Comparison of Golf Course EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin(1)	MTCA UCL Criterion(2)	MTCA 2X Criterion(3)	COPC
Benzo(b)Fluoranthene	6	17	0	126	DW Golf Course	0	0.00	0.00	No
Benzo(g,h,i)Perylene	6	17	0	No STD		--	--	--	No
Chrysene	6	17	0	12,600	DW Golf Course	0	0.00	0.00	No
Copper	15	93	26	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	56	80	757	118	DW Golf Course	38	6.40	7.80	Yes
Mercury (inorganic)	21	48	8	24	DW Golf Course	0	0.30	0.40	No
Monomethylamine Nitrate	16	6	0	19,900	DW Golf Course	0	0.00	0.00	No
Oil And Grease	16	69	2,200	2,000	DW Golf Course	6	1.10	1.10	Yes
TPH (418.1)	33	55	97	7,600	DW Golf Course	0	0.01	0.05	No
Trinitrotoluene, 2,4,6-	22	5	0	2	DW Golf Course	0	0.00	0.03	No
Golf Course 3 (0 to <=1 foot)									
Aluminum	8	100	18,317	1,000,000	DW Golf Course	0	0.02	0.02	No
Arsenic (inorganic)	63	100	132	60	DW Golf Course	37	2.20	16.20	Yes
Benzo(a)Anthracene	1	100	0	126	DW Golf Course	0	0.00	0.00	No
Benzo(a)Pyrene	1	100	0	13	DW Golf Course	0	0.01	0.01	No
Benzo(b)Fluoranthene	1	100	0	126	DW Golf Course	0	0.00	0.00	No
Benzo(g,h,i)Perylene	1	100	0	No STD		--	--	--	No
Benzo(k)Fluoranthene	1	100	0	1,260	DW Golf Course	0	0.00	0.00	No
Chrysene	1	100	0	12,600	DW Golf Course	0	0.00	0.00	No
Copper	8	100	64	90,900	DW Golf Course	0	0.00	0.00	No
Indeno(1,2,3-cd)pyrene	1	100	0	126	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	47	100	148	118	DW Golf Course	26	1.30	10.20	Yes
Mercury (inorganic)	17	94	6	24	DW Golf Course	0	0.30	0.50	No
Phenanthrene	1	100	0	No STD		--	--	--	No
TPH (418.1)	8	63	89	7,600	DW Golf Course	0	0.01	0.01	No
Golf Course 3 (1 to <=15 feet)									
Aluminum	1	100	6,100	1,000,000	DW Golf Course	0	0.01	0.01	No
Arsenic (inorganic)	3	100	5	60	DW Golf Course	0	0.08	0.08	No
Copper	1	100	330	90,900	DW Golf Course	0	0.00	0.00	No

Table F-50 – Comparison of Golf Course EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin(1)	MTCA UCL Criterion(2)	MTCA 2X Criterion(3)	COPC
Lead (and compounds) (inorganic)	3	33	31	118	DW Golf Course	0	0.30	0.30	No
Mercury (inorganic)	3	33	1	24	DW Golf Course	0	0.04	0.04	No
TPH (418.1)	1	100	44	7,600	DW Golf Course	0	0.01	0.01	No
Golf Course 4 (0 to <=1 foot)									
Arsenic (inorganic)	123	100	86	60	DW Golf Course	33	1.40	6.00	Yes
Benzo(a)Anthracene	11	36	9	126	DW Golf Course	0	0.07	0.07	No
Benzo(a)Pyrene	11	27	6	13	DW Golf Course	0	0.40	0.40	No
Benzo(b)Fluoranthene	11	73	7	126	DW Golf Course	0	0.06	0.06	No
Benzo(g,h,i)Perylene	11	55	4	No STD		--	--	--	No
Benzo(k)Fluoranthene	11	18	3	1,260	DW Golf Course	0	0.00	0.00	No
Chrysene	11	82	14	12,600	DW Golf Course	0	0.00	0.00	No
Copper	8	100	190	90,900	DW Golf Course	0	0.00	0.00	No
Dibenz(a,h)anthracene	11	18	0	13	DW Golf Course	0	0.02	0.02	No
Indeno(1,2,3-cd)pyrene	11	27	0	126	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	59	97	1,300	118	DW Golf Course	41	11.00	211.90	Yes
Mercury (inorganic)	10	70	9	24	DW Golf Course	0	0.40	0.40	No
Oil And Grease	2	100	250	2,000	DW Golf Course	0	0.10	0.10	No
Phenanthrene	11	64	7	No STD		--	--	--	No
TPH (418.1)	19	58	5,600	7,600	DW Golf Course	0	0.70	0.70	No
Golf Course 4 (1 to <=15 feet)									
Arsenic (inorganic)	14	100	34	60	DW Golf Course	7	0.60	1.70	No
Copper	8	100	22	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	53	81	2,500	118	DW Golf Course	57	21.20	21.20	Yes
Mercury (inorganic)	8	38	7	24	DW Golf Course	0	0.30	0.30	No
Oil And Grease	12	42	71	2,000	DW Golf Course	0	0.04	0.05	No
TPH (418.1)	20	10	35	7,600	DW Golf Course	0	0.01	0.07	No
Golf Course 5 (0 to <=1 foot)									
Aluminum	5	100	22,000	1,000,000	DW Golf Course	0	0.02	0.02	No
Arsenic (inorganic)	20	100	66	60	DW Golf Course	10	1.10	3.20	Yes

Table F-50 – Comparison of Golf Course EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin[(1)]	MTCA UCL Criterion[(2)]	MTCA 2X Criterion[(3)]	COPC
Copper	5	100	19	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	10	60	256	118	DW Golf Course	10	2.20	2.60	Yes
Mercury (inorganic)	5	20	0	24	DW Golf Course	0	0.00	0.00	No
Golf Course 5 (1 to <=15 feet)									
Aluminum	13	100	13,484	1,000,000	DW Golf Course	0	0.01	0.02	No
Arsenic (inorganic)	14	100	10	60	DW Golf Course	0	0.20	0.30	No
Copper	13	100	17	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	19	68	43	118	DW Golf Course	0	0.40	0.40	No
Mercury (inorganic)	13	15	0	24	DW Golf Course	0	0.00	0.01	No
Monomethylamine Nitrate	36	22	65	19,900	DW Golf Course	0	0.00	0.05	No
Oil And Grease	6	100	19,000	2,000	DW Golf Course	17	9.50	9.50	Yes
Phenanthrene	12	8	0	No STD		--	--	--	No
TPH (418.1)	17	24	10,000	7,600	DW Golf Course	12	1.30	1.30	Yes
Golf Course 6 (0 to <=1 foot)									
Arsenic (inorganic)	25	100	137	60	DW Golf Course	32	2.30	4.70	Yes
Benzo(a)Anthracene	2	100	0	126	DW Golf Course	0	0.00	0.00	No
Benzo(a)Pyrene	2	100	0	13	DW Golf Course	0	0.00	0.00	No
Benzo(b)Fluoranthene	2	100	0	126	DW Golf Course	0	0.00	0.00	No
Benzo(g,h,i)Perylene	2	50	0	No STD		--	--	--	No
Chrysene	2	50	0	12,600	DW Golf Course	0	0.00	0.00	No
Indeno(1,2,3-cd)pyrene	2	50	0	126	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	15	93	257	118	DW Golf Course	13	2.20	2.20	Yes
Phenanthrene	2	100	0	No STD		--	--	--	No
TPH (418.1)	2	50	84	7,600	DW Golf Course	0	0.01	0.01	No
Trinitrotoluene, 2,4,6-	2	50	0	2	DW Golf Course	0	0.01	0.01	No
Golf Course 6 (1 to <=15 feet)									
Arsenic (inorganic)	8	100	45	60	DW Golf Course	0	0.70	0.80	No
Benzo(a)Anthracene	1	100	0	126	DW Golf Course	0	0.00	0.00	No
Benzo(a)Pyrene	1	100	0	13	DW Golf Course	0	0.01	0.01	No

Table F-50 – Comparison of Golf Course EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin(1)	MTCA UCL Criterion(2)	MTCA 2X Criterion(3)	COPC
Benzo(b)Fluoranthene	1	100	0	126	DW Golf Course	0	0.00	0.00	No
Benzo(k)Fluoranthene	1	100	0	1,260	DW Golf Course	0	0.00	0.00	No
Chrysene	1	100	0	12,600	DW Golf Course	0	0.00	0.00	No
Copper	6	100	52	90,900	DW Golf Course	0	0.00	0.00	No
Dibenz(a,h)anthracene	1	100	0	13	DW Golf Course	0	0.01	0.01	No
Lead (and compounds) (inorganic)	11	46	260	118	DW Golf Course	18	2.20	2.20	Yes
Phenanthrene	1	100	0	No STD		--	--	--	No
Golf Course 7 (0 to <=1 foot)									
Arsenic (inorganic)	50	100	133	60	DW Golf Course	50	2.20	5.80	Yes
Lead (and compounds) (inorganic)	37	100	99	118	DW Golf Course	8	0.80	16.10	Yes
Trinitrotoluene, 2,4,6-	9	11	0	2	DW Golf Course	0	0.09	0.09	No
Golf Course 7 (1 to <=15 feet)									
Arsenic (inorganic)	8	100	13	60	DW Golf Course	0	0.20	0.30	No
Copper	7	100	44	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	21	29	65	118	DW Golf Course	10	0.60	2.50	Yes
Trinitrotoluene, 2,4,6-	10	20	0	2	DW Golf Course	0	0.04	0.04	No
Golf Course 8 (0 to <=1 foot)									
Arsenic (inorganic)	79	100	120	60	DW Golf Course	33	2.00	8.70	Yes
Benzo(a)Anthracene	2	50	0	126	DW Golf Course	0	0.00	0.00	No
Benzo(a)Pyrene	2	50	0	13	DW Golf Course	0	0.00	0.00	No
Chrysene	2	100	0	12,600	DW Golf Course	0	0.00	0.00	No
Copper	2	100	26	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	35	89	106	118	DW Golf Course	14	0.90	2.50	Yes
Mercury (inorganic)	2	50	0	24	DW Golf Course	0	0.00	0.00	No
Phenanthrene	2	50	0	No STD		--	--	--	No
TPH (418.1)	2	100	52	7,600	DW Golf Course	0	0.01	0.01	No
Trinitrotoluene, 2,4,6-	11	36	0	2	DW Golf Course	0	0.20	0.40	No
Golf Course 8 (1 to <=15 feet)									
Arsenic (inorganic)	11	100	7	60	DW Golf Course	0	0.10	0.20	No

Table F-50 – Comparison of Golf Course EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin(1)	MTCA UCL Criterion(2)	MTCA 2X Criterion(3)	COPC
Copper	6	100	24	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	27	22	6	118	DW Golf Course	0	0.05	0.50	No
Trinitrotoluene, 2,4,6-	12	33	0	2	DW Golf Course	0	0.02	0.02	No
Golf Course 9 (0 to <=1 foot)									
Arsenic (inorganic)	32	100	60	60	DW Golf Course	16	1.00	6.70	Yes
Lead (and compounds) (inorganic)	149	96	427	118	DW Golf Course	45	3.60	22.90	Yes
Nitroglycerine	11	9	0	6,580	DW Golf Course	0	0.00	0.00	No
Trinitrotoluene, 2,4,6-	20	20	0	2	DW Golf Course	0	0.07	0.20	No
Golf Course 9 (1 to <=15 feet)									
Arsenic (inorganic)	11	100	10	60	DW Golf Course	0	0.20	0.70	No
Benzo(b)Fluoranthene	1	100	0	126	DW Golf Course	0	0.00	0.00	No
Chrysene	1	100	0	12,600	DW Golf Course	0	0.00	0.00	No
Copper	10	100	28	90,900	DW Golf Course	0	0.00	0.00	No
Lead (and compounds) (inorganic)	59	29	17	118	DW Golf Course	2	0.10	2.80	Yes
Nitroglycerine	77	1	0	6,580	DW Golf Course	0	0.00	0.00	No
Trinitrotoluene, 2,4,6-	77	5	0	2	DW Golf Course	1	0.01	1.40	No

Notes:
(1) Frequency of Exceedence of Standard. A value > 10 triggers MTCA COPC = Yes.
(2) Ratio of RME concentration to Standard. A value > 1 triggers MTCA COPC = Yes.
(3) Ratio of MAX concentration to Standard. A value > 2 triggers MTCA COPC = Yes.
(4) Ecology Agreement for TPH that originated as Bunker C fuel. One area (Area 26 in GC-04 has TPH (418.1) that did not originate form Bunker C fuel. Those TPH data were compared to the MTCA value of 2,000 ng/kg for heavy oils.

Table F-51 – Comparison of Historical EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin[(1)]	MTCA UCL Criterion[(2)]	MTCA 2X Criterion[(3)]	COPC
Historical 1 (0 to <=1 foot)									
Arsenic (inorganic)	3	100	68	32	DW Historical	67	2.10	2.10	Yes
Lead (and compounds) (inorganic)	3	100	190	118	DW Historical	33	1.60	1.60	Yes
Historical 2 (0 to <=1 foot)									
Aldrin	1	100	1	0	DW Historical	100	2.00	2.00	Yes
Aluminum	1	100	15,000	825,000	DW Historical	0	0.02	0.02	No
Arsenic (inorganic)	8	100	73	32	DW Historical	75	2.30	2.30	Yes
Lead (and compounds) (inorganic)	8	100	280	118	DW Historical	25	2.40	2.40	Yes
Oil And Grease	1	100	120	2,000	DW Historical	0	0.06	0.06	No
Historical 3 (0 to <=1 foot)									
Arsenic (inorganic)	8	100	110	32	DW Historical	13	3.40	4.70	Yes
Lead (and compounds) (inorganic)	8	100	450	118	DW Historical	50	3.80	3.80	Yes

Notes:
(1) Frequency of Exceedence of Standard. A value > 10 triggers MTCA COPC = Yes.
(2) Ratio of RME concentration to Standard. A value > 1 triggers MTCA COPC = Yes.
(3) Ratio of MAX concentration to Standard. A value > 2 triggers MTCA COPC = Yes.

Table F-52 – Comparison of Industrial EU to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin (1)	MTCA UCL Criterion(2)	MTCA 2X Criterion (3)	COPC
Industial 1 (0 to <=1 foot)									
Arsenic (inorganic)	134	99	52	90	DW Industrial	9	0.60	2.00	No
Lead (and compounds) (inorganic)	144	98	169	1,000	DW Industrial	2	0.20	2.00	No
Industrial 1 (1 to <=15 feet)									
Aluminum	5	100	14,000	3,500,000	DW Industrial	0	0.00	0.00	No
Arsenic (inorganic)	17	100	12	90	DW Industrial	0	0.10	0.80	No
Benzo(a)Anthracene	15	7	0	180	DW Industrial	0	0.00	0.00	No
Benzo(a)Pyrene	15	7	0	18	DW Industrial	0	0.01	0.01	No
Benzo(b)Fluoranthene	15	7	0	180	DW Industrial	0	0.00	0.00	No
Benzo(g,h,i)Perylene	16	6	0	No STD		--	--	--	No
Benzo(k)Fluoranthene	15	7	0	1,800	DW Industrial	0	0.00	0.00	No
Chrysene	16	6	0	18,000	DW Industrial	0	0.00	0.00	No
Copper	15	100	41	130,000	DW Industrial	0	0.00	0.00	No
Dibenz(a,h)anthracene	16	6	0	18	DW Industrial	0	0.00	0.00	No
Indeno(1,2,3-cd)pyrene	16	6	0	180	DW Industrial	0	0.00	0.00	No
Lead (and compounds) (inorganic)	45	67	60	1,000	DW Industrial	2	0.06	1.50	No
Mercury (inorganic)	15	27	0	24	DW Industrial	0	0.00	0.01	No
Phenanthrene	16	13	0	No STD		--	--	--	No
TPH (418.1)	12	8	38	7,600	DW Industrial	0	0.01	0.03	No
Trinitrotoluene, 2,4,6-	38	8	0	2	DW Industrial	0	0.03	0.10	No

Notes:
(1) Frequency of Exceedence of Standard. A value > 10 triggers MTCA COPC = Yes.
(2) Ratio of RME concentration to Standard. A value > 1 triggers MTCA COPC = Yes.
(3) Ratio of MAX concentration to Standard. A value > 2 triggers MTCA COPC = Yes.

Table F-53 – Comparison of Open Space EUs to Soil Cleanup Levels and Remediation Levels

Constituent	Number of Samples	Frequency of Detection	MTCA UCL	Standard	Standard Description	MTCA 10% Criterioin[(1)]	MTCA UCL Criterion[(2)]	MTCA 2X Criterion[(3)]	COPC
Open Space 1 (0 to <=1 foot)									
Arsenic (inorganic)	4	100	10	32	DW Open Space	0	0.30	0.30	No
Copper	3	100	100	30,500	DW Open Space	0	0.00	0.00	No
Lead (and compounds) (inorganic)	3	100	410	118	DW Open Space	100	3.50	3.50	Yes
Mercury (inorganic)	3	100	1	24	DW Open Space	0	0.05	0.05	No
TPH (418.1)	3	100	1,900	7,600	DW Open Space	0	0.30	0.30	No
Open Space 2 (0 to <=1 foot)									
Arsenic (inorganic)	45	100	296	32	DW Open Space	62	9.20	13.80	Yes
Lead (and compounds) (inorganic)	50	96	757	118	DW Open Space	26	6.40	101.70	Yes
Open Space 2 (1 to <=15 feet)									
Arsenic (inorganic)	3	100	120	32	DW Open Space	33	3.80	3.80	Yes
Copper	2	100	14	30,500	DW Open Space	0	0.00	0.00	No
Open Space 3 (0 to <=1 foot)									
Arsenic (inorganic)	16	100	60	32	DW Open Space	31	1.90	3.40	Yes
Lead (and compounds) (inorganic)	6	100	38	118	DW Open Space	0	0.30	0.30	No
Open Space 3 (1 to <=15 feet)									
Arsenic (inorganic)	1	100	4	32	DW Open Space	0	0.10	0.10	No
Open Space 4 (0 to <=1 foot)									
Arsenic (inorganic)	17	100	36	32	DW Open Space	24	1.10	1.80	Yes
Lead (and compounds) (inorganic)	7	86	101	118	DW Open Space	0	0.90	0.90	No
Open Space 4 (1 to <=15 feet)									
Lead (and compounds) (inorganic)	3	67	22	118	DW Open Space	0	0.20	0.20	No

Notes:
(1) Frequency of Exceedence of Standard. A value > 10 triggers MTCA COPC = Yes.
(2) Ratio of RME concentration to Standard. A value > 1 triggers MTCA COPC = Yes.
(3) Ratio of MAX concentration to Standard. A value > 2 triggers MTCA COPC = Yes.