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Supplemental Human Health Risk Assessment
Source Area Utility Worker

Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

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1.0 INTRODUCTION

MACTEC has prepared this Supplemental Human Health Risk Assessment (HHRA) for the Centredale Manor Restoration Project (CMRP) Superfund Site (Site) in North Providence, Rhode Island, at the request of the United States Environmental Protection Agency (USEPA). This Supplemental HHRA provides evaluations of source area utility worker exposures that were not included in the November 2005 Interim Final Baseline Human Health Risk Assessment, Centredale Manor Restoration Project Superfund Site, North Providence, Rhode Island (MACTEC, 2005). This Supplemental HHRA has been conducted in accordance with the USEPA Risk Assessment Guidance for Superfund (RAGS) Parts A, D, E, and F (USEPA, 1989, 2001a, 2001b, 2009), as well as USEPA Region I risk assessment guidance contained in Risk Updates (USEPA, 1994, 1995, 1999), and the procedures identified in the 2005 Interim Final Baseline HHRA. Therefore, this supplemental HHRA does not repeat the technical summary of the exposure assessment and risk calculation procedures that are contained in that 2005 HHRA. This Supplemental HHRA identifies the receptor scenario, the data used in the risk assessment, and presents the results of the assessment. The 2005 HHRA did not evaluate groundwater exposures and therefore, the process for selection of chemicals of potential concern (COPCs) for groundwater is discussed below. This Supplemental HHRA includes vapor modeling using the Virginia Department of Environmental Quality's model to evaluate exposure of workers to volatiles in a construction/utility trench. Since this model was not utilized in the 2005 HHRA its use is described within this Supplemental HHRA.

The main area of the Site, consisting of approximately 9.04 acres, is located in North Providence, Rhode Island, just south of Route 44 on the eastern bank of the Woonasquatucket River. The main area of the Site is known as 2072 and 2074 Smith Street where currently there are two apartment complexes and three capped areas. The remaining portions of the Site consist of reaches, man-made ponds, and wetlands associated with the Woonasquatucket River. The purpose of this supplemental HHRA is to evaluate potential exposure of a utility worker to groundwater in the Source Area, as shown in Figure 2 of the *Interim Final Baseline Human Health Risk Assessment, Centredale Manor Restoration Project Superfund Site* (MACTEC, 2005).

This report is organized as follows:

Section 2.0 Hazard Identification
Section 3.0 Exposure Assessment
Section 4.0 Toxicity Assessment
Section 5.0 Risk Characterization
Section 6.0 Uncertainty Analysis
Section 7.0 Conclusions

2.0 HAZARD IDENTIFICATION

The objectives of this section are to present an orderly compilation of the available analytical data on the hazardous substances present at the site, to identify data sets suitable for use in a quantitative risk evaluation, and to identify COPCs upon which the quantitative assessment of risk will be based.

This risk assessment is focused on utility worker exposure to groundwater in the Source Area. Data associated with 38 groundwater monitoring wells in the vicinity of the Source Area are evaluated in this risk assessment. The 109 groundwater samples considered here were collected between March 1999 and February 2008. **Table 1** identifies the monitoring wells considered to be representative of source area groundwater. Groundwater samples were analyzed for one or more of the following: volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), dioxins/furans, inorganics, and metals. Thirty-one samples were analyzed for both total metals and inorganics and dissolved metals and inorganics. Four additional groundwater samples were analyzed for total metals only. All available data have been deemed usable and were included in the risk assessment, with the exception of the 2008 LEA VOC results and total metals results. The LEA VOC data were identified by USEPA as suitable for qualitative use only, and, accordingly, will only be used in a qualitative discussion in the Uncertainty Analysis. Because the underlying assumption of the dermal exposure model is that chemicals dissolved in water may diffuse through the skin, dissolved metals and inorganics data are used to characterize dermal exposure in this risk assessment. However, estimates of cancer risk and non-cancer hazard incorporating total metals and inorganics groundwater data are also presented in the Uncertainty Analysis for comparison purposes. The analytical data used in the risk assessment are summarized in **Table 2**.

Analytical results for each of the groundwater samples are presented in **Appendix A**. The selection of COPCs was conducted following USEPA guidance (USEPA, 1989).

Chemicals that are infrequently detected may be artifacts due to sampling, analytical, or other considerations, and may not be related to site operations or disposal practices. Based on RAGS Part A (USEPA, 1989), a chemical is considered for elimination from the quantitative risk assessment if: 1) it is detected infrequently in one or perhaps two environmental media; 2) it is not detected in any other sampled media or at high concentrations; and 3) there is no reason to believe that the chemical may be present. Chemicals that were detected in five percent or less of the samples have not been selected as COPCs. In addition, chemicals with all reported concentrations below screening levels have not been selected as COPCs. The screening level for individual chemicals is the lowest value from among the following: 2010 Regional Screening Levels (RSLs) for tap water, Rhode Island GB Groundwater Standards, Federal Maximum Contaminant Levels (MCL), and Federal Secondary MCLs (SMCLs). In addition, chemicals considered to be essential human nutrients (i.e., aluminum, copper, iron, magnesium, calcium, potassium, and sodium) were not considered in the quantitative risk assessment. Table 2 documents the selection of groundwater COPCs for the Source Area.

3.0 EXPOSURE ASSESSMENT

As defined by the USEPA (USEPA, 1989), exposure to a chemical is the contact of that chemical with the outer boundary of the body (i.e., skin and openings such as mouth, nostrils, or punctures and lesions). An exposure assessment is the quantitative or qualitative evaluation of that contact. It describes the intensity, frequency, and duration of contact, as well as the rates at which the chemical crosses the boundary (chemical intake or uptake rates), the route by which it crosses the boundary, and the resulting amount of chemical that actually crosses the boundary (a dose) and the amount absorbed (internal dose).

The exposure assessment is conducted to evaluate the hypothetical future utility worker that may potentially be present at the Site, the mechanisms or exposure pathways by which those workers may be potentially exposed to contamination at the Site, and the magnitude of exposure that may occur through the potential exposure pathways. This exposure assessment process involves three steps:

1. Characterization of the exposure setting in terms of physical characteristics, current and future uses of the Site, and the utility worker that may be potentially exposed to COPCs under the current and future land uses;
2. Identification of potential exposure pathways and exposure points to which the utility worker may be exposed; and
3. Quantification of exposure for the utility worker in terms of the amount of chemical ingested, inhaled, or absorbed through the skin from all exposure pathways. Exposures are quantified by developing receptor exposure scenarios, identifying exposure point concentrations (EPCs), and then calculating chemical intakes.

Exposure Setting

As mentioned previously, the Source Area of the property includes two apartment buildings and parking lots, as well as three capped areas. There are several utility lines that run under these capped areas including sewer, electric, cable TV/telephone, water, and gas. The focus of this risk assessment is to characterize potential future exposure and associated risk to a utility worker working in this area.

Exposure Pathway and Exposure Points

An exposure pathway describes the course a chemical takes from the source to the exposed individual. Exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine the significant pathways of human exposure. Exposure pathways generally consist of four elements: (1) a source and mechanism of chemical release, (2) a retention or transport medium, (3) a point of potential human contact with the contaminated medium (known as the exposure point), and (4) an exposure route at the contact point (e.g., ingestion of soil, inhalation of volatiles) (USEPA, 1989). In order for the exposure pathway to be considered potentially complete, all elements must be present.

Exposure pathways are identified by considering the activities performed by each potential receptor (e.g. excavating soil), the location of Site-related COPCs (e.g., groundwater), and the fate and transport characteristics of those COPCs (e.g., volatile, fixed). From this information, exposure points may be identified.

For this characterization, a utility worker is evaluated for dermal contact with groundwater and inhalation of vapors from groundwater during excavation and trenching activities.

Exposure Parameters

The utility worker conducting maintenance work or trenching in the Source Area is assumed to be exposed 66 days per year, for one year. Dermal contact is assumed to occur for one hour per day, with an exposed skin surface area of 2,100 square centimeters (cm^2). This assumes exposure to the hands and forearms. An inhalation exposure is assumed to occur for eight hours per day. The utility worker is assumed to have a body weight of 70 kg.

Identification of EPCs

In this conservative (health-protective) assessment, and consistent with USEPA Region 1 guidance, the EPC used in the calculation of risk for groundwater is the maximum detected concentration. Using the maximum detected concentrations represents a reasonable maximum exposure (RME) scenario and estimates a protective, worst-case exposure for the utility worker who could encounter groundwater. However, groundwater is a mobile medium and assuming a receptor would encounter all of the maximum detected concentrations in one location or that groundwater would not be diluted by mixing with other groundwater is not very likely. Therefore, a central tendency exposure (CTE) scenario is presented in the Uncertainty Section, which employs the average groundwater concentration.

Exposure and risks associated with dioxins and furans are evaluated in this risk assessment using the toxic equivalence (TEQ) approach described in Appendix D of the November 2005 *Interim Final Baseline Human Health Risk Assessment, Centredale Manor Restoration Project Superfund Site (MACTEC 2005).* The calculation of TEQ has been conducted using the approach described in *Toxicity Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife* (Van den Berg et al., 1998) and using the toxicity equivalency factors presented in *REVIEW, The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxin and Dioxin-Like Compounds* (Van den Berg et al., 2006).

Only detected dioxin and furan congeners were included in the calculation of TEQ for a given sample. If no dioxin or furan congeners were detected in a given sample, ½ the 2,3,7,8-TCDD detection limit was identified as the TEQ for that sample. RME (maximum detected concentration) and CTE (arithmetic mean concentration) EPCs utilized in this assessment are presented in Table 2.

Consistent with USEPA direction, the Virginia Department of Environmental Quality's model to evaluate exposure of workers to volatiles in a construction/utility trench was employed to estimate representative air concentrations (EPCs) in a trench. These EPCs were used to calculate cancer risk and non-cancer hazard associated with the utility worker's potential exposure to vapors while working in a trench. The default parameters of the trench model assume the trench is 8 feet long, 3 feet wide and 8 feet deep, and assumes vapors migrate from groundwater to air within the trench. Trench model calculations for the RME scenario are presented in **Table 3**.

4.0 TOXICITY ASSESSMENT

4.1 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to characterize the relationship between the level of exposure or the dose of the COPC and the likelihood of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity values (e.g., slope factors, reference dose values, or reference concentrations) are derived that can be used to estimate the likelihood of adverse effects as a function of human exposure to an agent. These toxicity values are used in the risk characterization process to estimate the potential for adverse effects occurring in humans at different exposure levels.

The dose-response relationship(s) for each chemical that has been selected as a COPC is presented in this section. The dose-response information may be divided into two major categories:

- Toxicity information associated with threshold (non-carcinogenic) health effects.
- Toxicity information concerning carcinogenicity, either from human epidemiologic data or from laboratory studies.

All the chemicals selected as COPCs are evaluated for potential *non-carcinogenic* health effects. In addition, any substance considered a *known, probable,* or *possible* human carcinogen is also evaluated for its potential carcinogenic effects. The classification of a chemical as a carcinogen does not preclude an evaluation of that same chemical for potential non-carcinogenic health risks, as all potentially carcinogenic chemicals may also exert non-carcinogenic health effects.

4.1.1 Dose-Response Assessment for Carcinogenic Effects

Historically, it has generally been assumed that carcinogenic effects are non-threshold effects (USEPA, 1989). This means that any dose, no matter how small, is assumed to pose a finite probability of generating a carcinogenic response. However, USEPA does employ both linear low-dose extrapolation models and non-linear (which might be threshold or non-threshold models) low-dose extrapolation models in deriving carcinogenic toxicity values. The 2005 Cancer Risk Guidelines indicate that use "of nonlinear approaches does not imply a biological threshold dose below which the response is zero." Thus, no dose of a carcinogen is thought to be risk-free. For carcinogenic effects, USEPA uses a two-part evaluation in which the substance is first assigned a weight-of-evidence classification, and then a slope factor (SF) or unit risk (UR) is calculated to reflect the carcinogenic potency.

The weight-of-evidence evaluation involves determining the likelihood that the agent is a human carcinogen. USEPA has developed a system for characterizing the overall weight of evidence for a chemical's carcinogenicity based on the availability of animal, human, and other supportive data (USEPA, 1989). The weight-of-evidence classification rates the likelihood that an agent is a human carcinogen. It qualitatively affects the interpretation of potential health risks. Three major factors are considered in characterizing the overall weight-of-evidence for carcinogenicity: (1) the quality of evidence from human studies, (2) the quality of evidence from animal studies, and (3) other supportive information, such as mutagenicity data and structure-activity data.

Per the 2005 USEPA *Guidelines for Carcinogen Risk Assessment* there are five recommended standard hazard descriptors: "*Carcinogenic to Humans*," "*Likely to Be Carcinogenic to Humans*," "*Suggestive*

Evidence of Carcinogenic Potential," "*Inadequate Information to Assess Carcinogenic Potential*," and "*Not Likely to Be Carcinogenic to Humans*."

Much of the information contained in the USEPA Integrated Risk Information System (IRIS), a major source of toxicity values, makes reference to an earlier cancer weight of evidence scheme that includes the following five categories:

Group A - Human Carcinogen. This category indicates there is sufficient evidence from epidemiological studies to support a causal association between an agent and human cancer.

Group B - Probable Human Carcinogen. This category generally indicates there is at least limited evidence from epidemiologic studies of carcinogenicity to humans (Group B1) or that, in the absence of data on humans, there is sufficient evidence of carcinogenicity in animals (Group B2).

Group C - Possible Human Carcinogen. This category indicates that there is limited evidence of carcinogenicity in animals in the absence of data on humans.

Group D - Not Classified. This category indicates that the evidence for carcinogenicity in animals is inadequate.

Group E - No Evidence of Carcinogenicity to Humans. This category indicates that there is evidence of non-carcinogenicity in at least two adequate animal tests in different species or in both epidemiologic and animal studies.

The potential for a chemical to increase the incidence of cancer in a target population is described by one of two values: the carcinogenic SF or the UR. Cancer SFs or URs have typically been identified by USEPA for chemicals in Groups A, B1, and B2. USEPA has historically decided on a case-by-case basis if cancer dose-response values would be identified for chemicals in Group C.

For some chemicals, human epidemiologic data is the basis of an estimate of the carcinogenic potency, although the most common basis of these values is an animal study. The SF is given in units of $(mg/kg/day)^{-1}$ and is based upon the concept of a lifetime average daily dose. Oral SFs are used to estimate the risks associated with exposure to carcinogens via ingestion. No SFs are available for the dermal route of exposure, but are instead calculated from oral SFs using the methodology described in Section 4.1.3.

The inhalation dose-response and exposure-response data used in this HHRA for carcinogenic effects, including SF and UR values, are presented in **Table 4**.

4.1.2 Dose-Response Assessment for Non-carcinogenic Effects

In contrast to carcinogens, non-carcinogens are believed to have threshold exposure levels below which adverse effects are not expected. USEPA has derived standards and guidelines based on acceptable levels of exposure for such compounds. Non-carcinogenic effects of concern on which many of the standards and guidelines are based include liver toxicity, reproductive effects, neurotoxicity, teratogenicity, and other chronic toxicities. Various criteria have been developed from experiments that can be used to estimate the dose-response relationship of non-carcinogens. Some of the same uncertainties involved in deriving cancer risk estimates (namely, selection of an appropriate data set and extrapolation of high-dose animal data to low-dose human exposure) are also involved in deriving non-carcinogenic dose-response criteria. Dose-response values used most often to evaluate non-carcinogenic effects are oral or dermal Reference Doses (RfDs) and inhalation Reference Concentrations (RfCs).

The RfD, expressed in units of mg/kg/day, 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 subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime (USEPA, 1989). When available, the RfD is the dose-response criterion most appropriate for quantitatively estimating non-carcinogenic effects. The RfD is derived from the following equation:

$$RfD\ (mg/kg/day) = \frac{NOAEL\ or\ LOAEL}{UF\ and/or\ MF}$$

The No Observed Adverse Effect Level (NOAEL) represents the dose of a chemical at which there are no statistically or biologically significant differences in the frequency of an adverse effect between the exposed population and its appropriate control. The Lowest Observed Adverse Effect Level (LOAEL) represents the lowest dose at which a statistically significant difference in the frequency of an effect is noted. Both the NOAEL and the LOAEL are reported in terms of mg/kg/day. An uncertainty factor (UF) of ten per type of uncertainty (e.g., extrapolation from animal sensitivity to human sensitivity, relationship between lowest adverse effect level and no adverse effect level) is used to account for interspecies and interspecies differences, severity of the adverse effect, whether the dose was an NOAEL or an LOAEL, and the adequacy of the data. The magnitude of the UF will therefore vary from chemical to chemical, ranging from 10 to 10,000. A modifying factor (MF), ranging from less than 1 to 10 may also be added to reflect qualitative uncertainties not explicitly addressed in the UFs. The toxicity endpoint upon which the RfD is derived and the UF and/or MF used in the calculation are presented in the dose-response tables. No RfDs are available for the dermal route of exposure but are instead calculated from oral RfDs using the methodology described below (USEPA, 2001b).

The use of chronic RfDs to evaluate the potential for adverse health effects resulting from substantially less-than-lifetime exposures may be overly protective. Subchronic RfDs have been developed for many chemicals to evaluate the potential non-carcinogenic effects of limited duration exposures. Subchronic RfDs are similar to chronic RfDs; the distinction is the length of exposure duration. When available, subchronic RfDs/RfCs are used in this risk assessment to evaluate non-carcinogenic effects to a utility worker. When subchronic RfDs are unavailable, chronic RfDs are used to evaluate non-carcinogenic effects for these receptors.

The inhalation dose-response and exposure-response data for non-carcinogenic effects (RfDs and RfCs) and their critical toxic effects are presented in **Table 5**, for both chronic and subchronic effects.

4.1.3 Dermal Dose-Response Values

Cancer SFs and non-cancer RfDs were developed to evaluate risk associated with the dermal contact exposure route. In accordance with USEPA guidance (USEPA, 2001a), dermal dose-response values are calculated from oral dose-response values using an oral absorption factor. The oral absorption factor represents the amount of substance that is absorbed from the gastrointestinal tract following oral administration of a substance. The absorbed dose represents the amount of substance that is potentially available for biological interaction; it is this dose-response relationship that the toxicity of a dermally absorbed substance must be evaluated by. Thus, for potentially carcinogenic substances, the dermal dose-response value is calculated as follows:

$$SF_{dermal} = SF_{oral} / Oral\ ABS$$

The dermal dose-response value for evaluating non-carcinogenic effects is calculated as follows:

$$RfD_{dermal} = RfD_{oral} \times Oral\ ABS$$

The Oral ABS is the fraction of contaminant absorbed in the gastrointestinal tract (dimensionless) in the critical toxicity study. Chemical-specific Oral ABS values are published by USEPA (USEPA, 2001b). In accordance with USEPA guidance (USEPA, 2001b), oral dose-response values are only adjusted using an Oral ABS value if the COPC has an oral ABS value less than 50%. Otherwise, the oral dose-response value is used as the dermal dose-response value. Dermal SFs and RfDs are also presented in **Tables 6** and **7**, respectively.

4.1.4 Sources of Dose-Response Values

Consistent with OSWER Directive 9285.7-53, *Human Health Toxicity Values in Superfund Risk Assessments* (USEPA, 2003), the following hierarchy of sources for dose-response and exposure-response values has been utilized in identifying dose-response values for this HHRA.

Tier 1- Integrated Risk Information System (IRIS), (http://www.epa.gov/iris/). In accordance with USEPA guidance, the main source of dose-response values is IRIS, which is a database established by USEPA containing all validated data on many toxic substances found at hazardous waste Sites. This database was used to identify the SFs and RfDs applied in this risk assessment (USEPA, 2010).

Tier 2- National Center for Environmental Assessment's (NCEA) peer reviewed toxicity values (PRTVs). NCEA's PRTVs are developed by the Superfund Technical Support Center (STSC) for the EPA Superfund program. STSC's reassessment of Health Effects Assessment Summary Tables (HEAST) toxicity values, as well as development of PRTVs in response to Regional or Headquarters Superfund program requests, are consistent with Agency practices on toxicity value development, use the most recent scientific literature, and are supported by both internal and external peer review, providing a high level of confidence in the use of these values in the Superfund Program.

Tier 3 - Other toxicity values

- Cal/EPA's toxicity values. Cal/EPA develops toxicity values for both cancer and non-cancer effects. Cal/EPA toxicity values are obtained on the Cal/EPA website at http://www.oehha.ca.gov/risk/chemicalDB//index.asp.

- The Agency for Toxic Substances and Disease Registry's (ATSDR) Maximum Risk Levels for Hazardous Substances (MRLs) address non-cancer effects only, and are available on the ATSDR website at http://www.atsdr.edc.gov/mrls.html.

- New York State Department of Health (NYSDOH). The NYSDOH has conducted a review of TCE non-cancer inhalation criteria, which is available here: http://www.health.state.ny.us/environmental/chemicals/trichloroethene/docs/cd_tce.pdf.

- Toxicity values remaining in current versions of HEAST (1997).

In this HHRA, the majority of dose-response values used are published in IRIS. For some Site-related COPCs, required dose-response data are only available as NCEA provisional values or from CAL-EPA. These dose-response values were used in this HHRA in order to provide a more complete evaluation of potential risks. Uncertainties related to the absence of dose-response data for COPCs are discussed in the risk assessment Uncertainty Analysis (Section 6).

In addition to toxicity values identified via the hierarchy identified above, New York State Department of Health's peer-reviewed reference concentration for TCE of 10 $\mu g/m^3$ has been selected for use in this risk assessment based on USEPA's recommendation as expressed in comments on a draft of the risk assessment.

Evaluation of Dioxin-Like Compounds in Site Media

The CSF for 2,3,7,8-TCDD is used to evaluate the potential risks associated with the TEQ for dioxin and furan congeners. Specifically, this CSF is applied to the calculated intakes for the dioxin-TEQ (sum of TEQs for individual dioxin and furan compounds). It should be noted that the 1997 HEAST CSF has been used in this HHRA to derive a dermal CSF. Inhalation of volatile dioxins and furans is evaluated with the inhalation unit risk of $3.80 \times 10^{+1}$ $(ug/m^3)^{-1}$ published by the CalEPA. Use of the draft 2003 EPA CSF is discussed in the Uncertainty Section.

5.0 RISK CHARACTERIZATION

For each COPC in each exposure media, excess lifetime cancer risk (ELCR) and a non-cancer Hazard Quotient has been calculated using the procedures described in the 2005 Interim Final Baseline Human Health Risk Assessment (MACTEC, 2005). The risks associated with individual COPCs were summed for each exposure medium and the risks for the exposure media were then summed to yield total groundwater-related cancer risk and total Hazard Index (HI) for the utility worker scenarios. These total risks are compared to the Superfund allowable cancer risk range of 10^{-6} to 10^{-4} and the HI benchmark of 1. Total cancer risk (7×10^{-4}) and HI (31) for the utility worker under the RME scenario are higher than the associated Superfund risk management values. Dermal exposure contributed a slightly higher cancer risk than did the inhalation pathway, however, inhalation exposure contributed a higher non-cancer risk

than did the dermal pathway. Inhalation exposure to volatiles released from groundwater during excavation activities contributed a cumulative ELCR of 3×10^{-4} and an HI of 28. The primary ELCR contributors were PCE (3×10^{-4}), dioxin TEQ (5×10^{-5}), and TCE (4×10^{-6}). The primary HI contributors were TCE (HQ = 14), PCE (HQ = 11), and dioxin TEQ (HQ = 2). A cancer risk of 4×10^{-4} and an HI of 3 were estimated for the dermal contact pathway. The primary ELCR contributor was PCE (2×10^{-4}), followed by dioxin TEQ (1×10^{-4}). The compound 2,4,6-trichlorophenol was the primary contributor to the HI (HQ = 2), followed by TCE (HQ = 1).

Table 8 presents the cancer risk and non-cancer hazard calculations for the current/future utility worker exposed to groundwater via direct dermal contact and inhalation of ambient vapors while working in a trench. **Table 9** summarizes the cancer risks and non-cancer hazards, and identifies cumulative non-cancer hazard for each target organ.

6.0 UNCERTAINTY ANALYSIS

Maximum detected concentrations were utilized as EPCs in the risk characterization (RME scenario) to determine a worst-case scenario for the utility worker who might come into contact with groundwater. However, groundwater is a mobile medium and assuming a receptor would encounter all of the maximum detected concentrations in one location or that it would not be diluted by mixing with other groundwater isn't very likely. Therefore, a central tendency exposure (CTE) scenario was also evaluated as a more realistic scenario.

Using average concentrations along with the same exposure parameters used in the RME scenario, such as exposure frequency and duration, overall cancer risk and hazard index for the utility worker are 3×10^{-5} and 2. In other words, for the CTE scenario, the total cancer risk falls within the Superfund risk range and the total HI is slightly greater than 1. Inhalation exposure to volatiles released from groundwater during excavation activities resulted in CTE cumulative cancer risk and non-cancer hazard index estimates of 1×10^{-5} (within the EPA cancer risk range) and 1 (equal to the non-cancer hazard risk limit), respectively. All non-cancer hazard quotients were below EPA's hazard limit of 1. A cancer risk of 2×10^{-5} and an HI of 0.1 were estimated for the dermal contact pathway. The primary contributors to risk

were dioxin TEQ (1×10^{-5}), followed by PCE (6×10^{-6}). All non-cancer hazards were below EPA's hazard limit of 1.

Table 10 presents the cancer risk and non-cancer hazard calculations for the current/future utility worker exposed to average groundwater concentrations via direct dermal contact and inhalation of ambient vapors while working in a trench. **Table 11** summarizes the cancer risks and non-cancer hazards, and identifies cumulative non-cancer hazard to target organs.

If the 2008 LEA VOC results (determined by USEPA to be of value only for qualitative evaluation) had been utilized in the risk characterization, cancer risk and HI estimates would have been much higher (total cancer risk = 2×10^{-3} and HI = 181). Dermal and inhalation exposures would have contributed near equal cancer risks, however, the inhalation exposure would have contributed a higher non-cancer hazard than the dermal pathway. Inhalation of vapors would contribute a cancer risk and hazard index of 1×10^{-3} and 168, respectively. PCE (9×10^{-4}), dioxin TEQ (5×10^{-5}), TCE (4×10^{-5}) and vinyl chloride (2×10^{-6}) would have been the greatest contributors to cancer risk, while TCE (HQ = 126), PCE (HQ = 40), and dioxin TEQ (HQ = 2) would have been the significant contributors to hazard. PCE (8×10^{-4}) would have contributed the most dermal cancer risk as well, followed by dioxin TEQ (1×10^{-4}). TCE (HQ = 11) would have been the primary contributor to non-cancer hazard, followed by 2,4,6-trichlorophenol (HQ = 2), and PCE (HQ = 1).

Table 12 presents the cancer risk and non-cancer hazard calculations for the current/future utility worker exposed to all groundwater, including LEA VOC data via direct dermal contact and inhalation of ambient vapors while working in a trench. **Table 13** summarizes the cancer risks and non-cancer hazards, and identifies cumulative non-cancer hazard to each target organ.

This assessment utilized the 2,3,7,8-TCDD oral SF of $1.5 \times 10^{+5}$ $(mg/kg/day)^{-1}$ to calculate cancer risk associated with dioxin/furan TEQ. This value is taken from HEAST 1997 and was also used in the 2005 Human Health Risk Assessment for this site. The uncertainty analysis of the 2005 Human Health Risk Assessment evaluated the potential impact of using an alternative oral SF that was included in the 2003 USEPA draft dioxin reassessment ($1 \times 10^{+6}$ $(mg/kg/day)^{-1}$). The 2003 draft dioxin reassessment has never been finalized. To be consistent with the uncertainty analysis of the 2005 Human Health Risk

Assessment, the potential impact of using the alternative oral CSF has also been evaluated here. Had the alternative SF of $1 \times 10^{+6}$ $(mg/kg/day)^{-1}$ for dioxin been utilized in this characterization, the RME total dermal risk (not including LEA VOC data) would have increased from 4×10^{-4} to 1×10^{-3}, and the total risk due to groundwater exposure would have increased from 7×10^{-4} to 2×10^{-3}. If the same calculations incorporating the 2003 dioxin TEQ slope factor had been conducted for the CTE scenario (not including LEA VOC data), total dermal risk would have increased from 2×10^{-5} to 9×10^{-5}, and the total risk due to groundwater exposure would have increased from 3×10^{-5} to 1×10^{-4}. Because the ELCR is above the Superfund allowable cancer risk range upper limit of 1×10^{-4} for both CSFs evaluated under the RME scenario, and the ELCR does not exceed the Superfund allowable cancer risk range upper limit of 1×10^{-4} for both CSFs evaluated under the CTE scenario, the cancer slope factor change has minimal impact on the overall outcome of the characterization. RME risk calculations incorporating the alternative dioxin TEQ slope factor are presented in **Appendix B**.

The risk assessment utilized dissolved metals and inorganics groundwater data to evaluate dermal exposures and risks. Calculations of dermal exposures and risks have also been performed using total metals and inorganics groundwater data for the purposes of this uncertainty analysis. If total metals results had been used to calculate risks instead of dissolved metals results, arsenic would have been included as a COPC, and chromium, nickel and thallium would not have been retained as COPCs. Risk calculations using total metals and inorganics results are included in **Appendix C**. Despite the different COPC list and slightly different EPC values, however, there would have been no change to overall cancer risk or non-cancer hazard estimates. For example, the RME dermal cancer risk and non-cancer hazard index for all groundwater constituents were 4×10^{-4} and 3, respectively, when dissolved metals data are used (Table 8) and when total metals data were used (Table C-1). Therefore, the selection of dissolved metals and inorganics data instead of total metals and inorganics data for evaluating dermal exposure has no impact on the calculated risks or associated conclusion.

When using the OSWER hierarchy for toxicity values to determine appropriate toxicity values to be used in the risk characterization, EPA has identified two external peer-reviewed values appropriate to be considered as potential Tier 3 non-cancer toxicity values for TCE. These two values come from CalEPA, with a reference exposure level (REL) of 600 ug/m^3, and the New York State Department of Health

(NYSDOH 2006), with an air criterion of 10 ug/m^3. CalEPA's REL is based on a pre-2000 review of literature and self-reported symptoms, such as neurological effects and eye irritation, in 19 workers over an average of eight years of exposure. Uncertainty associated with the CalEPA evaluation of TCE's non-cancer toxicity is due to the lack of reproductive and developmental toxicity studies and the lack of a no effect level. The NYSDOH's TCE air criterion was based on a pre-2007 review of literature on non-cancer health effects, neurological effects measured among 99 workers who were exposed for 11 year, and more recently published studies. Uncertainty associated with NYSDOH's evaluation of TCE's non-cancer toxicity is due to data gaps on developmental effects and immunotoxicity.

Since the NYSDOH value is based on a significantly larger number of study subjects, a more extensive presentation of health endpoints, a more recent evaluation of the available health effects literature, and uses objective clinical neurological measurements compared to the CalEPA REL basis of self-reported symptoms, EPA recommends using the NYSDOH's reference concentration to quantify non-cancer inhalation risk for TCE.

The RME assessment is based on the maximum detected concentration of each compound for all of the available groundwater data that are suitable for use in risk assessment. While it is possible that maximum concentrations could be encountered during excavation activities, it is likely that a lower concentration would be more representative of exposure over the entire excavation period, due to the mobility and mixing of groundwater. In addition, the assumed 66 days of utility worker exposure to shallow groundwater is likely to overestimate rather than underestimate the exposure duration, as it would be rare that an excavation containing exposed groundwater would remain open for that period of time.

The maximum reported PCE concentration in groundwater is the most significant contributor to cancer risk for the RME scenario. That maximum concentration (61 mg/L) was reported in a sample from MW-05S that was collected in 2002. PCE concentrations in samples from that well were 28 mg/L in 2003 And 17 mg/L in 2005. These data suggest that PCE concentrations are decreasing in that well over time and that the maximum reported concentration may substantially overestimate future exposure levels. In addition, PCE concentrations in samples from all other monitoring wells have been substantially lower than those in samples from MW-05S. This indicates that utility worker activity in all portions of the source area other than the area of MW-05S would likely result in exposure levels and risks that are

substantially lower than those identified based on the PCE data for monitoring well MW-05S. This suggests the CTE exposure scenario (using the arithmetic mean concentrations in groundwater samples) is a more practical estimate of utility worker activity and exposures.

Additional uncertainty is associated with use of Virginia DEQ's trench model. Isopropyl alcohol is not included in this model, and, therefore, risks and hazards due to inhalation of this chemical were not quantified. This is expected to have a minimal impact on risk estimates. The model also assumes default trench dimensions and uses a default air exchange rate. If future excavation activities were conducted, the trench size could vary substantially from the default dimensions, and meteorological conditions could affect air exchange rates. The model likely overestimates exposure.

The RME utility worker scenario for dermal contact with and inhalation of volatiles from groundwater is considered a conservative (health protective) scenario because industry health and safety practices would generally be implemented to minimize or eliminate potential for dermal contact with contaminated groundwater, and either personal protective equipment or engineering controls (venting of the subsurface environment or fresh air replacement in the excavation) would likely be implemented for excavations in areas of known groundwater contamination.

Although it is possible that risks were underestimated for some COPCs because toxicity data are not available for all COPCs, toxicity values are available for those chemicals considered to be of most concern. The assessment is still considered to be health-protective.

7.0 CONCLUSIONS

In the absence of health and safety measures to minimize or eliminate exposures to utility workers, RME cancer risk (7×10^{-4}) and HI (31) estimates related to potential future skin contact with groundwater and inhalation of volatiles potentially released from groundwater are above the Superfund cancer risk range and the Hazard Index benchmark value of one. However, when more realistic CTE exposures are evaluated using an average groundwater concentration, cancer risk (3×10^{-5}) falls within EPA's risk range, and non-cancer hazard (2) is slightly above EPA's HI benchmark of one.

8.0 REFERENCES

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TABLES

SUPPLEMENTAL UTILITY WORKER RISK ASSESSMENT

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Table 1
Monitoring Wells Considered Representative of Source Area Groundwater

Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Monitoring Well
GEC1
GEC2
GEC3
GEC4
GEC5
GEC6
GEC7
MW01S
MW02D
MW02M
MW02S
MW03S
MW04B
MW04D
MW04S
MW05S
MW-05S
MW06S
MW07D
MW07S
MW08S
MW09S
MW10B
MW10D
MW11B
MW11M
MW11S
MW12B
MW12D
MW13B
MW13D
MW13S
MW14M
MW15D
MW-LEA-01
MW-LEA-02
MW-LEA-03
TMW3

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Table 2
Selection of Chemicals of Potential Concern

Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Parameter (1)	Frequency of Detection	Range of Reporting Limits for Non-Detects	Range of Detection Concentrations	Maximum Detection Location	Average of All Samples (2)	USEPA Screening Value (3)	RI Screening Value (3)	MCL (mg/L)	SMCL (mg/L)	Potential ARARs (4)	Selected as a COPC? (5)	Rationale
Volatile Organics (mg/L)											Yes	
1,2,4-Trimethylbenzene	2 / 34	0.001 - 1	0.0021 - 0.093	MW08S	0.034	0.0015 n					Yes	ASL
1,3,5-Trimethylbenzene	2 / 35	0.001 - 1	0.025 - 0.061	MW08S	0.033	0.037 n					Yes	ASL
1,4-Dichlorobenzene	4 / 65	0.001 - 1.7	0.00053 - 0.005	MW06S	0.032	0.00043 c		0.075		0.075 MCL	Yes	ASL
Benzene	11 / 72	0.001 - 1.7	0.001 - 0.021	MW09S	0.029	0.00041 c	0.14	0.005		0.005 MCL	Yes	ASL
Chlorobenzene	13 / 65	0.001 - 1.7	0.00031 - 0.16	MW06S	0.038	0.0091 n	3.2	0.1		0.1 MCL	Yes	ASL
Chloroform	4 / 65	0.001 - 1.7	0.00025 - 0.0041	MW10D	0.032	0.00019 c		0.08		0.08 MCL	Yes	ASL
cis-1,2-Dichloroethene	18 / 72	0.001 - 0.1	0.00048 - 1.6	MW05S	0.057	0.037 n	2.4	0.07		0.07 MCL	Yes	ASL
Ethylbenzene	4 / 65	0.001 - 1.7	0.001 - 0.007	MW06S	0.032	0.0015 c	1.6	0.7		0.7 MCL	Yes	ASL
Isopropyl Alcohol	4 / 4		0.006 - 0.07	GEC2	0.034						Yes	NSL
Methylcyclohexane	2 / 31	0.01 - 1.7	0.005 - 0.013	MW06S	0.033						Yes	NSL
Tetrachloroethene	33 / 72	0.001 - 0.021	0.00021 - 61	MW05S	1.5	0.00011 c	0.15	0.005		0.005 MCL	Yes	ASL
Total Xylenes	6 / 38	0.001 - 1.7	0.003 - 0.069	MW06S	0.029	0.02 n		10		10 MCL	Yes	ASL
Trichloroethene	25 / 72	0.001 - 0.1	0.00031 - 2.5	MW05S	0.083	0.002 c	0.54	0.005		0.005 MCL	Yes	ASL
Vinyl Chloride	10 / 72	0.001 - 1.7	0.00039 - 0.027	GEC4	0.030	0.000016 c		0.002		0.002 MCL	Yes	ASL
Semivolatile Organics (mg/L)											Yes	
2,4,6-Trichlorophenol	2 / 31	0.01 - 0.014	0.002 - 2.9	MW05S	0.098	0.0037 n					Yes	ASL
Benzo(a)anthracene	5 / 38	0.00012 - 0.014	0.00018 - 0.0037	GEC3	0.0043	0.000029 c					Yes	ASL
Benzo(b)fluoranthene	5 / 38	0.00012 - 0.014	0.00014 - 0.0025	GEC3	0.0042	0.000029 c					Yes	ASL
Benzo(k)fluoranthene	5 / 38	0.00012 - 0.014	0.00015 - 0.0029	GEC3	0.0043	0.00029 c					Yes	ASL
Bis(2-ethylhexyl)phthalate	4 / 31	0.01 - 0.014	0.001 - 0.031	MW13D	0.0055	0.0048 c		0.006		0.006 MCL	Yes	ASL
Chrysene	5 / 38	0.00012 - 0.014	0.00022 - 0.0039	GEC3	0.0043	0.0029 c					Yes	ASL
Indeno(1,2,3-cd)pyrene	3 / 38	0.00012 - 0.014	0.00025 - 0.002	GEC3	0.0042	0.000029 c					Yes	ASL
Naphthalene	5 / 38	0.00012 - 0.014	0.00013 - 0.011	MW05S	0.0042	0.00014 c*					Yes	ASL
Dioxins/Furans (mg/L)											Yes	
1,2,3,4,6,7,8-HpCDD	3 / 37	6.4E-10 - 1.0E-08	2.9E-09 - 5.3E-09	MW02S	2.3E-09						Yes	NSL
1,2,3,4,7,8,9-HpCDF	2 / 37	2.1E-10 - 5.7E-09	2.0E-09 - 3.6E-09	MW07D	1.4E-09						Yes	NSL
1,2,3,4,7,8-HxCDD	2 / 37	4.8E-10 - 1.8E-08	1.8E-09 - 4.2E-09	MW07D	1.7E-09						Yes	NSL
1,2,3,4,7,8-HxCDF	5 / 37	5.7E-10 - 2.2E-08	6.7E-10 - 3.4E-09	MW13D	1.7E-09						Yes	NSL
1,2,3,6,7,8-HxCDD	2 / 37	4.6E-10 - 1.7E-08	1.8E-09 - 4.0E-09	MW07D	1.7E-09						Yes	NSL
1,2,3,6,7,8-HxCDF	2 / 37	8.0E-10 - 2.0E-08	1.6E-09 - 4.4E-09	MW07D	1.5E-09						Yes	NSL
1,2,3,7,8,9-HxCDD	2 / 37	4.6E-10 - 1.7E-08	3.8E-09 - 4.2E-09	MW07D	1.7E-09						Yes	NSL
1,2,3,7,8,9-HxCDF	3 / 37	9.0E-10 - 2.6E-08	3.0E-09 - 5.1E-09	MW07D	1.9E-09						Yes	NSL
1,2,3,7,8-PeCDD	7 / 37	8.0E-10 - 6.1E-09	1.5E-09 - 4.2E-07	MW05S	2.1E-08						Yes	NSL
1,2,3,7,8-PeCDF	4 / 37	7.0E-10 - 8.0E-09	2.3E-09 - 3.8E-09	MW07D	1.4E-09						Yes	NSL
1,2,4,5,7,8-hexachloro(9h)xanthene	1 / 1		2.7E-07 - 2.7E-07	MW05S	2.7E-07						Yes	NSL
2,3,4,6,7,8-HxCDF	4 / 37	7.0E-10 - 2.3E-08	1.4E-09 - 3.7E-09	MW07D	1.6E-09						Yes	NSL
2,3,4,7,8-PeCDF	4 / 37	6.0E-10 - 7.1E-09	6.0E-10 - 3.5E-09	MW04D	1.2E-09						Yes	NSL
2,3,7,8-TCDD	18 / 37	1.2E-09 - 5.7E-09	1.2E-09 - 4.2E-06	MW05S	3.5E-07	5.2E-10 c*		3E-08		3E-08 MCL	Yes	ASL
2,3,7,8-TCDF	4 / 37	3.4E-10 - 3.8E-09	1.8E-09 - 1.1E-08	GEC6	1.3E-09						Yes	NSL
OCDD	16 / 37	3.7E-10 - 2.2E-08	3.2E-09 - 5.2E-08	MW02S	8.7E-09						Yes	NSL
OCDF	7 / 37	3.1E-10 - 2.1E-08	3.9E-09 - 3.2E-08	MW13D	4.7E-09						Yes	NSL
TEQ	32 / 37	1.6E-09 - 3.1E-09	1.2E-12 - 4.4E-06	MW05S	3.7E-07	5.2E-10 c*		3E-08		3E-08 MCL	Yes	ASL
Total HpCDD	6 / 37	6.4E-10 - 1.0E-08	2.9E-09 - 1.1E-08	MW02S	3.0E-09						Yes	NSL
Total HpCDF	5 / 37	2.0E-10 - 1.1E-08	1.4E-09 - 7.6E-09	MW07D	2.0E-09						Yes	NSL
Total HxCDD	16 / 37	3.1E-10 - 1.2E-08	6.9E-09 - 3.1E-08	MW12D	8.4E-09						Yes	NSL
Total HxCDF	14 / 37	5.7E-10 - 1.7E-08	6.7E-10 - 1.9E-07	MW05S	1.7E-08						Yes	NSL
Total PeCDD	17 / 37	9.7E-10 - 8.9E-09	2.7E-09 - 9.8E-06	MW-LEA-01	4.5E-07						Yes	NSL

Table 2
Selection of Chemicals of Potential Concern

Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Parameter (1)	Frequency of Detection	Range of Reporting Limits for Non-Detects	Range of Detection Concentrations	Maximum Detection Location	Average of All Samples (2)	USEPA Screening Value (3)		RI Screening Value (3)	MCL (mg/L)	SMCL (mg/L)	Potential ARARs (4)		Selected as a COPC? (5)	Rationale
Total PeCDF	12 / 37	7.0E-10 - 1.9E-08	6.0E-10 - 1.1E-06	MW05S	1.1E-07								Yes	NSL
Total TCDD	25 / 37	1.6E-09 - 1.1E-08	2.3E-09 - 4.5E-06	MW05S	3.7E-07								Yes	NSL
Total TCDF	23 / 37	7.5E-10 - 1.1E-08	1.1E-09 - 2.7E-06	MW05S	1.0E-07								Yes	NSL
Dioxins/Furans, Filtered (mg/L)													Yes	
2,3,7,8-TCDD	1 / 4	1.9E-09 - 1.5E-08	7.3E-07 - 7.3E-07	MW-LEA-02	1.8E-07	5.2E-10	c*		3E-08		3E-08	MCL	Yes	ASL
Total PeCDD	1 / 4	2.4E-09 - 1.6E-08	1.1E-07 - 1.1E-07	MW-LEA-01	3.1E-08								Yes	NSL
Total PeCDF	1 / 4	1.9E-09 - 8.3E-09	2.2E-07 - 2.2E-07	MW-LEA-01	5.7E-08								Yes	NSL
Total TCDD	1 / 4	1.9E-09 - 1.5E-08	7.3E-07 - 7.3E-07	MW-LEA-02	1.8E-07								Yes	NSL
Metals, Total (mg/L)													Yes	
Aluminum	16 / 31	0.0356 - 0.146	0.0545 - 0.756	MW08S	0.14	3.7	n			0.05	0.05	SMCL	Yes	ASL
Arsenic	3 / 35	0.002 - 0.008	0.0058 - 0.02	GEC6	0.0028	0.000045	c		0.01		0.01	MCL	Yes	ASL
Cobalt	13 / 31	0.0007 - 0.0062	0.00085 - 0.0356	MW05S	0.0047	0.0011	n						Yes	ASL
Lead	6 / 35	0.0013 - 0.07	0.0027 - 0.07	GEC6	0.0070				0.015		0.015	MCL	Yes	ASL
Manganese	31 / 31		0.0522 - 5.53	MW09S	1.13	0.088	n			0.05	0.05	SMCL	Yes	ASL
Vanadium	7 / 31	0.0007 - 0.0032	0.0014 - 0.0387	MW03S	0.0028	0.00026	n						Yes	ASL
Metals, Dissolved (mg/L)													Yes	
Aluminum	7 / 31	0.01 - 0.108	0.0693 - 0.509	MW08S	0.060	3.7	n			0.05	0.05	SMCL	Yes	ASL
Chromium	7 / 31	0.0005 - 0.0224	0.0026 - 0.114	MW13B	0.0071				0.1		0.1	MCL	Yes	ASL
Cobalt	10 / 31	0.0007 - 0.0076	0.0007 - 0.0144	MW02M	0.0029	0.0011	n						Yes	ASL
Lead	3 / 31	0.0013 - 0.0148	0.0023 - 0.0277	MW03S	0.0020				0.015		0.015	MCL	Yes	ASL
Manganese	31 / 31		0.0355 - 5.59	MW09S	1.12	0.088	n			0.05	0.05	SMCL	Yes	ASL
Nickel	14 / 31	0.0011 - 0.0322	0.0016 - 0.0826	MW13B	0.0094	0.073	n						Yes	ASL
Thallium	3 / 31	0.0056 - 0.0062	0.0062 - 0.0069	MW09S	0.0032				0.002		0.002	MCL	Yes	ASL
Vanadium	6 / 31	0.0007 - 0.0032	0.0017 - 0.0362	MW03S	0.0025	0.00026	n						Yes	ASL
Inorganics (mg/L)													Yes	
Total Dissolved Solids	4 / 4		180 - 730	MW-LEA-02	418					500	500	SMCL	Yes	ASL
Total Dissolved Solids (unfiltered)	4 / 4		210 - 740	MW-LEA-02	438					500	500	SMCL	Yes	ASL
Total Suspended Solids (unfiltered)	2 / 4	1 - 1	2 - 14.6	MW-LEA-03	4.4								Yes	NSL
Alkalinity	31 / 31		9 - 570	MW08S	83.2								Yes	NSL
Sulfide	8 / 31	1 - 100	2 - 6	MW05S	5.3								Yes	NSL
Total Organic Carbon	31 / 31		1 - 35	MW09S	9.9								Yes	NSL

(1) Samples and data used in this summary are provided in Appendix A. Results from monitoring wells MW-LEA-1 through MW-LEA-3 are included in Appendix A, but were not used for creation of this table.
(2) Average concentration is the arithmetic mean calculated using 1/2 the detection limit for non-detects.
(3) USEPA Screening value is the Tapwater RSL (May 2010) for the lesser of cancer risks equal to 1E-06 or non-cancer risks equal to a hazard index of 0.1.
RSL for pyrene used for acenaphthylene, benzo(ghi)perylene, and phenanthrene.
RI Screening Value is the Rhode Island GB.
(4) There ARAR values are the Federal MCL, Federal SMCL.
(5) Parameter is selected as a COPC if the maximum detected concentration is greater than the identified screening value (or if a screening level is not available) unless the frequency of detection for that parameter is less than 5%.
ASL - Maximum detected concentration is above screening level.
BSL - Maximum detected concentration is below screening level
FOD - Frequency of detection less than 5%.
E - Essential Nutrient
NSL - No screening level available.
c - cancer
c* - wherethe non-cancer screening level is less than 100 times the cancer screening level
n - non-cancer value

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Checked by / Date: KASK 08/13/10

mg/L - milligrams per liter
COPC - Chemical of Potential Concern
ARAR - Applicable or Relevant and Appropriate Requirements

Table 3
Calculation of Ambient Air Concentrations in a Trench - Current/Future Utility Worker - RME

Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	CAS No.	Molecular Weight MWi g/mol	Henry's Law Constant Hi atm-m3/mol	Gas-Phase Mass Transfer Coefficient KiG cm/s	Liquid-Phase Mass Transfer Coefficient KiL cm/s	Overall Mass Transfer Coefficient Ki cm/s	Concentration of Contaminant in Groundwater Cgw ug/L	Volatilization Factor VF L/m3	Concentration of Contaminant in Trench Ctrench ug/m3	Concentration of Contaminant in Trench Ctrench mg/m3
TAL Inorganics										
Aluminum	7429-90-5	26.98					5.09E+02			
Chromium	7440-47-3	52.00					1.14E+02			
Cobalt	7440-48-4	58.93					1.44E+01			
Lead	7439-92-1	207.20					2.77E+01			
Manganese	7439-96-5	54.94					5.59E+03			
Nickel	7440-02-0	58.69					8.26E+01			
Thallium	7440-28-0	204.38					6.90E+00			
Vanadium	7440-62-2	50.94					3.62E+01			
TCL Volatile Organic Compounds (VOCs)										
Benzene	71-43-2	78.11	5.55E-03	5.09E-01	1.28E-03	1.27E-03	2.10E+01	9.35E+00	1.96E+02	1.96E-01
Chlorobenzene	108-90-7	112.56	3.70E-03	4.51E-01	1.07E-03	1.05E-03	1.60E+02	7.75E+00	1.24E+03	1.24E+00
Chloroform	67-66-3	119.38	3.67E-03	4.42E-01	1.04E-03	1.02E-03	4.10E+00	7.53E+00	3.09E+01	3.09E-02
1,4-Dichlorobenzene	106-46-7	147.00	2.43E-03	4.12E-01	9.33E-04	9.12E-04	5.00E+00	6.74E+00	3.37E+01	3.37E-02
cis-1,2-Dichloroethene	156-59-2	96.94	4.08E-03	4.74E-01	1.15E-03	1.13E-03	1.60E+03	8.36E+00	1.34E+04	1.34E+01
Ethylbenzene	100-41-4	106.17	7.88E-03	4.60E-01	1.10E-03	1.09E-03	7.00E+00	8.05E+00	5.63E+01	5.63E-02
Methylcyclohexane	108-87-2	98.19	4.30E-01	4.72E-01	1.14E-03	1.14E-03	1.30E+01	8.43E+00	1.10E+02	1.10E-01
Tetrachloroethene	127-18-4	165.83	1.84E-02	3.96E-01	8.79E-04	8.76E-04	6.10E+04	6.47E+00	3.94E+05	3.94E+02
Trichloroethene	79-01-6	131.39	1.03E-02	4.28E-01	9.87E-04	9.82E-04	2.50E+03	7.25E+00	1.81E+04	1.81E+01
Vinyl Chloride	75-01-4	62.50	2.70E-02	5.49E-01	1.43E-03	1.43E-03	2.70E+01	1.05E+01	2.85E+02	2.85E-01
Total Xylenes	1330-20-7	106.16	5.18E-03	4.60E-01	1.10E-03	1.09E-03	6.90E+01	8.02E+00	5.53E+02	5.53E-01
Other VOCs										
1,2,4-trimethylbenzene	95-63-6	120.19	6.16E-03	4.41E-01	1.03E-03	1.02E-03	9.30E+01	7.55E+00	7.02E+02	7.02E-01
1,3,5-trimethylbenzene	108-67-8	120.19	8.77E-03	4.41E-01	1.03E-03	1.03E-03	6.10E+01	7.57E+00	4.62E+02	4.62E-01
TCL Semivolatile Organic Compounds (SVOCs)										
Benzo(a)anthracene	56-55-3	228.29	3.35E-06	3.56E-01	7.49E-04	4.58E-05	3.70E+00	3.38E-01	1.25E+00	1.25E-03
Benzo(b)fluoranthene	205-99-2	252.31	1.11E-04	3.44E-01	7.12E-04	4.89E-04	2.50E+00	3.61E+00	9.03E+00	9.03E-03
Benzo(k)fluoranthene	207-08-9	252.31	8.29E-07	3.44E-01	7.12E-04	1.15E-05	2.90E+00	8.48E-02	2.46E-01	2.46E-04
bis-(2-Ethylhexyl)phthalate	117-81-7	390.56	1.02E-07	2.97E-01	5.72E-04	1.24E-06	3.10E+01	9.14E-03	2.83E-01	2.83E-04
Chrysene	218-01-9	228.29	9.46E-05	3.56E-01	7.49E-04	4.85E-04	3.90E+00	3.58E+00	1.40E+01	1.40E-02
Indeno(1,2,3-cd)pyrene	193-39-5	276.33	1.60E-06	3.34E-01	6.81E-04	2.12E-05	2.00E+00	1.56E-01	3.12E-01	3.12E-04
Naphthalene	91-20-3	128.17	4.83E-04	4.32E-01	9.99E-04	8.95E-04	1.10E+01	6.60E+00	7.26E+01	7.26E-02
2,4,6-Trichlorophenol	88-06-2	197.45	7.79E-06	3.73E-01	8.05E-04	1.04E-04	2.90E+03	7.66E-01	2.22E+03	2.22E+00
Chlorinated dioxins/dibenzofurans (CDDs/CDFs)										
2,3,7,8-TCDD	1746-01-6	322.00	7.92E-05	3.17E-01	6.30E-04	3.91E-04	4.38E-03	2.88E+00	1.26E-02	1.26E-05

Calculation source: Virginia Department of Environmental Quality Voluntary Remediation Program Risk Table 3.8: Exposure-point concentrations (inhalation) for construction/utility worker in a trench:Groundwater less than 15 feet deep. revised 10/5/07. Accessed at: http://www.deq.state.va.us/vrprisk/tables.html.

Prepared by/ Date: kask 07/07/10
Checked by/ Date: BJR 07/09/10

TABLE 4
CANCER TOXICITY DATA – INHALATION
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor (1		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation Cancer Slope Factor	
	Value	Units	Value	Units		Source(s)	Date(s)
VOLATILES							
1,2-Dichloroethene (cis)	NA		ND		D	IRIS	May 2010
1,2,4-Trimethylbenzene	ND		NA		ND		
1,3,5-Trimethylbenzene	ND		NA		ND		
Benzene	7.80E-06	$(ug/m^3)^{-1}$	2.8E-02	$(mg/kg/day)^{-1}$	Known human carcinogen	IRIS	May 2010
Chlorobenzene	NA		NA		D	IRIS	May 2010
Chloroform	2.30E-05	$(ug/m^3)^{-1}$	8.10E-02	$(mg/kg/day)^{-1}$	Likely carcinogenic in humans	IRIS	May 2010
Ethylbenzene	2.5E-06		NA		D	CALEPA	December 2008
Isopropyl alcohol	NA		NA				
Methylcyclohexane	NA		NA				
Tetrachloroethene	5.90E-06	$(ug/m^3)^{-1}$	2.00E-02	$(mg/kg/day)^{-1}$	NA	CALEPA	December 2008
Trichloroethene	2.00E-06	$(ug/m^3)^{-1}$	7.09E-03	$(mg/kg/day)^{-1}$	NA	CALEPA	December 2008
Vinyl Chloride (adult only)	4.40E-06	$(ug/m^3)^{-1}$	1.50E-02	$(mg/kg/day)^{-1}$	Known human carcinogen	IRIS	May 2010
Xylenes (total)	NA		NA		Inadequate data	IRIS	May 2010
SEMIVOLATILES							
1,4-Dichlorobenzene	1.10E-05	$(ug/m^3)^{-1}$	3.9E-02	$(mg/kg/day)^{-1}$	NA	CALEPA	December 2008
2,4,6-Trichlorophenol	3.10E-06	$(ug/m^3)^{-1}$	1.10E-02	$(mg/kg/day)^{-1}$	B2	IRIS	May 2010
Benzo(a)anthracene	1.10E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CALEPA	December 2008
Benzo(b)fluoranthene	1.10E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CALEPA	December 2008
Benzo(k)fluoranthene	1.10E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CALEPA	December 2008
bis(2-ethylhexyl)phthalate (BEHP)	2.40E-06	$(ug/m^3)^{-1}$	8.5E-03	$(mg/kg/day)^{-1}$	NA	CALEPA	December 2008
Chrysene	1.10E-05	$(ug/m^3)^{-1}$	3.9E-02	$(mg/kg/day)^{-1}$	B2	CALEPA	December 2008
Indeno(1,2,3-cd)pyrene	1.10E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CALEPA	December 2008
Naphthalene	3.4E-05		NA		Cannot be determined	CALEPA	December 2008
INORGANICS/METALS							
Aluminum	ND		ND		ND		
Chromium III	NA		NA		Inadequate data	IRIS	May 2010
Cobalt	ND		9.0E-03	$(mg/kg/day)^{-1}$	ND	PPRTV	
Lead	NA		NA		B2	IRIS	May 2010
Manganese	NA		NA		D	IRIS	May 2010
Nickel	2.40E-04	$(ug/m^3)^{-1}$	8.40E-01	$(mg/kg/day)^{-1}$	A	IRIS	May 2010
Thallium	NA		NA		D	IRIS	May 2010
Vanadium	ND		ND		ND		
DIOXINS/FURANS							
2,3,7,8-TCDD	3.80E+01	$(ug/m^3)^{-1}$	1.50E+05	$(mg/kg/day)^{-1}$	B2	CALEPA	December 2008

In accordance with OSWER 9285.7-53, unit risk values are identified from the following heirarchy of sources:
Tier 1:
IRIS = Integrated Risk Information System: May 2010
Tier 2:

Checked by: JHP 5/18/10

TABLE 4
CANCER TOXICITY DATA – INHALATION
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor (1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation Cancer Slope Factor	
	Value	Units	Value	Units		Source(s)	Date(s)

PPRTV = Preliminary Peer-Reviewed Reference Toxicity Value May 2010 Obtained from: http://www.epa.gov/reg3hwmd/risk/human/index.htm
Tier 3:
CALEPA - California Environmental Protection Agency December 2008 Obtained from: http://www.epa.gov/reg3hwmd/risk/human/index.htm

(1) - Inhalation cancer dose-response values are typically published as unit risk values. Unit risk values may be converted to slope factors using the following equation (HEAST, 1997):
*Adjustment = 70 kg [adult body weight] * 1000 ug/mg [conversion factor] / 20 m3/day [inhalation rate]*
and: Inhalation Slope Factor = Unit Risk * Adjustment
For slope factors obtained from NCEA (published in USEPA Region III RBC Table), it is assumed that the value has been converted from a Unit Risk value. Therefore, the slope factor is converted back to a unit risk value as follows: 20 m3/day / 70 kg * 1000 ug/mg
PAHs, adjusted by Relative Potency Factors of 1.0 [benzo(a)pyrene, dibenz(a,h)anthracene]; 0.1 [benzo(a)anthracene, benzo(b)flouoranthene, indeno(1,2,3-c,d)pyrene]; 0.01 [benzo(k)fluoranthene]; 0.001 [chrysene].
Value for nickel based on nickel as nickel refinery dust

Weight of Evidence:
A - Human carcinogen
B1 - *Probable human carcinogen - indicates that limited human data are available*
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen

mg = milligram
ug = microgram
kg = kilogram
m^3 = cubic meter
BW = body weight
ND = no data available

TABLE 5

NON-CANCER TOXICITY DATA -- INHALATION

Source Area

Centredale Manor Restoration Project Superfund Site

North Providence, Rhode Island

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC (1)		Extrapolated RfD (1)		Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfC: Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s)
VOLATILES									
1,2-Dichloroethene (cis)	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
1,2,4-Trimethylbenzene	chronic	7.0E-03	mg/m3	1.7E-03	mg/kg/day			PPRTV	May 2010
	subchronic	7.0E-03	mg/m3	1.7E-03	mg/kg/day			Chronic	
1,3,5-Trimethylbenzene	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Benzene	chronic	3.0E-02	mg/m3	8.6E-03	mg/kg/day	Immune system; decreased lymphocyte count	300/1	IRIS	May 2010
	subchronic	3.0E-02	mg/m3	8.6E-03	mg/kg/day	Immune system; decreased lymphocyte count	300/1	Chronic	
Chlorobenzene	chronic	5.0E-02	mg/m3	1.4E-02	mg/kg/day			PPRTV	May 2010
	subchronic	5.0E-02	mg/m3	1.4E-02	mg/kg/day			Chronic	
Chloroform	chronic	9.8E-02	mg/m3	2.8E-02	mg/kg/day			MRL	December 2009
	subchronic	2.5E-01	mg/m3	7.1E-02	mg/kg/day	Liver	100	MRL	December 2009
Ethylbenzene	chronic	1.0E+00	mg/m3	2.9E-01	mg/kg/day	Developmental; developmental toxicity	300/1	IRIS	May 2010
	subchronic	3.1E+00	mg/m3	8.8E-01	mg/kg/day	Nervous system	300	MRL	December 2009
Isopropyl alcohol	chronic	7.0E+00	mg/m3	2.0E+00	mg/kg/day			CALEPA	December 2008
	subchronic	7.0E+00	mg/m3	2.0E+00	mg/kg/day			Chronic	
Methylcyclohexane	chronic	3.0E+00	mg/m3	8.6E-01	mg/kg/day			HEAST97	FY 1997
	subchronic	3.0E+00	mg/m3	8.6E-01	mg/kg/day			Chronic	
Tetrachloroethene	chronic	2.7E-01	mg/m3	7.7E-02	mg/kg/day	Nervous system	100	MRL	December 2009
	subchronic	2.7E-01	mg/m3	7.7E-02	mg/kg/day	Nervous system		Chronic	
Trichloroethene	chronic	1.0E-02	mg/m3	2.9E-03	mg/kg/day	Nervous system		NYSDOH	October 2006
	subchronic	1.0E-02	mg/m3	2.9E-03	mg/kg/day	Nervous system		Chronic	
Vinyl Chloride	chronic	1.0E-01	mg/m3	2.9E-02	mg/kg/day	Liver; liver cell polymorphism	30/1	IRIS	May 2010
	subchronic	1.0E-01	mg/m3	2.9E-02	mg/kg/day	Liver; liver cell polymorphism	30/1	Chronic	
Xylenes (total)	chronic	1.0E-01	mg/m3	2.9E-02	mg/kg/day	CNS; impaired motor coordination	300/1	IRIS	May 2010
	subchronic	7.9E+00	mg/m3	2.3E+00	mg/kg/day	Nervous system	90	MRL	December 2009
SEMIVOLATILES									
2,4,6-Trichlorophenol	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Benzo(a)anthracene	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Benzo(b)fluoranthene	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Benzo(k)fluoranthene	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Bis(2-ethylhexyl)phthalate (BEHP)	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Chrysene	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Indeno(1,2,3-cd)pyrene	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Naphthalene	chronic	3.0E-03	mg/m3	8.6E-04	mg/kg/day	Lung/Hyperplasia and metaplasia of epithelial cells	3,000/1	IRIS	May 2010
	subchronic	3.0E-03	mg/m3	8.6E-04	mg/kg/day	Lung/Hyperplasia and metaplasia of epithelial cells	3,000/1	IRIS	May 2010
INORGANICS/METALS									

TABLE 5

NON-CANCER TOXICITY DATA – INHALATION

Source Area

Centredale Manor Restoration Project Superfund Site

North Providence, Rhode Island

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC (1)		Extrapolated RfD (1)		Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfC: Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s)
Aluminum	chronic	5.0E-03	mg/m3	1.4E-03	mg/kg/day			PPRTV	May 2010
	subchronic	5.0E-03	mg/m3	1.4E-03	mg/kg/day			Chronic	
Chromium III	chronic	ND		ND				IRIS	May 2010
	subchronic	5.0E-03	mg/m3	1.4E-03	mg/kg/day	Respiratory system	90	MRL	December 2009
Cobalt	chronic	6.0E-05	mg/m3	1.7E-06	mg/kg/day			PPRTV	May 2010
	subchronic	2.0E-05	mg/m3	5.7E-06	mg/kg/day			STSC	January 2010
Lead	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Manganese	chronic	5.0E-05	mg/m3	1.4E-05	mg/kg/day	CNS; impairment of neurobehavioral function	1,000/1	IRIS	May 2010
	subchronic	5.0E-05	mg/m3	1.4E-05	mg/kg/day	CNS; impairment of neurobehavioral function	1,000/1	Chronic	
Nickel	chronic	9.0E-05	mg/m3	2.6E-05	mg/kg/day	Respiratory system	30	MRL	December 2009
	subchronic	2.0E-04	mg/m3	5.7E-05	mg/kg/day	Respiratory system	30	MRL	December 2009
Thallium	chronic	ND		ND				IRIS	May 2010
	subchronic	ND		ND					
Vanadium	chronic	1.0E-04	mg/m3	2.9E-05	mg/kg/day	Respiratory	30	MRL	December 2009
	subchronic	1.0E-04	mg/m3	2.9E-05	mg/kg/day	Respiratory	30	Chronic	
DIOXINS/FURANS									
2,3,7,8-tetrachlorobenzo-p-dioxin (TCDD)	chronic	4.0E-08	mg/m3	1.1E-08	mg/kg/day	Liver; reproductive; endocrine; respiratory; hematological		CALEPA	December 2008
	subchronic	4.0E-08	mg/m3	1.1E-08	mg/kg/day	Liver; reproductive, endocrine, respiratory; hematological		Chronic	

Notes:

Checked by: JHP 5/18/10

In accordance with OSWER 9285.7-53, chronic RfDs are identified from the following hierarchy of sources:

Tier 1:

IRIS = Integrated Risk Information System: May 2010

Tier 2:

PPRTV = Preliminary Peer-Reviewed Toxicity Value: May 2010 Obtained from Oak Ridge National Laboratory Regional Screening Levels for Chemical Contaminants at Superfund Sites

STSC (3) January 2010 Obtained from: Superfund Technical Support Center. Value provided by USEPA Region 1, January 2010.

Tier 3:

HEAST97= Health Effects Assessment Summary Tables: FY 1997 From HEAST FY 1997 Update

MRL = Minimum Risk Level (ATSDR; chronic MRLs): December 2009

CALEPA - California Environmental Protection A December 2008 December 2008 Obtained from: http://www.epa.gov/reg3hwmd/risk/human/index.htm

NYSDOH = New York State Department of Health October 2006

mg = milligram

kg = kilogram

ug - microgram

m^3 - cubic meter

BW = body weight

Subchronic RfDs are obtained from:

- ATSDR: Intermitant MRLs
- HEAST: subchronic RfDs (from HEAST FY 1997)
- Equal to chronic RfDs when values are not published in HEAST or by ATSDR

chronic - the chronic value is used as the subchronic RfD

(1) - Inhalation non-cancer dose-response values are typically published as RfC values. RfC values may be converted to RfDs using the following equation (HEAST, 1997):

RfD (mg/kg-d) = RfC (mg/m^3) x 20 m^3/d / 70 kg, unless otherwise indicated

For RfDs obtained from NCEA (published in USEPA Region III RBC Table), it is assumed that the value has been converted from a RfC value. Therefore, the RfD is converted back to a RfC value as follows: RfC (mg/m^3) = RfD (mg/kg/day) x 70 kg / 20 m^3/day

There is a National Ambient Air Quality Standard for lead of 1.5 µg/m3 averaged over three months

TABLE 6
CANCER TOXICITY DATA -- ORAL/DERMAL
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral Cancer Slope Factor	
	Value	Units	Efficiency for Dermal (1)	Value	Units		Source(s)	Date(s)
VOLATILES								
1,2-Dichloroethene (cis)	ND			ND		D	IRIS	May 2010
1,2,4-Trimethylbenzene	ND			ND		ND		
1,3,5-Trimethylbenzene	ND			ND		ND		
Benzene	5.5E-02	$(mg/kg/day)^{-1}$	100%	5.5E-02	$(mg/kg/day)^{-1}$	Known carcinogen	IRIS	May 2010
Chlorobenzene	NA			NA		D	IRIS	May 2010
Chloroform	NA		100%	NA		Likely carcinogenic in humans [a]	IRIS	May 2010
Ethylbenzene	NA			NA		D	IRIS	May 2010
Isopropyl alcohol	NA			NA				
Methylcyclohexane	NA			NA				
Tetrachloroethene	5.4E-01	$(mg/kg/day)^{-1}$	100%	5.4E-01	$(mg/kg/day)^{-1}$	NA	CALEPA	December 2008
Trichloroethene	5.9E-03	$(mg/kg/day)^{-1}$	100%	5.9E-03	$(mg/kg/day)^{-1}$	NA	CALEPA	December 2008
Vinyl Chloride (adult only)	7.2E-01	$(mg/kg/day)^{-1}$	100%	7.2E-01	$(mg/kg/day)^{-1}$	Known carcinogen	IRIS	May 2010
Xylenes (total)	NA			NA		Inadequate evidence	IRIS	May 2010
SEMIVOLATILES								
1,4-Dichlorobenzene	5.4E-03	$(mg/kg/day)^{-1}$	100%	5.4E-03	$(mg/kg/day)^{-1}$	C	CALEPA	December 2008
2,4,6-Trichlorophenol	1.1E-02	$(mg/kg/day)^{-1}$	100%	1.1E-02	$(mg/kg/day)^{-1}$	B2	IRIS	May 2010
Benzo(a)anthracene	7.3E-01	$(mg/kg/day)^{-1}$	89%	7.3E-01	$(mg/kg/day)^{-1}$	B2 [b]	USEPA	May 2010
Benzo(b)fluoranthene	7.3E-01	$(mg/kg/day)^{-1}$	89%	7.3E-01	$(mg/kg/day)^{-1}$	B2 [b]	USEPA	May 2010
Benzo(k)fluoranthene	7.3E-02	$(mg/kg/day)^{-1}$	89%	7.3E-02	$(mg/kg/day)^{-1}$	B2 [b]	USEPA	May 2010
Bis(2-ethylhexyl)phthalate (BEHP)	1.4E-02	$(mg/kg/day)^{-1}$	100%	1.4E-02	$(mg/kg/day)^{-1}$	B2	IRIS	May 2010
Chrysene	7.3E-03	$(mg/kg/day)^{-1}$	89%	7.3E-03	$(mg/kg/day)^{-1}$	B2 [b]	USEPA	May 2010
Indeno(1,2,3-cd)pyrene	7.3E-01	$(mg/kg/day)^{-1}$	89%	7.3E-01	$(mg/kg/day)^{-1}$	B2 [b]	USEPA	May 2010
Naphthalene	NA		89%	NA		Cannot be determined	IRIS	May 2010
INORGANICS/METALS								
Aluminum	ND			ND		ND		
Chromium III	NA			NA		Inadequate evidence	IRIS	May 2010
Cobalt	ND			ND		ND		
Lead	NA			NA		B2	IRIS	May 2010
Manganese	NA			NA		D	IRIS	May 2010
Nickel	ND			ND		ND	IRIS	May 2010
Thallium	NA			NA		D	IRIS	May 2010
Vanadium	ND			ND		ND		
DIOXINS/FURANS								
2,3,7,8-tetrachlorobenzo-p-dioxin (TCDD) [c]	1.5E+05	$(mg/kg/day)^{-1}$	70%	1.5E+05	$(mg/kg/day)^{-1}$	NA	HEAST97	FY 1997

Notes:
In accordance with OSWER 9285.7-53, slope factors are identified from the following heirarchy of sources:
Tier 1:
IRIS = Integrated Risk Information System: May 2010
Tier 2:
PPRTV = Preliminary Peer-Reviewed Reference Toxicity Value May 2010 Obtained from: http://www.epa.gov/reg3hwmd/risk/human/index.htm
USEPA = Regional Screening Level (RSL) Summary Table. May 2010 Obtained from: http://www.epa.gov/reg3hwmd/risk/human/index.htm. CSFs were calculated using the benzo(a)pyrene CSF from IRIS and the toxicity equivalency factors (TEFs) from 1993 Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (EPA/600/R-93/089).
Tier 3:
HEAST97= Health Effects Assessment Summary Tables: FY 1997 From HEAST FY 1997 Update
CALEPA - California Environmental Protection Agency December 2008 Obtained from: http://www.epa.gov/reg3hwmd/risk/human/index.htm

mg = milligram
kg = kilogram
BW = body weight
ND = no data available

Checked by: JHP 5/18/10

(1) Values obtained from RAGS Volume 1 (Part E, Supplemental Guidance for Dermal Risk Assessment, Interim Guidance) (EPA, 2004)

Weight of Evidence:

TABLE 6
CANCER TOXICITY DATA -- ORAL/DERMAL
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral Cancer Slope Factor	
	Value	Units		Value	Units		Source(s)	Date(s)

Per this guidance, a value of 100% is used for analytes without published values.

(2) Adjusted Dermal SF = Oral SF / Oral to Dermal Adjustment Factor. Per RAGS Part E (USEPA, 2004), adjustments are only performed for chemicals that have an oral absorption efficiency of less than 50%.

[a] - The RfD for chloroform is protective for cancer risk.

[b] - Slope Factor for Benzo(a)Pyrene used for other carcinogenic PAHs, adjusted by Relative Potency Factors of 1.0 [benzo(a)pyrene, dibenz(a,h)anthracene]; 0.1 [benzo(a)anthracene, benzo(b)flouoranthene, indeno(1,2,3-c,d)pyrene]; 0.01 [benzo(k)fluoranthene]; 0.001 [chrysene].

[c] - The 2005 HHRA quantified dioxin risks using an oral cancer slope factor of 1×10^{-6} per mg/kg/day. The affects of this change will be calculated in Appendix B.

A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen

TABLE 7
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral Absorption Efficiency for Dermal (1)	Adjusted Dermal RfD (2) Value	Adjusted Dermal RfD (2) Units	Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s) Source(s)	RfD: Target Organ(s) Date(s)
VOLATILES										
1,2-Dichloroethene (cis)	chronic	1.0E-02	mg/kg/day	100%	1.0E-02	mg/kg/day			PPRTV	May 2010
	subchronic	3.0E-01	mg/kg/day	100%	3.0E-01	mg/kg/day	Hematological	100/1	MRL	December 2009
1,2,4-Trimethylbenzene	chronic	ND			ND					
	subchronic	ND			ND					
1,3,5-Trimethylbenzene	chronic	1.0E-02	mg/kg/day	100%	1.0E-02	mg/kg/day			PPRTV	May 2010
	subchronic	1.0E-02	mg/kg/day	100%	1.0E-02	mg/kg/day			Chronic	
Benzene	chronic	4.0E-03	mg/kg/day	100%	4.0E-03	mg/kg/day	Immune system; decreased lymphocyte count	300	IRIS	May 2010
	subchronic	4.0E-03	mg/kg/day	100%	4.0E-03	mg/kg/day	Immune system; decreased lymphocyte count	300	Chronic	
Chlorobenzene	chronic	2.0E-02	mg/kg/day	100%	2.0E-02	mg/kg/day	Liver; hepatic changes	1,000/1	IRIS	May 2010
	subchronic	4.0E-01	mg/kg/day	100%	4.0E-01	mg/kg/day	Liver; hepatic changes	100	MRL	December 2009
Chloroform	chronic	1.0E-02	mg/kg/day	100%	1.0E-02	mg/kg/day	Liver; fatty cyst formation in liver	100/1	IRIS	May 2010
	subchronic	1.0E-01	mg/kg/day	100%	1.0E-01	mg/kg/day	Liver	100	MRL	December 2009
Ethylbenzene	chronic	1.0E-01	mg/kg/day	100%	1.0E-01	mg/kg/day	Liver and kidney; liver and kidney toxicity	1,000/1	IRIS	May 2010
	subchronic	5.0E-01	mg/kg/day	100%	5.0E-01	mg/kg/day	Liver; liver toxicity	100	MRL	December 2009
Isopropyl alcohol	chronic	ND			ND					
	subchronic	ND			ND					
Methylcyclohexane	chronic	ND			ND					
	subchronic	ND			ND					
Tetrachloroethene	chronic	1.0E-02	mg/kg/day	100%	1.0E-02	mg/kg/day	Liver; hepatotoxicity	1,000/1	IRIS	May 2010
	subchronic	1.0E-01	mg/kg/day	100%	1.0E-01	mg/kg/day	Liver; hepatotoxicity	100/1	HEAST97	FY 1997
Trichloroethene	chronic	n 3.0E-04	mg/kg/day	100%	3.0E-04	mg/kg/day	Liver and kidney		NCEA	January-00
	subchronic	n 3.0E-04	mg/kg/day	100%	3.0E-04	mg/kg/day	Liver and kidney		Chronic	
Vinyl Chloride	chronic	3.0E-03	mg/kg/day	100%	3.0E-03	mg/kg/day	Liver; liver cell polymorphism	30/1	IRIS	May 2010
	subchronic	3.0E-03	mg/kg/day	100%	3.0E-03	mg/kg/day	Liver; liver cell polymorphism	30/1	Chronic	
Xylenes (total)	chronic	2.0E-01	mg/kg/day	100%	2.0E-01	mg/kg/day	General toxicity; increased mortality	1,000/1	IRIS	May 2010
	subchronic	4.0E-01	mg/kg/day	100%	4.0E-01	mg/kg/day	Nervous system	1,000	MRL	December 2009
SEMIVOLATILES										
1,4-Dichlorobenzene	chronic	7.0E-02	mg/kg/day	100%	7.0E-02	mg/kg/day	Liver	100	MRL	December 2009
	subchronic	7.0E-02	mg/kg/day	100%	7.0E-02	mg/kg/day	Liver	100	MRL	December 2009
2,4,6-Trichlorophenol	chronic	1.0E-03	mg/kg/day	100%	1.0E-03	mg/kg/day			PPRTV	May 2010
	subchronic	1.0E-03	mg/kg/day	100%	1.0E-03	mg/kg/day			Chronic	
Benzo(a)anthracene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney; renal tubular pathology	3,000/1	Surrogate (1)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney; renal tubular pathology	300/1	Surrogate (1)	
Benzo(b)fluoranthene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney; renal tubular pathology	3,000/1	Surrogate (1)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney; renal tubular pathology	300/1	Surrogate (1)	
Benzo(k)fluoranthene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney; renal tubular pathology	3,000/1	Surrogate (1)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney; renal tubular pathology	300/1	Surrogate (1)	
Bis(2-ethylhexyl)phthalate (BEHP)	chronic	2.0E-02	mg/kg/day	100%	2.0E-02	mg/kg/day	Liver; increased liver weight	1,000/1	IRIS	May 2010
	subchronic	1.0E-01	mg/kg/day	100%	1.0E-01	mg/kg/day	Reproductive	100	MRL	December 2009
Chrysene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney; renal tubular pathology	3,000/1	Surrogate (1)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney; renal tubular pathology	300/1	Surrogate (1)	
Indeno(1,2,3-cd)pyrene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney; renal tubular pathology	3,000/1	Surrogate (1)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney; renal tubular pathology	300/1	Surrogate (1)	
Naphthalene	chronic	2.0E-02	mg/kg/day	89%	2.0E-02	mg/kg/day	Decreased body weight	3,000/1	IRIS	May 2010
	subchronic	6.0E-01	mg/kg/day	89%	6.0E-01	mg/kg/day	CNS	90	MRL	December 2009
INORGANICS/METALS										
Aluminum	chronic	1.0E+00	mg/kg/day	100%	1.0E+00	mg/kg/day			PPRTV	May 2010
	subchronic	1.0E+00	mg/kg/day	100%	1.0E+00	mg/kg/day	CNS	30	MRL	December 2009
Chromium III	chronic	1.5E+00	mg/kg/day	1.3%	2.0E-02	mg/kg/day	No effects observed	100/10	IRIS	May 2010
	subchronic	1.5E+00	mg/kg/day	1.3%	2.0E-02	mg/kg/day	No effects observed	100/10	Chronic	
Cobalt	chronic	3.0E-04	mg/kg/day	100%	3.0E-04	mg/kg/day			PPRTV	May 2010
	subchronic	3.0E-03	mg/kg/day	100%	3.0E-03	mg/kg/day	Hematological; increased hemoglobin; polycythemia	10	STSC	January 2010
Lead	chronic	ND			ND				IRIS	May 2010
	subchronic	ND			ND					
Manganese (drinking water)	chronic	2.4E-02	mg/kg/day	4%	9.6E-04	mg/kg/day	CNS; impairment of neurobehavioral function	1/3	IRIS	May 2010
	subchronic	2.4E-02	mg/kg/day	4%	9.6E-04	mg/kg/day	CNS; impairment of neurobehavioral function	1/3	Chronic	
Nickel	chronic	2.0E-02	mg/kg/day	4%	8.0E-04	mg/kg/day	Decreased body and organ weights	300/1	IRIS	May 2010

TABLE 7
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Adjusted Dermal RfD (2)		Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s)
	subchronic	2.0E-02	mg/kg/day	4%	8.0E-04	mg/kg/day	Decreased body and organ weights	300/1	HEAST97	FY 1997
Thallium	chronic	ND			ND				IRIS	May 2010
	subchronic	8.0E-04	mg/kg/day	100%	8.0E-04	mg/kg/day	No effects observed	300/1	HEAST97	FY 1997
Vanadium	chronic	9.0E-03	mg/kg/day	2.6%	2.3E-04	mg/kg/day	Decreased hair cysteine	100/1	IRIS	May 2010
	subchronic	1.0E-02	mg/kg/day	2.6%	2.6E-04	mg/kg/day	Kidney	100/1	MRL	December 2009
DIOXINS/FURANS										
2,3,7,8-tetrachlorobenzo-p-dioxin (TCDD)	chronic	ND			ND					

Notes:

Checked by: JHP 5/18/10

In accordance with OSWER 9285.7-53, chronic RfDs are identified from the following heirarchy of sources:

Tier 1:
IRIS = Integrated Risk Information System: May 2010

Tier 2:
PPRTV = Preliminary Peer-Reviewed Toxicity Value: May 2010 Obtained from: http://www.epa.gov/reg3hwmd/risk/human/index.htm
STSC (3) January 2010 Obtained from: Superfund Technical Support Center. Value provided by USEPA Region 1, January 2010.

Tier 3:
HEAST97= Health Effects Assessment Summary Tables: FY 1997 From HEAST FY 1997 Update
MRL = Minimum Risk Level (ATSDR: chronic MRLs): December 2009
NCEA = National Center for Environmental Assessment September 2004 Obtained from Region IX PRG Table

mg = milligram
kg = kilogram
surrogate - a value for a closely related chemical is used as the RfD
BW = body weight
chronic - the chronic value is used as the subchronic RfD
ND = no data available

n = Value is and NCEA provisional value provided for informational purposes only

Subchronic RfDs are obtained from:
- ATSDR: Intermitent MRLs
- HEAST: subchronic RfDs (from HEAST FY 1997)
- Equal to chronic RfDs when values are not published in HEAST or by ATSDR

(1) Values obtained from RAGS Volume 1 (Part E, Supplemental Guidance for Dermal Risk Assessment, Interim Guidance) (EPA, 2004)
Per this guidance, a value of 100% is used for analytes without published values.
(2) Adjusted Dermal RfD = Oral RfD x Oral to Dermal Adjustment Factor. Per RAGS Part E (USEPA, 2004), adjustments are only performed for chemicals that have an oral absorption efficiency of less than 50%.

Per USEPA Region I "Risk Updates, No. 5", (August, 1999), Non-carcinogenic PAHs without published RfDs should be evaluated using the published RfD for a structurally similar PAH.
Surrogate (1) - Value for pyrene used as a surrogate
For manganese in non-drinking water media: As recommended by USEPA Region I Risk Update, a non-dietary RfD is obtained by subtracting typical dietary intake of manganese (5 mg/kday) from critical dose (10 mg/day). A modifying factor of 1 is then applied, per USEPA Region 1.
Vanadium - Region 1 - RfD for vanadium is the RfD for Vanadium pentoxide of 9E-3, adjusted for the amount of vanadium in vanadium pentoxide (56%), per USEPA Region I.

TABLE 8
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS – REASONABLE MAXIMUM EXPOSURE- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
GROUND WATER	GROUND WATER	GROUNDWATER	DERMAL	1,2,4-Trimethylbenzene	0.093	mg/l	NC		NC			--		ND		
				1,3,5-Trimethylbenzene	0.001	mg/l	NC		NC			--		1.0E-02	mg/kg/day	
				1,4-Dichlorobenzene	0.005	mg/l	3.8E-08	mg/kg/day	5.4E-03	(mg/kg/day)-1	2.E-10	2.7E-06	mg/kg/day	3.0E-02	mg/kg/day	4.E-05
				Benzene	0.021	mg/l	3.8E-08	mg/kg/day	5.5E-02	(mg/kg/day)-1	2.E-09	2.7E-06	mg/kg/day	4.0E-03	mg/kg/day	7.E-04
				Chlorobenzene	0.16	mg/l	NC		NC			4.6E-05	mg/kg/day	6.0E-01	mg/kg/day	1.E-04
				Chloroform	0.0011	mg/l	4.2E-09	mg/kg/day	NA			3.0E-07	mg/kg/day	1.0E-01	mg/kg/day	3.E-06
				cis-1,2-Dichloroethene	1.6	mg/l	NC		NC			--		3.0E-01	mg/kg/day	
				Ethylbenzene	0.007	mg/l	NC		NC			3.3E-06	mg/kg/day	5.0E-01	mg/kg/day	7.E-06
				Isopropyl Alcohol	0.07	mg/l	NC		NC			--		ND		
				Methylcyclohexane	0.013	mg/l	NC		NC			--		ND		
				Tetrachloroethene	61	mg/l	4.2E-04	mg/kg/day	5.4E-01	(mg/kg/day)-1	2.E-04	2.9E-02	mg/kg/day	1.0E-01	mg/kg/day	3.E-01
				Total Xylenes	0.069	mg/l	NC		NC			--		4.0E-01	mg/kg/day	
				Trichloroethene	2.5	mg/l	4.8E-06	mg/kg/day	5.9E-03	(mg/kg/day)-1	3.E-08	3.3E-04	mg/kg/day	3.0E-03	mg/kg/day	1.E+00
				Vinyl Chloride	0.027	mg/l	1.7E-08	mg/kg/day	7.2E-01	(mg/kg/day)-1	1.E-08	1.2E-06	mg/kg/day	3.0E-03	mg/kg/day	4.E-04
				2,4,6-Trichlorophenol	2.9	mg/l	3.5E-05	mg/kg/day	1.1E-02	(mg/kg/day)-1	3.E-07	1.8E-03	mg/kg/day	1.0E-03	mg/kg/day	2.E+00
				Benzo(a)anthracene	0.0037	mg/l	5.4E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	4.E-07	3.7E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(b)fluoranthene	0.0025	mg/l	6.3E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	5.E-07	4.1E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(k)fluoranthene	0.0029	mg/l	--		7.3E-02	(mg/kg/day)-1		--		3.0E-01	mg/kg/day	
				Bis(2-ethylhexyl)phthalate	0.031	mg/l	5.4E-07	mg/kg/day	1.4E-02	(mg/kg/day)-1	8.E-09	3.8E-05	mg/kg/day	1.0E-01	mg/kg/day	4.E-04
				Chrysene	0.0039	mg/l	5.6E-07	mg/kg/day	7.3E-03	(mg/kg/day)-1	4.E-09	3.9E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Indeno(1,2,3-cd)pyrene	0.002	mg/l	5.2E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	4.E-07	3.6E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Naphthalene	0.011	mg/l	NC		NC			5.7E-05	mg/kg/day	6.0E-01	mg/kg/day	1.E-05
				TEQ	1.3837E-06	mg/l	9.9E-10	mg/kg/day	1.5E+05	(mg/kg/day)-1	1.E-04	6.9E-08	mg/kg/day	ND		
				Aluminum	0.509	mg/l	NC		NC			--		1.0E+00	mg/kg/day	
				Chromium	0.114	mg/l	NC		NC			6.2E-07	mg/kg/day	2.0E-02	mg/kg/day	3.E-05
				Cobalt	0.0146	mg/l	NC		NC			--		3.0E-03	mg/kg/day	
				Lead	0.0277	mg/l	--		NA			--		ND		
				Manganese	5.59	mg/l	NC		NC			--		9.6E-04	mg/kg/day	
				Nickel	0.0826	mg/l	NC		NC			9.0E-06	mg/kg/day	8.0E-04	mg/kg/day	1.E-04
				Thallium	0.0069	mg/l	NC		NC			3.7E-06	mg/kg/day	8.0E-04	mg/kg/day	5.E-05
				Vanadium	0.0362	mg/l	NC		NC			2.0E-07	mg/kg/day	2.0E-04	mg/kg/day	8.E-04
			EXPOSURE ROUTE TOTAL								2.E-06					3
		EXPOSURE POINT TOTAL									2.E-06					3
	EXPOSURE MEDIUM TOTAL										2.E-06					3
	AIR	TRENCH - AIR	VAPOR INHALATION	1,2,4-Trimethylbenzene	3.0E+02	ug/m3	NC		NC			5.3E+00	ug/m3	7.0E+00	ug/m3	8.E-01
				1,3,5-Trimethylbenzene	4.6E+02	ug/m3	NC		NC			3.5E+00	ug/m3	ND		
				1,4-Dichlorobenzene	3.4E+01	ug/m3	3.6E-03	ug/m3	1.1E-05	(ug/m3)-1	4.E-08	2.5E-01	ug/m3	8.0E+02	ug/m3	3.E-04
				Benzene	2.0E+02	ug/m3	2.1E-02	ug/m3	7.8E-06	(ug/m3)-1	2.E-07	1.5E+00	ug/m3	3.0E+01	ug/m3	5.E-02
				Chlorobenzene	1.2E+03	ug/m3	NC		NC			9.3E+00	ug/m3	5.0E+01	ug/m3	2.E-01
				Chloroform	3.1E+01	ug/m3	3.3E-03	ug/m3	2.3E-05	(ug/m3)-1	8.E-08	2.3E-01	ug/m3	2.5E-02	ug/m3	9.E-04
				cis-1,2-Dichloroethene	1.3E+04	ug/m3	NC		NC			1.0E+02	ug/m3	ND		
				Ethylbenzene	5.6E+01	ug/m3	NC		NC			4.2E-01	ug/m3	3.1E-03	ug/m3	1.E-04
				Isopropyl Alcohol	NL	ug/m3	NC		NC					7.0E+03	ug/m3	
				Methylcyclohexane	1.1E+02	ug/m3	NC		NC			8.3E-01	ug/m3	3.0E+03	ug/m3	3.E-04
				Tetrachloroethene	3.9E+05	ug/m3	4.2E-01	ug/m3	5.9E-06	(ug/m3)-1	3.E-04	3.0E+03	ug/m3	2.7E+02	ug/m3	1.E+01
				Total Xylenes	5.5E+02	ug/m3	NC		NC			4.2E+00	ug/m3	7.9E+03	ug/m3	5.E-04
				Trichloroethene	1.8E+04	ug/m3	1.9E-00	ug/m3	2.0E-06	(ug/m3)-1	4.E-06	1.4E+02	ug/m3	1.0E+01	ug/m3	1.E+01
				Vinyl Chloride	2.8E+02	ug/m3	3.1E-02	ug/m3	4.4E-06	(ug/m3)-1	1.E-07	2.1E+00	ug/m3	1.0E+02	ug/m3	2.E-02
				2,4,6-Trichlorophenol	2.2E+03	ug/m3	2.4E-01	ug/m3	3.1E-06	(ug/m3)-1	7.E-07	1.7E+01	ug/m3	ND		
				Benzo(a)anthracene	1.3E+00	ug/m3	1.3E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-08	9.4E-03	ug/m3	ND		
				Benzo(b)fluoranthene	9.0E+00	ug/m3	9.7E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-07	6.8E-02	ug/m3	ND		
				Benzo(k)fluoranthene	2.5E-01	ug/m3	2.6E-05	ug/m3	1.1E-04	(ug/m3)-1	3.E-09	1.9E-03	ug/m3	ND		
				Bis(2-ethylhexyl)phthalate	2.8E-01	ug/m3	3.0E-05	ug/m3	2.4E-06	(ug/m3)-1	7.E-11	2.1E-03	ug/m3	ND		
				Chrysene	1.4E+01	ug/m3	1.5E-03	ug/m3	1.1E-05	(ug/m3)-1	2.E-08	1.1E-01	ug/m3	ND		
				Indeno(1,2,3-cd)pyrene	3.1E-01	ug/m3	3.4E-05	ug/m3	1.1E-04	(ug/m3)-1	4.E-09	2.4E-03	ug/m3	ND		
				Naphthalene	7.3E+01	ug/m3	NC		NC			5.5E-01	ug/m3	3.0E+00	ug/m3	2.E-01
				TEQ	1.3E-02	ug/m3	1.4E-06	ug/m3	3.8E+01	(ug/m3)-1	5.E-05	9.5E-05	ug/m3	4.0E-05	ug/m3	2.E+00
				Aluminum	NV	ug/m3	NA		NC					5.0E+00	ug/m3	
				Chromium	NV	ug/m3	NA		NC					5.0E+00	ug/m3	
				Cobalt	NV	ug/m3	NA		NC					2.0E-02	ug/m3	

TABLE 8
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS – REASONABLE MAXIMUM EXPOSURE- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
				Lead	NV	ug/m3	NA		NA					ND		
				Manganese	NV	ug/m3	NA		NC					5.0E-02	ug/m3	
				Nickel	NV	ug/m3	NA		2.4E-04	(ug/m3)-1				2.0E-01	ug/m3	
				Thallium	NV	ug/m3	NA		NC					ND		
				Vanadium	NV	ug/m3	NA		NC					1.0E-01	ug/m3	
			EXPOSURE ROUTE TOTAL								5.E-04					28
		EXPOSURE POINT TOTAL									5.E-04					28
	EXPOSURE MEDIUM TOTAL										5.E-04					28
GROUNDWATER TOTAL											7.E-04					31
TOTAL RECEPTOR RISK ACROSS ALL MEDIA											7.E-04	TOTAL RECEPTOR HAZARD ACROSS ALL MEDIA				31

NOTES.
(1) - Blank cells indicate that an RfD or RfC is not avalailable from the sources used to obtain dose-response data for this risk assessment.
NC - Not carcinogenic by this exposure route.
NA - Not applicable: exposure route not applicable for this chemical/exposure medium.
NL - Not inlcluded in the calculation table for ambient air concentrations in a trench from groundwater.
NV - Not volatile; ambient air concentration was not calculated for this chemical.
-- - Not calculated, dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 01/21/10
Checked by: RRD 3/24/10

TABLE 9
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (I)					NON-CARCINOGENIC HAZARD QUOTIENT (I)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
GROUND WATER	GROUND WATER	GROUNDWATER											
			1,2,4-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,3,5-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,4-Dichlorobenzene	--	NA	2.0E-10	NA	2.0E-10	Endocrine			3.8E-05	3.8E-05
			Benzene	--	NA	3.1E-09	NA	3.1E-09	Immune system /			6.6E-04	6.6E-04
			Chlorobenzene	NC	NA	NC	NA		Liver			1.1E-04	1.1E-04
			Chloroform	--	NA	--	NA		Liver			3.0E-06	3.0E-06
			cis-1,2-Dichloroethene	NC	NA	NC	NA		Hematological			--	
			Ethylbenzene	NC	NA	NC	NA		Liver / Kidney			6.7E-06	6.7E-06
			Isopropyl Alcohol	NC	NA	NC	NA					--	
			Methylcyclohexane	NC	NA	NC	NA					--	
			Tetrachloroethene	--	NA	2.2E-04	NA	2.2E-04	Liver			2.9E-01	2.9E-01
			Total Xylenes	NC	NA	NC	NA		Nervous System			--	
			Trichloroethene	--	NA	2.8E-08	NA	2.8E-08	Liver / Kidney			1.1E+00	1.1E+00
			Vinyl Chloride	--	NA	1.2E-08	NA	1.2E-08	Liver			4.0E-04	4.0E-04
			2,4,6-Trichlorophenol	--	NA	2.8E-07	NA	2.8E-07	Undetermined			1.8E+00	1.8E+00
			Benzo(a)anthracene	--	NA	3.9E-07	NA	3.9E-07	Kidney			1.2E-04	1.2E-04
			Benzo(b)fluoranthene	--	NA	4.6E-07	NA	4.6E-07	Kidney			1.5E-04	1.5E-04
			Benzo(k)fluoranthene	--	NA	--	NA		Kidney			--	
			Bis(2-ethylhexyl)phthalate	--	NA	7.6E-09	NA	7.6E-09	Reproductive			3.8E-04	3.8E-04
			Chrysene	--	NA	4.1E-09	NA	4.1E-09	Kidney			1.3E-04	1.3E-04
			Indeno(1,2,3-cd)pyrene	--	NA	3.8E-07	NA	3.8E-07	Kidney			1.2E-04	1.2E-04
			Naphthalene	NC	NA	NC	NA		Nervous System			9.6E-06	9.6E-06
			TEQ	--	NA	1.5E-04	NA	1.5E-04				--	
			Aluminum	NC	NA	NC	NA		Nervous System			--	
			Chromium	NC	NA	NC	NA		NOAEL			3.2E-05	3.2E-05
			Cobalt	NC	NA	NC	NA		Hematological			--	
			Lead	--	NA	--	NA					--	
			Manganese	NC	NA	NC	NA		Nervous System			--	
			Nickel	NC	NA	NC	NA		General Toxicity			1.1E-04	1.1E-04
			Thallium	NC	NA	NC	NA		NOAEL			4.7E-05	4.7E-05
			Vanadium	NC	NA	NC	NA		Kidney			7.6E-04	7.6E-04
		EXPOSURE POINT TOTAL						4E-04					3
	EXPOSURE MEDIUM TOTAL							9E-04					3
GROUND WATER	AIR	FRENCH - AIR											
			1,2,4-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	7.6E-01	NA	7.6E-01
			1,3,5-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	--	NA	
			1,4-Dichlorobenzene	NA	4.0E-08	NA	NA	4.0E-08	Developmental	NA	3.2E-04	NA	3.2E-04
			Benzene	NA	1.6E-07	NA	NA	1.6E-07	Immune system	NA	4.9E-02	NA	4.9E-02
			Chlorobenzene	NA	NC	NA	NA		Undetermined	NA	1.9E-01	NA	1.9E-01
			Chloroform	NA	7.6E-08	NA	NA	7.6E-08	Liver	NA	9.3E-04	NA	9.3E-04
			cis-1,2-Dichloroethene	NA	NC	NA	NA			NA	--	NA	
			Ethylbenzene	NA	NC	NA	NA		Developmental	NA	1.4E-04	NA	1.4E-04
			Isopropyl Alcohol	NA	NC	NA	NA						
			Methylcyclohexane	NA	NC	NA	NA			NA	2.8E-04	NA	2.8E-04
			Tetrachloroethene	NA	2.5E-04	NA	NA	2.5E-04	Nervous System	NA	1.1E+01	NA	1.1E+01
			Total Xylenes	NA	NC	NA	NA		Nervous System	NA	5.3E-04	NA	5.3E-04
			Trichloroethene	NA	3.9E-06	NA	NA	3.9E-06	Nervous System	NA	1.4E+01	NA	1.4E+01
			Vinyl Chloride	NA	1.3E-07	NA	NA	1.3E-07	Liver	NA	2.1E-02	NA	2.1E-02
			2,4,6-Trichlorophenol	NA	7.4E-07	NA	NA	7.4E-07		NA	--	NA	
			Benzo(a)anthracene	NA	1.5E-08	NA	NA	1.5E-08		NA	--	NA	
			Benzo(b)fluoranthene	NA	1.1E-07	NA	NA	1.1E-07		NA	--	NA	
			Benzo(k)fluoranthene	NA	2.9E-09	NA	NA	2.9E-09		NA	--	NA	
			Bis(2-ethylhexyl)phthalate	NA	7.3E-11	NA	NA	7.3E-11		NA	--	NA	
			Chrysene	NA	1.7E-08	NA	NA	1.7E-08		NA	--	NA	
			Indeno(1,2,3-cd)pyrene	NA	3.7E-09	NA	NA	3.7E-09		NA	--	NA	
			Naphthalene	NA	NC	NA	NA		Respiratory	NA	1.8E-01	NA	1.8E-01
			TEQ	NA	5.2E-05	NA	NA	5.2E-05	Liver / Reproductive /	NA	2.4E+00	NA	2.4E+00
			Aluminum	NA	NA	NA	NA		Undetermined				
			Chromium	NA	NA	NA	NA		Respiratory				

TABLE 9
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
			Cobalt	NA	NA	NA	NA						
			Lead	NA	NA	NA	NA						
			Manganese	NA	NA	NA	NA		Nervous System				
			Nickel	NA	NA	NA	NA		Respiratory				
			Thallium	NA	NA	NA	NA						
			Vanadium	NA	NA	NA	NA						
		EXPOSURE POINT TOTAL						3E-04					28
	EXPOSURE MEDIUM TOTAL							3E-04					28
GROUNDWATER TOTAL								7E-04					31
RECEPTOR TOTAL								7E-04					31
							TOTAL RISK ACROSS ALL MEDIA	7E-04	TOTAL HAZARD ACROSS ALL MEDIA				31

NOTES:
NC - Not carcinogenic by this exposure route.
NA - Not applicable; exposure route not applicable for this chemical/exposure medium.
-- - Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 01/21/10
Checked by: RRD 3/24/10

TOTAL GENERAL TOXICITY HI =	1.1E-03
	--
TOTAL DEVELOPMENTAL HI =	4.5E-04
TOTAL ENDOCRINE HI =	2.4E+00
	--
	--
TOTAL HEMATOLOGICAL HI =	2.4E+00
TOTAL IMMUNE SYSTEM HI =	5.0E-02
TOTAL KIDNEY HI =	1.1E+00
TOTAL LIVER HI =	3.8E+00
	--
TOTAL NERVOUS SYSTEM HI =	2.5E+01
TOTAL NOAEL HI =	2.7E+00
TOTAL REPRODUCTIVE HI =	2.4E+00
	--
TOTAL RESPIRATORY HI =	2.6E+00

TABLE 10
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS -- CENTRAL TENDENCY EXPOSURE- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA - CTE SCENARIO
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
GROUND WATER	GROUND WATER	GROUNDWATER	DERMAL	1,2,4-Trimethylbenzene	0.034	mg/l	NC		NC			--		ND		
				1,3,5-Trimethylbenzene	0.033	mg/l	NC		NC			--		1.0E-02	mg/kg/day	
				1,4-Dichlorobenzene	0.032	mg/l	2.4E-07	mg/kg/day	5.4E+03	(mg/kg/day)-1	1.E-09	1.7E-05	mg/kg/day	7.0E-02	mg/kg/day	2.E-04
				Benzene	0.029	mg/l	5.3E-08	mg/kg/day	5.5E-02	(mg/kg/day)-1	3.E-09	3.7E-06	mg/kg/day	4.0E-03	mg/kg/day	9.E-04
				Chlorobenzene	0.038	mg/l	NC		NC			1.3E-05	mg/kg/day	4.0E-01	mg/kg/day	3.E-05
				Chloroform	0.032	mg/l	3.3E-06	mg/kg/day	NA			2.3E-06	mg/kg/day	1.0E-01	mg/kg/day	2.E-05
				cis-1,2-Dichloroethene	0.057	mg/l	NC		NC			--		3.0E-01	mg/kg/day	
				Ethylbenzene	0.032	mg/l	NC		NC			1.5E-05	mg/kg/day	5.0E-01	mg/kg/day	3.E-05
				Isopropyl Alcohol	0.031	mg/l	NC		NC			--		ND		
				Methylcyclohexane	0.032	mg/l	NC		NC			--		ND		
				Tetrachloroethene	1.5	mg/l	1.0E-05	mg/kg/day	5.4E-01	(mg/kg/day)-1	6.E-06	7.3E-04	mg/kg/day	1.0E-01	mg/kg/day	7.E-03
				Total Xylenes	0.029	mg/l	NC		NC			--		4.0E-01	mg/kg/day	
				Trichloroethene	0.083	mg/l	1.6E-07	mg/kg/day	5.9E-03	(mg/kg/day)-1	9.E-10	1.1E-05	mg/kg/day	3.0E-04	mg/kg/day	4.E-02
				Vinyl Chloride	0.030	mg/l	1.9E-08	mg/kg/day	7.2E-01	(mg/kg/day)-1	1.E-08	1.3E-06	mg/kg/day	3.0E-03	mg/kg/day	4.E-04
				2,4,6-Trichlorophenol	0.096	mg/l	8.5E-07	mg/kg/day	1.1E-02	(mg/kg/day)-1	9.E-09	6.0E-05	mg/kg/day	1.0E-03	mg/kg/day	6.E-02
				Benzo(a)anthracene	0.0063	mg/l	6.3E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	5.E-07	4.3E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(b)fluoranthene	0.0062	mg/l	1.1E-06	mg/kg/day	7.3E-01	(mg/kg/day)-1	8.E-07	7.4E-05	mg/kg/day	3.0E-01	mg/kg/day	2.E-04
				Benzo(k)fluoranthene	0.0063	mg/l	--		7.3E-02	(mg/kg/day)-1		--		3.0E-01	mg/kg/day	
				Bis(2-ethylhexyl)phthalate	0.0055	mg/l	9.7E-08	mg/kg/day	1.4E-02	(mg/kg/day)-1	1.E-09	6.8E-06	mg/kg/day	1.0E-01	mg/kg/day	7.E-05
				Chrysene	0.0063	mg/l	6.2E-07	mg/kg/day	7.3E-03	(mg/kg/day)-1	5.E-09	4.4E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Indeno(1,2,3-cd)pyrene	0.0062	mg/l	1.1E-06	mg/kg/day	7.3E-01	(mg/kg/day)-1	8.E-07	7.7E-05	mg/kg/day	3.0E-01	mg/kg/day	3.E-04
				Naphthalene	0.0042	mg/l	NC		NC			2.2E-06	mg/kg/day	6.0E-01	mg/kg/day	4.E-06
				TEQ	3.67E-07	mg/l	8.3E-11	mg/kg/day	1.5E+05	(mg/kg/day)-1	1.E-05	5.8E-09	mg/kg/day	ND		
				Aluminum	0.069	mg/l	NC		NC			--		1.0E+00	mg/kg/day	
				Chromium	0.0071	mg/l	NC		NC			7.7E-08	mg/kg/day	5.0E-04	mg/kg/day	2.E-04
				Cobalt	0.0029	mg/l	NC		NC			--		3.0E-03	mg/kg/day	
				Lead	0.0020	mg/l	--		NA			--		ND		
				Manganese	1.3	mg/l	NC		NC			6.1E-06	mg/kg/day	2.0E-03	mg/kg/day	2.E-03
				Nickel	0.0094	mg/l	NC		NC			1.0E-08	mg/kg/day	8.0E-03	mg/kg/day	1.E-05
				Thallium	0.0032	mg/l	NC		NC			1.7E-08	mg/kg/day	8.0E-03	mg/kg/day	2.E-05
				Vanadium	0.0025	mg/l	NC		NC			1.4E-08	mg/kg/day	2.6E-03	mg/kg/day	5.E-05
			EXPOSURE ROUTE TOTAL								2.E-05					0.1
		EXPOSURE POINT TOTAL									2.E-05					0.1
	EXPOSURE MEDIUM TOTAL										2.E-05					0.1
	AIR	TRENCH - AIR	AMBIENT INHALATION	1,2,4-Trimethylbenzene	257	ug/m3	NC		NC			1.9E+00	ug/m3	7.0E+00	ug/m3	3.E-01
				1,3,5-Trimethylbenzene	250	ug/m3	NC		NC			1.9E+00	ug/m3	ND		
				1,4-Dichlorobenzene	216	ug/m3	2.3E-02	ug/m3	1.1E-05	(ug/m3)-1	3.E-07	1.6E+00	ug/m3	8.0E+02	ug/m3	2.E-03
				Benzene	271	ug/m3	2.9E-02	ug/m3	7.8E-06	(ug/m3)-1	2.E-07	2.0E+00	ug/m3	3.0E+01	ug/m3	7.E-02
				Chlorobenzene	295	ug/m3	NC		NC			2.2E+00	ug/m3	5.0E+01	ug/m3	4.E-02
				Chloroform	241	ug/m3	2.6E-02	ug/m3	2.3E-05	(ug/m3)-1	6.E-07	1.8E+00	ug/m3	2.5E+02	ug/m3	7.E-03
				cis-1,2-Dichloroethene	477	ug/m3	NC		NC			3.6E+00	ug/m3	ND		
				Ethylbenzene	257	ug/m3	NC		NC			1.9E+00	ug/m3	3.1E+03	ug/m3	6.E-04
				Isopropyl Alcohol	NL	ug/m3	NC		NC					7.0E+03	ug/m3	
				Methylcyclohexane	278	ug/m3	NC		NC			2.1E+00	ug/m3	3.0E+03	ug/m3	7.E-04
				Tetrachloroethene	9700	ug/m3	1.0E+00	ug/m3	5.9E-06	(ug/m3)-1	6.E-06	7.3E+01	ug/m3	2.7E+02	ug/m3	3.E-01
				Total Xylenes	232	ug/m3	NC		NC			1.8E+00	ug/m3	7.9E+03	ug/m3	2.E-04
				Trichloroethene	601	ug/m3	6.5E-02	ug/m3	2.0E-06	(ug/m3)-1	1.E-07	4.5E+00	ug/m3	1.0E+01	ug/m3	5.E-01
				Vinyl Chloride	516	ug/m3	3.4E-02	ug/m3	4.4E-06	(ug/m3)-1	1.E-07	2.4E+00	ug/m3	1.0E+02	ug/m3	2.E-02
				2,4,6-Trichlorophenol	75	ug/m3	8.1E-03	ug/m3	3.1E-06	(ug/m3)-1	3.E-08	5.7E-01	ug/m3	ND		
				Benzo(a)anthracene	1.5	ug/m3	1.6E-04	ug/m3	1.1E-04	(ug/m3)-1	2.E-08	1.1E-02	ug/m3	ND		
				Benzo(b)fluoranthene	15	ug/m3	1.6E-03	ug/m3	1.1E-04	(ug/m3)-1	2.E-07	1.1E-01	ug/m3	ND		
				Benzo(k)fluoranthene	0.36	ug/m3	3.9E-05	ug/m3	1.1E-04	(ug/m3)-1	4.E-09	2.7E-03	ug/m3	ND		
				Bis(2-ethylhexyl)phthalate	0.05	ug/m3	5.4E-06	ug/m3	2.4E-06	(ug/m3)-1	1.E-11	3.8E-04	ug/m3	ND		
				Chrysene	15	ug/m3	1.7E-03	ug/m3	1.1E-05	(ug/m3)-1	2.E-08	1.2E-01	ug/m3	ND		
				Indeno(1,2,3-cd)pyrene	0.66	ug/m3	7.1E-05	ug/m3	1.1E-04	(ug/m3)-1	8.E-09	4.9E-03	ug/m3	ND		
				Naphthalene	28	ug/m3	NC		NC			2.1E-01	ug/m3	3.0E+00	ug/m3	7.E-02
				TEQ	0.0011	ug/m3	1.1E-07	ug/m3	3.8E+01	(ug/m3)-1	4.E-06	8.0E-06	ug/m3	4.0E-05	ug/m3	2.E-01
				Aluminum	NV	ug/m3	NC		NC					5.0E+00	ug/m3	
				Chromium	NV	ug/m3	--		8.4E-02	(ug/m3)-1				1.0E-01	ug/m3	

TABLE 10
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS – CENTRAL TENDENCY EXPOSURE- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA - CTE SCENARIO
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
				Cobalt	NV	ug/m3	NC		NC					2.0E-02	ug/m3	
				Lead	NV	ug/m3	--		NA					ND		
				Manganese	NV	ug/m3	NC		NC					5.0E-02	ug/m3	
				Nickel	NV	ug/m3	--		2.4E-04	(ug/m3)-1				2.0E-01	ug/m3	
				Thallium	NV	ug/m3	NC		NC					ND		
				Vanadium	NV	ug/m3	NC		NC					1.0E-01	ug/m3	
			EXPOSURE ROUTE TOTAL								1.E-05					1
		EXPOSURE POINT TOTAL									1.E-05					1
	EXPOSURE MEDIUM TOTAL										1.E-05					1
GROUNDWATER TOTAL											3.E-05					2
TOTAL RECEPTOR RISK ACROSS ALL MEDIA											3.E-05	TOTAL RECEPTOR HAZARD ACROSS ALL MEDIA				2

NOTES:
(1) - Blank cells indicate that an RfD or RfC is not available from the sources used to obtain dose-response data for this risk assessment.
NC - Not carcinogenic by this exposure route.
NA - Not applicable: exposure route not applicable for this chemical/exposure medium.
NL - Not included in the calculation table for ambient air concentrations in a trench from groundwater.
NV - Not volatile; exposure route not complete for this chemical.
-- - Not calculated, dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 01/21/10
Checked by: RRD 03/24/10

TABLE 11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CENTRAL TENDENCY EXPOSURE- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA - CTE SCENARIO
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
GROUND WATER	GROUND WATER	GROUNDWATER	1,2,4-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,3,5-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,4-Dichlorobenzene	--	NA	1.3E-09	NA	1.3E-09	Endocrine			2.4E-04	2.4E-04
			Benzene	--	NA	2.9E-09	NA	2.9E-09	Immune system /			9.3E-04	9.3E-04
			Chlorobenzene	NC	NA	NC	NA		Liver			2.7E-05	2.7E-05
			Chloroform	--	NA	--	NA		Liver			2.3E-05	2.3E-05
			Cis-1,2-Dichloroethene	NC	NA	NC	NA		Hematological			--	
			Ethylbenzene	NC	NA	NC	NA		Liver / Kidney			3.1E-05	3.1E-05
			Isopropyl Alcohol	NC	NA	NC	NA					--	
			Methylcyclohexane	NC	NA	NC	NA					--	
			Tetrachloroethene	--	NA	5.6E-06	NA	5.6E-06	Liver			7.3E-03	7.3E-03
			Total Xylenes	NC	NA	NC	NA		Nervous System			--	
			Trichloroethene	--	NA	9.3E-10	NA	9.3E-10	Liver / Kidney			2.7E-02	2.7E-02
			Vinyl Chloride	--	NA	1.4E-08	NA	1.4E-08	Liver			4.4E-04	4.4E-04
			2,4,6-Trichlorophenol	--	NA	9.4E-09	NA	9.4E-09	Undetermined			6.0E-02	6.0E-02
			Benzo(a)anthracene	--	NA	4.5E-07	NA	4.5E-07	Kidney			1.4E-04	1.4E-04
			Benzo(b)fluoranthene	--	NA	7.5E-07	NA	7.5E-07	Kidney			2.5E-04	2.5E-04
			Benzo(k)fluoranthene	--	NA	--	NA		Kidney			--	
			Bis(2-ethylhexyl)phthalate	--	NA	1.4E-09	NA	1.4E-09	Reproductive			6.8E-05	6.8E-05
			Chrysene	--	NA	4.5E-09	NA	4.5E-09	Kidney			1.5E-04	1.5E-04
			Indeno(1,2,3-cd)pyrene	--	NA	8.0E-07	NA	8.0E-07	Kidney			2.6E-04	2.6E-04
			Naphthalene	NC	NA	NC	NA		Nervous System			3.7E-06	3.7E-06
			TEQ	--	NA	1.2E-05	NA	1.2E-05				--	
			Aluminum	NC	NA	NC	NA		Nervous System			--	
			Chromium	NC	NA	NC	NA		NOAEL			1.5E-04	1.5E-04
			Cobalt	NC	NA	NC	NA		Hematological			--	
			Lead	--	NA	--	NA					--	
			Manganese	NC	NA	NC	NA		Nervous System			2.1E-03	2.1E-03
			Nickel	NC	NA	NC	NA		General Toxicity			1.3E-05	1.3E-05
			Thallium	NC	NA	NC	NA		NOAEL			2.2E-05	2.2E-05
			Vanadium	NC	NA	NC	NA		Kidney			5.3E-05	5.3E-05
		EXPOSURE POINT TOTAL						2E-05					0.1
	EXPOSURE MEDIUM TOTAL							2E-05					0.1
GROUND WATER	AIR	TRENCH - AIR	1,2,4-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	2.8E-01	NA	2.8E-01
			1,3,5-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	--	NA	
			1,4-Dichlorobenzene	NA	2.6E-07	NA	NA	2.6E-07	Developmental	NA	2.0E-03	NA	2.0E-03
			Benzene	NA	2.3E-07	NA	NA	2.3E-07	Immune system	NA	6.8E-02	NA	6.8E-02
			Chlorobenzene	NA	NC	NA	NA		Undetermined	NA	4.4E-02	NA	4.4E-02
			Chloroform	NA	6.0E-07	NA	NA	6.0E-07	Liver	NA	7.3E-03	NA	7.3E-03
			Cis-1,2-Dichloroethene	NA	NC	NA	NA			NA	--	NA	
			Ethylbenzene	NA	NC	NA	NA		Developmental	NA	6.3E-04	NA	6.3E-04
			Isopropyl Alcohol	NA	NC	NA	NA						
			Methylcyclohexane	NA	NC	NA	NA			NA	7.0E-04	NA	7.0E-04
			Tetrachloroethene	NA	6.2E-06	NA	NA	6.2E-06	Nervous System	NA	2.7E-01	NA	2.7E-01
			Total Xylenes	NA	NC	NA	NA		Nervous System	NA	2.2E-04	NA	2.2E-04
			Trichloroethene	NA	1.3E-07	NA	NA	1.3E-07	Nervous System	NA	4.5E-01	NA	4.5E-01
			Vinyl Chloride	NA	1.5E-07	NA	NA	1.5E-07	Liver	NA	2.4E-02	NA	2.4E-02
			2,4,6-Trichlorophenol	NA	2.5E-08	NA	NA	2.5E-08		NA	--	NA	
			Benzo(a)anthracene	NA	1.7E-08	NA	NA	1.7E-08		NA	--	NA	
			Benzo(b)fluoranthene	NA	1.8E-07	NA	NA	1.8E-07		NA	--	NA	
			Benzo(k)fluoranthene	NA	4.3E-09	NA	NA	4.3E-09		NA	--	NA	
			Bis(2-ethylhexyl)phthalate	NA	1.3E-11	NA	NA	1.3E-11		NA	--	NA	
			Chrysene	NA	1.8E-08	NA	NA	1.8E-08		NA	--	NA	
			Indeno(1,2,3-cd)pyrene	NA	7.5E-09	NA	NA	7.5E-09		NA	--	NA	
			Naphthalene	NA	NC	NA	NA		Respiratory	NA	7.0E-02	NA	7.0E-02
			TEQ	NA	4.3E-06	NA	NA	4.3E-06	Liver / Reproductive /	NA	2.0E-01	NA	2.0E-01
			Aluminum	NA	NC	NA	NA		Undetermined				
			Chromium	NA	--	NA	NA		Respiratory				
			Cobalt	NA	NC	NA	NA						

TABLE 11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CENTRAL TENDENCY EXPOSURE- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA - CTE SCENARIO
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
			Lead	NA	--	NA	NA						
			Manganese	NA	NC	NA	NA		Nervous System				
			Nickel	NA	--	NA	NA		Respiratory				
			Thallium	NA	NC	NA	NA						
			Vanadium	NA	NC	NA	NA						
RECEPTOR TOTAL								3E-05					2
							TOTAL RISK ACROSS ALL MEDIA	3E-05	TOTAL HAZARD ACROSS ALL MEDIA				2

NOTES:
NC - Not carcinogenic by this exposure route.
NA - Not applicable; exposure route not applicable for this chemical/exposure medium.
-- - Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 01/21/10
Checked by: RRD 03/24/10

TOTAL GENERAL TOXICITY HI =	1.3E-05
	--
TOTAL DEVELOPMENTAL HI =	2.7E-03
TOTAL ENDOCRINE HI =	2.0E-01
	--
	--
TOTAL HEMATOLOGICAL HI =	2.0E-01
TOTAL IMMUNE SYSTEM HI =	6.9E-02
TOTAL KIDNEY HI =	3.8E-02
TOTAL LIVER HI =	2.7E-01
	--
TOTAL NERVOUS SYSTEM HI =	7.3E-01
TOTAL NOAEL HI =	3.8E-01
TOTAL REPRODUCTIVE HI =	2.0E-01
	--
TOTAL RESPIRATORY HI =	2.7E-01

TABLE 12
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS -- REASONABLE MAXIMUM EXPOSURE - WITH LEA DATA- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (I)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
GROUND WATER	GROUND WATER	GROUNDWATER	DERMAL	1,4-Dichlorobenzene	0.0050	mg/l	3.3E-08	mg/kg/day	5.4E-03	(mg/kg/day)-1	2.E-10	2.7E-06	mg/kg/day	7.0E-02	mg/kg/day	4.E-05
				Benzene	0.021	mg/l	3.8E-08	mg/kg/day	5.5E-02	(mg/kg/day)-1	2.E-09	2.7E-06	mg/kg/day	4.0E-03	mg/kg/day	7.E-04
				Chlorobenzene	0.10	mg/l	NC		NC			4.6E-05	mg/kg/day	4.0E-01	mg/kg/day	1.E-04
				Chloroform	0.0041	mg/l	4.3E-09	mg/kg/day	NA			3.0E-07	mg/kg/day	1.0E-01	mg/kg/day	3.E-06
				cis-1,2-Dichloroethene	23	mg/l	NC		NC			--		3.0E-01	mg/kg/day	
				Ethylbenzene	0.028	mg/l	NC		NC			1.3E-05	mg/kg/day	5.0E-01	mg/kg/day	3.E-05
				Isopropyl Alcohol	0.070	mg/l	NC		NC			--		ND		
				Methylcyclohexane	0.10	mg/l	NC		NC			--		ND		
				Tetrachloroethene	220	mg/l	1.5E-03	mg/kg/day	5.4E-01	(mg/kg/day)-1	8.E-04	1.0E-01	mg/kg/day	1.0E-01	mg/kg/day	1.E+00
				Total Xylenes	0.069	mg/l	NC		NC			--		4.0E-01	mg/kg/day	
				Trichloroethene	23	mg/l	4.0E-05	mg/kg/day	5.9E-03	(mg/kg/day)-1	3.E-07	3.1E-03	mg/kg/day	3.0E-01	mg/kg/day	1.E+01
				Vinyl Chloride	0.48	mg/l	3.1E-07	mg/kg/day	7.2E+01	(mg/kg/day)-1	2.E-07	2.1E-05	mg/kg/day	3.0E-03	mg/kg/day	7.E-03
				2,4,6-Trichlorophenol	2.9	mg/l	2.5E-05	mg/kg/day	1.1E-02	(mg/kg/day)-1	3.E-07	1.8E-03	mg/kg/day	1.0E-03	mg/kg/day	2.E+00
				Benzo(a)anthracene	0.0037	mg/l	5.4E-07	mg/kg/day	7.3E+01	(mg/kg/day)-1	4.E-07	3.7E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(b)fluoranthene	0.0025	mg/l	6.3E-07	mg/kg/day	7.3E+01	(mg/kg/day)-1	5.E-07	4.4E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(k)fluoranthene	0.0029	mg/l	--		7.3E+02	(mg/kg/day)-1		--		3.0E-01	mg/kg/day	
				Bis(2-ethylhexyl)phthalate	0.031	mg/l	5.4E-07	mg/kg/day	1.4E+02	(mg/kg/day)-1	8.E-09	3.8E-05	mg/kg/day	1.0E-01	mg/kg/day	4.E-04
				Chrysene	0.0039	mg/l	5.6E-07	mg/kg/day	7.3E+03	(mg/kg/day)-1	4.E-09	3.9E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Indeno(1,2,3-cd)pyrene	0.002	mg/l	5.2E-07	mg/kg/day	7.3E+01	(mg/kg/day)-1	4.E-07	3.6E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Naphthalene	0.011	mg/l	NC		NC			5.7E-06	mg/kg/day	6.0E-01	mg/kg/day	1.E-05
				TEQ	4.58E-06	mg/l	9.9E-10	mg/kg/day	1.5E+05	(mg/kg/day)-1	1.E-04	6.9E-08	mg/kg/day	ND		
				Aluminum	0.51	mg/l	NC		NC			--		1.0E+00	mg/kg/day	
				Chromium	0.11	mg/l	NC		NC			1.2E-06	mg/kg/day	5.0E-04	mg/kg/day	2.E-02
				Cobalt	0.014	mg/l	NC		NC			--		3.0E-03	mg/kg/day	
				Lead	0.028	mg/l	--		NA			--		ND		
				Manganese	5.6	mg/l	NC		NC			3.0E-05	mg/kg/day	2.8E-02	mg/kg/day	1.E-02
				Nickel	0.063	mg/l	NC		NC			9.0E-08	mg/kg/day	8.0E-03	mg/kg/day	1.E-04
				Thallium	0.0009	mg/l	NC		NC			3.7E-08	mg/kg/day	8.0E-05	mg/kg/day	5.E-05
				Vanadium	0.036	mg/l	NC		NC			2.0E-07	mg/kg/day	2.6E-03	mg/kg/day	8.E-04
			EXPOSURE ROUTE TOTAL								1.E-03					13
		EXPOSURE POINT TOTAL									1.E-03					13
	EXPOSURE MEDIUM TOTAL										1.E-03					13
	AIR	TRENCH - AIR	VAPOR INHALATION	1,4-Dichlorobenzene	34	ug/m3	3.6E-03	ug/m3	1.1E-05	(ug/m3)-1	4.E-08	2.5E-01	ug/m3	8.0E+02	ug/m3	3.E-04
				Benzene	196	ug/m3	2.1E-02	ug/m3	7.8E-06	(ug/m3)-1	2.E-07	1.5E+00	ug/m3	3.0E+01	ug/m3	5.E-02
				Chlorobenzene	1240	ug/m3	NC		NC			9.3E+00	ug/m3	5.0E+01	ug/m3	2.E-01
				Chloroform	31	ug/m3	3.3E-03	ug/m3	2.3E-05	(ug/m3)-1	8.E-08	2.3E-01	ug/m3	2.5E+02	ug/m3	9.E-04
				cis-1,2-Dichloroethene	175581	ug/m3	NC		NC			1.3E+03	ug/m3	ND		
				Ethylbenzene	225	ug/m3	NC		NC			1.7E+00	ug/m3	3.1E+03	ug/m3	6.E-04
				Isopropyl Alcohol	NL	ug/m3	NC		NC					7.0E+03	ug/m3	
				Methylcyclohexane	842	ug/m3	NC		NC			6.3E+00	ug/m3	3.0E+03	ug/m3	2.E-03
				Tetrachloroethene	1422609	ug/m3	1.5E+02	ug/m3	5.9E-06	(ug/m3)-1	9.E-04	1.1E+04	ug/m3	2.7E+02	ug/m3	4.E+01
				Total Xylenes	553	ug/m3	NC		NC			4.2E+00	ug/m3	7.9E+03	ug/m3	5.E-04
				Trichloroethene	166667.0	ug/m3	1.8E+01	ug/m3	2.0E-06	(ug/m3)-1	4.E-05	1.3E+03	ug/m3	1.0E+01	ug/m3	1.E+02
				Vinyl Chloride	5159	ug/m3	5.4E-01	ug/m3	8.4E-06	(ug/m3)-1	2.E-06	3.8E+01	ug/m3	1.0E+02	ug/m3	4.E-01
				2,4,6-Trichlorophenol	2220	ug/m3	2.4E-01	ug/m3	3.1E-06	(ug/m3)-1	7.E-07	1.7E+01	ug/m3	ND		
				Benzo(a)anthracene	1.3	ug/m3	1.3E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-08	9.4E-03	ug/m3	ND		
				Benzo(b)fluoranthene	9.0	ug/m3	9.7E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-07	6.8E-02	ug/m3	ND		
				Benzo(k)fluoranthene	0.25	ug/m3	2.6E-05	ug/m3	1.1E-04	(ug/m3)-1	3.E-09	1.9E-03	ug/m3	ND		
				Bis(2-ethylhexyl)phthalate	0.28	ug/m3	3.0E-05	ug/m3	2.4E-06	(ug/m3)-1	7.E-11	2.1E-03	ug/m3	ND		
				Chrysene	14	ug/m3	1.5E-03	ug/m3	1.1E-05	(ug/m3)-1	2.E-08	1.1E-01	ug/m3	ND		
				Indeno(1,2,3-cd)pyrene	0.31	ug/m3	3.4E-05	ug/m3	1.1E-04	(ug/m3)-1	4.E-09	2.4E-03	ug/m3	ND		
				Naphthalene	73	ug/m3	NC		NC			5.5E-01	ug/m3	3.0E+00	ug/m3	2.E-01
				TEQ	0.012	ug/m3	1.4E-06	ug/m3	3.8E+01	(ug/m3)-1	5.E-05	9.5E-05	ug/m3	4.0E-05	ug/m3	2.E+00
				Aluminum	NV	ug/m3	NC		NC			NA		5.0E+00	ug/m3	
				Chromium	NV	ug/m3	--		8.4E-02	(ug/m3)-1		NA		1.0E-01	ug/m3	
				Cobalt	NV	ug/m3	NC		NC			NA		2.0E-02	ug/m3	
				Lead	NV	ug/m3	--		NA			NA		ND		
				Manganese	NV	ug/m3	NC		NC			NA		3.0E-02	ug/m3	
				Nickel	NV	ug/m3	--		2.4E-04	(ug/m3)-1		NA		2.0E-01	ug/m3	
				Thallium	NV	ug/m3	NC		NC			NA		ND		

TABLE 12
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS – REASONABLE MAXIMUM EXPOSURE - WITH LEA DATA- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
				Vanadium	NV	ug/m³	NC		NC			NA		1.0E-01	ug/m³	
			EXPOSURE ROUTE TOTAL								1.E-03					168
		EXPOSURE POINT TOTAL									1.E-03					168
	EXPOSURE MEDIUM TOTAL										1.E-03					168
GROUNDWATER TOTAL											2.E-03					181
TOTAL RECEPTOR RISK ACROSS ALL MEDIA											2.E-03	TOTAL RECEPTOR HAZARD ACROSS ALL MEDIA				181

NOTES
(1) - Blank cells indicate that an RfD or RfC is not avalailable from the sources used to obtain dose-response data for this risk assessment.
NC - Not carcinogenic by this exposure route.
NA - Not applicable: exposure route not applicable for this chemical/exposure medium.
NL - Not included in the calculation table for ambient air concentrations in a trench from groundwater.
NV - Not volatile; exposure route not complete for this chemical.
-- - Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 01/21/10
Checked by: RRD 03/24/10

TABLE 13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE - WITH LEA DATA- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
GROUND WATER	GROUND WATER	GROUNDWATER											
			1,4-Dichlorobenzene	--	NA	2.0E-10	NA	2.0E-10	Endocrine			3.8E-05	3.8E-05
			Benzene	--	NA	2.1E-09	NA	2.1E-09	Immune system /			6.6E-04	6.6E-04
			Chlorobenzene	NC	NA	NC	NA		Liver			1.1E-04	1.1E-04
			Chloroform	--	NA	--	NA		Liver			3.0E-06	3.0E-06
			cis-1,2-Dichloroethene	NC	NA	NC	NA		Hematological			--	
			Ethylbenzene	NC	NA	NC	NA		Liver / Kidney			2.7E-05	2.7E-05
			Isopropyl Alcohol	NC	NA	NC	NA					--	
			Methylcyclohexane	NC	NA	NC	NA					--	
			Tetrachloroethene	--	NA	8.1E-04	NA	8.1E-04	Liver			1.0E+00	1.0E+00
			Total Xylenes	NC	NA	NC	NA		Nervous System			--	
			Trichloroethene	--	NA	2.6E-07	NA	2.6E-07	Liver / Kidney			1.0E+01	1.0E+01
			Vinyl Chloride	--	NA	2.2E-07	NA	2.2E-07	Liver			7.1E-03	7.1E-03
			2,4,6-Trichlorophenol	--	NA	2.8E-07	NA	2.8E-07	Undetermined			1.8E+00	1.8E+00
			Benzo(a)anthracene	--	NA	3.9E-07	NA	3.9E-07	Kidney			1.2E-04	1.2E-04
			Benzo(b)fluoranthene	--	NA	4.6E-07	NA	4.6E-07	Kidney			1.5E-04	1.5E-04
			Benzo(k)fluoranthene	--	NA	--	NA		Kidney			--	
			Bis(2-ethylhexyl)phthalate	--	NA	7.6E-09	NA	7.6E-09	Reproductive			3.8E-04	3.8E-04
			Chrysene	--	NA	4.1E-09	NA	4.1E-09	Kidney			1.3E-04	1.3E-04
			Indeno(1,2,3-cd)pyrene	--	NA	3.8E-07	NA	3.8E-07	Kidney			1.2E-04	1.2E-04
			Naphthalene	NC	NA	NC	NA		Nervous System			9.6E-06	9.6E-06
			TEQ	--	NA	1.5E-04	NA	1.5E-04				--	
			Aluminum	NC	NA	NC	NA		Nervous System			--	
			Chromium	NC	NA	NC	NA		NOAEL			2.5E-03	2.5E-03
			Cobalt	NC	NA	NC	NA		Hematological			--	
			Lead	--	NA	--	NA					--	
			Manganese	NC	NA	NC	NA		Nervous System			1.1E-02	1.1E-02
			Nickel	NC	NA	NC	NA		General Toxicity			1.1E-04	1.1E-04
			Thallium	NC	NA	NC	NA		NOAEL			4.7E-05	4.7E-05
			Vanadium	NC	NA	NC	NA		Kidney			7.6E-04	7.6E-04
		EXPOSURE POINT TOTAL						1E-03					15
	EXPOSURE MEDIUM TOTAL							1E-03					15
GROUND WATER	AIR	TRENCH - AIR											
			1,4-Dichlorobenzene	NA	4.0E-08	NA	NA	4.0E-08	Developmental	NA	3.7E-04	NA	3.E-04
			Benzene	NA	1.6E-07	NA	NA	1.6E-07	Immune system	NA	4.9E-02	NA	5.E-02
			Chlorobenzene	NA	NC	NA	NA		Undetermined	NA	1.9E-01	NA	2.E-01
			Chloroform	NA	7.6E-08	NA	NA	7.6E-08	Liver	NA	9.3E-04	NA	9.E-04
			cis-1,2-Dichloroethene	NA	NC	NA	NA			NA	--	NA	
			Ethylbenzene	NA	NC	NA	NA		Developmental	NA	5.5E-04	NA	6.E-04
			Isopropyl Alcohol	NA	NC	NA	NA						
			Methylcyclohexane	NA	NC	NA	NA			NA	2.1E-03	NA	2.E-03
			Tetrachloroethene	NA	9.0E-04	NA	NA	9.0E-04	Nervous System	NA	4.0E+01	NA	4.E+01
			Total Xylenes	NA	NC	NA	NA		Nervous System	NA	5.3E-04	NA	5.E-04
			Trichloroethene	NA	3.6E-05	NA	NA	3.6E-05	Nervous System	NA	1.3E+02	NA	1.E+02
			Vinyl Chloride	NA	2.4E-06	NA	NA	2.4E-06	Liver	NA	3.8E-01	NA	4.E-01
			2,4,6-Trichlorophenol	NA	7.4E-07	NA	NA	7.4E-07		NA	--	NA	
			Benzo(a)anthracene	NA	1.5E-08	NA	NA	1.5E-08		NA	--	NA	
			Benzo(b)fluoranthene	NA	1.1E-07	NA	NA	1.1E-07		NA	--	NA	
			Benzo(k)fluoranthene	NA	2.9E-10	NA	NA	2.9E-10		NA	--	NA	
			Bis(2-ethylhexyl)phthalate	NA	7.3E-11	NA	NA	7.3E-11		NA	--	NA	
			Chrysene	NA	1.7E-08	NA	NA	1.7E-08		NA	--	NA	
			Indeno(1,2,3-cd)pyrene	NA	3.7E-09	NA	NA	3.7E-09		NA	--	NA	
			Naphthalene	NA	NC	NA	NA		Respiratory	NA	1.8E-01	NA	2.E-01
			TEQ	NA	5.2E-05	NA	NA	5.2E-05	Liver / Reproductive /	NA	2.4E+00	NA	2.E+00
			Aluminum	NA	NC	NA	NA		Undetermined	NA	NA	NA	
			Chromium	NA	--	NA	NA		Respiratory	NA	NA	NA	
			Cobalt	NA	NC	NA	NA			NA	NA	NA	
			Lead	NA	--	NA	NA			NA	NA	NA	
			Manganese	NA	NC	NA	NA		Nervous System	NA	NA	NA	
			Nickel	NA	--	NA	NA		Respiratory	NA	NA	NA	
			Thallium	NA	NC	NA	NA			NA	NA	NA	

TABLE 13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE - WITH LEA DATA- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
			Vinadium	NA	NC	NA	NA			NA	NA	NA	
		EXPOSURE POINT TOTAL						1E-03					168
	EXPOSURE MEDIUM TOTAL							1E-03					168
GROUNDWATER TOTAL								2E-03					181
RECEPTOR TOTAL								2E-03					181
							TOTAL RISK ACROSS ALL MEDIA	2E-03	TOTAL HAZARD ACROSS ALL MEDIA				181

NOTES:
NC - Not carcinogenic by this exposure route.
NA - Not applicable; exposure route not applicable for this chemical/exposure medium.
--- Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 01/21/10
Checked by: RRD 03/24/10

TOTAL GENERAL TOXICITY HI =	1.1E-04
	--
TOTAL DEVELOPMENTAL HI =	8.7E-04
TOTAL ENDOCRINE HI =	2.4E+00
	--
	--
TOTAL HEMATOLOGICAL HI =	2.4E+00
TOTAL IMMUNE SYSTEM HI =	5.0E-01
TOTAL KIDNEY HI =	1.9E+01
TOTAL LIVER HI =	1.4E+01
	--
TOTAL NERVOUS SYSTEM HI =	1.7E+02
TOTAL NOAEL HI =	1.9E+00
TOTAL REPRODUCTIVE HI =	2.4E+00
	--
TOTAL RESPIRATORY HI =	2.6E+00

APPENDIX A

SUPPLEMENTAL UTILITY WORKER RISK ASSESSMENT

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Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	GEC1 10/23/2002	GEC1 3/22/1999	GEC2 10/23/2002	GEC2 3/22/1999	GEC2 8/21/2001	GEC3 10/24/2002	GEC3 3/22/1999	GEC4 10/23/2002	GEC4 3/22/1999	GEC5 10/23/2002	GEC5 3/22/1999	GEC6 10/23/2002
Dioxins and Furans (pg/L)												
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-Dioxin (unfiltered)												
1,2,3,4,6,7,8-HpCDD					3.9 U							
1,2,3,4,6,7,8-HpCDF					5.9 U							
1,2,3,4,7,8,9-HpCDF					2.4 UJ							
1,2,3,4,7,8-HxCDD					1.8 EMPC							
1,2,3,4,7,8-HxCDF					3.9 U							
1,2,3,6,7,8-HxCDD					1.8 EMPC							
1,2,3,6,7,8-HxCDF					3 U							
1,2,3,7,8,9-HxCDD					2.3 U							
1,2,3,7,8,9-HxCDF					1.9 U							
1,2,3,7,8-PeCDD					2.2 U							
1,2,3,7,8-PeCDF					4.7 U							
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin (unfiltered)												
1,2,4,5,7,8-hexachloro(9h)xanthene												
2,3,4,6,7,8-HxCDF					1.5 U							
2,3,4,7,8-PeCDF					2.5 EMPC							
2,3,7,8-TCDD					3.2 U							
2,3,7,8-TCDD (unfiltered)												
2,3,7,8-TCDF					2.4 EMPC							
Heptachlorodibenzo-p-Dioxins (unfiltered)												
Hexachlorodibenzofurans (unfiltered)												
OCDD					20.4 U							
OCDF					17.6 U							
Pentachlorodibenzofurans (unfiltered)												
Pentachlorodibenzo-p-Dioxins (unfiltered)												
TEQ					0 UJ							
Tetrachlorodibenzo-p-Dioxins (unfiltered)												
Total Hepta-Dioxins												
Total Hepta-Furans												
Total Hexa-Furans												
Total HpCDD					6.9 EMPC							
Total HpCDF					5.9 UJ							
Total HxCDD					16 EMPC							
Total HxCDF					8.4 EMPC							
Total PeCDD					2.2 UJ							
Total PeCDF					7.2 EMPC							
Total Penta-Dioxins												
Total Penta-Furans												
Total TCDD					9.4 EMPC							
Total TCDF					4.8 EMPC							
Total Tetrachlorodibenzofurans, NOS (unfiltered)												
Total Tetra-Dioxins												
Total Tetra-Furans												

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	GEC1 10/23/2002	GEC1 3/22/1999	GEC2 10/23/2002	GEC2 3/22/1999	GEC2 8/21/2001	GEC3 10/24/2002	GEC3 3/22/1999	GEC4 10/23/2002	GEC4 3/22/1999	GEC5 10/23/2002	GEC5 3/22/1999	GEC6 10/23/2002
2,3,7,8-TCDD (filtered)												
Pentachlorodibenzofurans (filtered)												
Pentachlorodibenzo-p-Dioxins (filtered)												
Tetrachlorodibenzo-p-Dioxins (filtered)												
Metals (Total) (ug/L)												
Aluminum					69.3							
Arsenic		5 U		5 U	2 U						18	
Barium		140		30	145						330	
Beryllium					0.28 UJ							
Cadmium					0.4 U							
Calcium					168000							
Chromium		10 U		10 U	4.1 U						20	
Cobalt					6.2 U							
Copper					6.3 U							
Iron					4410							
Lead		70 U		10 U	1.3 UJ						60 U	
Magnesium					5820							
Manganese					2200							
Nickel					2.4 U							
Potassium					16700 J							
Silver					0.77 UJ							
Sodium					120000							
Thallium					5.6 UJ							
Vanadium					0.9 U							
Zinc					41.9 U							
Metals (Dissolved) (ug/L)												
Aluminum					14.4 U							
Arsenic					3.4 UJ							
Barium					134							
Cadmium					0.4 U							
Calcium					155000							
Chromium					3.4 U							
Cobalt					7.2 U							
Copper					4.7 U							
Iron					4040 J							
Lead					1.3 UJ							
Magnesium					5360							
Manganese					2030							
Nickel					2.5 U							
Potassium					15300 J							
Silver					0.7 U							
Sodium					84700							
Thallium					5.6 UJ							
Vanadium					0.9 U							

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Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	GEC1 10/23/2002	GEC1 3/22/1999	GEC2 10/23/2002	GEC2 3/22/1999	GEC2 8/21/2001	GEC3 10/24/2002	GEC3 3/22/1999	GEC4 10/23/2002	GEC4 3/22/1999	GEC5 10/23/2002	GEC5 3/22/1999	GEC6 10/23/2002
Zinc					25.9 U							
Semi-Volatiles (ug/L)												
1-methylnaphthalene		0.18 U		0.15			0.47		0.17		0.12 U	
2,4,6-trichlorophenol					10 U							
2,4-dichlorophenol					10 U							
2-methylnaphthalene		0.18 U		0.14 U	10 U		0.6		0.18		0.12 U	
4-methylphenol					10 U							
Acenaphthene		0.18 U		0.14 U	10 U		0.91		0.12 U		0.12 U	
Acenaphthylene		0.18 U		0.14 U	10 U		0.55		0.12 U		0.12 U	
Anthracene		0.18 U		0.14 U	10 U		1.7		0.21		0.12 U	
Benzo(a)anthracene		0.18 U		0.18	10 U		3.7		0.43		0.12 U	
Benzo(a,e)pyrene		0.18 U		0.15			3.1		0.39		0.12 U	
Benzo(b)fluoranthene		0.18 U		0.14	10 U		2.5		0.35		0.12 U	
Benzo(g,h,i)perylene		0.18 U		0.14 U	10 U		1.8		0.23		0.12 U	
Benzo(k)fluoranthene		0.18 U		0.15	10 U		2.9		0.38		0.12 U	
Bis(2-ethylhexyl)phthalate					10 UJ							
C3-benzene Isomer												
C4-benzene Isomer												
Chrysene		0.18 U		0.22	10 U		3.9		0.52		0.12 U	
Dibenzo(a,h)anthracene		0.18 U		0.14 U	10 U		0.47		0.12 U		0.12 U	
Fluoranthene		0.25		0.46	10 U		10		1.4		0.12 U	
Fluorene		0.18 U		0.14 U	10 U		1.2		0.16		0.12 U	
Indeno(1,2,3-cd)pyrene		0.18 U		0.14 U	10 U		2		0.25		0.12 U	
Naphthalene		0.18 U		0.15	10 U		1.9		0.13		0.12 U	
Phenanthrene		0.3		0.54	10 U		7.4		0.92		0.12 U	
Propanoic Acid, 2-methyl-, 2,2-dimethyl-												
Propanoic Acid, 2-methyl-, 3-hydroxy-2,4												
Pyrene		0.24		0.43	10 U		8		1.1		0.12 U	
Substituted Phenol_total												
Trichloropropene												
Unknown Alkyl Phenol					3 J							
Unknown Amide												
Unknown Phthalate												
Unknown Siloxane_total												
Vanillin												
Volatiles (ug/L)												
1,1,2,2-Tetrachloroethane	1 U		1 U		10 U	1 U		1 U		1 U		1 U
1,2,4-Trimethylbenzene	1 U		1 U			1 U		1 U		1 U		1 U
1,2-Dibromo-3-Chloropropane	1 U		1 U		10 UJ	1 U		1 U		1 U		1 U
1,2-DIBROMOETHANE	1 U		1 U		10 U	1 U		1 U		1 U		1 U
1,2-DICHLOROBENZENE	1 U		1 U		10 U	1 U		1 U		1 U		0.22 J
1,3,5-Trimethylbenzene	1 U		1 U			1 U		1 U		1 U		1 U
1,3-DICHLOROBENZENE	1 U		1 U		10 U	1 U		1 U		1 U		1 U
1,4-DICHLOROBENZENE	1 U		1 U		10 U	1 U		1 U		1 U		1 U

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	GEC1 10/23/2002	GEC1 3/22/1999	GEC2 10/23/2002	GEC2 3/22/1999	GEC2 8/21/2001	GEC3 10/24/2002	GEC3 3/22/1999	GEC4 10/23/2002	GEC4 3/22/1999	GEC5 10/23/2002	GEC5 3/22/1999	GEC6 10/23/2002
2-hexanone					10 UJ							
Acetone		10 U		24	10 UJ		10 U		10 U		10 U	
Benzene	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U		1 U		10 U	1 U		1 U		1 U		1 U
C3-benzene Isomer												
C7 Benzene Isomer												
Chlorobenzene	1 U		1 U		10 U	1 U		1 U		1 U		1.5
Chlorodibromomethane												
Chloroethane	1 UJ		1 UJ		10 U	1 UJ		1 UJ		1 U		1 U
Chloroform	1 U		1 U		10 U	1 U		1 U		1 U		1 U
CIS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	10 U	1 U	1 U	2.8	1 U	21	38 U	5.6
cis-1,2-Dichloroethylene												
Cyclohexane					10 U							
Cyclotrisiloxane, Hexamethyl-												
Ethylbenzene	1 U		1 U		10 U	1 U		1 U		1 U		1 U
Indane												
Isopropyl Alcohol					NJ							
ISOPROPYLBENZENE	1 U		1 U		10 U	1 U		1 U		1 U		1 U
Laboratory Artifact_total												
Methyl Acetate					10 U							
Methyl tert-Butyl ether					10 U							
Methylcyclohexane					10 U							
Methylene Chloride	2 U		2 U		10 UJ	2 U		2 U		2 U		2 U
M-XYLENE & P-XYLENE	2 U		2 U			2 U		2 U		2 U		2 U
Naphthalene	1 U		1 U			1 U		1 U		1 U		1 U
N-PROPYLBENZENE	1 U		1 U			1 U		1 U		1 U		1 U
o-Xylene	1 U		1 U			1 U		1 U		1 U		1 U
P-ISOPROPYLTOLUENE	1 U		1 U			1 U		1 U		1 U		1 U
Tetrachloroethylene	1 U	1.5 U	1 U	1.5 U	10 U	1 U	1.5 U	1 U	1.5 U	0.86 J	2.2	11
Toluene	1 U		1 U		10 U	1 U		1 U		1 U		1 U
Total Xylenes		4.1		1 U	10 U		1 U		1 U		1 U	
trans-1,2-Dichloroethylene	1 UJ		1 UJ		10 UJ	1 UJ		1 UJ		1 U		1 UJ
Trichloroethylene	1 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U	1 U	0.62 J	1.3	0.74 J
Unknown Alcohol												
Vinyl Chloride	1 U	2 U	1 U	2 U	10 U	1 U	2 U	1	27	1.8	2 U	0.39 J
Xylenes,m- & p-												
Pesticides & PCBs (ug/L)												
Aroclor-1254		0.25 U		0.25 U							0.25 U	
alpha-Chlordane					0.05 U							
Dieldrin					0.1 U							
gamma-Chlordane					0.05 U							

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Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	GEC6 3/22/1999	GEC6 8/21/2001	GEC7 10/23/2002	GEC7 3/22/1999	MW01S 10/24/2002	MW01S 2/21/2001	MW01S 8/16/2001	MW02D 10/22/2002	MW02D 8/13/2001	MW02M 10/22/2002	MW02M 8/13/2001
Dioxins and Furans (pg/L)											
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-Dioxin (unfiltered)											
1,2,3,4,6,7,8-HpCDD		6.3 U				5.6 U	5 U		2.3 U		3.2 U
1,2,3,4,6,7,8-HpCDF		3.1 U				3.8 U	2.6 U		1.1 U		1.4 U
1,2,3,4,7,8,9-HpCDF		3.7 UJ				4.6 U	3.1 U		1.2 U		1.6 U
1,2,3,4,7,8-HxCDD		3.7 U				4.1 U	3 U		1.3 U		1.6 U
1,2,3,4,7,8-HxCDF		2.2 U				2.6 U	1.7 U		0.57 U		0.67 EMPC
1,2,3,6,7,8-HxCDD		3.8 U				4.1 U	3 U		1.3 U		1.7 U
1,2,3,6,7,8-HxCDF		2.3 U				2.6 U	1.8 U		0.8 U		1.1 U
1,2,3,7,8,9-HxCDD		3.7 U				3.9 U	3 U		1.2 U		1.6 U
1,2,3,7,8,9-HxCDF		2.8 U				3 U	2.2 U		0.9 U		1.3 U
1,2,3,7,8-PeCDD		3.5 U				3.4 U	2.7 U		0.8 U		1.2 U
1,2,3,7,8-PeCDF		2.5 U				2.2 U	2 U		0.7 U		1 U
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin (unfiltered)											
1,2,4,5,7,8-hexachloro(9h)xanthene											
2,3,4,6,7,8-HxCDF		2.2 U				2.8 U	1.7 U		0.7 U		1.1 U
2,3,4,7,8-PeCDF		2.4 U				2.2 U	1.9 U		0.6 U		0.6 J
2,3,7,8-TCDD		10.8 EMPC				2.4 U	4.7 EMPC		1.2 J		1.2 U
2,3,7,8-TCDD (unfiltered)											
2,3,7,8-TCDF		11.1 EMPC				1.9 U	1.6 U		0.6 U		0.9 U
Heptachlorodibenzo-p-Dioxins (unfiltered)											
Hexachlorodibenzofurans (unfiltered)											
OCDD		7.3 EMPC				19 J	14.8 U		3.2 EMPC		3.2 U
OCDF		9.5 U				7.2 U	8.7 U		2.7 U		3.8 U
Pentachlorodibenzofurans (unfiltered)											
Pentachlorodibenzo-p-Dioxins (unfiltered)											
TEQ		0 UJ					4.7 J		1.2 J		0.3 J
Tetrachlorodibenzo-p-Dioxins (unfiltered)											
Total Hepta-Dioxins											
Total Hepta-Furans											
Total Hexa-Furans											
Total HpCDD		6.3 UJ				5.6 U	5 UJ		2.3 UJ		3.2 UJ
Total HpCDF		3.3 UJ				4.2 U	2.8 UJ		1.2 UJ		1.5 UJ
Total HxCDD		3.7 UJ				4.1 U	3 UJ		18.5 EMPC		17.4 EMPC
Total HxCDF		81.1 EMPC				2.7 U	1.8 UJ		0.57 UJ		0.67 EMPC
Total PeCDD		6.6 UJ				3.4 U	2.7 UJ		5.9 EMPC		3.8 EMPC
Total PeCDF		18.5 UJ				2.2 U	1.9 UJ		0.7 UJ		0.6 J
Total Penta-Dioxins											
Total Penta-Furans											
Total TCDD		32.7 EMPC				23.8 EMPC	4.7 EMPC		4.4 EMPC		2.3 EMPC
Total TCDF		11.1 EMPC				6.7 EMPC	1.6 UJ		3.1 EMPC		4.1 EMPC
Total Tetrachlorodibenzofurans, NOS (unfiltered)											
Total Tetra-Dioxins											
Total Tetra-Furans											

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	GEC6 3/22/1999	GEC6 8/21/2001	GEC7 10/23/2002	GEC7 3/22/1999	MW01S 10/24/2002	MW01S 2/21/2001	MW01S 8/16/2001	MW02D 10/22/2002	MW02D 8/13/2001	MW02M 10/22/2002	MW02M 8/13/2001
2,3,7,8-TCDD (filtered)											
Pentachlorodibenzofurans (filtered)											
Pentachlorodibenzo-p-Dioxins (filtered)											
Tetrachlorodibenzo-p-Dioxins (filtered)											
Metals (Total) (ug/L)											
Aluminum		35.6 U				35.1 U	59.9 J		93.7		45.7 U
Arsenic	20	2 U				4.5 J	6.3 U		2.8 UJ		2.6 U
Barium	210	42.1				112	32.7		32.1 U		55 U
Beryllium		0.23 UJ				0.19 UJ	0.1 U		0.1 UJ		0.1 U
Cadmium		0.4 U				0.6 U	0.7 U		0.7 U		0.7 U
Calcium		20100				56300	12300		36900		36700
Chromium	20	1.7 U				0.85 UJ	1.7 J		1.3 U		5.4 U
Cobalt		1.2 UJ				3.4	1.8 U		3.7 U		34
Copper		5.4 U				0.7 U	2.2 U		2.2 U		2.2 U
Iron		136 U				63400	8220		191		60.4 U
Lead	70	1.3 UJ				1.7 U	1.5 U		1.5 UJ		1.5 UJ
Magnesium		2730				4900	897		4360		5330
Manganese		630				2460	351		672		1500
Nickel		0.9 U				1.3 U	3 U		9.5		15
Potassium		2980 J				5600 J	3170 J		6220 J		7440 J
Silver		0.76 UJ				0.5 U	4 U		4 U		4 U
Sodium		34500				136000	127000 J		96800		111000
Thallium		5.6 UJ				6.5 J	5.7 U		5.7 U		5.7 U
Vanadium		0.9 U				2.4	3.2 U		3.2 U		3.2 U
Zinc		28.7 U				6.2 UJ	21.2		11 UJ		11.3 UJ
Metals (Dissolved) (ug/L)											
Aluminum		49.5 U				36.3 U	49.6 J		100		45.7 U
Arsenic		2 U				4.2 U	6.4 U		2.6 U		2.6 U
Barium		43				112	30.9		31.9		51.9 U
Cadmium		0.4 U				0.6 U	0.7 U		0.7 U		0.7 U
Calcium		20800				56100	11700		36300		34200
Chromium		2.3 U				0.5 U	4.5		1.3 U		1.3 U
Cobalt		0.71 UJ				3.6	1.8 U		3.2 J		14.4
Copper		8.6 U				0.7 U	2.2 U		2.2 U		2.2 U
Iron		138 UJ				63400	7840		144		13.1 U
Lead		1.3 UJ				1.7 U	1.5 U		1.5 U		2.2 UJ
Magnesium		2870				4930	861		4290		4960
Manganese		638				2450	335		666		1410
Nickel		1.7 UJ				1.3 U	3 U		9.4		10.2
Potassium		3120 J				5550 J	2980 J		5990 J		6960 J
Silver		0.72 UJ				0.5 U	4 U		4 U		4 U
Sodium		36200				136000	121000 J		91000 J		104000
Thallium		5.6 UJ				6.2 U	5.7 U		5.7 U		5.7 U
Vanadium		0.9 U				2.1	3.2 U		3.2 U		3.2 U

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	GEC6 3/22/1999	GEC6 8/21/2001	GEC7 10/23/2002	GEC7 3/22/1999	MW01S 10/24/2002	MW01S 2/21/2001	MW01S 8/16/2001	MW02D 10/22/2002	MW02D 8/13/2001	MW02M 10/22/2002	MW02M 8/13/2001
Zinc		16.6 U				8.8 UJ	12.2 UJ		19 U		10.1 UJ
Semi-Volatiles (ug/L)											
1-methylnaphthalene	0.12 U			0.23							
2,4,6-trichlorophenol		10 U				10 U	10 U		10 U		10 U
2,4-dichlorophenol		10 U				10 U	10 U		10 U		10 U
2-methylnaphthalene	0.12 U	10 U		0.24		10 U	10 U		10 U		10 U
4-methylphenol		10 U				10 U	10 U		10 U		10 U
Acenaphthene	0.12 U	10 U		0.69		10 U	10 U		10 U		10 U
Acenaphthylene	0.12 U	10 U		0.24		10 U	10 U		10 U		10 U
Anthracene	0.12 U	10 U		0.47		10 U	10 U		10 UJ		10 U
Benzo(a)anthracene	0.22	10 U		0.49		10 U	10 U		10 U		10 U
Benzo(a,e)pyrene	0.18			0.54							
Benzo(b)fluoranthene	0.17	10 U		0.94		10 U	10 U		10 U		10 U
Benzo(g,h,i)perylene	0.12 U	10 U		0.46		10 U	10 U		10 U		10 U
Benzo(k)fluoranthene	0.18	10 U		0.88		10 U	10 U		10 U		10 U
Bis(2-ethylhexyl)phthalate		10 U				4 J	16		10 U		10 U
C3-benzene Isomer											
C4-benzene Isomer											
Chrysene	0.28	10 U		1.3		10 U	10 U		10 U		10 U
Dibenzo(a,h)anthracene	0.12 U	10 U		0.14 U		10 U	10 U		10 U		10 U
Fluoranthene	0.81	10 U		5.3		10 U	10 U		10 U		10 U
Fluorene	0.12 U	10 U		0.73		10 U	10 U		10 U		10 U
Indeno(1,2,3-cd)pyrene	0.12 U	10 U		0.53		10 U	10 U		10 U		10 U
Naphthalene	0.12 U	10 U		0.14 U		10 U	10 U		10 U		10 U
Phenanthrene	0.77	10 U		1.6		10 U	10 U		10 U		10 U
Propanoic Acid, 2-methyl-, 2,2-dimethyl-											
Propanoic Acid, 2-methyl-, 3-hydroxy-2,4											
Pyrene	0.61	10 U		2.9		10 U	10 U		10 U		10 U
Substituted Phenol_total											
Trichloropropene							3 J				
Unknown Alkyl Phenol											
Unknown Amide						5 J					
Unknown Phthalate											
Unknown Siloxane_total											
Vanillin											
Volatiles (ug/L)											
1,1,2,2-Tetrachloroethane		10 U	1 U		1 U	10 U	10 U	4 U	10 U	5 U	10 U
1,2,4-Trimethylbenzene			1 U		1 U			4 U		5 U	
1,2-Dibromo-3-Chloropropane		10 UJ	1 U		1 U	10 U	10 U	4 U		5 U	
1,2-DIBROMOETHANE		10 U	1 U		1 U	10 U	10 U	4 U	10 U	5 U	10 U
1,2-DICHLOROBENZENE		10 U	1 U		1 U	10 U	10 U	4 U	10 U	5 U	10 U
1,3,5-Trimethylbenzene			1 U		1 U			4 U		5 U	
1,3-DICHLOROBENZENE		10 U	0.27 J		1 U	10 U	10 U	4 U	10 U	5 U	10 U
1,4-DICHLOROBENZENE		10 U	1 U		1 U	10 U	10 U	4 U	10 U	5 U	10 U

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	GEC6 3/22/1999	GEC6 8/21/2001	GEC7 10/23/2002	GEC7 3/22/1999	MW01S 10/24/2002	MW01S 2/21/2001	MW01S 8/16/2001	MW02D 10/22/2002	MW02D 8/13/2001	MW02M 10/22/2002	MW02M 8/13/2001
2-hexanone		10 UJ				10 U	10 U		10 U		10 U
Acetone	10 U	10 UJ		10 U		10 U	18 UJ		10 UJ		10 UJ
Benzene	1 U	10 U	1 U	1.3	1 U	10 U	10 U	4 U	10 U	5 U	10 U
Bromoform		10 U	1 U		1 U	10 U	10 U	4 U	10 U	5 U	10 U
C3-benzene Isomer											
C7 Benzene Isomer											
Chlorobenzene		10 U	0.31 J		1 U	10 U	10 U	4 U	10 U	5 U	10 U
Chlorodibromomethane											
Chloroethane		10 U	1 U		1 UJ	10 UJ	10 U	4 U	10 U	5 U	10 U
Chloroform		10 U	1 U		1 U	10 U	10 U	4 U	10 U	5 U	10 U
CIS-1,2-DICHLOROETHENE	10 U	18	0.48 J	5.6 U	1 U	10 U	10 UJ	12	2 J	5 U	10 U
cis-1,2-Dichloroethylene											
Cyclohexane		10 U				10 U	10 U		10 U		10 U
Cyclotrisiloxane, Hexamethyl-											
Ethylbenzene		10 U	1 U		1 U	10 U	10 U	4 U	10 U	5 U	10 U
Indane											
Isopropyl Alcohol											
ISOPROPYLBENZENE		10 U	1 U		1 U	10 U	10 U	4 U	10 U	5 U	10 U
Laboratory Artifact_total											
Methyl Acetate		10 U				10 U	5 UJ		10 U		10 U
Methyl tert-Butyl ether		10 U				10 U	10 UJ		4 J		3 J
Methylcyclohexane		10 U				10 U	10 U		10 U		10 U
Methylene Chloride		10 UJ	2 U		2 U	10 U	10 UJ	1.9 J	10 U	10 U	10 U
M-XYLENE & P-XYLENE			2 U		2 U			8 U		10 U	
Naphthalene			1 U		1 U			4 U		5 U	
N-PROPYLBENZENE			1 U		1 U			4 U		5 U	
o-Xylene			1 U		1 U			4 U		5 U	
P-ISOPROPYLTOLUENE			1 U		1 U			4 U		5 U	
Tetrachloroethylene	150	*	0.21 J	11	1 U	10 U	10 U	73	*	110	110
Toluene		10 U	1 U		1 U	10 U	10 U	1.8 J	10 U	5 U	10 U
Total Xylenes	1 U	10 U		4		10 U	10 U		10 U		10 U
trans-1,2-Dichloroethylene		10 UJ	1 U		1 UJ	10 U	10 UJ	4 U	10 U	5 U	10 U
Trichloroethylene	1 U	10 U	1 U	2	1 U	10 U	10 U	4.2	27	1.1 J	2 J
Unknown Alcohol											
Vinyl Chloride	2 U	10 U	1 U	6.9	1 U	10 UJ	10 U	4 U	10 U	5 U	10 U
Xylenes,m- & p-											
Pesticides & PCBs (ug/L)											
Aroclor-1254	0.264										
alpha-Chlordane		0.05 U				0.05 U	0.05 U		0.05 UJ		0.05 U
Dieldrin		0.1 U				0.1 U	0.1 U		0.1 UJ		0.1 U
gamma-Chlordane		0.05 U				0.05 U	0.05 U		0.05 UJ		0.05 U

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW02S 10/22/2002	MW02S 2/22/2001	MW02S 8/13/2001	MW03S 11/21/2002	MW03S 2/21/2001	MW03S 8/16/2001	MW04B 10/22/2002	MW04B 8/14/2001	MW04D 10/22/2002	MW04D 8/14/2001	MW04S 10/22/2002
Dioxins and Furans (pg/L)											
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-Dioxin (unfiltered)											
1,2,3,4,6,7,8-HpCDD		5.3 EMPC	4.2 U		6 U	8.4 U		4 U		2 U	
1,2,3,4,6,7,8-HpCDF		1.8 U	2.2 U		3.9 U	3.9 U		2.3 U		1 U	
1,2,3,4,7,8,9-HpCDF		2.1 U	2.8 U		4.6 U	4.9 U		2.8 U		2 EMPC	
1,2,3,4,7,8-HxCDD		1.8 U	2.5 U		3.9 U	5.3 U		2.5 U		1.2 U	
1,2,3,4,7,8-HxCDF		1.2 U	1.8 U		2.7 U	3.3 U		1.7 U		2.5 EMPC	
1,2,3,6,7,8-HxCDD		1.8 U	2.6 U		4 U	5.4 U		2.6 U		1.2 U	
1,2,3,6,7,8-HxCDF		1.2 U	1.8 U		2.6 U	3.4 U		1.7 U		2.4 U	
1,2,3,7,8,9-HxCDD		1.7 U	2.5 U		3.8 U	5.3 U		2.5 U		3.8 EMPC	
1,2,3,7,8,9-HxCDF		1.4 U	2.2 U		3 U	4.2 U		2.1 U		4 J	
1,2,3,7,8-PeCDD		1.6 U	1.9 U		3.5 U	4.9 U		1.6 U		3.2 J	
1,2,3,7,8-PeCDF		1.1 U	1.6 U		2.4 U	3.9 U		1.4 U		3.6 EMPC	
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin (unfiltered)											
1,2,4,5,7,8-hexachloro(9h)xanthene											
2,3,4,6,7,8-HxCDF		1.3 U	1.8 U		2.8 U	3.3 U		1.7 U		3 EMPC	
2,3,4,7,8-PeCDF		1.1 U	1.5 U		2.4 U	3.7 U		1.4 U		3.5 J	
2,3,7,8-TCDD		4.7 J	1.8 U		3.6 EMPC	11.3		1.6 U		3.9 J	
2,3,7,8-TCDD (unfiltered)											
2,3,7,8-TCDF		0.8 U	1.6 U		1.9 U	3.4 U		1.5 U		0.8 U	
Heptachlorodibenzo-p-Dioxins (unfiltered)											
Hexachlorodibenzofurans (unfiltered)											
OCDD		52 J	13.5 U		15.5 J	16.7 EMPC		10.4 U		21 U	
OCDF		3.7 U	3.8 U		7.2 U	10.7 U		3.7 U		5.1 EMPC	
Pentachlorodibenzofurans (unfiltered)											
Pentachlorodibenzo-p-Dioxins (unfiltered)											
TEQ			0 U			11		0 U		10 J	
Tetrachlorodibenzo-p-Dioxins (unfiltered)											
Total Hepta-Dioxins											
Total Hepta-Furans											
Total Hexa-Furans											
Total HpCDD		10.8 EMPC	4.2 UJ		6 U	8.4 UJ		4 UJ		7.7 EMPC	
Total HpCDF		4	2.5 UJ		4.2 U	3.9 UJ		2.5 UJ		4.1 EMPC	
Total HxCDD		1.8 U	2.5 UJ		3.9 U	5.3 UJ		2.5 UJ		8.6 EMPC	
Total HxCDF		1.3 U	1.9 UJ		2.8 U	5.3 UJ		1.8 UJ		11.8 EMPC	
Total PeCDD		1.6 U	1.9 UJ		3.5 U	4.9 UJ		4.6 EMPC		8.9 UJ	
Total PeCDF		1.1 U	1.5 UJ		2.4 U	3.8 UJ		1.4 UJ		3.5 J	
Total Penta-Dioxins											
Total Penta-Furans											
Total TCDD		4.7	1.8 UJ		3.6 EMPC	11.3 UJ		1.6 UJ		3.9 UJ	
Total TCDF		0.8 U	1.6 UJ		4.1	10.7 UJ		1.5 UJ		0.8 UJ	
Total Tetrachlorodibenzofurans, NOS (unfiltered)											
Total Tetra-Dioxins											
Total Tetra-Furans											

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW02S 10/22/2002	MW02S 2/22/2001	MW02S 8/13/2001	MW03S 11/21/2002	MW03S 2/21/2001	MW03S 8/16/2001	MW04B 10/22/2002	MW04B 8/14/2001	MW04D 10/22/2002	MW04D 8/14/2001	MW04S 10/22/2002
2,3,7,8-TCDD (filtered)											
Pentachlorodibenzofurans (filtered)											
Pentachlorodibenzo-p-Dioxins (filtered)											
Tetrachlorodibenzo-p-Dioxins (filtered)											
Metals (Total) (ug/L)											
Aluminum		68.6 U	45.7 U		146 U	118		45.7 U		80.1 J	
Arsenic		4.2 U	2.6 U		4.2 U	3.9 UJ		2.6 U		2.6 U	
Barium		79.3	168		82.7	44.8		35.7 U		56 U	
Beryllium		0.23	0.1 U		0.16 UJ	0.1 U		0.1 U		0.1 U	
Cadmium		0.6 U	0.7 U		0.99 J	0.7 U		0.7 U		0.7 U	
Calcium		24700	47700		12900	15200		42200		35100	
Chromium		1.9 U	1.5 UJ		6.6	2.8		1.3 U		1.3 U	
Cobalt		0.7 U	1.8 U		0.85 J	1.8 U		2.7 UJ		1.8 U	
Copper		0.7 U	2.2 U		20.2	50		2.2 U		9.9	
Iron		5310	9960		2580	6830		86.5 U		182	
Lead		1.7 U	1.5 UJ		12.2	37		1.5 UJ		1.5 UJ	
Magnesium		2010	4130		764	1110		5130		5080	
Manganese		704	1450		60.5	118		194		337	
Nickel		2.5 J	3 U		11.8	5 J		5.2 J		8.2	
Potassium		2810 J	4410 J		8940 J	2850 J		5270 J		5590 J	
Silver		0.5 U	4 U		0.5 U	4 U		4 U		4 U	
Sodium		65400	61300		371000	55000 J		83000		92100	
Thallium		6.2 U	5.7 U		6.2 U	5.7 U		5.7 U		5.7 U	
Vanadium		0.7 U	3.2 U		6.4	38.7		3.2 U		3.2 U	
Zinc		1.1 UJ	16 UJ		169 J	54		19.5 UJ		24.4 UJ	
Metals (Dissolved) (ug/L)											
Aluminum		41.4 U	45.7 U		68.8 U	98.9		45.7 U		45.7 U	
Arsenic		4.2 U	2.6 U		4.2 U	5.3 U		2.6 U		2.6 U	
Barium		80.4	171		100	44.4		33.9 U		52.2 U	
Cadmium		0.6 U	0.7 U		1 J	0.7 U		0.7 U		0.7 U	
Calcium		24200	47800		15900	15500		42200		34600	
Chromium		0.5 U	1.3 U		1 U	2.6		1.3 U		1.3 U	
Cobalt		0.7 U	1.8 U		0.7 J	1.8 U		1.8 U		1.8 U	
Copper		0.7 U	5.3		15.2	40.1		10.5		5.5	
Iron		4950	10000		2180	6850		32.7 U		52.9 U	
Lead		1.7 U	1.8 UJ		1.7 U	27.7		1.5 UJ		1.5 UJ	
Magnesium		1950	4170		898	1140		5100		4960	
Manganese		654	1460		83.1	121		194		322	
Nickel		1.6 J	3 U		10.5	5.3 J		4.3 J		7.3	
Potassium		2740 J	4470 J		9090 J	2890 J		5020 J		5330 J	
Silver		0.5 U	4 U		0.5 U	4 U		4 U		4 U	
Sodium		67300	61800		378000	54800 J		80600		88500	
Thallium		6.2 U	5.7 U		6.2 U	5.7 U		5.7 U		5.7 U	
Vanadium		0.7 U	3.2 U		2.4	36.2		3.2 U		3.2 U	

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW02S 10/22/2002	MW02S 2/22/2001	MW02S 8/13/2001	MW03S 11/21/2002	MW03S 2/21/2001	MW03S 8/16/2001	MW04B 10/22/2002	MW04B 8/14/2001	MW04D 10/22/2002	MW04D 8/14/2001	MW04S 10/22/2002
Zinc		1.1 UJ	35.2 UJ		174 J	52.9 U		17.7 UJ		17.6 UJ	
Semi-Volatiles (ug/L)											
1-methylnaphthalene											
2,4,6-trichlorophenol		10 U	10 U		10 U	10 U		10 U		10 U	
2,4-dichlorophenol		10 U	10 U		10 U	10 U		10 U		10 U	
2-methylnaphthalene		10 U	10 U		10 U	10 U		10 U		10 U	
4-methylphenol		10 U	10 U		10 U	10 U		10 U		10 U	
Acenaphthene		10 U	10 U		10 U	10 U		10 U		10 U	
Acenaphthylene		10 U	10 U		10 U	10 U		10 U		10 U	
Anthracene		10 U	10 U		10 U	10 U		10 UJ		10 U	
Benzo(a)anthracene		10 U	10 U		10 U	10 U		10 U		10 U	
Benzo(a,e)pyrene											
Benzo(b)fluoranthene		10 U	10 U		10 U	10 U		10 U		10 U	
Benzo(g,h,i)perylene		10 U	10 U		10 U	10 U		10 U		10 U	
Benzo(k)fluoranthene		10 U	10 U		10 U	10 U		10 U		10 U	
Bis(2-ethylhexyl)phthalate		10 U	10 U		1 J	10 U		10 U		10 U	
C3-benzene Isomer											
C4-benzene Isomer											
Chrysene		10 U	10 U		10 U	10 U		10 U		10 U	
Dibenzo(a,h)anthracene		10 U	10 U		10 U	10 U		10 U		10 U	
Fluoranthene		10 U	10 U		10 U	10 U		10 U		10 U	
Fluorene		10 U	10 U		10 U	10 U		10 U		10 U	
Indeno(1,2,3-cd)pyrene		10 U	10 U		10 U	10 U		10 U		10 U	
Naphthalene		10 U	10 U		10 U	10 U		10 U		10 U	
Phenanthrene		10 U	10 U		10 U	10 U		10 U		10 U	
Propanoic Acid, 2-methyl-, 2,2-dimethyl-											
Propanoic Acid, 2-methyl-, 3-hydroxy-2,4											
Pyrene		10 U	10 U		10 U	10 U		10 U		10 U	
Substituted Phenol_total											
Trichloropropene								2 J			
Unknown Alkyl Phenol											
Unknown Amide											
Unknown Phthalate											
Unknown Siloxane_total		32 J_5									
Vanillin											
Volatiles (ug/L)											
1,1,2,2-Tetrachloroethane	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U
1,2,4-Trimethylbenzene	1 U			1 U			1 U		1 U		1 U
1,2-Dibromo-3-Chloropropane	1 U	10 U		1 U	10 U	10 U	1 U		1 U		1 U
1,2-DIBROMOETHANE	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U
1,2-DICHLOROBENZENE	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U
1,3,5-Trimethylbenzene	1 U			1 U			1 U		1 U		1 U
1,3-DICHLOROBENZENE	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U
1,4-DICHLOROBENZENE	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW02S 10/22/2002	MW02S 2/22/2001	MW02S 8/13/2001	MW03S 11/21/2002	MW03S 2/21/2001	MW03S 8/16/2001	MW04B 10/22/2002	MW04B 8/14/2001	MW04D 10/22/2002	MW04D 8/14/2001	MW04S 10/22/2002
2-hexanone		10 U	10 U		10 U	10 U		10 U		10 U	
Acetone		10 U	10 U		24 U	10 UJ		10 UJ		10 UJ	
Benzene	1 U	10 U	1 J	1 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U
Bromoform	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U
C3-benzene Isomer											
C7 Benzene Isomer											
Chlorobenzene	2.1	10 U	1 J	1 U	10 U	10 U	1 U	10 U	1 U	10 U	2.1
Chlorodibromomethane											
Chloroethane	1 U	10 UJ	10 U	1 U	10 UJ	10 U	1 U	10 U	1 U	10 U	1 U
Chloroform	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	0.31 J	10 U	1 U
CIS-1,2-DICHLOROETHENE	1 U	10 U	10 U	1 U	10 U	10 UJ	1 U	10 U	1 U	10 U	5.9
cis-1,2-Dichloroethylene											
Cyclohexane		10 U	10 U		10 U	10 U		10 U		10 U	
Cyclotrisiloxane, Hexamethyl-											
Ethylbenzene	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U
Indane											
Isopropyl Alcohol					7 J						
ISOPROPYLBENZENE	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U
Laboratory Artifact_total											
Methyl Acetate		10 U	10 U		10 U	10 UJ		10 U		10 U	
Methyl tert-Butyl ether		10 U	10 U		11	10 UJ		4 J		4 J	
Methylcyclohexane		10 U	10 U		10 U	10 U		10 U		10 U	
Methylene Chloride	2 U	10 U	10 U	2 U	10 U	10 UJ	2 U	10 U	2 U	10 U	2 U
M-XYLENE & P-XYLENE	2 U			0.22 J			2 U		2 U		2 U
Naphthalene	1 U			1 U			1 U		1 U		1 U
N-PROPYLBENZENE	1 U			1 U			1 U		1 U		1 U
o-Xylene	1 U			1 U			1 U		1 U		1 U
P-ISOPROPYLTOLUENE	1 U			1 U			1 U		1 U		1 U
Tetrachloroethylene	1 U	10 U	10 U	1 U	10 U	10 U	17	63	27	64	4.4
Toluene	1 U	10 U	10 U	0.44 U	10 U	10 U	1 U	10 U	1 U	10 U	1 U
Total Xylenes		10 U	10 U		10 U	10 U		10 U		10 U	
trans-1,2-Dichloroethylene	1 U	10 U	10 U	1 U	10 U	10 UJ	1 U	10 U	1 U	10 U	1 U
Trichloroethylene	1 U	10 U	10 U	1 UJ	10 U	10 U	0.39 J	0.9 J	0.46 J	1 J	3.2
Unknown Alcohol											
Vinyl Chloride	0.69 J	10 UJ	10 U	1 U	10 UJ	10 U	1 U	10 U	1 U	10 U	0.68 J
Xylenes,m- & p-											
Pesticides & PCBs (ug/L)											
Aroclor-1254											
alpha-Chlordane		0.05 U	0.05 U		0.05 U	0.05 U		0.05 U		0.05 U	
Dieldrin		0.1 U	0.1 U		0.1 U	0.1 U		0.1 U		0.1 U	
gamma-Chlordane		0.05 U	0.05 U		0.05 U	0.05 U		0.05 U		0.05 U	

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW04S 8/14/2001	MW05S 10/24/2002	MW05S 11/21/2002	MW-05S 2/25/2008	MW05S 6/30/2005	MW05S 8/15/2001	MW06S 10/23/2002	MW06S 2/22/2001	MW06S 8/15/2001	MW07D 10/23/2002	MW07D 8/15/2001
Dioxins and Furans (pg/L)											
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-Dioxin (unfiltered)				0.902 U							
1,2,3,4,6,7,8-HpCDD	5.8 U		1.2 U		2.88	6.2 U		6.7 U	4.4 U		3.7 EMPC
1,2,3,4,6,7,8-HpCDF	3.4 EMPC		1.26 U		1.41	3.4 U		4.4 U	2.2 U		4 U
1,2,3,4,7,8,9-HpCDF	1.7 U		1.65 U		1.49 U	4.1 U		5.2 U	2.6 U		3.6 EMPC
1,2,3,4,7,8-HxCDD	5.8 EMPC		1.61 U		2.38 U	3.7 U		5.1 U	2.6 U		4.2 J
1,2,3,4,7,8-HxCDF	3.7 U		0.87 U		3.51 U	2.9 U		3.1 U	1.5 U		4.5 U
1,2,3,6,7,8-HxCDD	6.6 EMPC		1.71 U		2.32 U	3.8 U		5.1 U	2.6 U		4 J
1,2,3,6,7,8-HxCDF	2.5 EMPC		0.84 U		3.38 U	1.6 EMPC		3 U	1.6 U		4.4 J
1,2,3,7,8,9-HxCDD	5.1 J		1.52 U		2.12 U	3.7 U		4.9 U	2.6 U		4.2 EMPC
1,2,3,7,8,9-HxCDF	2.5 J		0.96 U		3.92 U	3 EMPC		3.5 U	2 U		5.1 EMPC
1,2,3,7,8-PeCDD	3.2 J		5.42 U		6.19	202		4.5 U	2.2 U		3.3 EMPC
1,2,3,7,8-PeCDF	3.9 J		1.72 U		8.02 UJ	2.3 U		2.9 U	2.3 J		3.8 J
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin (unfiltered)				424.418							
1,2,4,5,7,8-hexachloro(9h)xanthene						270 J					
2,3,4,6,7,8-HxCDF	3.4 J		0.9 U		3.47 U	3.1 J		3.3 U	1.6 U		3.7 J
2,3,4,7,8-PeCDF	2.8 EMPC		3.23 U		7.1 UJ	2.2 U		2.9 U	1.5 U		2.9 EMPC
2,3,7,8-TCDD	1.4 U		1032.69		4144.76	4180 J		3 U	6.6 J		3.4 J
2,3,7,8-TCDD (unfiltered)				338.874 J							
2,3,7,8-TCDF	0.9 U		1.82 U		1.82	9.3 J		2.3 U	1.2 U		1.1 U
Heptachlorodibenzo-p-Dioxins (unfiltered)				0.803 U							
Hexachlorodibenzofurans (unfiltered)				188.874							
OCDD	9.7 U		4.62 U		16.53	10.2 EMPC		12.6 J	7.1 U		13.1 U
OCDF	7 EMPC		2.46 U		4.5	9.3 U		8.6 U	5.9 U		7.3 U
Pentachlorodibenzofurans (unfiltered)				556.593							
Pentachlorodibenzo-p-Dioxins (unfiltered)				1979.688							
TEQ	7.14 J		1032.69		4151.177003	4400 J			6.7 J		11 J
Tetrachlorodibenzo-p-Dioxins (unfiltered)				338.874 J							
Total Hepta-Dioxins			1.2 UJ		2.88 J						
Total Hepta-Furans			1.43 UJ		1.41 J						
Total Hexa-Furans			16.77 UJ		40.13 J						
Total HpCDD	5.8 UJ					6.2 UJ		6.7 U	4.4 UJ		3.7 EMPC
Total HpCDF	3.4 EMPC					4.2 EMPC		4.8 U	2.4 UJ		7.6 EMPC
Total HxCDD	45.6 EMPC					8.2 EMPC		5 U	2.6 UJ		19.6 EMPC
Total HxCDF	12 EMPC					99.2 J		3.2 U	1.6 UJ		17.6 EMPC
Total PeCDD	5.7 EMPC					3940 J		4.5 U	2.2 UJ		3.3 EMPC
Total PeCDF	6.9 J					1140 J		2.9 U	2.3 J		3.8 J
Total Penta-Dioxins			118.37 J		125.42 J						
Total Penta-Furans			275.25 J		415.07 J						
Total TCDD	1.4 UJ					4460 J		16.4 EMPC	6.6 UJ		3.4 UJ
Total TCDF	0.9 UJ					2710 J		2.3 U	1.2 UJ		1.1 EMPC
Total Tetrachlorodibenzofurans, NOS (unfiltered)				541.784							
Total Tetra-Dioxins			1071.22 J		4350.55 J						
Total Tetra-Furans			113.44 J		129.63 J						

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW04S 8/14/2001	MW05S 10/24/2002	MW05S 11/21/2002	MW-05S 2/25/2008	MW05S 6/30/2005	MW05S 8/15/2001	MW06S 10/23/2002	MW06S 2/22/2001	MW06S 8/15/2001	MW07D 10/23/2002	MW07D 8/15/2001
2,3,7,8-TCDD (filtered)				2.604 U							
Pentachlorodibenzofurans (filtered)				2.671 U							
Pentachlorodibenzo-p-Dioxins (filtered)				3.621 U							
Tetrachlorodibenzo-p-Dioxins (filtered)				2.604 U							
Metals (Total) (ug/L)											
Aluminum	45.7 U					508		143 U	54.5 J		91.3 J
Arsenic	3.7 UJ					4.4 UJ		4.2 U	5.2 U		2.6 U
Barium	55.1 U					88.6		63.2	54.4 U		32
Beryllium	0.1 U					0.12 UJ		0.2 U	0.1 U		0.1 U
Cadmium	0.7 U					0.7 U		0.6 U	0.7 U		0.7 U
Calcium	31100					27000		25900	34900		14500
Chromium	1.3 U					12.9		1.5 U	2.2 UJ		3
Cobalt	16					35.6		0.7 U	3.9 U		7.1
Copper	5.2					4.8		0.7 U	11.3		2.2 U
Iron	3540					329		28500	26900		80.6
Lead	1.5 UJ					1.5 U		1.7 U	2.4 UJ		1.5 U
Magnesium	4370					1810		2910	3750		1680
Manganese	2290					593		1840	1800		73.9
Nickel	3 U					12.8		2.3 J	3 U		3 U
Potassium	5230 J					4200 J		4090 J	5740 J		2700 J
Silver	4 U					4 U		0.5 U	4 U		4 U
Sodium	51200					33200 J		29000	37000		23300 J
Thallium	5.7 U					5.7 U		6.2 U	5.7 U		5.7 U
Vanadium	3.2 U					3.2 U		2.1	3.2 U		3.2 U
Zinc	22.7 UJ					23		3 UJ	23.7 UJ		35.1
Metals (Dissolved) (ug/L)											
Aluminum	45.7 U					352		39.9 U	45.7 U		45.7 U
Arsenic	2.6 U					3.6 UJ		4.2 U	5.3 U		2.6 U
Barium	52.1 U					81		62.6	56.3 U		30.7
Cadmium	0.7 U					0.7 U		0.6 U	0.7 U		0.7 U
Calcium	30400					25800		26400	36800		14200
Chromium	1.6 UJ					5.5		1 U	2.9 U		1.3 U
Cobalt	9.9 U					3.1 J		0.7 U	4.8 U		6.5
Copper	2.2 U					3.4 J		0.7 U	11.2		2.2 U
Iron	4150					238		28600	28200		13.1 U
Lead	1.5 UJ					1.5 U		1.7 U	1.5 UJ		1.5 U
Magnesium	4250					1720		2970	3930		1620
Manganese	2350					564		1860	1870		72.8
Nickel	3 U					5.4 J		2 J	3 U		3 U
Potassium	4910 J					3960 J		4110 J	6100 J		2530 J
Silver	4 U					4 U		0.5 U	4 U		4 U
Sodium	47900					31700 J		29500	38800		22800 J
Thallium	5.7 U					5.7 U		6.2 U	5.7 U		5.7 U
Vanadium	3.2 U					3.2 U		1.8	3.2 U		3.2 U

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW04S 8/14/2001	MW05S 10/24/2002	MW05S 11/21/2002	MW-05S 2/25/2008	MW05S 6/30/2005	MW05S 8/15/2001	MW06S 10/23/2002	MW06S 2/22/2001	MW06S 8/15/2001	MW07D 10/23/2002	MW07D 8/15/2001
Zinc	17 UJ					14.8 UJ		2.7 UJ	17 UJ		30.8 U
Semi-Volatiles (ug/L)											
1-methylnaphthalene											
2,4,6-trichlorophenol	10 U					*		10 U	10 U		10 U
2,4-dichlorophenol	10 U					60		10 U	10 U		10 U
2-methylnaphthalene	10 U					10 U		10 U	10 U		10 U
4-methylphenol	10 U					1 J		10 U	10 U		10 U
Acenaphthene	10 U					10 U		10 U	10 U		10 U
Acenaphthylene	10 U					10 U		10 U	10 U		10 U
Anthracene	10 UJ					10 UJ		10 U	10 UJ		10 UJ
Benzo(a)anthracene	10 U					10 U		10 U	10 U		10 U
Benzo(a,e)pyrene											
Benzo(b)fluoranthene	10 U					10 U		10 U	10 U		10 U
Benzo(g,h,i)perylene	10 U					10 U		10 U	10 U		10 U
Benzo(k)fluoranthene	10 U					10 U		10 U	10 U		10 U
Bis(2-ethylhexyl)phthalate	10 U					10 U		10 U	10 U		10 U
C3-benzene Isomer								3 J			
C4-benzene Isomer								3 J			
Chrysene	10 U					10 U		10 U	10 U		10 U
Dibenzo(a,h)anthracene	10 U					10 U		10 U	10 U		10 U
Fluoranthene	10 U					10 U		10 U	10 U		10 U
Fluorene	10 U					10 U		10 U	10 U		10 U
Indeno(1,2,3-cd)pyrene	10 U					10 U		10 U	10 U		10 U
Naphthalene	10 U					11		1 J	10 U		10 U
Phenanthrene	10 U					10 U		10 U	10 U		10 U
Propanoic Acid, 2-methyl-, 2,2-dimethyl-											
Propanoic Acid, 2-methyl-, 3-hydroxy-2,4											
Pyrene	10 U					10 U		10 U	10 U		10 U
Substituted Phenol_total									35 J_2		
Trichloropropene											
Unknown Alkyl Phenol											
Unknown Amide											
Unknown Phthalate											
Unknown Siloxane_total											
Vanillin											
Volatiles (ug/L)											
1,1,2,2-Tetrachloroethane	10 U	1000 U		2000 Uw	1000 U	1700 U	10 U	10 U	10 U	1 U	10 U
1,2,4-Trimethylbenzene		1000 U		2000 Uw	1000 U		10 U			1 U	
1,2-Dibromo-3-Chloropropane		1000 U		2000 Uw	1000 UJ	1700 U	10 U	10 U	10 U	1 U	
1,2-DIBROMOETHANE	10 U	1000 U			1000 U	1700 U	10 U	10 U	10 U	1 U	10 U
1,2-DICHLOROBENZENE	10 U	1000 U			1000 U	1700 U	13	21	4 J	1 U	10 U
1,3,5-Trimethylbenzene		1000 U		2000 Uw	1000 U		10 U			1 U	
1,3-DICHLOROBENZENE	10 U	1000 U			1000 U	1700 U	10 U	10 U	10 U	1 U	10 U
1,4-DICHLOROBENZENE	10 U	1000 U			1000 U	1700 U	6.2 J	5 J	3 J	1 U	10 U

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW04S 8/14/2001	MW05S 10/24/2002	MW05S 11/21/2002	MW-05S 2/25/2008	MW05S 6/30/2005	MW05S 8/15/2001	MW06S 10/23/2002	MW06S 2/22/2001	MW06S 8/15/2001	MW07D 10/23/2002	MW07D 8/15/2001
2-hexanone	10 U					1700 UJ		10 U	10 UJ		10 U
Acetone	10 UJ			2000 Uw		3300 UJ		10 U	10 UJ		10 UJ
Benzene	2 J	1000 U		2000 Uw	1000 UJ	1700 U	11	5 J	6 J	1 UJ	10 U
Bromoform	10 U	1000 U		2000 Uw	1000 U	1700 U	10 U	10 UJ	10 U	1 U	10 U
C3-benzene Isomer											
C7 Benzene Isomer											
Chlorobenzene	5 J	1000 U		2000 Uw	1000 U	1700 U	190	100	58	1 U	10 U
Chlorodibromomethane				2000 Uw							
Chloroethane	10 U	1000 U		2000 Uw	1000 U	1700 U	14 J	10 U	10 U	1 U	10 U
Chloroform	10 U	1000 U		2000 Uw	1000 U	1700 U	10 U	10 U	10 U	1 U	10 U
CIS-1,2-DICHLOROETHENE	7 J	520 J			1000	1200 J	10 U	4 J	4 J	1 U	10 U
cis-1,2-Dichloroethylene				1800 Jw							
Cyclohexane	10 U			2000 Uw		1700 U		10 U	4 J		10 U
Cyclotrisiloxane, Hexamethyl-											
Ethylbenzene	10 U	1000 U		2000 Uw	1000 U	1700 U	2.7 J	7 J	10 U	1 U	10 U
Indane											
Isopropyl Alcohol											
ISOPROPYLBENZENE	10 U	1000 U			1000 U	1700 U	10 U	1 J	10 U	1 U	10 U
Laboratory Artifact_total											
Methyl Acetate	10 U			2000 Uw		430 J		10 U	10 U		10 U
Methyl tert-Butyl ether	2 J			2000 Uw		1700 U		10 U	10 U		10 U
Methylcyclohexane	10 U			2000 Uw		1700 U		13	5 J		10 U
Methylene Chloride	10 U	2000 U		2000 Uw	700 U	1700 UJ	3.6 J	20 U	10 UJ	2 U	10 U
M-XYLENE & P-XYLENE		2000 U			2000 U		12 J			2 U	
Naphthalene		1000 U		2000 Uw	1000 U		10 U			1 U	
N-PROPYLBENZENE		1000 U			1000 U		10 U			1 U	
o-Xylene		1000 U		2000 Uw	1000 U		11			1 U	
P-ISOPROPYLTOLUENE		1000 U			1000 U		10 U			1 U	
Tetrachloroethylene	17 U	37000		40000 Uw	17000	*	10 U	10 U	10 U	10	10 U
Toluene	10 U	1000 U		2000 Uw	1000 U	1700 U	10 U	5 J	10 U	1 U	10 U
Total Xylenes	10 U					1700 U		69	3 J		10 U
trans-1,2-Dichloroethylene	10 U	1000 UJ		2000 Uw	1000 U	1700 UJ	10 U	10 U	10 UJ	1 U	10 U
Trichloroethylene	0.8 J	2200		2400 Jw	1400	2500	10 U	10 U	0.9 J	0.31 J	10 U
Unknown Alcohol	14 J										
Vinyl Chloride	3 J	1000 U		2000 Uw	1000 U	1700 U	10 U	10 UJ	10 U	1 U	10 U
Xylenes,m- & p-				2000 Uw							
Pesticides & PCBs (ug/L)											
Aroclor-1254											
alpha-Chlordane	0.05 U					0.05 U		0.05 U	0.032 J		0.05 U
Dieldrin	0.1 U					0.1 U		0.1 U	0.11		0.1 U
gamma-Chlordane	0.05 U					0.05 U		0.05 U	0.049 J		0.05 U

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW07S 10/23/2002	MW07S 2/22/2001	MW07S 8/15/2001	MW08S 10/22/2002	MW08S 2/21/2001	MW08S 8/15/2001	MW09S 10/22/2002	MW09S 2/21/2001	MW09S 8/15/2001	MW10B 10/22/2002	MW10B 8/23/2001	MW10D 10/22/2002
Dioxins and Furans (pg/L)												
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-Dioxin (unfiltered)												
1,2,3,4,6,7,8-HpCDD		6.5 U	3.9 U		4.4 U	4.6 U		6 U	4.3 U		2.2 U	
1,2,3,4,6,7,8-HpCDF		3.6 U	2.1 U		2.5 U	2.3 U		3.7 U	2.1 U		2.2 U	
1,2,3,4,7,8,9-HpCDF		4.3 U	2.5 U		3 U	2.7 U		4.4 U	2.6 U		2.5 UJ	
1,2,3,4,7,8-HxCDD		4 U	2.4 U		2.9 U	2.4 U		3.8 U	2.8 U		2.6 U	
1,2,3,4,7,8-HxCDF		2.6 U	2.1 U		1.9 U	1.6 U		2.5 U	1.6 U		1.3 EMPC	
1,2,3,6,7,8-HxCDD		4 U	2.4 U		2.9 U	2.4 U		3.8 U	2.9 U		2.7 U	
1,2,3,6,7,8-HxCDF		2.5 U	1.5 U		1.8 U	1.7 U		2.4 U	1.6 U		1.7 U	
1,2,3,7,8,9-HxCDD		3.9 U	2.4 U		2.8 U	2.4 U		3.6 U	2.8 U		2.6 U	
1,2,3,7,8,9-HxCDF		2.9 U	1.9 U		2.1 U	2.1 U		2.8 U	2 U		1.9 U	
1,2,3,7,8-PeCDD		3.5 U	2 U		2.5 U	2.1 U		3.2 U	2.4 U		2.5 U	
1,2,3,7,8-PeCDF		2.4 U	2.7 J		1.9 U	1.5 U		2.2 U	1.7 U		2.1 U	
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin (unfiltered)												
1,2,4,5,7,8-hexachloro(9h)xanthene												
2,3,4,6,7,8-HxCDF		2.7 U	1.4 EMPC		2 U	1.6 U		2.6 U	1.6 U		1.6 U	
2,3,4,7,8-PeCDF		2.4 U	1.5 U		1.8 U	1.4 U		2.2 U	1.6 U		2 U	
2,3,7,8-TCDD		2.4 U	1.8 U		1.9 U	5.1 J		18.2	10.2		2.5 U	
2,3,7,8-TCDD (unfiltered)												
2,3,7,8-TCDF		2.1 U	1.4 U		1.5 U	1.1 U		1.8 U	1.4 U		1.8 U	
Heptachlorodibenzo-p-Dioxins (unfiltered)												
Hexachlorodibenzofurans (unfiltered)												
OCDD		13.1 EMPC	5.8 EMPC		19.4 J	7.4 U		11.1 J	10.1 U		4.4 U	
OCDF		7.2 U	5.9 U		5.1 U	7.5 U		6.7 U	6.1 U		4.7 U	
Pentachlorodibenzofurans (unfiltered)												
Pentachlorodibenzo-p-Dioxins (unfiltered)												
TEQ			0.28 J			5.1 J			10 J		0 UJ	
Tetrachlorodibenzo-p-Dioxins (unfiltered)												
Total Hepta-Dioxins												
Total Hepta-Furans												
Total Hexa-Furans												
Total HpCDD		6.5 U	3.9 UJ		4.4 U	4.6 UJ		6 U	4.3 UJ		2.2 UJ	
Total HpCDF		3.9 U	2.3 UJ		2.7 U	2.5 UJ		4.1 U	2.3 UJ		2.3 UJ	
Total HxCDD		4 U	2.4 UJ		2.9 U	2.4 UJ		3.7 U	2.8 UJ		23.4 EMPC	
Total HxCDF		2.7 U	3.4 EMPC		2 U	1.7 UJ		2.6 U	1.7 UJ		1.3 EMPC	
Total PeCDD		3.5 U	2.7 EMPC		2.5 U	2.1 UJ		3.2 U	2.4 UJ		8.9 EMPC	
Total PeCDF		2.4 U	2.7 J		1.9 U	1.4 UJ		2.2 U	1.6 UJ		2 UJ	
Total Penta-Dioxins												
Total Penta-Furans												
Total TCDD		8.1 EMPC	1.8 UJ		1.9 U	5.1 UJ		18.2	10.2 UJ		5.8 EMPC	
Total TCDF		24.3 EMPC	1.4 UJ		1.5 U	1.1 UJ		3.6 EMPC	1.4 UJ		1.8 UJ	
Total Tetrachlorodibenzofurans, NOS (unfiltered)												
Total Tetra-Dioxins												
Total Tetra-Furans												

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW07S 10/23/2002	MW07S 2/22/2001	MW07S 8/15/2001	MW08S 10/22/2002	MW08S 2/21/2001	MW08S 8/15/2001	MW09S 10/22/2002	MW09S 2/21/2001	MW09S 8/15/2001	MW10B 10/22/2002	MW10B 8/23/2001	MW10D 10/22/2002
2,3,7,8-TCDD (filtered)												
Pentachlorodibenzofurans (filtered)												
Pentachlorodibenzo-p-Dioxins (filtered)												
Tetrachlorodibenzo-p-Dioxins (filtered)												
Metals (Total) (ug/L)												
Aluminum		97.7 U	45.7 U		756	112		85.3 U	88.6 J		57.4 U	
Arsenic		4.2 U	4.2 U		5.8 J	8 U		4.2 U	6.8 U		2 U	
Barium		33.7	32.6 U		31.8	17.3		9.7	12.7 J		35.3	
Beryllium		0.27 U	0.1 U		0.59 U	0.1 U		0.33 U	0.1 U		0.87 UJ	
Cadmium		0.6 U	0.7 U		0.6 U	0.7 U		0.6 U	0.7 U		0.4 U	
Calcium		31200	25900		15900	36100		28600	23000		32800	
Chromium		0.83 UJ	1.6 UJ		52.7	6		6.6	3.1		20.7 U	
Cobalt		11.2	6 U		8.3	3.7		14	2.2 J		2.6	
Copper		0.7 U	11.2		2.1	2.2 J		1.7	4 J		7.3 U	
Iron		31600	23300		8490	35300		68900	49100		391 U	
Lead		1.7 U	1.5 UJ		17	2.7 J		1.7 U	3.8		2 UJ	
Magnesium		2560	2290		3660	6810		6860	5350		4030	
Manganese		2680	2020		1100	3600		4480	5530		407	
Nickel		4.5	3 U		11.2	3 U		30.9	3 U		44.5	
Potassium		4540 J	4960 J		9670 J	13600 J		3670 J	4520 J		5040 J	
Silver		0.5 U	4 U		0.5 U	4 U		0.5 U	4 U		0.92	
Sodium		27100	35500		132000	151000 J		40500	31600 J		46300	
Thallium		6.2 U	5.7 U		6.2 U	5.7 U		8.6 J	5.7 U		5.6 U	
Vanadium		1.6	3.2 U		10.9	3.2 U		3.5	3.2 U		0.9 U	
Zinc		4.2 UJ	15.2 UJ		7.7 UJ	19.1		55.1 J	23.8		81.7 U	
Metals (Dissolved) (ug/L)												
Aluminum		77.2 U	45.7 U		509	84.2 J		74.7 U	69.3 J		19 U	
Arsenic		4.2 U	3.5 UJ		5.8 J	8 U		4.2 U	6.8 U		2 U	
Barium		34.4	31.9 U		21.2	17.3		9.1	11.8 J		32.8	
Cadmium		0.6 U	0.7 U		0.6 U	0.7 U		0.6 U	0.7 U		0.4 U	
Calcium		32700	25300		15800	37800		27500	23300		31000	
Chromium		1.1 U	2.1 UJ		43.5	6.7		6.5	3.9		4.7 U	
Cobalt		11.8	7.6 U		8.1	5.2		13.5	2.7 J		1.2 UJ	
Copper		0.7 U	7.6		0.71 J	2.4 J		0.7 U	2.2 U		7 U	
Iron		33500	23200		7690	36800		66200	48400		212 U	
Lead		1.7 U	1.5 UJ		2.3 J	3.8		1.7 U	1.5 U		14.8 U	
Magnesium		2630	2240		3660	7090		6550	5390		3800	
Manganese		2800	1990		1070	3760		4280	5590		383	
Nickel		4.4	3 U		10.9	3 U		30.4	3 U		32.2 U	
Potassium		4750 J	4760 J		9650 J	14100 J		3480 J	4510 J		4650 J	
Silver		0.5 U	4 U		0.5 U	4 U		0.5 U	4 U		1.1	
Sodium		28000	35000		132000	156000 J		39000	32200 J		44300	
Thallium		6.2 U	5.7 U		6.2 U	6.2 J		6.3 J	6.9 J		5.6 U	
Vanadium		1.7	3.2 U		9.1	3.2 U		3.2	3.2 U		0.9 U	

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW07S 10/23/2002	MW07S 2/22/2001	MW07S 8/15/2001	MW08S 10/22/2002	MW08S 2/21/2001	MW08S 8/15/2001	MW09S 10/22/2002	MW09S 2/21/2001	MW09S 8/15/2001	MW10B 10/22/2002	MW10B 8/23/2001	MW10D 10/22/2002
Zinc		6.2 UJ	14.2 UJ		5.3 UJ	19.4 U		76 J	20.2 U		108 U	
Semi-Volatiles (ug/L)												
1-methylnaphthalene												
2,4,6-trichlorophenol		10 U	10 U		10 U	2 J		10 U	10 U		10 U	
2,4-dichlorophenol		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
2-methylnaphthalene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
4-methylphenol		1 J	10 U		3 J	10 U		10 U	10 U		10 U	
Acenaphthene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Acenaphthylene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Anthracene		10 U	10 UJ		10 U	10 U		10 U	10 UJ		10 U	
Benzo(a)anthracene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Benzo(a,e)pyrene												
Benzo(b)fluoranthene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Benzo(g,h,i)perylene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Benzo(k)fluoranthene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Bis(2-ethylhexyl)phthalate		10 U	10 U		1 J	2 J		10 U	10 U		10 U	
C3-benzene Isomer												
C4-benzene Isomer												
Chrysene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Dibenzo(a,h)anthracene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Fluoranthene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Fluorene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Indeno(1,2,3-cd)pyrene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Naphthalene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Phenanthrene		10 U	10 U		1 J	10 U		10 U	10 U		10 U	
Propanoic Acid, 2-methyl-, 2,2-dimethyl-												
Propanoic Acid, 2-methyl-, 3-hydroxy-2,4												
Pyrene		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Substituted Phenol_total												
Trichloropropene			3 J									
Unknown Alkyl Phenol												
Unknown Amide												
Unknown Phthalate		9 J										
Unknown Siloxane_total					45 J_7							
Vanillin											2 J	
Volatiles (ug/L)												
1,1,2,2-Tetrachloroethane	1 U	10 U	4 J	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U
1,2,4-Trimethylbenzene	1 U	/		93 J			1 U			1 U		1 U
1,2-Dibromo-3-Chloropropane	1 U	10 U	7 J	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U
1,2-DIBROMOETHANE	1 U	10 U	1 J	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U
1,2-DICHLOROBENZENE	1 U	10 U	10 U	1.9	1 J	10 U	1 U	10 U	10 U	1 U	10 U	1 U
1,3,5-Trimethylbenzene	1 U			25			1 U			1 U		1 U
1,3-DICHLOROBENZENE	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U
1,4-DICHLOROBENZENE	1 U	10 U	10 U	0.53 J	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U

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Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW07S 10/23/2002	MW07S 2/22/2001	MW07S 8/15/2001	MW08S 10/22/2002	MW08S 2/21/2001	MW08S 8/15/2001	MW09S 10/22/2002	MW09S 2/21/2001	MW09S 8/15/2001	MW10B 10/22/2002	MW10B 8/23/2001	MW10D 10/22/2002
2-hexanone		10 U	6 J		10 U	10 UJ		10 U	10 UJ		10 U	
Acetone		10 U	10 UJ		11 U	10 UJ		35 U	13 UJ		10 UJ	
Benzene	1 U	10 U	10 U	10	6 J	4 J	9.7	1 J	21	1 U	10 U	1 U
Bromoform	1 U	10 U	2 J	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U
C3-benzene Isomer					6 J							
C7 Benzene Isomer					29 J							
Chlorobenzene	1 U	10 U	10 U	23	10	40	3.4	1 J	10 U	1 U	10 U	1 U
Chlorodibromomethane												
Chloroethane	1 UJ	10 UJ	10 U	1 U	10 UJ	10 U	0.47 J	10 UJ	10 U	1 U	10 U	1 U
Chloroform	1 U	10 U	10 U	1 U	10 U	10 U	1 U	10 U	10 U	1.7	10 U	4.1
CIS-1,2-DICHLOROETHENE	1 U	10 U	10 U	8.5	10 U	10 U	14	2 J	12	1 U	10 U	1 U
cis-1,2-Dichloroethylene												
Cyclohexane		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Cyclotrisiloxane, Hexamethyl-					6 J							
Ethylbenzene	1 U	10 U	10 U	2.4	1 J	10 U	1 U	10 U	10 U	1 U	10 U	1 U
Indane					9 J							
Isopropyl Alcohol		6 J										
ISOPROPYLBENZENE	1 U	10 U	10 U	2	10 U	10 U	1 U	10 U	10 U	1 U	10 U	1 U
Laboratory Artifact_total						44 J_2						
Methyl Acetate		10 U	6 J		10 U	10 U		10 U	10 U		10 U	
Methyl tert-Butyl ether		10 U	1 J		10 U	10 U		10 U	10 U		10 U	
Methylcyclohexane		10 U	10 U		10 U	10 U		10 U	10 U		10 U	
Methylene Chloride	2 U	10 U	10 UJ	2 U	10 U	10 UJ	2 U	10 U	10 UJ	2 U	10 U	2 U
M-XYLENE & P-XYLENE	2 U			13			2 U			2 U		2 U
Naphthalene	1 U			1.7			1 U			1 U		1 U
N-PROPYLBENZENE	1 U			7.4			1 U			1 U		1 U
o-Xylene	1 U			15			1 U			1 U		1 U
P-ISOPROPYLTOLUENE	1 U			1.2			1 U			1 U		1 U
Tetrachloroethylene	1 U	10 U	10 U	1 U	10 U	16 U	3.3	2 J	21 U	0.25 J	10 U	0.39 J
Toluene	1 U	5 J	10 U	1.4	1 J	10 U	1 U	10 U	10 U	1 U	10 U	1 U
Total Xylenes		10 U	10 U		27	8 J		10 U	10 U		10 U	
trans-1,2-Dichloroethylene	1 UJ	10 U	10 UJ	0.62 J	10 U	10 UJ	1 U	10 U	10 UJ	1 U	10 UJ	1 U
Trichloroethylene	1 U	10 U	10 U	2.3	10 U	10 U	0.72 J	10 U	1 J	1 U	10 U	1 U
Unknown Alcohol												
Vinyl Chloride	1 U	10 UJ	10 U	0.72 J	10 UJ	10 U	14	10 UJ	10 J	1 U	10 U	1 U
Xylenes,m- & p-												
Pesticides & PCBs (ug/L)												
Aroclor-1254												
alpha-Chlordane		0.05 U	0.05 U		0.05 U	0.05 U		0.05 U	0.05 U		0.05 U	
Dieldrin		0.1 U	0.1 U		0.1 U	0.1 U		0.1 U	0.1 U		0.1 U	
gamma-Chlordane		0.05 U	0.018 J		0.05 U	0.05 U		0.05 U	0.05 U		0.05 U	

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Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW10D 8/23/2001	MW11B 10/23/2002	MW11B 8/22/2001	MW11M 10/23/2002	MW11M 8/22/2001	MW11S 10/24/2002	MW11S 8/22/2001	MW12B 10/24/2002	MW12B 8/22/2001	MW12D 10/24/2002	MW12D 8/22/2001
Dioxins and Furans (pg/L)											
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-Dioxin (unfiltered)											
1,2,3,4,6,7,8-HpCDD	6.5 U		3.6 U		3.8 U		3.7 U		4.2 U		3.9 U
1,2,3,4,6,7,8-HpCDF	3.9 U		1.8 U		1.7 U		2.1 U		5.6 U		2.4 U
1,2,3,4,7,8,9-HpCDF	4.8 UJ		2.2 UJ		2.4 UJ		2.4 UJ		2.5 UJ		2.7 UJ
1,2,3,4,7,8-HxCDD	4.3 U		2.3 U		2.3 U		2.5 U		2.6 U		2.7 U
1,2,3,4,7,8-HxCDF	3 U		2.9 EMPC		1.5 U		1.5 U		3.1 U		1.3 U
1,2,3,6,7,8-HxCDD	4.5 U		2.4 U		2.4 U		2.6 U		2.7 U		2.8 U
1,2,3,6,7,8-HxCDF	3.1 U		2.8 U		1.5 U		1.5 U		1.6 U		1.8 U
1,2,3,7,8,9-HxCDD	4.4 U		2.4 U		2.3 U		2.4 U		2.6 U		2.7 U
1,2,3,7,8,9-HxCDF	4 EMPC		1.8 U		1.9 U		1.8 U		2 U		2.1 U
1,2,3,7,8-PeCDD	3.5 U		2.5 U		2.3 U		1.5 EMPC		2.8 U		2.7 U
1,2,3,7,8-PeCDF	2.8 U		1.9 U		1.7 U		1.9 U		3.9 U		2.3 U
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin (unfiltered)											
1,2,4,5,7,8-hexachloro(9h)xanthene											
2,3,4,6,7,8-HxCDF	3 U		1.4 U		1.5 U		1.5 U		1.6 U		1.7 U
2,3,4,7,8-PeCDF	2.7 U		1.8 U		1.6 U		1.8 U		1.9 U		2.1 U
2,3,7,8-TCDD	3.5 U		2.3 U		1.9 U		2.2 U		4.7 U		2.7 U
2,3,7,8-TCDD (unfiltered)											
2,3,7,8-TCDF	2.8 U		1.7 U		1.8 U		1.5 U		1.7 U		1.8 U
Heptachlorodibenzo-p-Dioxins (unfiltered)											
Hexachlorodibenzofurans (unfiltered)											
OCDD	10.2 EMPC		11.1 EMPC		4.8 U		7.4 U		19.5 U		6.2 U
OCDF	6.7 U		11.6 U		5.1 EMPC		5.2 U		17.2 U		5.4 U
Pentachlorodibenzofurans (unfiltered)											
Pentachlorodibenzo-p-Dioxins (unfiltered)											
TEQ	0 UJ		0 UJ		0 UJ		0 UJ		0 UJ		0 UJ
Tetrachlorodibenzo-p-Dioxins (unfiltered)											
Total Hepta-Dioxins											
Total Hepta-Furans											
Total Hexa-Furans											
Total HpCDD	6.5 UJ		3.6 UJ		3.8 UJ		3.7 UJ		9.1 EMPC		3.9 UJ
Total HpCDF	4.3 UJ		2 UJ		1.7 UJ		2.3 UJ		5.6 UJ		2.5 UJ
Total HxCDD	4.4 UJ		6.9 EMPC		8.2 EMPC		29.5 EMPC		6 EMPC		31.1 EMPC
Total HxCDF	4 EMPC		5.7 EMPC		1.6 UJ		1.6 UJ		3.1 UJ		1.3 UJ
Total PeCDD	3.5 UJ		2.5 UJ		2.3 UJ		6.1 EMPC		2.8 UJ		13.9 EMPC
Total PeCDF	2.8 UJ		1.8 UJ		1.6 UJ		1.8 UJ		3.9 UJ		2.2 UJ
Total Penta-Dioxins											
Total Penta-Furans											
Total TCDD	3.5 UJ		14.1 EMPC		44.6 EMPC		11.1 EMPC		11.2 EMPC		15.6 EMPC
Total TCDF	7.5 EMPC		3.9 EMPC		10.8 EMPC		10.1 EMPC		1.7 UJ		7.6 EMPC
Total Tetrachlorodibenzofurans, NOS (unfiltered)											
Total Tetra-Dioxins											
Total Tetra-Furans											

Data received from D. Dahlen May 7, 2009

Appendix A
Summary of Source Area Groundwater Analytical Data
Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW10D 8/23/2001	MW11B 10/23/2002	MW11B 8/22/2001	MW11M 10/23/2002	MW11M 8/22/2001	MW11S 10/24/2002	MW11S 8/22/2001	MW12B 10/24/2002	MW12B 8/22/2001	MW12D 10/24/2002	MW12D 8/22/2001
2,3,7,8-TCDD (filtered)											
Pentachlorodibenzofurans (filtered)											
Pentachlorodibenzo-p-Dioxins (filtered)											
Tetrachlorodibenzo-p-Dioxins (filtered)											
Metals (Total) (ug/L)											
Aluminum	46.1 U		67.4 U		85.4 U		383		4980		37.5 U
Arsenic	2 U		2 U		2 U		3.5 UJ		2.2 UJ		2.8 UJ
Barium	53.5		40.6		128		66.7		88.5		32.6
Beryllium	0.9 UJ		0.36 UJ		0.84 UJ		0.92 UJ		1.5 UJ		0.79 UJ
Cadmium	0.54		0.4 U		0.4 U		0.4 U		0.4 U		0.4 U
Calcium	24300		13800		18500		15100		44600		13500
Chromium	2.8 U		3 U		3.1 U		20.4 U		15.4 U		0.9 UJ
Cobalt	1.2		0.7 U		0.7 U		5.3		6.2 U		0.7 U
Copper	10.3 U		8.1 U		7.1 U		8.8 U		13.7 U		8.1 U
Iron	92.9 U		80.6 U		32.3 UJ		618 U		3970		89.4 U
Lead	1.3 UJ		1.3 UJ		1.3 UJ		18 U		4.6 J		3.8 UJ
Magnesium	3520		1730		2090		2060		4500		1930
Manganese	899		110		602		239		210		134
Nickel	153		6.1 U		4.9 U		38.7		14.1 U		2.9 U
Potassium	4900 J		2630 J		3200 J		3230 J		3690 J		2490 J
Silver	0.73		0.7 U		0.7 U		0.7 U		0.78 UJ		0.7 U
Sodium	61300		16600		30500		32000		42700		26200
Thallium	5.6 U		5.6 UJ		5.6 UJ		5.6 U		5.6 UJ		5.6 U
Vanadium	0.9 U		0.9 U		0.9 U		0.9 U		6.3		0.9 U
Zinc	23.8 U		54.9 U		25.9 U		56.7 U		56.3 U		30.3 U
Metals (Dissolved) (ug/L)											
Aluminum	33.5 U		43.6 U		108 U		70.2 U		178		19 U
Arsenic	3.4 UJ		2 U		2 U		2.7 UJ		2 U		2 U
Barium	53.3		41.1		124		58.5		51.7		32.3
Cadmium	0.65		0.56 J		0.4 U		0.4		0.4 U		0.4 U
Calcium	24400		14500		18200		14400		38300		13600
Chromium	2.3 U		1.1 U		0.6 UJ		2.8 U		4.4 U		8.9 U
Cobalt	0.7 U		0.7 U		0.7 U		2.2 U		0.7 U		1.2 UJ
Copper	8 U		8.4 U		7.8 U		7.1 U		6.2 U		7.2 U
Iron	52.1 U		25.5 UJ		35 UJ		174 U		500 J		105 U
Lead	1.3 UJ		1.3 UJ		1.3 UJ		1.3 UJ		1.3 UJ		3.5 UJ
Magnesium	3500		1760		2060		1930		2870		1920
Manganese	909		119		595		209		134		134
Nickel	152		6.9 U		4.8 U		52.2		7.1 U		6.9 U
Potassium	4890 J		2780 J		3100 J		3080 J		3680 J		2450 J
Silver	1.1		0.7 U		0.7 U		0.82		0.7 U		1.4
Sodium	61400		17300		30000		31200		45800		26000
Thallium	5.6 U		5.6 UJ		5.6 UJ		5.6 U		5.6 UJ		5.6 U
Vanadium	0.9 U		0.9 U		0.9 U		0.9 U		1.9		0.9 U

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Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW10D 8/23/2001	MW11B 10/23/2002	MW11B 8/22/2001	MW11M 10/23/2002	MW11M 8/22/2001	MW11S 10/24/2002	MW11S 8/22/2001	MW12B 10/24/2002	MW12B 8/22/2001	MW12D 10/24/2002	MW12D 8/22/2001
Zinc	26 U		65.2 U		51.3 U		49.4 U		33.9 U		18.3 U
Semi-Volatiles (ug/L)											
1-methylnaphthalene											
2,4,6-trichlorophenol	10 U		10 U		10 U		10 U		10 U		10 U
2,4-dichlorophenol	10 U		10 U		10 U		10 U		10 U		10 U
2-methylnaphthalene	10 U		10 U		10 U		10 U		10 U		10 U
4-methylphenol	10 U		10 U		10 U		10 U		10 U		10 U
Acenaphthene	10 U		10 U		10 U		10 U		10 U		10 U
Acenaphthylene	10 U		10 U		10 U		10 U		10 U		10 U
Anthracene	10 U		10 U		10 U		10 U		10 U		10 U
Benzo(a)anthracene	10 U		10 U		10 U		10 U		10 U		10 U
Benzo(a,e)pyrene											
Benzo(b)fluoranthene	10 U		10 U		10 U		10 U		10 U		10 U
Benzo(g,h,i)perylene	10 U		10 UJ		10 UJ		10 U		10 UJ		10 U
Benzo(k)fluoranthene	10 U		10 U		10 U		10 U		10 U		10 U
Bis(2-ethylhexyl)phthalate	10 U		10 U		10 U		10 U		10 U		10 U
C3-benzene Isomer											
C4-benzene Isomer											
Chrysene	10 U		10 U		10 U		10 U		10 U		10 U
Dibenzo(a,h)anthracene	10 U		10 U		10 U		10 U		10 U		10 U
Fluoranthene	10 U		10 U		10 U		10 U		10 U		10 U
Fluorene	10 U		10 U		10 U		10 U		10 U		10 U
Indeno(1,2,3-cd)pyrene	10 U		10 U		10 U		10 U		10 U		10 U
Naphthalene	10 U		10 U		10 U		10 U		10 U		10 U
Phenanthrene	10 U		10 U		10 U		10 U		10 U		10 U
Propanoic Acid, 2-methyl-, 2,2-dimethyl-											
Propanoic Acid, 2-methyl-, 3-hydroxy-2,4											
Pyrene	10 U		10 U		10 U		10 U		10 U		10 U
Substituted Phenol_total											
Trichloropropene											
Unknown Alkyl Phenol											
Unknown Amide											
Unknown Phthalate											
Unknown Siloxane_total											
Vanillin											
Volatiles (ug/L)											
1,1,2,2-Tetrachloroethane	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
1,2,4-Trimethylbenzene		1 U		1 U		1 U		1 U		1 U	
1,2-Dibromo-3-Chloropropane	10 U	1 U	10 UJ	1 U	10 UJ	1 U	10 U	1 U	10 UJ	1 U	10 U
1,2-DIBROMOETHANE	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
1,2-DICHLOROBENZENE	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
1,3,5-Trimethylbenzene		1 U		1 U		1 U		1 U		1 U	
1,3-DICHLOROBENZENE	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
1,4-DICHLOROBENZENE	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U

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Source Area
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

PARAMETER	MW10D 8/23/2001	MW11B 10/23/2002	MW11B 8/22/2001	MW11M 10/23/2002	MW11M 8/22/2001	MW11S 10/24/2002	MW11S 8/22/2001	MW12B 10/24/2002	MW12B 8/22/2001	MW12D 10/24/2002	MW12D 8/22/2001
2-hexanone	10 U		10 UJ		10 UJ		10 U		10 UJ		10 U
Acetone	10 UJ		10 UJ		10 UJ		16 UJ		10 UJ		10 UJ
Benzene	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
Bromoform	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
C3-benzene Isomer											
C7 Benzene Isomer											
Chlorobenzene	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
Chlorodibromomethane											
Chloroethane	10 U	1 UJ	10 U	1 UJ	10 U	1 UJ	10 U	1 UJ	10 U	1 U	10 U
Chloroform	10 U	1 U	10 U	1 U	10 U	1 U	10 U	0.25 J	10 U	1 U	10 U
CIS-1,2-DICHLOROETHENE	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
cis-1,2-Dichloroethylene											
Cyclohexane	10 U		10 U		10 U		10 U		10 U		10 U
Cyclotrisiloxane, Hexamethyl-											
Ethylbenzene	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
Indane											
Isopropyl Alcohol	NJ						NJ				
ISOPROPYLBENZENE	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
Laboratory Artifact_total											
Methyl Acetate	10 U		10 U		10 U		10 U		10 U		10 U
Methyl tert-Butyl ether	10 U		10 U		10 U		10 U		10 U		10 U
Methylcyclohexane	10 U		10 U		10 U		10 U		10 U		10 U
Methylene Chloride	10 U	2 U	10 UJ	2 U	10 UJ	2 U	10 U	2 U	10 UJ	2 U	10 U
M-XYLENE & P-XYLENE		2 U		2 U		2 U		2 U		2 U	
Naphthalene		1 U		1 U		1 U		1 U		1 U	
N-PROPYLBENZENE		1 U		1 U		1 U		1 U		1 U	
o-Xylene		1 U		1 U		1 U		1 U		1 U	
P-ISOPROPYLTOLUENE		1 U		1 U		1 U		1 U		1 U	
Tetrachloroethylene	10 U	1 U	10 U	1 U	10 U	1 U	10 U	0.89 J	10 U	0.64 J	18
Toluene	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
Total Xylenes	10 U		10 U		10 U		10 U		10 U		10 U
trans-1,2-Dichloroethylene	10 UJ	1 UJ	10 UJ	1 UJ	10 UJ	1 UJ	10 UJ	1 UJ	10 UJ	1 U	10 UJ
Trichloroethylene	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
Unknown Alcohol											
Vinyl Chloride	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U	1 U	10 U
Xylenes,m- & p-											
Pesticides & PCBs (ug/L)											
Aroclor-1254											
alpha-Chlordane	0.05 U		0.05 U		0.05 U		0.05 U		0.05 U		0.05 U
Dieldrin	0.1 U		0.1 U		0.1 U		0.1 U		0.1 U		0.1 U
gamma-Chlordane	0.05 U		0.05 U		0.05 U		0.05 U		0.05 U		0.05 U

Data received from D. Dahlen May 7, 2009

APPENDIX B

SUPPLEMENTAL UTILITY WORKER RISK ASSESSMENT

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TABLE B-1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS – REASONABLE MAXIMUM EXPOSURE USING THE 2003 DIOXIN TEQ SLOPE FACTOR- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
GROUND WATER	GROUND WATER	GROUNDWATER	DERMAL	1,2,4-Trimethylbenzene	0.035	mg/l	NC		NC			--		ND		
				1,3,5-Trimethylbenzene	0.061	mg/l	NC		NC			--		1.0E-02	mg/kg/day	
				1,4-Dichlorobenzene	0.005	mg/l	7.8E-08	mg/kg/day	5.4E-03	(mg/kg/day)-1	2.E-10	2.7E-06	mg/kg/day	7.0E-02	mg/kg/day	4.E-05
				Benzene	0.021	mg/l	7.8E-08	mg/kg/day	5.5E-02	(mg/kg/day)-1	2.E-09	2.7E-06	mg/kg/day	4.0E-03	mg/kg/day	7.E-04
				Chlorobenzene	0.16	mg/l	NC		NC			1.6E-05	mg/kg/day	4.0E-01	mg/kg/day	1.E-04
				Chloroform	0.0041	mg/l	4.2E-09	mg/kg/day	NA			3.0E-07	mg/kg/day	1.0E-01	mg/kg/day	3.E-06
				cis-1,2-Dichloroethene	1.6	mg/l	NC		NC			--		3.0E-01	mg/kg/day	
				Ethylbenzene	0.007	mg/l	NC		NC			5.3E-06	mg/kg/day	5.0E-01	mg/kg/day	7.E-06
				Isopropyl Alcohol	0.07	mg/l	NC		NC			--		ND		
				Methylcyclohexane	0.013	mg/l	NC		NC			--		ND		
				Tetrachloroethene	61	mg/l	4.2E-01	mg/kg/day	5.4E-01	(mg/kg/day)-1	2.E-04	2.9E-02	mg/kg/day	1.0E-01	mg/kg/day	3.E-01
				Total Xylenes	0.009	mg/l	NC		NC			--		4.0E-01	mg/kg/day	
				Trichloroethene	2.5	mg/l	6.8E-06	mg/kg/day	5.9E-03	(mg/kg/day)-1	3.E-08	3.3E-04	mg/kg/day	5.0E-04	mg/kg/day	1.E-00
				Vinyl Chloride	0.027	mg/l	1.7E-08	mg/kg/day	7.2E-01	(mg/kg/day)-1	1.E-08	1.2E-06	mg/kg/day	3.0E-03	mg/kg/day	4.E-04
				2,4,6-Trichlorophenol	2.9	mg/l	2.5E-05	mg/kg/day	1.1E-02	(mg/kg/day)-1	3.E-07	1.8E-03	mg/kg/day	1.0E-03	mg/kg/day	2.E+00
				Benzo(a)anthracene	0.0037	mg/l	5.4E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	4.E-07	3.2E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(b)fluoranthene	0.0025	mg/l	6.3E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	5.E-07	4.4E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(k)fluoranthene	0.0029	mg/l	--		7.3E-02	(mg/kg/day)-1				3.0E-01	mg/kg/day	
				Bis(2-ethylhexyl)phthalate	0.031	mg/l	5.4E-07	mg/kg/day	1.4E-02	(mg/kg/day)-1	8.E-09	3.8E-05	mg/kg/day	1.0E-01	mg/kg/day	4.E-04
				Chrysene	0.0039	mg/l	5.6E-07	mg/kg/day	7.3E-03	(mg/kg/day)-1	4.E-09	3.9E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Indeno(1,2,3-cd)pyrene	0.002	mg/l	5.2E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	4.E-07	3.6E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Naphthalene	0.011	mg/l	NC		NC			5.7E-06	mg/kg/day	6.0E-01	mg/kg/day	1.E-05
				TEQ	4.38E-05	mg/l	9.9E-10	mg/kg/day	1.0E+05	(mg/kg/day)-1	1.E-05	6.9E-08	mg/kg/day	ND		
				Aluminum	0.509	mg/l	NC		NC			--		1.0E+00	mg/kg/day	
				Chromium	0.114	mg/l	NC		NC			6.2E-07	mg/kg/day	2.0E-02	mg/kg/day	3.E-05
				Cobalt	0.0016	mg/l	NC		NC			--		3.0E-03	mg/kg/day	
				Lead	0.0277	mg/l	--		NA			--		ND		
				Manganese	5.59	mg/l	NC		NC			--		9.0E-03	mg/kg/day	
				Nickel	0.0820	mg/l	NC		NC			9.0E-06	mg/kg/day	8.0E-03	mg/kg/day	1.E-03
				Thallium	0.0089	mg/l	NC		NC			3.7E-06	mg/kg/day	8.0E-03	mg/kg/day	5.E-05
				Vanadium	0.0363	mg/l	NC		NC			2.0E-07	mg/kg/day	2.0E-03	mg/kg/day	8.E-05
			EXPOSURE ROUTE TOTAL								1.E-02					3
		EXPOSURE POINT TOTAL									1.E-02					3
EXPOSURE MEDIUM TOTAL											1.E-02					3
	AIR	TRENCH - AIR	AMBIENT INHALATION	1,2,4-Trimethylbenzene	7.0E+02	ug/m3	NC		NC			5.3E+00	ug/m3	7.0E+00	ug/m3	8.E-01
				1,3,5-Trimethylbenzene	4.6E+02	ug/m3	NC		NC			3.5E+00	ug/m3	ND		
				1,4-Dichlorobenzene	3.4E+01	ug/m3	3.6E-03	ug/m3	1.1E-05	(ug/m3)-1	4.E-08	2.5E-01	ug/m3	8.0E-02	ug/m3	3.E-04
				Benzene	2.0E+02	ug/m3	2.1E-02	ug/m3	7.8E-06	(ug/m3)-1	2.E-07	1.5E+00	ug/m3	3.0E+01	ug/m3	5.E-02
				Chlorobenzene	1.2E+03	ug/m3	NC		NC			9.3E+00	ug/m3	5.0E+01	ug/m3	2.E-01
				Chloroform	3.1E+01	ug/m3	3.3E-03	ug/m3	2.3E-05	(ug/m3)-1	8.E-08	2.3E-01	ug/m3	2.5E+02	ug/m3	9.E-04
				cis-1,2-Dichloroethene	4.3E+04	ug/m3	NC		NC			1.0E+02	ug/m3	ND		
				Ethylbenzene	5.6E+01	ug/m3	NC		NC			4.2E-01	ug/m3	3.1E+03	ug/m3	1.E-04
				Isopropyl Alcohol	NL	ug/m3	NC		NC					7.0E+03	ug/m3	
				Methylcyclohexane	1.1E+02	ug/m3	NC		NC			8.3E-01	ug/m3	3.0E+03	ug/m3	3.E-04
				Tetrachloroethene	3.9E+05	ug/m3	4.2E+01	ug/m3	5.9E-06	(ug/m3)-1	3.E-04	3.0E+03	ug/m3	2.7E+02	ug/m3	1.E+01
				Total Xylenes	5.5E+02	ug/m3	NC		NC			4.2E+00	ug/m3	7.9E+03	ug/m3	5.E-04
				Trichloroethene	1.3E+04	ug/m3	1.9E+00	ug/m3	2.0E-06	(ug/m3)-1	4.E-06	1.4E+02	ug/m3	1.0E+01	ug/m3	1.E+01
				Vinyl Chloride	2.8E+02	ug/m3	3.1E-02	ug/m3	8.8E-06	(ug/m3)-1	3.E-07	2.1E+00	ug/m3	1.0E+02	ug/m3	2.E-02
				2,4,6-Trichlorophenol	2.2E+03	ug/m3	2.4E-01	ug/m3	3.1E-06	(ug/m3)-1	7.E-07	1.7E+01	ug/m3	ND		
				Benzo(a)anthracene	1.3E+00	ug/m3	1.3E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-08	9.4E-03	ug/m3	ND		
				Benzo(b)fluoranthene	9.0E+00	ug/m3	9.7E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-07	6.8E-02	ug/m3	ND		
				Benzo(k)fluoranthene	2.5E-01	ug/m3	2.6E-05	ug/m3	1.1E-04	(ug/m3)-1	3.E-09	1.9E-03	ug/m3	ND		
				Bis(2-ethylhexyl)phthalate	2.8E-01	ug/m3	3.0E-05	ug/m3	2.4E-06	(ug/m3)-1	7.E-11	2.1E-03	ug/m3	ND		
				Chrysene	1.4E+01	ug/m3	1.5E-03	ug/m3	1.1E-05	(ug/m3)-1	2.E-08	1.1E-01	ug/m3	ND		
				Indeno(1,2,3-cd)pyrene	3.1E-01	ug/m3	3.4E-05	ug/m3	1.1E-04	(ug/m3)-1	4.E-09	2.4E-03	ug/m3	ND		
				Naphthalene	7.3E+01	ug/m3	NC		NC			5.5E-01	ug/m3	3.0E+00	ug/m3	2.E-01
				TEQ	1.3E-02	ug/m3	1.4E-06	ug/m3	3.8E+01	(ug/m3)-1	5.E-05	9.5E-05	ug/m3	4.0E-05	ug/m3	2.E+00
				Aluminum	NV	ug/m3	NA		NC					5.0E+00	ug/m3	
				Chromium	NV	ug/m3	NA		NC					5.0E+00	ug/m3	
				Cobalt	NV	ug/m3	NA		NC					2.0E-02	ug/m3	

TABLE B-1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS – REASONABLE MAXIMUM EXPOSURE USING THE 2003 DIOXIN TEQ SLOPE FACTOR- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
				Lead	NV	ug/m3	NA		NA					ND		
				Manganese	NV	ug/m3	NA		NC					5.0E-02	ug/m3	
				Nickel	NV	ug/m3	NA		2.4E-04	(ug/m3)-1				2.0E-01	ug/m3	
				Thallium	NV	ug/m3	NA		NC					ND		
				Vanadium	NV	ug/m3	NA		NC					1.0E-01	ug/m3	
			EXPOSURE ROUTE TOTAL								3.E-04					28
		EXPOSURE POINT TOTAL									3.E-04					28
	EXPOSURE MEDIUM TOTAL										3.E-04					28
GROUNDWATER TOTAL											2.E-03					31
TOTAL RECEPTOR RISK ACROSS ALL MEDIA											2.E-03	TOTAL RECEPTOR HAZARD ACROSS ALL MEDIA				31

NOTES:
(1) - Blank cells indicate that an RfD or RfC is not avalailable from the sources used to obtain dose-response data for this risk assessment.
NC - Not carcinogenic by this exposure route.
NA - Not applicable: exposure route not applicable for this chemical/exposure medium.
NL - Not included in the calculation table for ambient air concentrations in a trench from groundwater.
NV - Not volatile; ambient air concentration was not calculated for this chemical.
-- - Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 01/21/10
Checked by: RRD 3/24/10

TABLE B-2
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE USING THE 2003 DIOXIN TEQ SLOPE FACTOR- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (I)					NON-CARCINOGENIC HAZARD QUOTIENT (I)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
GROUND WATER	GROUND WATER	GROUNDWATER	1,2,4-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,3,5-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,4-Dichlorobenzene	--	NA	2.0E-10	NA	2.0E-10	Endocrine			3.8E-05	3.8E-05
			Benzene	--	NA	2.1E-09	NA	2.1E-09	Immune system /			6.6E-04	6.6E-04
			Chlorobenzene	NC	NA	NC	NA		Liver			1.1E-04	1.1E-04
			Chloroform	--	NA	--	NA		Liver			3.0E-06	3.0E-06
			cis-1,2-Dichloroethene	NC	NA	NC	NA		Hematological			--	
			Ethylbenzene	NC	NA	NC	NA		Liver / Kidney			6.7E-06	6.7E-06
			Isopropyl Alcohol	NC	NA	NC	NA					--	
			Methylcyclohexane	NC	NA	NC	NA					--	
			Tetrachloroethene	--	NA	2.2E-04	NA	2.2E-04	Liver			2.9E-01	2.9E-01
			Total Xylenes	NC	NA	NC	NA		Nervous System			--	
			Trichloroethene	--	NA	2.8E-08	NA	2.8E-08	Liver / Kidney			1.1E-09	1.1E-09
			Vinyl Chloride	--	NA	1.2E-08	NA	1.2E-08	Liver			4.0E-04	4.0E-04
			2,4,6-Trichlorophenol	--	NA	2.8E-07	NA	2.8E-07	Undetermined			1.8E-00	1.8E+00
			Benzo(a)anthracene	--	NA	3.9E-07	NA	3.9E-07	Kidney			1.2E-04	1.2E-04
			Benzo(b)fluoranthene	--	NA	4.6E-07	NA	4.6E-07	Kidney			1.5E-04	1.5E-04
			Benzo(k)fluoranthene	--	NA	--	NA		Kidney			--	
			Bis(2-ethylhexyl)phthalate	--	NA	7.6E-09	NA	7.6E-09	Reproductive			3.8E-04	3.8E-04
			Chrysene	--	NA	4.1E-09	NA	4.1E-09	Kidney			1.3E-04	1.3E-04
			Indeno(1,2,3-cd)pyrene	--	NA	3.8E-07	NA	3.8E-07	Kidney			1.2E-04	1.2E-04
			Naphthalene	NC	NA	NC	NA		Nervous System			9.6E-06	9.6E-06
			TEQ	--	NA	9.9E-04	NA	9.9E-04				--	
			Aluminum	NC	NA	NC	NA		Nervous System			--	
			Chromium	NC	NA	NC	NA		NOAEL			3.2E-05	3.2E-05
			Cobalt	NC	NA	NC	NA		Hematological			--	
			Lead	--	NA	--	NA					--	
			Manganese	NC	NA	NC	NA		Nervous System			--	
			Nickel	NC	NA	NC	NA		General Toxicity			1.1E-04	1.1E-04
			Thallium	NC	NA	NC	NA		NOAEL			4.7E-05	4.7E-05
			Vanadium	NC	NA	NC	NA		Kidney			7.6E-04	7.6E-04
		EXPOSURE POINT TOTAL						1E-03					3
	EXPOSURE MEDIUM TOTAL							1E-03					3
GROUND WATER	AIR	TRENCH - AIR	1,2,4-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	7.6E-01	NA	7.6E-01
			1,3,5-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	--	NA	
			1,4-Dichlorobenzene	NA	4.0E-08	NA	NA	4.0E-08	Developmental	NA	3.2E-04	NA	3.2E-04
			Benzene	NA	1.6E-07	NA	NA	1.6E-07	Immune system	NA	4.9E-02	NA	4.9E-02
			Chlorobenzene	NA	NC	NA	NA		Undetermined	NA	1.9E-01	NA	1.9E-01
			Chloroform	NA	7.6E-08	NA	NA	7.6E-08	Liver	NA	9.5E-04	NA	9.5E-04
			cis-1,2-Dichloroethene	NA	NC	NA	NA			NA	--	NA	
			Ethylbenzene	NA	NC	NA	NA		Developmental	NA	1.4E-04	NA	1.4E-04
			Isopropyl Alcohol	NA	NC	NA	NA						
			Methylcyclohexane	NA	NC	NA	NA			NA	2.8E-04	NA	2.8E-04
			Tetrachloroethene	NA	2.5E-04	NA	NA	2.5E-04	Nervous System	NA	1.1E+01	NA	1.1E+01
			Total Xylenes	NA	NC	NA	NA		Nervous System	NA	5.5E-04	NA	5.5E-04
			Trichloroethene	NA	3.9E-06	NA	NA	3.9E-06	Nervous System	NA	1.4E+01	NA	1.4E+01
			Vinyl Chloride	NA	2.7E-07	NA	NA	2.7E-07	Liver	NA	2.1E-02	NA	2.1E-02
			2,4,6-Trichlorophenol	NA	7.4E-07	NA	NA	7.4E-07		NA	--	NA	
			Benzo(a)anthracene	NA	1.5E-08	NA	NA	1.5E-08		NA	--	NA	
			Benzo(b)fluoranthene	NA	1.1E-07	NA	NA	1.1E-07		NA	--	NA	
			Benzo(k)fluoranthene	NA	2.9E-09	NA	NA	2.9E-09		NA	--	NA	
			Bis(2-ethylhexyl)phthalate	NA	7.3E-11	NA	NA	7.3E-11		NA	--	NA	
			Chrysene	NA	1.7E-08	NA	NA	1.7E-08		NA	--	NA	
			Indeno(1,2,3-cd)pyrene	NA	3.7E-09	NA	NA	3.7E-09		NA	--	NA	
			Naphthalene	NA	NC	NA	NA		Respiratory	NA	1.8E-01	NA	1.8E-01
			TEQ	NA	5.2E-05	NA	NA	5.2E-05	Liver / Reproductive /	NA	2.4E+00	NA	2.4E+00
			Aluminum	NA	NA	NA	NA		Undetermined				
			Chromium	NA	NA	NA	NA		Respiratory				

TABLE B-2
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE USING THE 2003 DIOXIN TEQ SLOPE FACTOR- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (I)					NON-CARCINOGENIC HAZARD QUOTIENT (I)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
			Cobalt	NA	NA	NA	NA						
			Lead	NA	NA	NA	NA						
			Manganese	NA	NA	NA	NA		Nervous System				
			Nickel	NA	NA	NA	NA		Respiratory				
			Thallium	NA	NA	NA	NA						
			Vanadium	NA	NA	NA	NA						
		EXPOSURE POINT TOTAL						3E-04					28
	EXPOSURE MEDIUM TOTAL							3E-04					28
GROUNDWATER TOTAL								2E-03					31
RECEPTOR TOTAL								2E-03					31
							TOTAL RISK ACROSS ALL MEDIA	2E-03	TOTAL HAZARD ACROSS ALL MEDIA				31

NOTES:
NC - Not carcinogenic by this exposure route.
NA - Not applicable; exposure route not applicable for this chemical/exposure medium.
-- - Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 01/21/10
Checked by: RRD 3/24/10

TOTAL GENERAL TOXICITY HI =	1.1E-04
	--
TOTAL DEVELOPMENTAL HI =	4.5E-04
TOTAL ENDOCRINE HI =	2.4E+00
	--
	--
TOTAL HEMATOLOGICAL HI =	2.4E+00
TOTAL IMMUNE SYSTEM HI =	5.0E-02
TOTAL KIDNEY HI =	1.1E+00
TOTAL LIVER HI =	3.8E+00
	--
TOTAL NERVOUS SYSTEM HI =	2.5E+01
TOTAL NOAEL HI =	2.7E+00
TOTAL REPRODUCTIVE HI =	3.4E+00
	--
TOTAL RESPIRATORY HI =	2.6E+00

APPENDIX C

SUPPLEMENTAL UTILITY WORKER RISK ASSESSMENT

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TABLE C-1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS – REASONABLE MAXIMUM EXPOSURE - TOTAL METALS- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
GROUND WATER	GROUND WATER	GROUNDWATER	DERMAL	1,2,4-Trimethylbenzene	0.093	mg/l	NC		NC			--		ND		
				1,3,5-Trimethylbenzene	0.061	mg/l	NC		NC			--		1.0E-02	mg/kg/day	
				1,4-Dichlorobenzene	0.005	mg/l	3.8E-08	mg/kg/day	5.4E-03	(mg/kg/day)-1	2.E-10	2.7E-06	mg/kg/day	7.0E-02	mg/kg/day	4.E-05
				Benzene	0.021	mg/l	3.8E-08	mg/kg/day	5.5E-02	(mg/kg/day)-1	2.E-09	2.7E-06	mg/kg/day	4.0E-03	mg/kg/day	7.E-04
				Chlorobenzene	0.16	mg/l	NC		NC			4.0E-05	mg/kg/day	6.0E-01	mg/kg/day	1.E-04
				Chloroform	0.0011	mg/l	4.2E-09	mg/kg/day	NA			3.0E-07	mg/kg/day	1.0E-01	mg/kg/day	3.E-06
				cis-1,2-Dichloroethene	1.6	mg/l	NC		NC			--		3.0E-01	mg/kg/day	
				Ethylbenzene	0.007	mg/l	NC		NC			3.1E-06	mg/kg/day	5.0E-01	mg/kg/day	7.E-06
				Isopropyl Alcohol	0.07	mg/l	NC		NC			--		ND		
				Methylcyclohexane	0.013	mg/l	NC		NC			--		ND		
				Tetrachloroethene	61	mg/l	4.2E-01	mg/kg/day	5.4E-01	(mg/kg/day)-1	2.E-04	2.9E-02	mg/kg/day	1.0E-01	mg/kg/day	3.E-01
				Total Xylenes	0.009	mg/l	NC		NC			--		4.0E-01	mg/kg/day	
				Trichloroethene	2.5	mg/l	4.8E-06	mg/kg/day	5.9E-03	(mg/kg/day)-1	3.E-08	3.3E-04	mg/kg/day	3.0E-04	mg/kg/day	1.E+00
				Vinyl Chloride	0.027	mg/l	1.7E-08	mg/kg/day	7.2E-01	(mg/kg/day)-1	1.E-08	1.2E-06	mg/kg/day	3.0E-03	mg/kg/day	4.E-04
				2,4,6-Trichlorophenol	2.9	mg/l	2.5E-05	mg/kg/day	1.1E-02	(mg/kg/day)-1	3.E-07	1.8E-03	mg/kg/day	1.0E-03	mg/kg/day	2.E+00
				Benzo(a)anthracene	0.0037	mg/l	5.4E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	4.E-07	3.7E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(b)fluoranthene	0.0025	mg/l	6.3E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	5.E-07	4.4E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(k)fluoranthene	0.0029	mg/l	--		7.3E-02	(mg/kg/day)-1		--		3.0E-01	mg/kg/day	
				Bis(2-ethylhexyl)phthalate	0.031	mg/l	5.5E-07	mg/kg/day	1.4E-02	(mg/kg/day)-1	8.E-09	3.5E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Chrysene	0.0039	mg/l	5.6E-07	mg/kg/day	7.3E-03	(mg/kg/day)-1	4.E-09	3.9E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Indeno(1,2,3-cd)pyrene	0.002	mg/l	5.2E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	4.E-07	3.0E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Naphthalene	0.011	mg/l	NC		NC			5.7E-06	mg/kg/day	6.0E-01	mg/kg/day	1.E-05
				TEQ	4.3837E-06	mg/l	9.9E-10	mg/kg/day	1.5E+05	(mg/kg/day)-1	1.E-04	6.9E-08	mg/kg/day	ND		
				Aluminum	0.756	mg/l	NC		NC			--		1.0E+00	mg/kg/day	
				Arsenic	0.02	mg/l	1.5E-09	mg/kg/day	1.5E+00	(mg/kg/day)-1	2.E-09	1.1E-07	mg/kg/day	3.0E-04	mg/kg/day	4.E-04
				Cobalt	0.0356	mg/l	NC		NC			--		3.0E-03	mg/kg/day	
				Lead	0.07	mg/l	--		NA			--		ND		
				Manganese	5.53	mg/l	NC		NC			--		9.6E-04	mg/kg/day	
				Vanadium	0.0387	mg/l	NC		NC			2.1E-07	mg/kg/day	2.0E-04	mg/kg/day	8.E-04
			EXPOSURE ROUTE TOTAL								6.E-04					3
		EXPOSURE POINT TOTAL									6.E-04					3
	EXPOSURE MEDIUM TOTAL										6.E-04					3
	AIR	TRENCH - AIR	VAPOR INHALATION	1,2,4-Trimethylbenzene	5.0E+02	ug/m3	NC		NC			5.3E+00	ug/m3	7.0E+00	ug/m3	8.E-01
				1,3,5-Trimethylbenzene	4.6E+02	ug/m3	NC		NC			3.5E+00	ug/m3	ND		
				1,4-Dichlorobenzene	3.4E+01	ug/m3	2.6E-05	ug/m3	1.1E-05	(ug/m3)-1	4.E-08	2.5E-01	ug/m3	8.0E+02	ug/m3	3.E-04
				Benzene	2.0E+02	ug/m3	2.1E-02	ug/m3	7.8E-06	(ug/m3)-1	2.E-07	1.5E+00	ug/m3	3.0E+01	ug/m3	5.E-02
				Chlorobenzene	1.2E+03	ug/m3	NC		NC			9.3E+00	ug/m3	5.0E+01	ug/m3	2.E-01
				Chloroform	3.1E+01	ug/m3	3.3E-03	ug/m3	2.3E-05	(ug/m3)-1	8.E-08	2.3E-01	ug/m3	2.5E+02	ug/m3	9.E-04
				cis-1,2-Dichloroethene	1.3E+04	ug/m3	NC		NC			1.0E+02	ug/m3	ND		
				Ethylbenzene	5.6E+01	ug/m3	NC		NC			4.2E-01	ug/m3	3.1E+03	ug/m3	1.E-04
				Isopropyl Alcohol	NL	ug/m3	NC		NC					7.0E+03	ug/m3	
				Methylcyclohexane	1.1E+02	ug/m3	NC		NC			8.3E-01	ug/m3	3.0E+03	ug/m3	3.E-04
				Tetrachloroethene	3.9E+05	ug/m3	4.2E+01	ug/m3	5.9E-06	(ug/m3)-1	3.E-04	3.0E+03	ug/m3	2.7E+02	ug/m3	1.E+01
				Total Xylenes	5.5E+02	ug/m3	NC		NC			4.2E+00	ug/m3	7.9E+03	ug/m3	5.E-04
				Trichloroethene	1.8E+04	ug/m3	1.9E+00	ug/m3	2.0E-06	(ug/m3)-1	4.E-06	1.4E+02	ug/m3	1.0E+01	ug/m3	1.E+01
				Vinyl Chloride	2.8E+02	ug/m3	2.1E+02	ug/m3	4.4E-06	(ug/m3)-1	1.E-07	2.1E+00	ug/m3	1.0E+02	ug/m3	2.E-02
				2,4,6-Trichlorophenol	2.2E+03	ug/m3	2.6E-01	ug/m3	3.1E-06	(ug/m3)-1	7.E-07	1.7E+01	ug/m3	ND		
				Benzo(a)anthracene	1.3E+03	ug/m3	1.3E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-08	9.4E-03	ug/m3	ND		
				Benzo(b)fluoranthene	9.0E+00	ug/m3	9.7E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-07	6.8E-02	ug/m3	ND		
				Benzo(k)fluoranthene	2.5E-01	ug/m3	2.6E-05	ug/m3	1.1E-04	(ug/m3)-1	3.E-09	1.9E-03	ug/m3	ND		
				Bis(2-ethylhexyl)phthalate	2.8E-01	ug/m3	3.0E-05	ug/m3	2.4E-06	(ug/m3)-1	7.E-11	2.1E-03	ug/m3	ND		
				Chrysene	1.4E+01	ug/m3	1.5E-03	ug/m3	1.1E-05	(ug/m3)-1	2.E-08	1.1E-01	ug/m3	ND		
				Indeno(1,2,3-cd)pyrene	3.1E-01	ug/m3	3.4E-05	ug/m3	1.1E-04	(ug/m3)-1	4.E-09	2.4E-03	ug/m3	ND		
				Naphthalene	7.3E+01	ug/m3	NC		NC			5.5E-01	ug/m3	3.0E+00	ug/m3	2.E-01
				TEQ	4.3E-02	ug/m3	1.4E-06	ug/m3	3.8E+01	(ug/m3)-1	5.E-05	9.5E-05	ug/m3	4.0E-05	ug/m3	2.E+00
				Aluminum	NV	ug/m3	NA		NC					5.0E+00	ug/m3	
				Arsenic	NV	ug/m3	NA		4.3E-03	(ug/m3)-1				1.5E-02	ug/m3	
				Cobalt	NV	ug/m3	NA		NC					2.0E-02	ug/m3	
				Lead	NV	ug/m3	NA		NA					ND		
				Manganese	NV	ug/m3	NA		NC					5.0E-02	ug/m3	

TABLE C-1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS – REASONABLE MAXIMUM EXPOSURE - TOTAL METALS- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
				Vanadium	NV	ug/m3	NA		NC					1.0E-01	ug/m3	
			EXPOSURE ROUTE TOTAL								3.E-04					28
		EXPOSURE POINT TOTAL									3.E-04					28
	EXPOSURE MEDIUM TOTAL										3.E-04					28
GROUNDWATER TOTAL											7.E-04					31
TOTAL RECEPTOR RISK ACROSS ALL MEDIA											7.E-04	TOTAL RECEPTOR HAZARD ACROSS ALL MEDIA				31

NOTES:
(1) - Blank cells indicate that an RfD or RfC is not avalailable from the sources used to obtain dose-response data for this risk assessment.
NC - Not carcinogenic by this exposure route.
NA - Not applicable; exposure route not applicable for this chemical/exposure medium.
NL - Not included in the calculation table for ambient air concentrations in a trench from groundwater.
NV - Not volatile; ambient air concentration was not calculated for this chemical.
-- - Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 08/13/10
Checked by: BJR 08/13/10

TABLE G-2
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE - TOTAL METALS- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (I)					NON-CARCINOGENIC HAZARD QUOTIENT (I)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
GROUND WATER	GROUND WATER	GROUNDWATER											
			1,2,4-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,3,5-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,4-Dichlorobenzene	--	NA	2.0E-10	NA	2.0E-10	Undetermined			3.8E-05	3.8E-05
			Benzene	--	NA	2.1E-09	NA	2.1E-09	Immune system /			6.6E-04	6.6E-04
			Chlorobenzene	NC	NA	NC	NA		Liver			1.1E-04	1.1E-04
			Chloroform	--	NA	--	NA		Liver			3.0E-06	3.0E-06
			cis-1,2-Dichloroethene	NC	NA	NC	NA		Hematological			--	
			Ethylbenzene	NC	NA	NC	NA		Liver / Kidney			6.7E-06	6.7E-06
			Isopropyl Alcohol	NC	NA	NC	NA					--	
			Methylcyclohexane	NC	NA	NC	NA					--	
			Tetrachloroethene	--	NA	2.1E-04	NA	2.2E-04	Liver			2.9E-01	2.9E-01
			Total Xylenes	NC	NA	NC	NA		Nervous System			--	
			Trichloroethene	--	NA	2.8E-08	NA	2.8E-08	Liver / Kidney			1.1E-00	1.1E+00
			Vinyl Chloride	--	NA	1.2E-08	NA	1.2E-08	Liver			4.0E-04	4.0E-04
			2,4,6-Trichlorophenol	--	NA	2.8E-07	NA	2.8E-07	Undetermined			1.8E+00	1.8E+00
			Benzo(a)anthracene	--	NA	3.9E-07	NA	3.9E-07	Kidney			1.2E-04	1.2E-04
			Benzo(b)fluoranthene	--	NA	4.6E-07	NA	4.6E-07	Kidney			1.5E-04	1.5E-04
			Benzo(k)fluoranthene	--	NA	--	NA		Kidney			--	
			Bis(2-ethylhexyl)phthalate	--	NA	7.6E-09	NA	7.6E-09	Reproductive			3.8E-04	3.8E-04
			Chrysene	--	NA	4.1E-09	NA	4.1E-09	Kidney			1.3E-04	1.3E-04
			Indeno(1,2,3-cd)pyrene	--	NA	3.8E-07	NA	3.8E-07	Kidney			1.2E-04	1.2E-04
			Naphthalene	NC	NA	NC	NA		Nervous System			9.6E-06	9.6E-06
			TEQ	--	NA	1.5E-04	NA	1.5E-04				--	
			Aluminum	NC	NA	NC	NA		Nervous System			--	
			Arsenic	--	NA	2.3E-09	NA	2.3E-09	Skin			3.6E-04	3.6E-04
			Cobalt	NC	NA	NC	NA		Hematological			--	
			Lead	--	NA	--	NA					--	
			Manganese	NC	NA	NC	NA		Nervous System			--	
			Vanadium	NC	NA	NC	NA		Kidney			8.1E-04	8.1E-04
		EXPOSURE POINT TOTAL						4E-04					3
	EXPOSURE MEDIUM TOTAL							4E-04					3
GROUND WATER	AIR	TRENCH - AIR											
			1,2,4-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	7.6E-01	NA	7.6E-01
			1,3,5-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	--	NA	
			1,4-Dichlorobenzene	NA	4.0E-08	NA	NA	4.0E-08	Developmental	NA	3.2E-04	NA	3.2E-04
			Benzene	NA	1.6E-07	NA	NA	1.6E-07	Immune system	NA	4.9E-02	NA	4.9E-02
			Chlorobenzene	NA	NC	NA	NA		Undetermined	NA	1.9E-01	NA	1.9E-01
			Chloroform	NA	7.6E-08	NA	NA	7.6E-08	Liver	NA	9.3E-04	NA	9.3E-04
			cis-1,2-Dichloroethene	NA	NC	NA	NA			NA	--	NA	
			Ethylbenzene	NA	NC	NA	NA		Developmental	NA	1.4E-04	NA	1.4E-04
			Isopropyl Alcohol	NA	NC	NA	NA						
			Methylcyclohexane	NA	NC	NA	NA			NA	2.8E-04	NA	2.8E-04
			Tetrachloroethene	NA	2.5E-04	NA	NA	2.5E-04	Nervous System	NA	1.1E+01	NA	1.1E+01
			Total Xylenes	NA	NC	NA	NA		Nervous System	NA	5.3E-04	NA	5.3E-04
			Trichloroethene	NA	3.9E-06	NA	NA	3.9E-06	Nervous System	NA	1.4E+01	NA	1.4E+01
			Vinyl Chloride	NA	1.3E-07	NA	NA	1.3E-07	Liver	NA	2.1E-02	NA	2.1E-02
			2,4,6-Trichlorophenol	NA	7.4E-07	NA	NA	7.4E-07		NA	--	NA	
			Benzo(a)anthracene	NA	1.5E-08	NA	NA	1.5E-08		NA	--	NA	
			Benzo(b)fluoranthene	NA	1.1E-07	NA	NA	1.1E-07		NA	--	NA	
			Benzo(k)fluoranthene	NA	2.9E-09	NA	NA	2.9E-09		NA	--	NA	
			Bis(2-ethylhexyl)phthalate	NA	7.3E-11	NA	NA	7.3E-11		NA	--	NA	
			Chrysene	NA	1.2E-08	NA	NA	1.2E-08		NA	--	NA	
			Indeno(1,2,3-cd)pyrene	NA	3.7E-09	NA	NA	3.7E-09		NA	--	NA	
			Naphthalene	NA	NC	NA	NA		Respiratory	NA	1.8E-01	NA	1.8E-01
			TEQ	NA	5.2E-05	NA	NA	5.2E-05	Liver / Reproductive /	NA	2.4E+00	NA	2.4E+00
			Aluminum	NA	NA	NA	NA		Undetermined				
			Arsenic	NA	NA	NA	NA		Developmental /				
			Cobalt	NA	NA	NA	NA						
			Lead	NA	NA	NA	NA						

TABLE C-2
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE - TOTAL METALS- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
			Manganese	NA	NA	NA	NA		Nervous System				
			Vanadium	NA	NA	NA	NA						
		EXPOSURE POINT TOTAL						3E-04					28
	EXPOSURE MEDIUM TOTAL							3E-04					28
GROUNDWATER TOTAL								7E-04					31
RECEPTOR TOTAL								7E-04					31
							TOTAL RISK ACROSS ALL MEDIA	7E-04	TOTAL HAZARD ACROSS ALL MEDIA				31

NOTES:
NC - Not carcinogenic by this exposure route.
NA - Not applicable; exposure route not applicable for this chemical/exposure medium.
--- Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 08/13/10
Checked by: BJR 08/13/10

	–
	–
TOTAL DEVELOPMENTAL HI =	4.5E-04
TOTAL ENDOCRINE HI =	2.4E+00
	–
	–
TOTAL HEMATOLOGICAL HI =	2.4E+00
TOTAL IMMUNE SYSTEM HI =	5.0E-02
TOTAL KIDNEY HI =	1.1E+00
TOTAL LIVER HI =	1.8E+00
	–
TOTAL NERVOUS SYSTEM HI =	2.5E+01
TOTAL NOAEL HI =	2.7E+00
TOTAL REPRODUCTIVE HI =	2.4E+00
TOTAL SKIN HI =	3.0E-04
TOTAL RESPIRATORY HI =	2.6E+00

TABLE C-3
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS -- CENTRAL TENDENCY EXPOSURE - TOTAL METALS- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA - CTE SCENARIO
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
GROUND WATER	GROUND WATER	GROUNDWATER	DERMAL	1,2,4-Trimethylbenzene	0.034	mg/l	NC		NC			--		ND		
				1,3,5-Trimethylbenzene	0.033	mg/l	NC		NC			--		1.0E-02	mg/kg/day	
				1,4-Dichlorobenzene	0.032	mg/l	2.4E-07	mg/kg/day	5.4E-03	(mg/kg/day)-1	1.E-09	1.7E-05	mg/kg/day	3.0E-02	mg/kg/day	2.E-04
				Benzene	0.029	mg/l	5.3E-08	mg/kg/day	5.5E-02	(mg/kg/day)-1	3.E-09	3.7E-06	mg/kg/day	4.0E-03	mg/kg/day	9.E-04
				Chlorobenzene	0.038	mg/l	NC		NC			1.3E-05	mg/kg/day	4.0E-01	mg/kg/day	3.E-05
				Chloroform	0.032	mg/l	3.3E-08	mg/kg/day	NA			2.3E-06	mg/kg/day	1.0E-01	mg/kg/day	2.E-05
				cis-1,2-Dichloroethene	0.057	mg/l	NC		NC			-		3.0E-01	mg/kg/day	
				Ethylbenzene	0.052	mg/l	NC		NC			1.5E-05	mg/kg/day	5.0E-01	mg/kg/day	3.E-05
				Isopropyl Alcohol	0.034	mg/l	NC		NC			--		ND		
				Methylcyclohexane	0.033	mg/l	NC		NC			-		ND		
				Tetrachloroethene	1.5	mg/l	1.0E-05	mg/kg/day	5.4E-01	(mg/kg/day)-1	6.E-06	7.3E-04	mg/kg/day	1.0E-01	mg/kg/day	7.E-03
				Total Xylenes	0.029	mg/l	NC		NC			--		4.0E-01	mg/kg/day	
				Trichloroethene	0.083	mg/l	1.6E-07	mg/kg/day	5.9E-03	(mg/kg/day)-1	9.E-10	1.1E-05	mg/kg/day	3.0E-03	mg/kg/day	4.E-02
				Vinyl Chloride	0.030	mg/l	1.9E-08	mg/kg/day	7.2E-01	(mg/kg/day)-1	1.E-08	1.3E-06	mg/kg/day	3.0E-03	mg/kg/day	4.E-04
				2,4,6-Trichlorophenol	0.092	mg/l	5.8E-07	mg/kg/day	1.1E-02	(mg/kg/day)-1	9.E-09	6.0E-05	mg/kg/day	1.0E-03	mg/kg/day	6.E-02
				Benzo(a)anthracene	0.0043	mg/l	6.2E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	5.E-07	4.3E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(b)fluoranthene	0.0062	mg/l	1.1E-06	mg/kg/day	7.3E-01	(mg/kg/day)-1	8.E-07	7.4E-05	mg/kg/day	3.0E-01	mg/kg/day	2.E-04
				Benzo(k)fluoranthene	0.0043	mg/l	--		7.3E-02	(mg/kg/day)-1		--		3.0E-01	mg/kg/day	
				Bis(2-ethylhexyl)phthalate	0.0055	mg/l	9.7E-08	mg/kg/day	1.4E-02	(mg/kg/day)-1	1.E-09	6.8E-06	mg/kg/day	1.0E-01	mg/kg/day	7.E-05
				Chrysene	0.0043	mg/l	6.3E-07	mg/kg/day	7.3E-03	(mg/kg/day)-1	5.E-09	4.4E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Indeno(1,2,3-cd)pyrene	0.0062	mg/l	1.1E-06	mg/kg/day	7.3E-01	(mg/kg/day)-1	8.E-07	7.7E-05	mg/kg/day	3.0E-01	mg/kg/day	3.E-04
				Naphthalene	0.0062	mg/l	NC		NC			2.2E-06	mg/kg/day	6.0E-01	mg/kg/day	4.E-06
				TEQ	3.67E-07	mg/l	8.3E-11	mg/kg/day	1.5E+05	(mg/kg/day)-1	1.E-05	5.8E-09	mg/kg/day	ND		
				Aluminum	0.14	mg/l	NC		NC			--		1.0E+00	mg/kg/day	
				Arsenic	0.0028	mg/l	2.3E-10	mg/kg/day	1.5E+00	(mg/kg/day)-1	3.E-10	1.5E-08	mg/kg/day	3.0E-04	mg/kg/day	5.E-05
				Cobalt	0.0067	mg/l	NC		NC			--		3.0E-03	mg/kg/day	
				Lead	0.0036	mg/l	--		NA			--		ND		
				Manganese	1.13	mg/l	NC		NC			--		9.6E-04	mg/kg/day	
				Vanadium	0.0028	mg/l	NC		NC			1.5E-08	mg/kg/day	2.8E-04	mg/kg/day	6.E-05
			EXPOSURE ROUTE TOTAL								2.E-05					0.1
		EXPOSURE POINT TOTAL									2.E-05					0.1
EXPOSURE MEDIUM TOTAL											2.E-05					0.1
	AIR	TRENCH - AIR	AMBIENT INHALATION	1,2,4-Trimethylbenzene	257	ug/m3	NC		NC			1.9E+00	ug/m3	7.0E+00	ug/m3	3.E-01
				1,3,5-Trimethylbenzene	250	ug/m3	NC		NC			1.9E+00	ug/m3	ND		
				1,4-Dichlorobenzene	246	ug/m3	2.3E-02	ug/m3	1.1E-05	(ug/m3)-1	3.E-07	1.6E+00	ug/m3	8.0E+02	ug/m3	2.E-03
				Benzene	271	ug/m3	2.9E-02	ug/m3	7.8E-06	(ug/m3)-1	2.E-07	2.0E+00	ug/m3	3.0E+01	ug/m3	7.E-02
				Chlorobenzene	295	ug/m3	NC		NC			2.2E+00	ug/m3	5.0E+01	ug/m3	4.E-02
				Chloroform	241	ug/m3	2.6E-02	ug/m3	2.3E-05	(ug/m3)-1	6.E-07	1.8E+00	ug/m3	2.5E+02	ug/m3	7.E-03
				cis-1,2-Dichloroethene	477	ug/m3	NC		NC			3.6E+00	ug/m3	ND		
				Ethylbenzene	257	ug/m3	NC		NC			1.9E+00	ug/m3	3.1E-03	ug/m3	6.E-04
				Isopropyl Alcohol	NC	ug/m3	NC		NC					7.0E+03	ug/m3	
				Methylcyclohexane	278	ug/m3	NC		NC			2.1E+00	ug/m3	3.0E+03	ug/m3	7.E-04
				Tetrachloroethene	9700	ug/m3	1.0E+00	ug/m3	5.9E-06	(ug/m3)-1	6.E-06	7.3E+01	ug/m3	2.7E+02	ug/m3	3.E-01
				Total Xylenes	232	ug/m3	NC		NC			1.8E+00	ug/m3	3.9E+03	ug/m3	2.E-04
				Trichloroethene	601	ug/m3	6.5E-02	ug/m3	2.0E-06	(ug/m3)-1	1.E-07	4.5E+00	ug/m3	1.0E+01	ug/m3	5.E-01
				Vinyl Chloride	316	ug/m3	3.4E-02	ug/m3	4.4E-06	(ug/m3)-1	1.E-07	2.4E+00	ug/m3	1.0E+02	ug/m3	2.E-02
				2,4,6-Trichlorophenol	75	ug/m3	8.1E-03	ug/m3	3.1E-06	(ug/m3)-1	3.E-08	5.7E-01	ug/m3	ND		
				Benzo(a)anthracene	1.5	ug/m3	1.6E-04	ug/m3	7.1E-04	(ug/m3)-1	2.E-08	1.1E-02	ug/m3	ND		
				Benzo(b)fluoranthene	15	ug/m3	1.6E-03	ug/m3	1.1E-04	(ug/m3)-1	2.E-07	1.1E-01	ug/m3	ND		
				Benzo(k)fluoranthene	0.36	ug/m3	3.9E-05	ug/m3	1.1E-04	(ug/m3)-1	4.E-09	2.7E-03	ug/m3	ND		
				Bis(2-ethylhexyl)phthalate	0.05	ug/m3	5.4E-06	ug/m3	2.4E-06	(ug/m3)-1	1.E-11	3.8E-06	ug/m3	ND		
				Chrysene	15	ug/m3	1.7E-03	ug/m3	1.1E-05	(ug/m3)-1	2.E-08	1.2E-01	ug/m3	ND		
				Indeno(1,2,3-cd)pyrene	0.66	ug/m3	7.1E-05	ug/m3	1.1E-04	(ug/m3)-1	8.E-09	4.9E-03	ug/m3	ND		
				Naphthalene	28	ug/m3	NC		NC			2.1E-01	ug/m3	3.0E-01	ug/m3	7.E-02
				TEQ	0.0011	ug/m3	1.1E-07	ug/m3	3.8E+01	(ug/m3)-1	4.E-06	8.0E-06	ug/m3	4.0E-05	ug/m3	2.E-01
				Aluminum	NV	ug/m3	NC		NC					5.0E+00	ug/m3	
				Arsenic	NV	ug/m3	--		4.3E-03	(ug/m3)-1				1.5E-02	ug/m3	
				Cobalt	NV	ug/m3	NC		NC					2.0E-02	ug/m3	
				Lead	NV	ug/m3	--		NA					ND		
				Manganese	NV	ug/m3	NC		NC					5.0E-02	ug/m3	

TABLE C-3
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS -- CENTRAL TENDENCY EXPOSURE - TOTAL METALS- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA - CTE SCENARIO
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
				Vanadium	NV	ug/m3	NC		NC					1.0E-01	ug/m3	
			EXPOSURE ROUTE TOTAL								1.E-05					1
		EXPOSURE POINT TOTAL									1.E-05					1
	EXPOSURE MEDIUM TOTAL										1.E-05					1
GROUNDWATER TOTAL											3.E-05					2
TOTAL RECEPTOR RISK ACROSS ALL MEDIA											3.E-05	TOTAL RECEPTOR HAZARD ACROSS ALL MEDIA				2

NOTES
(1) - Blank cells indicate that an RfD or RfC is not avalailable from the sources used to obtain dose-response data for this risk assessment.
NC - Not carcinogenic by this exposure route.
NA - Not applicable: exposure route not applicable for this chemical/exposure medium.
NL - Not inlcluded in the calculation table for ambient air concentrations in a trench from groundwater.
NV - Not volatile; exposure route not complete for this chemical.
-- - Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 08/13/10
Checked by: BJR 08/13/10

TABLE C-4
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CENTRAL TENDENCY EXPOSURE - TOTAL METALS- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA - CTE SCENARIO
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
GROUND WATER	GROUND WATER	GROUNDWATER	1,2,4-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,3,5-Trimethylbenzene	NC	NA	NC	NA		Undetermined			--	
			1,4-Dichlorobenzene	--	NA	1.3E-09	NA	1.3E-09	Endocrine			2.4E-04	2.4E-04
			Benzene	--	NA	2.9E-09	NA	2.9E-09	Immune system /			9.3E-04	9.3E-04
			Chlorobenzene	NC	NA	NC	NA		Liver			2.7E-05	2.7E-05
			Chloroform	--	NA	--	NA		Liver			2.3E-05	2.3E-05
			cis-1,2-Dichloroethene	NC	NA	NC	NA		Hematological			--	
			Ethylbenzene	NC	NA	NC	NA		Liver / Kidney			3.1E-05	3.1E-05
			Isopropyl Alcohol	NC	NA	NC	NA					--	
			Methylcyclohexane	NC	NA	NC	NA					--	
			Tetrachloroethene	--	NA	5.6E-06	NA	5.6E-06	Liver			7.5E-03	7.5E-03
			Total Xylenes	NC	NA	NC	NA		Nervous System			--	
			Trichloroethene	--	NA	9.3E-10	NA	9.3E-10	Liver / Kidney			3.7E-02	3.7E-02
			Vinyl Chloride	--	NA	1.4E-08	NA	1.4E-08	Liver			4.4E-04	4.4E-04
			2,4,6-Trichlorophenol	--	NA	9.4E-09	NA	9.4E-09	Undetermined			6.0E-02	6.0E-02
			Benzo(a)anthracene	--	NA	4.5E-07	NA	4.5E-07	Kidney			1.4E-04	1.4E-04
			Benzo(b)fluoranthene	--	NA	7.8E-07	NA	7.8E-07	Kidney			2.5E-04	2.5E-04
			Benzo(k)fluoranthene	--	NA	--	NA		Kidney			--	
			Bis(2-ethylhexyl)phthalate	--	NA	1.4E-09	NA	1.4E-09	Reproductive			6.8E-05	6.8E-05
			Chrysene	--	NA	4.5E-09	NA	4.5E-09	Kidney			1.5E-04	1.5E-04
			Indeno(1,2,3-cd)pyrene	--	NA	8.0E-07	NA	8.0E-07	Kidney			2.6E-04	2.6E-04
			Naphthalene	NC	NA	NC	NA		Nervous System			3.7E-06	3.7E-06
			TEQ	--	NA	1.2E-05	NA	1.2E-05				--	
			Aluminum	NC	NA	NC	NA		Nervous System			--	
			Arsenic	--	NA	3.3E-10	NA	3.3E-10	Skin			5.1E-05	5.1E-05
			Cobalt	NC	NA	NC	NA		Hematological			--	
			Lead	--	NA	--	NA					--	
			Manganese	NC	NA	NC	NA		Nervous System			--	
			Vanadium	NC	NA	NC	NA		Kidney			5.9E-05	5.9E-05
		EXPOSURE POINT TOTAL						2E-05					0.1
	EXPOSURE MEDIUM TOTAL							2E-05					0.1
GROUND WATER	AIR	TRENCH - AIR	1,2,4-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	2.8E-01	NA	2.8E-01
			1,2,5-Trimethylbenzene	NA	NC	NA	NA		Undetermined	NA	--	NA	
			1,4-Dichlorobenzene	NA	2.6E-07	NA	NA	2.6E-07	Developmental	NA	2.0E-03	NA	2.0E-03
			Benzene	NA	2.3E-07	NA	NA	2.3E-07	Immune system	NA	6.8E-02	NA	6.8E-02
			Chlorobenzene	NA	NC	NA	NA		Undetermined	NA	4.4E-02	NA	4.4E-02
			Chloroform	NA	6.0E-07	NA	NA	6.0E-07	Liver	NA	7.3E-03	NA	7.3E-03
			cis-1,2-Dichloroethene	NA	NC	NA	NA			NA	--	NA	
			Ethylbenzene	NA	NC	NA	NA		Developmental	NA	6.3E-04	NA	6.3E-04
			Isopropyl Alcohol	NA	NC	NA	NA						
			Methylcyclohexane	NA	NC	NA	NA			NA	7.0E-04	NA	7.0E-04
			Tetrachloroethene	NA	6.2E-06	NA	NA	6.2E-06	Nervous System	NA	2.7E-01	NA	2.7E-01
			Total Xylenes	NA	NC	NA	NA		Nervous System	NA	2.2E-04	NA	2.2E-04
			Trichloroethene	NA	1.3E-07	NA	NA	1.3E-07	Nervous System	NA	4.5E-01	NA	4.5E-01
			Vinyl Chloride	NA	1.5E-07	NA	NA	1.5E-07	Liver	NA	2.4E-02	NA	2.4E-02
			2,4,6-Trichlorophenol	NA	2.5E-08	NA	NA	2.5E-08		NA	--	NA	
			Benzo(a)anthracene	NA	1.3E-08	NA	NA	1.3E-08		NA	--	NA	
			Benzo(b)fluoranthene	NA	1.8E-07	NA	NA	1.8E-07		NA	--	NA	
			Benzo(k)fluoranthene	NA	4.3E-09	NA	NA	4.3E-09		NA	--	NA	
			Bis(2-ethylhexyl)phthalate	NA	1.3E-11	NA	NA	1.3E-11		NA	--	NA	
			Chrysene	NA	1.8E-08	NA	NA	1.8E-08		NA	--	NA	
			Indeno(1,2,3-cd)pyrene	NA	7.8E-09	NA	NA	7.8E-09		NA	--	NA	
			Naphthalene	NA	NC	NA	NA		Respiratory	NA	7.0E-02	NA	7.0E-02
			TEQ	NA	4.3E-06	NA	NA	4.3E-06	Liver / Reproductive /	NA	2.0E-01	NA	2.0E-01
			Aluminum	NA	NC	NA	NA		Undetermined				
			Arsenic	NA	--	NA	NA		Developmental /				
			Cobalt	NA	NC	NA	NA						
			Lead	NA	--	NA	NA						
			Manganese	NA	NC	NA	NA		Nervous System				

TABLE C-4
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - CENTRAL TENDENCY EXPOSURE - TOTAL METALS- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA - CTE SCENARIO
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
			Vanadium	NA	NC	NA	NA						
RECEPTOR TOTAL								3E-05					2
							TOTAL RISK ACROSS ALL MEDIA	3E-05				TOTAL HAZARD ACROSS ALL MEDIA	2

NOTES:
NC - Not carcinogenic by this exposure route.
NA - Not applicable; exposure route not applicable for this chemical/exposure medium.
-- - Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 08/13/10
Checked by: BJR 08/13/10

	--
	--
TOTAL DEVELOPMENTAL HI =	2.7E-03
TOTAL ENDOCRINE HI =	2.0E-01
	--
	--
TOTAL HEMATOLOGICAL HI =	2.0E-01
TOTAL IMMUNE SYSTEM HI =	6.9E-02
TOTAL KIDNEY HI =	3.8E-02
TOTAL LIVER HI =	2.7E-03
	--
TOTAL NERVOUS SYSTEM HI =	7.2E-01
TOTAL NOAEL HI =	3.8E-01
TOTAL REPRODUCTIVE HI =	2.0E-01
TOTAL SKIN HI =	5.1E-05
TOTAL RESPIRATORY HI =	2.7E-01

TABLE C-5
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS – REASONABLE MAXIMUM EXPOSURE - TOTAL METALS - WITH LEA DATA - CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
GROUND WATER	GROUND WATER	GROUNDWATER	DERMAL	1,4-Dichlorobenzene	0.0050	mg/l	7.8E-08	mg/kg/day	5.4E-03	(mg/kg/day)-1	2.E-10	2.7E-06	mg/kg/day	7.0E-02	mg/kg/day	4.E-05
				Benzene	0.024	mg/l	3.8E-08	mg/kg/day	5.5E-02	(mg/kg/day)-1	2.E-09	2.7E-06	mg/kg/day	4.0E-03	mg/kg/day	7.E-04
				Chlorobenzene	0.10	mg/l	NC		NC			3.6E-05	mg/kg/day	4.0E-01	mg/kg/day	1.E-04
				Chloroform	0.0061	mg/l	4.2E-09	mg/kg/day	NA			3.0E-07	mg/kg/day	1.0E-01	mg/kg/day	3.E-06
				cis-1,2-Dichloroethene	21	mg/l	NC		NC			--		3.0E-01	mg/kg/day	
				Ethylbenzene	0.028	mg/l	NC		NC			1.3E-05	mg/kg/day	5.0E-01	mg/kg/day	3.E-05
				Isopropyl Alcohol	0.074	mg/l	NC		NC			--		ND		
				Methylcyclohexane	0.10	mg/l	NC		NC			--		ND		
				Tetrachloroethene	220	mg/l	1.5E-03	mg/kg/day	5.4E-01	(mg/kg/day)-1	8.E-04	1.0E-01	mg/kg/day	1.0E-01	mg/kg/day	1.E+00
				Total Xylenes	0.069	mg/l	NC		NC			--		4.0E-01	mg/kg/day	
				Trichloroethene	25	mg/l	4.4E-05	mg/kg/day	5.9E-03	(mg/kg/day)-1	3.E-07	3.1E-03	mg/kg/day	3.0E-04	mg/kg/day	1.E+01
				Vinyl Chloride	0.48	mg/l	3.1E-07	mg/kg/day	7.2E-01	(mg/kg/day)-1	2.E-07	2.1E-05	mg/kg/day	3.0E-03	mg/kg/day	7.E-03
				2,4,6-Trichlorophenol	2.9	mg/l	2.5E-05	mg/kg/day	1.1E-02	(mg/kg/day)-1	3.E-07	1.8E-03	mg/kg/day	1.0E-03	mg/kg/day	2.E+00
				Benzo(a)anthracene	0.0037	mg/l	5.4E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	4.E-07	2.7E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(b)fluoranthene	0.0025	mg/l	6.3E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	5.E-07	1.1E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Benzo(k)fluoranthene	0.0029	mg/l	--		7.3E-02	(mg/kg/day)-1		--		3.0E-01	mg/kg/day	
				Bis(2-ethylhexyl)phthalate	0.031	mg/l	5.4E-07	mg/kg/day	1.4E-02	(mg/kg/day)-1	8.E-09	3.8E-05	mg/kg/day	1.0E-01	mg/kg/day	4.E-04
				Chrysene	0.0039	mg/l	5.6E-07	mg/kg/day	7.3E-03	(mg/kg/day)-1	4.E-09	3.9E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Indeno(1,2,3-cd)pyrene	0.002	mg/l	5.2E-07	mg/kg/day	7.3E-01	(mg/kg/day)-1	4.E-07	3.6E-05	mg/kg/day	3.0E-01	mg/kg/day	1.E-04
				Naphthalene	0.011	mg/l	NC		NC			5.7E-06	mg/kg/day	6.0E-01	mg/kg/day	1.E-05
				TEQ	4.38E-06	mg/l	9.9E-10	mg/kg/day	1.5E+05	(mg/kg/day)-1	1.E-04	6.9E-08	mg/kg/day	ND		
				Aluminum	0.756	mg/l	NC		NC			--		1.0E+00	mg/kg/day	
				Arsenic	0.02	mg/l	1.5E-09	mg/kg/day	1.5E+03	(mg/kg/day)-1	2.E-09	1.1E-07	mg/kg/day	3.0E-04	mg/kg/day	4.E-04
				Cobalt	0.0356	mg/l	NC		NC			--		3.0E-03	mg/kg/day	
				Lead	0.07	mg/l	--		NA			--		ND		
				Manganese	5.55	mg/l	NC		NC			3.0E-05	mg/kg/day	2.8E-03	mg/kg/day	1.E-02
				Vanadium	0.0557	mg/l	NC		NC			2.1E-07	mg/kg/day	2.6E-04	mg/kg/day	8.E-04
			EXPOSURE ROUTE TOTAL								1.E-03					13
		EXPOSURE POINT TOTAL									1.E-03					13
	EXPOSURE MEDIUM TOTAL										1.E-03					13
	AIR	TRENCH - AIR	VAPOR INHALATION	1,4-Dichlorobenzene	34	ug/m3	3.6E-03	ug/m3	1.1E-05	(ug/m3)-1	4.E-08	2.5E-01	ug/m3	8.0E-02	ug/m3	3.E-04
				Benzene	196	ug/m3	2.1E-02	ug/m3	7.8E-06	(ug/m3)-1	2.E-07	1.5E+00	ug/m3	3.0E+01	ug/m3	5.E-02
				Chlorobenzene	1240	ug/m3	NC		NC			9.3E+00	ug/m3	5.0E+01	ug/m3	2.E-01
				Chloroform	31	ug/m3	3.3E-03	ug/m3	2.3E-05	(ug/m3)-1	8.E-08	2.3E-01	ug/m3	2.5E+02	ug/m3	9.E-04
				cis-1,2-Dichloroethene	175583	ug/m3	NC		NC			1.3E+03	ug/m3	ND		
				Ethylbenzene	275	ug/m3	NC		NC			1.7E+00	ug/m3	3.1E+03	ug/m3	6.E-04
				Isopropyl Alcohol	NI	ug/m3	NC		NC					7.0E+03	ug/m3	
				Methylcyclohexane	843	ug/m3	NC		NC			6.3E+00	ug/m3	3.0E+03	ug/m3	2.E-03
				Tetrachloroethene	1422609	ug/m3	1.5E+02	ug/m3	5.9E-06	(ug/m3)-1	9.E-04	1.1E+04	ug/m3	2.7E+02	ug/m3	4.E+01
				Total Xylenes	553	ug/m3	NC		NC			4.2E+00	ug/m3	7.9E+03	ug/m3	5.E-04
				Trichloroethene	166667	ug/m3	1.8E+01	ug/m3	2.0E-06	(ug/m3)-1	4.E-05	1.3E+03	ug/m3	1.0E+01	ug/m3	1.E+02
				Vinyl Chloride	5059	ug/m3	3.4E-01	ug/m3	4.4E-06	(ug/m3)-1	2.E-06	3.8E+01	ug/m3	1.0E+02	ug/m3	4.E-01
				2,4,6-Trichlorophenol	2220	ug/m3	2.4E-01	ug/m3	3.1E-06	(ug/m3)-1	7.E-07	1.7E+01	ug/m3	ND		
				Benzo(a)anthracene	1.3	ug/m3	1.5E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-08	9.4E-02	ug/m3	ND		
				Benzo(b)fluoranthene	0.9	ug/m3	9.7E-04	ug/m3	1.1E-04	(ug/m3)-1	1.E-07	6.8E-02	ug/m3	ND		
				Benzo(k)fluoranthene	0.25	ug/m3	2.6E-05	ug/m3	1.1E-04	(ug/m3)-1	3.E-09	1.9E-02	ug/m3	ND		
				Bis(2-ethylhexyl)phthalate	0.28	ug/m3	3.0E-05	ug/m3	2.4E-06	(ug/m3)-1	7.E-11	2.1E-02	ug/m3	ND		
				Chrysene	14	ug/m3	1.5E-03	ug/m3	1.1E-05	(ug/m3)-1	2.E-08	1.1E-01	ug/m3	ND		
				Indeno(1,2,3-cd)pyrene	0.51	ug/m3	5.4E-05	ug/m3	1.1E-04	(ug/m3)-1	4.E-09	2.4E-02	ug/m3	ND		
				Naphthalene	53	ug/m3	NC		NC			5.5E-01	ug/m3	3.0E+00	ug/m3	2.E-01
				TEQ	0.013	ug/m3	1.4E-06	ug/m3	3.8E+01	(ug/m3)-1	5.E-05	9.5E-05	ug/m3	4.0E-05	ug/m3	2.E+00
				Aluminum	NV	ug/m3	NC		NC			NA		5.0E+00	ug/m3	
				Arsenic	NV	ug/m3	--		4.3E-03	(ug/m3)-1		NA		1.5E-02	ug/m3	
				Cobalt	NV	ug/m3	NC		NC			NA		2.0E-02	ug/m3	
				Lead	NV	ug/m3	--		NA			NA		ND		
				Manganese	NV	ug/m3	NC		NC			NA		5.0E-02	ug/m3	
				Vanadium	NV	ug/m3	NC		NC			NA		1.0E-01	ug/m3	

TABLE C-5
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS -- REASONABLE MAXIMUM EXPOSURE - TOTAL METALS - WITH LEA DATA- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	EXPOSURE ROUTE	CHEMICAL	EPC		CANCER RISK CALCULATIONS					NON-CANCER HAZARD CALCULATIONS				
					VALUE	UNITS	INTAKE/EXPOSURE CONCENTRATION		CSF/UNIT RISK		CANCER RISK	INTAKE/EXPOSURE CONCENTRATION		RfD/RfC (1)		HAZARD QUOTIENT
							VALUE	UNITS	VALUE	UNITS		VALUE	UNITS	VALUE	UNITS	
			EXPOSURE ROUTE TOTAL								1.E-03					158
		EXPOSURE POINT TOTAL									1.E-03					158
	EXPOSURE MEDIUM TOTAL										1.E-03					158
GROUNDWATER TOTAL											2.E-03					181
TOTAL RECEPTOR RISK ACROSS ALL MEDIA											2.E-03	TOTAL RECEPTOR HAZARD ACROSS ALL MEDIA				181

NOTES:
(1) - Blank cells indicate that an RfD or RfC is not avalailable from the sources used to obtain dose-response data for this risk assessment.
NC - Not carcinogenic by this exposure route.
NA - Not applicable: exposure route not applicable for this chemical/exposure medium.
NL - Not included in the calculation table for ambient air concentrations in a trench from groundwater.
NV - Not volatile: exposure route not complete for this chemical.
-- - Not calculated: dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 08/13/2010
Checked by: BJR 08/13/10

TABLE C-6
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE - TOTAL METALS - WITH LEA DATA- CURRENT/FUTURE- UTILITY WORKER- ADULT
SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
GROUND WATER	GROUND WATER	GROUNDWATER	1,4-Dichlorobenzene	--	NA	2.0E-10	NA	2.0E-10	Endocrine			3.8E-05	3.8E-05
			Benzene	--	NA	2.1E-09	NA	2.1E-09	Immune system /			6.6E-04	6.6E-04
			Chlorobenzene	NC	NA	NC	NA		Liver			1.1E-04	1.1E-04
			Chloroform	--	NA	--	NA		Liver			3.0E-06	3.0E-06
			cis-1,2-Dichloroethene	NC	NA	NC	NA		Hematological			--	
			Ethylbenzene	NC	NA	NC	NA		Liver / Kidney			2.7E-05	2.7E-05
			Isopropyl Alcohol	NC	NA	NC	NA					--	
			Methylcyclohexane	NC	NA	NC	NA					--	
			Tetrachloroethene	--	NA	8.1E-04	NA	8.1E-04	Liver			1.0E+00	1.0E+00
			Total Xylenes	NC	NA	NC	NA		Nervous System			--	
			Trichloroethene	--	NA	2.6E-07	NA	2.6E-07	Liver / Kidney			1.0E-01	1.0E-01
			Vinyl Chloride	--	NA	2.2E-07	NA	2.2E-07	Liver			7.1E-03	7.1E-03
			2,4,6-Trichlorophenol	--	*NA*	*2.8E-07*	*NA*	*2.8E-07*	*Undetermined*			*1.8E+00*	*1.8E+00*
			Benzo(a)anthracene	--	NA	3.9E-07	NA	3.9E-07	Kidney			1.2E-04	1.2E-04
			Benzo(b)fluoranthene	--	NA	4.6E-07	NA	4.6E-07	Kidney			1.5E-04	1.5E-04
			Benzo(k)fluoranthene	--	NA	--	NA		Kidney			--	
			Bis(2-ethylhexyl)phthalate	--	NA	7.6E-09	NA	7.6E-09	Reproductive			3.8E-04	3.8E-04
			Chrysene	--	NA	4.1E-09	NA	4.1E-09	Kidney			1.3E-04	1.3E-04
			Indeno(1,2,3-cd)pyrene	--	NA	3.8E-07	NA	3.8E-07	Kidney			1.2E-04	1.2E-04
			Naphthalene	NC	NA	NC	NA		Nervous System			9.6E-06	9.6E-06
			TEQ	--	NA	1.5E-04	NA	1.5E-04				--	
			Aluminum	NC	NA	NC	NA		Nervous System			--	
			Arsenic	--	NA	2.3E-09	NA	2.3E-09	Skin			3.6E-04	3.6E-04
			Cobalt	NC	NA	NC	NA		Hematological			--	
			Lead	--	NA	--	NA					--	
			Manganese	NC	NA	NC	NA		Nervous System			1.1E-02	1.1E-02
			Vanadium	NC	NA	NC	NA		Kidney			8.1E-04	8.1E-04
		EXPOSURE POINT TOTAL						1E-03					13
	EXPOSURE MEDIUM TOTAL							1E-03					13
GROUND WATER	AIR	TRENCH - AIR	1,4-Dichlorobenzene	NA	4.0E-08	NA	NA	4.0E-08	Developmental	NA	3.2E-04	NA	3.E-04
			Benzene	NA	1.6E-07	NA	NA	1.6E-07	Immune system	NA	4.9E-02	NA	5.E-02
			Chlorobenzene	NA	NC	NA	NA		Undetermined	NA	1.9E-01	NA	2.E-01
			Chloroform	NA	7.6E-08	NA	NA	7.6E-08	Liver	NA	9.3E-04	NA	9.E-04
			cis-1,2-Dichloroethene	NA	NC	NA	NA			NA	--	NA	
			Ethylbenzene	NA	NC	NA	NA		Developmental	NA	5.5E-04	NA	6.E-04
			Isopropyl Alcohol	NA	NC	NA	NA						
			Methylcyclohexane	NA	NC	NA	NA			NA	2.1E-03	NA	2.E-03
			Tetrachloroethene	NA	9.0E-04	NA	NA	9.0E-04	Nervous System	NA	4.0E+01	NA	4.E+01
			Total Xylenes	NA	NC	NA	NA		Nervous System	NA	5.3E-04	NA	5.E-04
			Trichloroethene	NA	3.6E-05	NA	NA	3.6E-05	Nervous System	NA	1.5E+02	NA	1.E+02
			Vinyl Chloride	NA	2.4E-06	NA	NA	2.4E-06	Liver	NA	3.8E-01	NA	4.E-01
			2,4,6-Trichlorophenol	NA	7.4E-07	NA	NA	7.4E-07		NA	--	NA	
			Benzo(a)anthracene	NA	1.5E-08	NA	NA	1.5E-08		NA	--	NA	
			Benzo(b)fluoranthene	NA	1.1E-07	NA	NA	1.1E-07		NA	--	NA	
			Benzo(k)fluoranthene	NA	2.9E-09	NA	NA	2.9E-09		NA	--	NA	
			Bis(2-ethylhexyl)phthalate	NA	7.3E-11	NA	NA	7.3E-11		NA	--	NA	
			Chrysene	NA	1.7E-08	NA	NA	1.7E-08		NA	--	NA	
			Indeno(1,2,3-cd)pyrene	NA	3.2E-09	NA	NA	3.2E-09		NA	--	NA	
			Naphthalene	NA	NC	NA	NA		Respiratory	NA	1.8E-01	NA	2.E-01
			TEQ	NA	5.2E-05	NA	NA	5.2E-05	Liver / Reproductive /	NA	2.4E+00	NA	2.E+01
			Aluminum	NA	NC	NA	NA		Undetermined	NA	NA	NA	
			Arsenic	NA	--	NA	NA		Developmental /	NA	NA	NA	
			Cobalt	NA	NC	NA	NA			NA	NA	NA	
			Lead	NA	--	NA	NA			NA	NA	NA	
			Manganese	NA	NC	NA	NA		Nervous System	NA	NA	NA	
			Vanadium	NA	NC	NA	NA			NA	NA	NA	
		EXPOSURE POINT TOTAL						1E-03					168
	EXPOSURE MEDIUM TOTAL							1E-03					168

TABLE C-6
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs - REASONABLE MAXIMUM EXPOSURE - TOTAL METALS - WITH LEA DATA- CURRENT/FUTURE- UTILITY WORKER- ADULT
- SOURCE AREA
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SCENARIO TIMEFRAME: CURRENT/FUTURE
RECEPTOR POPULATION: UTILITY WORKER
RECEPTOR AGE: ADULT

MEDIUM	EXPOSURE MEDIUM	EXPOSURE POINT	CHEMICAL	CARCINOGENIC RISK (1)					NON-CARCINOGENIC HAZARD QUOTIENT (1)				
				INGESTION	INHALATION	DERMAL	EXTERNAL (RADIATION)	EXPOSURE ROUTES TOTAL	PRIMARY TARGET ORGAN	INGESTION	INHALATION	DERMAL	EXPOSURE ROUTES TOTAL
GROUNDWATER TOTAL								2E-03					181
RECEPTOR TOTAL								2E-03					181
							TOTAL RISK ACROSS ALL MEDIA	2E-03	TOTAL HAZARD ACROSS ALL MEDIA				181

NOTES:
NC - Not carcinogenic by this exposure route.
NA - Not applicable; exposure route not applicable for this chemical/exposure medium.
-- - Not calculated; dose-response data and/or dermal absorption values are not available.

Prepared by: KASK 08/13/2010
Checked by: BJR 08/13/10

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TOTAL DEVELOPMENTAL HI =	8.7E-04
TOTAL ENDOCRINE HI =	2.4E+00
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	--
TOTAL HEMATOLOGICAL HI =	2.4E+00
TOTAL IMMUNE SYSTEM HI =	5.0E-02
TOTAL KIDNEY HI =	1.0E+01
TOTAL LIVER HI =	1.4E+01
	--
TOTAL NERVOUS SYSTEM HI =	1.7E+02
TOTAL NOAEL HI =	1.9E+00
TOTAL REPRODUCTIVE HI =	2.4E+00
TOTAL SKIN HI =	3.6E-04
TOTAL RESPIRATORY HI =	2.6E+00