Exhibit 21

SCREENING-LEVEL RISK ASSESSMENT FOR THE USPCI CLIVE INCINERATION FACILITY

Prepared for

USPCI
Clive Incineration Facility

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I. EXECUTIVE SUMMARY

ENVIRON has been retained by USPCI to assess the potential for public health impacts of chemical substances which may be emitted during operations of the USPCI Clive Incinerator facility. The Clive incinerator is located on private land south of Interstate 80 (I-80), approximately 37 miles northwest of Grantsville in Tooele County, Utah. The incinerator is designed to thermally treat hazardous, toxic, medical and non-hazardous waste. This Screening Level Risk Assessment (SLRA) was conducted in support of a modification request to reduce the Destruction and Removal Efficiency (DRE) performance standard from 99.9999% to 99.99%.

This assessment has been conducted consistent with the "SLRA guidance" (USEPA 1994a) provided by the Utah Department of Environmental Quality (Downs 1994), which is designed to produce conservative estimates of potential carcinogenic risks and noncarcinogenic health effects posed by chemical emissions from the Clive incinerator. In addition, the Utah Department of Environmental Quality has provided USPCI with additional guidance in reviewing drafts of this report.

The SLRA is composed of the following steps: (1) identification of chemicals of concern potentially released from the incinerator; (2) air dispersion and deposition modeling; (3) exposure assessment of significant receptors to incinerator emissions; and (4) risk characterization, including a discussion of the uncertainties underlying the quantitative risk estimates. Based on these steps the SLRA evaluates whether the emissions from the incinerator produce impacts that are in compliance with health-based standards set by USEPA. The criteria levels established by USEPA for this facility are a value less than 0.25 for the hazard index, which is a measure of the potential for noncarcinogenic effects, and a cancer risk of less than 1 case in one hundred thousand exposed individuals (i.e., less than 1×10^{-5}).

TABLE I-1 Excess Lifetime Cancer Risks to Hypothetical Receptors				
Receptor Location	**Exposure Pathway**	**Subsistence Farmer**	**Resident Adult**	**Resident Child**
Nearest Resident	Indirect Exposure	7×10^{-7}	2×10^{-8}	2×10^{-8}
	Direct Exposure	2×10^{-7}	1×10^{-7}	2×10^{-8}
	Total	9×10^{-7}	1×10^{-7}	4×10^{-8}
North Edge of Buffer Zone	Indirect Exposure	2×10^{-6}	7×10^{-8}	5×10^{-8}
	Direct Exposure	4×10^{-7}	3×10^{-7}	6×10^{-8}
	Total	3×10^{-6}	4×10^{-7}	1×10^{-7}
South Edge of Buffer Zone	Indirect Exposure	2×10^{-6}	6×10^{-8}	5×10^{-8}
	Direct Exposure	4×10^{-7}	3×10^{-7}	6×10^{-8}
	Total	2×10^{-6}	4×10^{-7}	1×10^{-7}

TABLE I-2 Hazard Indices				
Receptor Location	**Exposure Pathway**	**Subsistence Farmer**	**Resident Adult**	**Resident Child**
Nearest Residence	Indirect Exposure			
	Liver	0.014	0.00026	0.00119
	Neurotoxic	0.045	0.00046	0.0026
	Direct Exposure			
	Liver	0.018	0.018	0.018
	Neurotoxic	0.022	0.022	0.022
	Total*	0.022	0.022	0.022
North Edge of Buffer Zone	Indirect Exposure			
	Liver	0.049	0.00092	0.0042
	Neurotoxic	0.15	0.0016	0.0091
	Direct Exposure			
	Liver	0.048	0.048	0.048
	Neurotoxic	0.060	0.060	0.060
	Total*	0.060	0.060	0.060
South Edge of Buffer Zone	Indirect Exposure			
	Liver	0.046	0.00086	0.0039
	Neurotoxic	0.15	0.0015	0.0086
	Direct Exposure			
	Liver	0.045	0.045	0.045
	Neurotoxic	0.057	0.057	0.057
	Total*	0.057	0.057	0.057

Note:

* Total is the sum of all HQs for the individual constituents for direct exposure.

Because the facility has not begun normal operations, and a trial burn has not been conducted, site-specific data on chemical emissions from the incinerator are not currently available. Consequently, chemical-specific emission rates were developed for the facility using conservative methodologies designed to overpredict actual emissions. Potential emissions from the incinerator were based on assuming: (1) maximum permitted emissions for those chemicals explicitly listed in the permit; (2) a DRE performance standard of 99.99% for organic hazardous constituents regulated under the Resource Conservation and Recovery Act (RCRA); (3) a DRE of 99.9999% for polychlorinated biphenyls (PCBs) that are regulated under the Toxic Substances Control Act (TSCA); and (4) emission rates for barium and thallium based on the procedures for determining default values for system removal efficiencies (SREs) described in *40 CFR Part 266, Appendix IX* (page 611).

Consistent with the SLRA guidance, potential emissions from the incinerator stack were modeled using the COMPDEP air dispersion model to predict chemical concentrations and deposition rates in the vicinity of the facility.

The quantitative assessment of exposures and risks presented in the SLRA focuses on three specific locations selected from the modeled receptors. The following three locations were chosen, based on discussions with UDEQ, because they best characterize conservative, worst-case exposure from stack emissions: 1) the location of the nearest current resident in the general vicinity of Iosepa in the Skull Valley ("Nearest Resident"); 2) a "theoretical" location directly north of the incinerator, in the prevailing wind direction at the north edge of the 10 mile buffer zone boundary ("North Edge of Buffer Zone"); and 3) a "theoretical" location directly south of the incinerator, the closest site at the south edge of the 10 mile buffer zone boundary ("South Edge of Buffer Zone"). The "theoretical" receptors represent locations where no actual residents reside, but reflect the nearest downwind locations at the buffer zone boundary that could theoretically support residential development. Local zoning restrictions preclude residential occupation within the designated buffer zone known as the West Desert Hazardous Industry Area (see Appendix G, Attachment G-1).

At each of the three identified locations, chemical-specific concentrations were estimated in environmental media (e.g., air, soil and food) to which individuals may be

exposed. Procedures used to estimate concentrations in these environmental media are specified in SLRA guidance and consist of fate and transport models that are designed to overstate actual media concentrations. This is achieved by employing models that neglect degradation and other attenuation mechanisms that would reduce environmental concentrations, and applying USEPA-recommended conservative default input assumptions in the model.

At each of the three locations, in accordance with SLRA guidance, exposure to a hypothetical subsistence farmer, adult resident and child resident was assessed. These hypothetical individuals may be directly exposed to emissions from the incineration by the inhalation route (direct exposure), or indirectly by incorporation of chemicals in the food chain and consumption of contaminated vegetables, meat or dairy products. Direct and indirect exposures to hypothetical individuals at the three identified locations were estimated and cancer risks and the potential for noncancer effects were calculated using SLRA guidance. Tables I-1 and I-2 present the calculated excess lifetime cancer risks and hazard indices for each receptor at these three locations. In all cases, the risks calculated for receptors on the north edge of the buffer zone boundary were the greatest. Thus, for illustrative purposes, all subsequent calculations and results in this report are presented for this location.

Table I-1 summarizes the excess lifetime cancer risks to the subsistence farmer, adult resident and child resident through indirect and direct exposure to emissions from the facility for each of the three receptor locations. The total (sum of indirect and direct exposures) excess lifetime cancer risks are 3×10^{-6}, 4×10^{-7} and 1×10^{-7} for the hypothetical subsistence farmer, adult resident and child resident, respectively, at the north edge of the buffer zone boundary. These calculated risks are at least 3-fold lower than the USEPA benchmark of acceptability of 1×10^{-5} (see USEPA 1994b). Thus, the excess lifetime cancer risk associated with exposure to emissions from the Clive incinerator are considered *de minimis*.

Table I-2 summarizes the potential for noncarcinogenic effects for each identified receptor through indirect and direct exposure to emissions from the facility at each of the three locations. The potential for noncarcinogenic effects is evaluated as the hazard quotient, which is the ratio of the chemical-specific exposure dose and a reference dose

derived by USEPA to be adequately protective of human health. Based on SLRA guidance, hazard quotient values for chemicals affecting the same target organ are summed to derive the hazard indices listed in Tables I-2. Noncarcinogenic effects measured via hepatotoxicity (liver effects) due to indirect exposure to facility emissions were 0.049, 0.00092 and 0.0042 for the subsistence farmer, adult resident and child resident, respectively, at the north edge of the buffer zone boundary. Neurotoxicity due to indirect exposure to emissions at the north edge of the buffer zone boundary was calculated to be 0.15, 0.0016 and 0.0091 for the subsistence farmer, adult resident and child resident, respectively. For the direct exposure calculations, hepatoxicity was calculated to be 0.048 and neurotoxicity was calculated to be 0.060 for each receptor. As expected, the hazard index values calculated for each toxic endpoint by direct exposure is identical across receptors at a given location, because no receptor-specific variables are used in the calculation of these values.

The USEPA (1994b) has established a benchmark for hazard indices of 0.25, a level which is designed to be adequately protective of human health considering noncancer effects. Addition of the direct exposure hazard quotient for each chemical yields a hazard index of 0.060, a factor of 4 below the 0.25 level. Thus, the potential for noncancer health effects is below the level of regulatory concern.

The modeled concentration of lead in the soil was calculated to be 0.3 mg/kg. This value is well below the USEPA benchmark of 100 mg/kg (USEPA 1994b). In addition, the modeled concentration of lead in air was calculated to be 0.004 $\mu g/m^3$, well below the USEPA benchmark of 0.2 $\mu g/m^3$ (USEPA 1994b). These calculations indicate that no adverse effects due to lead released from the incinerator stack would be expected.

These results demonstrate that all USEPA-established criteria are met and, therefore, no unacceptable carcinogenic or noncarcinogenic health risks are expected to result from exposure to stack gas constituents emitted from the USPCI Clive facility.

II. INTRODUCTION

A. Purpose

The purpose of this document was to conduct a screening level risk assessment (SLRA) of the potential risks to hypothetical receptors from exposure to emissions from the Clive incinerator located in Tooele County, Utah. This SLRA was conducted in support of a modification request to reduce the DRE performance standard from 99.9999 % to 99.99%. Based on the calculations and results presented here, all USEPA-established criteria are met and, therefore, no unacceptable carcinogenic risks or noncarcinogenic health effects would be expected from exposure to incinerator emissions from this facility under the modified performance standard.

This screening level risk assessment was conducted following the draft *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes* (USEPA 1994a; SLRA guidance; Downs 1994) with modifications suggested in three draft errata to USEPA (1994a) provided to USPCI by the Utah Department of Environmental Quality. The screening procedure is based on the guidance in the interim final report *Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions* (USEPA 1990), the draft *Addendum to Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustion Emissions* (USEPA 1993) and the draft implementation guidance entitled *Implementation Guidance for Conducting Indirect Exposure Analysis at RCRA Combustion Units* (USEPA 1994b).

The screening procedure provides a conservative estimate of potential carcinogenic risks and noncarcinogenic health effects posed to hypothetical receptors from exposure via direct and indirect pathways to emissions of the most significant substances from the facility.

This screening assessment follows the approach included in the SLRA guidance. Exposure routes considered in this SLRA include both direct exposures from inhalation

and indirect exposures from dermal contact with soil and ingestion (both soil and food chain exposures). Indirect exposure analysis expands the analysis of routes by which contamination may reach individuals. These pathways predominantly involve concentration of contaminants in biological media (e.g., plants) and subsequent ingestion of contaminated foods. Aspects of the fate, transport and food chain modeling have been made intentionally conservative in this screening study to overestimate the actual risk associated with emissions from the facility (USEPA 1994a).

Three receptor scenarios have been developed for this evaluation: 1) a subsistence farmer; 2) a resident adult; and 3) a resident child. Pathways of exposure include beef, milk and vegetable consumption, incidental soil ingestion, dermal contact with soil and inhalation for the farmer; and consumption of vegetables, incidental soil ingestion, dermal contact with soil and inhalation for the residents. The target risk levels identified in the implementation guidance are a total carcinogenic risk of less than 1×10^{-5} and hazard indices less than 0.25 (USEPA 1994b).

B. Site Background

USPCI has constructed a commercial transfer, storage and treatment facility capable of incinerating wastes. The incinerator was designed to thermally treat hazardous, toxic, medical and non-hazardous wastes regulated under the Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments Reauthorization Act (SARA Title III). Non-hazardous and medical wastes are currently regulated as solid waste under RCRA, Subtitle D, by the Utah Division of Solid and Hazardous Waste (DSHW) (Solid Waste Permitting and Management Regulations R45 0-301). USPCI is required to comply with all regulations that may be applicable to its facility.

The Clive incinerator is located three miles south of Interstate 80 (I-80) about 80 miles west of Salt Lake City, Utah. The facility is located on private land, approximately 37 miles northwest of Grantsville in Tooele County. The Clive incinerator is located within the West Desert Hazardous Industry Area, which has been designated by the

Board of County Commissioners of Tooele County for the location of commercial hazardous waste treatment, storage and disposal facilities.

III. EXPOSURE ASSESSMENT

The purpose of this assessment was to perform a screening level evaluation of the potential risks from direct and indirect exposure to incinerator emissions. This type of risk assessment follows four basic steps: (1) estimation of emissions from the incinerator stack (these estimates are used until actual operating data are collected); (2) air dispersion and deposition modeling of pollutant emissions to estimate the concentrations of various pollutants at locations surrounding the facility; (3) estimation of chemical concentrations in soil, plants and other environmental media, and exposure to individuals from contact with these media; and (4) estimation of the noncancer hazards and carcinogenic risk based on the estimated intakes and toxicological properties of individual contaminants. As part of the screening assessment, default values were used as parameters in the exposure algorithms. These default values were taken from the SLRA guidance when site-specific values could not be determined. The default values used are typically conservative and tend to overestimate the actual risk associated with exposure to incinerator emissions (USEPA 1994a). According to the guidance, if the final estimated risk is below levels of concern, then there is good reason to conclude that further analysis of the risk from stack emissions is unnecessary (USEPA 1994a).

A. Estimation of Chemical-Specific Emission Rates

The SLRA has been conducted considering exposures to the identified receptors through direct inhalation and via indirect pathways of exposure, i.e., incorporation of chemicals into the food chain. In the absence of site-specific data, the following procedure was used to select chemicals and develop emission rates for the quantitative risk evaluation.

1. Selection of Chemicals

USEPA (1994a) guidance requires that the risks associated with indirect exposures be evaluated for a specified list of constituents, which consist of environmentally persistent compounds such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), dioxins and dioxin-like compounds, and metals. Consistent with this guidance, Table III-1 lists the compounds that were evaluated for assessing exposures through indirect pathways. As shown in the table, as per the SLRA guidance from USEPA, PAHs are represented by benzo(a)pyrene, the most potent carcinogen of the PAHs identified in the guidance, and dioxins and dioxin-like compounds are represented by 2,3,7,8-tetrachlorodibenzo(p)dioxin (2,3,7,8-TCDD) equivalents.

In addition to the indirect pathways, exposure to these compounds would also occur through direct inhalation. USEPA (1994a) guidance requires that uncombusted or partially combusted chemicals and other products of incomplete combustion that are released from the incinerator stack be considered in evaluating direct exposures. Since the facility has not begun normal operations, site-specific data are unavailable to develop emission estimates for all chemicals that could potentially be released from the incinerator. However, based on professional experience (expert testimony of J.J. Santoleri as referenced in the risk assessment attachment to the June 14, 1994 USPCI request for Class 3 modification regarding its Clive incineration facility) and information contained in the Environmental Impact Statement (USDI 1990), a list of constituents was identified that could be present in significant concentrations in the feed to the incinerator. These constituents are included in Table III-1 for assessing exposures via direct inhalation.

Other chemicals could potentially be present in stack emissions that may not be present in significant concentrations in the waste feed but could be produced in the combustion process. In order to identify these compounds, stack testing data from the nearby Aptus facility was reviewed. Attachment A-1 of Appendix A contains the Aptus results of stack testing of the Hazardous Substance List Compounds under three test conditions, each condition consisting of three runs conducted between

TABLE III-1 Estimated Emission Rates		
Chemical	Estimated Emission Rate (g/sec)	Basis
INDIRECT EXPOSURE[a]		
Antimony	2.14×10^{0}	b, c
Arsenic	5.65×10^{-3}	c
Barium	3.78×10^{0}	d
Benzo(a)pyrene Toxicity Equivalents	3.89×10^{-3}	e
Beryllium	2.97×10^{-4}	c
Bis(2-ethylhexyl)phthalate	1.07×10^{-4}	f
Cadmium	9.92×10^{-3}	c
Chromium (VI)	2.38×10^{-3}	c
Dinitrobenzene, 1,3-	3.89×10^{-3}	e
Dinitrotoluene, 2,4-	3.89×10^{-3}	e
Dinitrotoluene, 2,6-	3.89×10^{-3}	e
Di-n-octylphthalate	1.90×10^{-5}	f
Hexachlorobenzene	1.93×10^{-4}	f
Lead	6.43×10^{-1}	c
Mercury	5.72×10^{-1}	c
Nickel	$3.78 \times 10^{+1}$	b, c
Nitrobenzene	3.89×10^{-3}	e
PCBs, Total	4.70×10^{-4}	g
Pentachloronitrobenzene	3.89×10^{-3}	e
Pentachlorophenol	3.89×10^{-3}	e
Selenium	$2.86 \times 10^{+1}$	b, c
Silver	$2.14 \times 10^{+1}$	b, c
TCDD Toxicity Equivalents, 2,3,7,8-	3.05×10^{-7}	f
Thallium (I)	2.14×10^{-1}	d

TABLE III-1 Estimated Emission Rates		
Chemical	**Estimated Emission Rate (g/sec)**	**Basis**
DIRECT EXPOSURE		
Acetone	3.89×10^{-3}	e
Acrylamide	3.89×10^{-3}	e, h
Acrylonitrile	3.89×10^{-3}	e, h
Benzene	3.89×10^{-3}	e, h
Benzoic Acid	1.78×10^{-3}	f
Bromodichloromethane	2.03×10^{-4}	f
Bromoform	2.31×10^{-3}	f
Bromomethane	1.13×10^{-4}	f
Butyl Alcohol	3.89×10^{-3}	e
Butylbenzylphthalate	3.38×10^{-5}	f
Carbon Disulfide	3.89×10^{-3}	e
Carbon Tetrachloride	3.89×10^{-3}	e, i
Chlorobenzene	3.89×10^{-3}	e, i
Chloroform	2.34×10^{-3}	f
Chloromethane	1.10×10^{-3}	f
Creosote	3.89×10^{-3}	e
Cresols	3.89×10^{-3}	e
Cresylic Acid	3.89×10^{-3}	e
Cyclohexanone	3.89×10^{-3}	e
Dibromochloromethane	1.56×10^{-3}	f
Dichlorobenzene, 1,2-	4.95×10^{-5}	f
Dichlorobenzene, 1,3-	4.49×10^{-5}	f
Dichlorobenzene, 1,4-	3.87×10^{-5}	f
Dichloroethane, 1,1-	3.78×10^{-5}	f

TABLE III-1 Estimated Emission Rates		
Chemical	Estimated Emission Rate (g/sec)	Basis
Dichloroethane, 1,2-	1.93×10^{-4}	f
Dichloroethylene, 1,1-	1.29×10^{-4}	f
Dichloroethylene, 1,2-	8.24×10^{-4}	f
Dichlorophenol, 2,4-	4.56×10^{-5}	f
Dichloropropene, cis-1,3-	8.20×10^{-5}	f
Dichloropropene, trans-1,3-	6.69×10^{-5}	f
Dimethylphthalate	2.12×10^{-5}	f
Di-n-butylphthalate	5.76×10^{-5}	f
Ethoxyethanol, 2-	3.89×10^{-3}	e
Ethyl Acetate	3.89×10^{-3}	e
Ethyl Ether	3.89×10^{-3}	e
Ethylbenzene	3.89×10^{-3}	e
Hexachlorocyclopentadiene	2.73×10^{-4}	f
Isobutanol	3.89×10^{-3}	e
Methanol	3.89×10^{-3}	e
Methyl Ethyl Ketone	3.89×10^{-3}	e
Methylene Chloride	3.89×10^{-3}	e, i
Methylnaphthalene, 2-	3.34×10^{-5}	f
Napthalene	6.27×10^{-5}	f
Nitropropane, 2-	3.89×10^{-3}	e
Orthodichlorobenzene	3.89×10^{-3}	e
Phenol	3.82×10^{-5}	f
Pyridine	3.89×10^{-3}	e
Tetrachloroethylene	3.89×10^{-3}	e, i
Toluene	3.89×10^{-3}	e, i

TABLE III-1 Estimated Emission Rates		
Chemical	**Estimated Emission Rate (g/sec)**	**Basis**
Trichlorobenzene, 1,2,4-	1.02×10^{-4}	f
Trichloroethane, 1,1,1-	3.89×10^{-3}	e, i
Trichloroethane, 1,1,2-	3.89×10^{-3}	e
Trichloroethylene	3.89×10^{-3}	e
Trichlorofluoromethane	4.78×10^{-5}	f
Trichlorophenol, 2,4,6-	2.64×10^{-4}	f
Trichlorotrifluoroethane	3.89×10^{-3}	e
Trichlorotrifluoroethene	3.89×10^{-3}	e
Vinyl Chloride	4.41×10^{-4}	f
Xylene	3.89×10^{-3}	e

Notes (see text and Appendix A for further detail):

a All chemicals listed in USEPA (1994a) SLRA guidance.
b Calculated from allowable feed rate and assumed 0% SRE as follows:
feed rate (g/sec) = emission rate (g/sec)
c Permit limit.
d Calculated from allowable feed rate and assumed 90% SRE as follows:
feed rate (g/sec) x (1-SRE) = emission rate (g/sec)
e Calculated assuming compound comprises 1% of a 30,859 lb/hr organic waste stream (USPCI 1994) and 99.99% DRE as follows:
feed rate (g/sec) x fraction of waste stream that is compound of interest x (1-DRE) = emission rate (g/sec)
f Arithmetic average of Aptus trial burn data (Appendix A, Attachment A-1, A-2).
g Calculated from TSCA Approval Order of a 3,700 lb/hr PCB waste stream and 99.9999% DRE as follows:
feed rate (g/sec) x (1-DRE) = emission rate (g/sec)
h Chemical listed in Attachment 1 to USPCI's Request for Class 3 Modification (June 14, 1994).
i Chemical listed in both EIS (USDI 1990, page D-8) and Attachment 1 to USPCI's Request for Class 3 Modification (June 14, 1994).

March and May 1992. Additional compounds were identified from the testing results and included in Table III-1 for evaluating risks associated with direct exposures.

2. Development of Emission Rates

Because the Clive facility has not yet conducted a trial burn, emission rates for the facility had to be estimated from other sources. As mentioned above, a list of constituents is specified in the SLRA guidance (USEPA 1994a) for evaluating indirect pathways of exposure, which are included in Table III-1. These constituents were broadly classified into organic chemicals and metals and further divided based on the sources of information available for characterizing emissions.

Indirect exposure - organic emissions

The SLRA was conducted to evaluate the risks associated with operation of the incinerator at a DRE of 99.99% for RCRA hazardous wastes and 99.9999% for TSCA wastes, specifically PCBs. Furthermore, the TSCA Approval (June 14, 1994) includes a feed rate limit for PCBs of 3,700 lb/hr. Thus, although it is unlikely that the facility will continuously operate at the maximum permitted capacity and it is likely that the actual DRE for PCBs would exceed 99.9999%, to ensure compliance with the standard, it was conservatively assumed that the facility will operate at a maximum feed rate of 3,700 lb/hr and a DRE of 99.9999%. This would conservatively produce an emission rate for PCBs of 4.70×10^{-4} g/sec as presented in Table III-1.

The other organic compounds listed in Table III-1 are not expected to be present in significant concentrations in the feed to the incinerator, and as evident from the results of the Aptus stack testing, would not be present in significant concentrations in the stack gases. Only 4 of the other 11 organic chemicals being evaluated for indirect exposures were detected in the Aptus test results contained in Attachment A-1 of Appendix A. For estimating emission rates for these four chemicals, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, hexachlorobenzene and 2,3,7,8-TCDD equivalents, the available data from Aptus was used. Attachment A-2 of Appendix A contains the results of Aptus testing for dioxins and dioxin-like

compounds. Emission rates were estimated using the reported concentrations listed in the cited attachments and the volumetric flow rate of stack gases for the Clive incinerator (51,700 dscfm or 24.4 dscm/sec, UDEQ 1991) using the following equation:

$$\textit{stack concentration}\left(\frac{ng}{dscm}\right) \times \textit{stack flow rate}\left(\frac{dscm}{sec}\right) \times \frac{g}{10^9\ ng} = \textit{emission rate}\left(\frac{g}{sec}\right)$$

This equation is applied as follows, using hexachlorobenzene and 2,3,7,8-TCDD equivalents as examples:

	Hexachlorobenzene
Run No.	Stack concentration (ng/dscm)
11	3,540
12	not listed
13	not listed
4	5,400
5	11,070
6	11,660
7	not listed
8	not listed
9	not listed
avg of 4 runs	7,918

$$7{,}918\ \frac{ng}{dscm} \times 24.4\ \frac{dscm}{sec} \times \frac{g}{10^9\ ng} = 1.93 \times 10^{-4}\ \frac{g}{sec}$$

Run No.	2,3,7,8-TCDD equivalents Stack Concentration (ng/dscm)
11	20.69
12	17.46
13	8.71
4	10.28
5	19.08
6	15.93
7	9.22
8	6.08
9	5.07
avg of 9 runs	12.50

$$12.50 \frac{ng}{dscm} \times 24.4 \frac{dscm}{sec} \times \frac{g}{10^9\ ng} = 3.05 \times 10^{-7} \frac{g}{sec}$$

The concentration in stack gases was determined based on the arithmetic average for the nine Aptus runs reporting detectable levels. Runs in which the chemical was not detected were not included in the average, thereby overstating the actual emissions.

Where Aptus data for specific chemicals were not available (7 of the chemicals evaluated via the indirect exposure pathway), it was conservatively assumed that the chemical constitutes one percent of the estimated 30,859 lb/hr (3,888 g/sec) organic waste feed rate (USPCI 1994), to which a DRE of 99.99% was applied as shown in the following equation:

$$\textit{feed rate}\left(\frac{g}{sec}\right) \times \textit{fraction of chemical} \times (1\text{-}DRE) = \textit{emission rate}\left(\frac{g}{sec}\right)$$

This equation is applied as follows, using acetone as an example:

$$3{,}888 \frac{g}{sec} \times 0.01 \times (1-0.9999) = 3.89 \times 10^{-3} \frac{g}{sec}$$

It should be noted that application of this procedure for the 7 organic chemicals that were not detected in the Aptus test runs produces an emission rate of 3.89×10^{-3}, which is the highest emission rate in Table III-1. The assumption of these 7 chemicals being present in significant concentrations (1 percent) in the waste stream is extremely conservative.

Indirect exposure - metals

Permit limits (UDEQ 1991) have been established for six metals (arsenic, beryllium, cadmium, chromium, lead and mercury) which are listed in Table III-1. It was conservatively assumed that the facility will operate at the permit limits for these metals and all of the chromium emissions will be in the carcinogenic hexavalent form. Thus, these maximum permitted rates were used in Table III-1.

Emission rates for barium and thallium were estimated based on the procedures for determining default values for system removal efficiencies (SREs) described in *40 CFR Part 266, Appendix IX* (page 611). For a spray dryer and fabric filter combination, the conservatively estimated SRE is specified to be 90 percent for volatile metals. Barium and thallium typically enter the air pollution control system as fine, submicron particles for which a 90 percent SRE would be appropriate as a conservative estimate. Confirmation of this value will be conducted during the trial burn for the incinerator. Thus, emission rates for barium and thallium were developed based on an SRE of 90 percent and the maximum allowable feed rates of 300 and 17.01 lbs/hr, respectively, as listed in the trial burn plan (UDEQ 1991).

The emission rate of thallium was estimated as follows, for illustrative purposes:

$$feed\ rate\ \left(\frac{g}{sec}\right)\ x\ (1-SRE)\ =\ emission\ rate\ \left(\frac{g}{sec}\right)$$

$$2.14\ \frac{g}{sec}\ x\ (1-0.90)\ =\ 2.14\ x\ 10^{-1}\ \frac{g}{sec}$$

Finally, it was conservatively assumed that all the antimony, nickel, selenium and silver in the waste feed to the incinerator would be emitted from the stack. Thus, the emission rates for these metals in Table III-1 reflect the maximum allowable feed rates of 17.0, 300.0, 226.8, and 170.1 lb/hr, respectively (2.14, 37.8, 28.6, and 21.4 g/s, respectively) (UDEQ 1991).

Direct exposure

As mentioned previously, the list of chemicals that was evaluated for direct inhalation exposures was developed based on consideration of chemicals that were identified as being present in the waste feed in significant amounts (based on the EIS and USPCI's request for Class 3 modification, June 14, 1994), and those that were detected in stack emissions from the Aptus test runs. Emissions of constituents that may be present in the feed in significant concentrations, but were not identified in the Aptus testing, were calculated based on conservatively assuming each chemical constitutes 1 percent of the organic waste feed, and applying a 99.99% DRE to the chemical feed rate.

Emission rates for compounds identified from the Aptus testing were developed using the reported Aptus concentrations in Attachment A-1, Appendix A, and the Clive incinerator stack flow rate as described above. Table III-1 summarizes the estimated emission rates using the conservative methodologies described above. It should be noted that as part of the trial burn for the facility, an expanded list of organic compounds will be analyzed in stack gases as shown in Attachment A-3, Appendix A, which will provide site-specific data.

B. Air Dispersion Modeling and Deposition Calculations

Stack emissions from the facility's incinerator may disperse downwind, deposit in the area surrounding the facility and migrate in the environment to points of potential human exposure. Plants and livestock in the vicinity of the USPCI facility may also be exposed to stack emissions and provide a potential source of indirect exposure to humans near the facility. Air dispersion modeling of stack emissions was conducted to evaluate exposures in the vicinity of the facility.

1. COMPDEP Model

Atmospheric dispersion and transport of emissions from the Clive incinerator were evaluated using USEPA-approved dispersion modeling tools and approaches, as provided in the SLRA guidance (USEPA 1994a). The USEPA-recommended COMPDEP air dispersion model is used to predict impacts in flat and complex terrain (elevations above stack height). Local meteorological data (e.g., wind speeds, wind directions, stability category) from two years of observations (1991 and 1992) at the meteorological monitoring tower at the Clive facility were used in the modeling. Precipitation data from Dugway and Grantsville, Utah, were used as input data to the model. Terrain features were developed from USGS topographic maps of the region. Overall, the dispersion model input parameters, such as surface roughness, particle size distribution and dispersion characteristics were developed based on the SLRA guidance (USEPA 1994a). Details of the input data are provided in Appendix G.

2. Exposure Locations

The Clive facility is located within the designated West Desert Hazardous Industry Area, where no residences can be located. Accordingly, for purposes of the SLRA, locations of actual or theoretical residents were identified. The nearest actual receptors live in the vicinity of Iosepa in the Skull Valley approximately 25 miles from the facility. This location was modeled for the purposes of the SLRA. In addition, based on discussions with UDEQ, attempts were made to determine the closest theoretical resident to the Clive facility. The Tooele County Zoning

Ordinance, Chapter 18, prohibits dwelling units within 10 miles of a hazardous waste zone (see Appendix G, Attachment G-1). Therefore, a 10 mile radius was identified around the boundaries of the West Desert Hazardous Industry Area, and two theoretical receptors were identified for the quantitative assessment of risks. These theoretical receptors were located on the south boundary of the 10 mile buffer zone and on the north boundary of the buffer zone. The south location is the closest to the Clive facility, while the north receptor is in the direction of the prevailing winds. The nearest actual residence and both of the theoretical receptor locations were modeled in the SLRA; however, since the greatest exposure and risk was associated with the north boundary receptor location (Tables I-1, I-2, III-2), details of the assessment are only presented for this location. In addition, it should be noted that the south boundary location is within the Wendover Air Force Range (Appendix G, Attachment G-1).

The COMPDEP modeling results using the maximum prediction from the two individual years of meteorological data for the three receptor locations are summarized in Table III-2. These results were used to determine the risks and hazards to receptors at these locations. Since, as previously stated, the exposure and risk is greatest at the northern theoretical location, the chemical-specific air concentrations/deposition rates are presented for only that location in Appendix A, Table A-1. The average daily intake via inhalation of each chemical of concern is listed in Appendix C, Table C-14; Appendix D, Table D-7; and Appendix E, Table E-7.

C. Exposure Receptors

While four human receptors are identified in the SLRA guidance (USEPA 1994a), it has been determined by USPCI and UDEQ that, because of the location of the Clive facility, a subsistence fisher does not require evaluation in the SLRA. Therefore, the following three receptors were evaluated at all three locations: 1) a subsistence farmer; 2) an adult resident and 3) a child resident.

TABLE III-2
COMPDEP Modeling: Maximum Results for Discrete Receptors For Unit Emissions (1 g/s)

Receptor	Receptor Location (UTM meters)	Year	Annual Dry Deposition (g/m^2)	Annual Wet Deposition (g/m^2)	Annual Combined Deposition (g/m^2)	Annual Average Concentration ($\mu g/m^3$)
Nearest Residence	358380 E 4503600 N	1991	1.00×10^{-4}	6.55×10^{-6}	1.07×10^{-4}	2.38×10^{-3}
North Edge of Buffer Zone	318438 E 4540714 N	1992	3.61×10^{-4}	1.05×10^{-5}	3.72×10^{-4}	6.30×10^{-3}
South Edge of Buffer Zone	318438 E 4489238 N	1991	3.35×10^{-4}	1.49×10^{-5}	3.50×10^{-4}	6.00×10^{-3}

USEPA guidance (USEPA 1994a) specifies the particular exposure scenarios that should be evaluated and provides default values for most input parameters (see Appendix B, Table B-1). In addition, the guidance also allows the flexibility to use available site-specific information to modify certain assumptions. For example, site-specific land use information may be used to determine that certain assumptions regarding the exposure scenarios are implausible (e.g., that exposure occurs at the points of maximum air concentration and maximum deposition) and to make alternative assumptions (e.g., to identify locations at which the exposure scenarios used for the screening analysis are plausible).

1. Subsistence Farmer

Exposures of a subsistence farmer were evaluated by considering exposure pathways for consumption of beef, consumption of cow's milk, consumption of aboveground vegetables, consumption of root vegetables, incidental ingestion of soil and inhalation of airborne contaminants. The exposure assumptions adopted for the subsistence farmer receptor are listed in Table III-3. The exposure parameter values in Table III-3 are conservative default values specified in the SLRA guidance (USEPA 1994a). Site-specific parameter values include average annual precipitation (P), irrigation (I), surface runoff (R), and evapotranspiration (EV). Long-term data for these parameters in the Clive incinerator area are reported to be P (average precipitation for 1991 and 1992) is 19 cm/yr, I is 70 cm/yr (Baes et al. 1984), R is less than 3 cm/yr (Geraghty et al. 1973) and EV is less than 60 cm/yr (Geraghty et al. 1973).

2. Adult Resident

Exposures of the adult resident were evaluated by considering exposure pathways for consumption of aboveground vegetables, consumption of root vegetables, incidental ingestion of soil and inhalation of airborne contaminants. Exposure assumptions adopted for the adult resident receptor are listed in Table III-3 based on the SLRA guidance (USEPA 1994a).

TABLE III-3
Exposure Parameter Values

Exposure Parameter			Exposure Scenario		
			Subsistence Farmer	Adult Resident	Child Resident
CR_{soil}	=	Consumption rate of soil (kg/day)	0.0001	0.0001	0.0002
F_{soil}	=	Fraction of consumed soil contaminated (unitless)	1	1	1
CR_{ag}	=	Consumption rate of above ground vegetables (kg/day)	0.024	0.024	0.005
F_{ag}	=	Fraction of above ground vegetables contaminated (unitless)	0.95	0.25	0.25
CR_{bg}	=	Consumption rate of root vegetables (kg/day)	0.0063	0.0063	0.0014
F_{bg}	=	Fraction of root vegetables contaminated (unitless)	0.95	0.25	0.25
CR_{beef}	=	Consumption rate of beef (kg/day)	0.1	NA	NA
F_{beef}	=	Fraction of beef contaminated (unitless)	0.44	NA	NA
CR_{milk}	=	Consumption rate of milk (kg/day)	0.3	NA	NA
F_{milk}	=	Fraction of milk contaminated (unitless)	0.40	NA	NA
ED	=	Exposure duration (yr)	40	30	6
EF	=	Exposure frequency (day/yr)	350	350	350
BW	=	Body weight (kg)	70	70	15
AT	=	Averaging time (yr)	70	70	70
AT	=	Averaging time (day)	25,550	25,550	25,550
IR	=	Inhalation rate (m^3/hour)	1	1	0.2
ET	=	Exposure time (hour/day)	24	24	24
Tc	=	Total time period over which deposition occurs (yr)	30	30	30
P	=	Average annual precipitation (cm/yr)*	19	19	19
I	=	Average annual irrigation (cm/yr)	70	70	70
R	=	Average annual surface runoff (cm/yr)	3	3	3
EV	=	Average annual evapotranspiration (cm/yr)	60	60	60

Notes:

* Average annual precipitation was calculated using 1991 and 1992 data.

Source

U.S. Environmental Protection Agency (USEPA). 1994. *Guidance for performing screening level risk analyses at combustion facilities burning hazardous wastes. Draft.* Office of Emergency and Remedial Response. Washington, D.C. April 15.

3. Child Resident

Exposures of the child resident were evaluated by considering exposure pathways for consumption of aboveground vegetables, consumption of root vegetables, incidental ingestion of soil and inhalation of airborne contaminants. Exposure assumptions adopted for the child resident receptor are listed in Table III-3 based on the SLRA guidance (USEPA 1994a).

D. Estimation of Media Concentrations and Chemical Intakes via Different Exposure Routes

The USEPA equations used to estimate concentrations in environmental media based on the air dispersion and deposition modeling are summarized in Appendix B. Appendix B also contains chemical-specific parameter values used in the fate and transport equations. USEPA (1994a) provides specific guidance on the equations and conservative default values for the input parameters that were incorporated in this analysis. Appendix C contains the equations used to estimate chemical concentrations in milk and meat that are consumed by the subsistence farmer. Accumulation of chemicals in milk and meat was assumed to occur as a result of partitioning of chemicals released from the incinerator stack into media such as forage and soil consumed by dairy cows and cattle.

Appendices C, D and E provide the equations used to calculate the exposure dose for the subsistence farmer, adult resident and child resident, respectively. These equations are also specified in the SLRA guidance (USEPA 1994a) and combine the media concentrations in Appendix B with behavioral characteristics, such as ingestion rates of individuals and duration of exposure, to estimate exposures via different routes of exposure.

The potential routes of exposure evaluated in this SLRA are discussed in further detail in this section. Inhalation of incinerator stack gases and particulates is the only direct route of exposure. Other routes, including ingestion of beef and vegetables, ingestion of soil, and dermal contact with soil are indirect exposure routes.

1. **Soil Exposure Routes**

Incidental ingestion of soil: This pathway incorporated consumption of 100 mg/day of soil for the adult receptors and 200 mg/day for the child (see Appendix C, Table C-5; Appendix D, Table D-1; and Appendix E, Table E-1). The concentration of chemicals in soil was developed from the deposition (combined wet and dry) at the location of the receptors (see Appendix B, Table B-2). Consistent with the conservative SLRA guidance (USEPA 1994a and errata), the soil mixing depth within which deposited chemicals would be mixed was assumed to be 1 cm when estimating concentrations in milk, beef and aboveground vegetation and 20 cm for root vegetables. The soil bulk density was 1.5 g/cm^3. The estimated concentration of each chemical of concern in soil is listed in Appendix B, Tables B-9, B-10 and B-11 for the subsistence farmer, adult resident and child resident, respectively.

2. **Terrestrial Food Chain Exposure Routes**

Consumption of beef: This pathway included the subsistence farmer's consumption of 100 g/day of beef with 44% being obtained from the affected area as specified by USEPA (1994a; see Appendix C, Table C-8). The concentration of the constituents in beef was determined by incorporating the consumption of plants impacted by the facility and consumption of soil, along with the chemical-specific biotransfer factor for beef (see Appendix C, Table C-3). The concentration of the chemical in plants incorporates both direct deposition (wet and dry) onto plants and air-to-plant transfer from the vapor phase (see Appendix C, Tables C-1 and C-2). The estimated concentration of each chemical of concern in beef is listed in Appendix C, Table C-12 for the subsistence farmer receptor.

Consumption of cow's milk: This pathway included the subsistence farmer's consumption of 300 g/day of milk with 40% coming from the affected area as specified by USEPA (1994a; see Appendix C, Table C-9). The milk concentration incorporated the consumption of both soil and plants by the cow and the chemical-specific biotransfer factor for milk (see Appendix C, Table C-4). The plant and soil levels were calculated as they were for the beef ingestion. The estimated

concentration of each chemical of concern in milk is listed in Appendix C, Table C-12 for the subsistence farmer receptor.

Consumption of aboveground vegetables: This pathway was based on consumption of 24 g/day of aboveground vegetables for the adult and 5 g/day of aboveground vegetables for the child as specified by USEPA (1994a; see Appendix C, Table C-6; Appendix D, Table D-2; and Appendix E, Table E-2). In addition, for the subsistence farmer it was assumed that 95% of the vegetables are grown in the affected area, while for the adult and child resident it was assumed that 25% of the vegetables are home grown. The concentration of chemicals in the aboveground plant was a combination of direct deposition (both wet and dry) and air-to-plant transfer, which incorporated the chemical-specific air-to-plant biotransfer factor (see Appendix B, Tables B-6 and B-7). The estimated concentration of each chemical of concern in aboveground vegetables is listed in Appendix B, Tables B-9, B-10 and B-11 for each receptor.

Consumption of root vegetables: This pathway was based on consumption of 6.3 g/day of root vegetables by the adults and 1.4 g/day by the child as specified by USEPA (1994a; see Appendix C, Table C-7; Appendix D, Table D-3; and Appendix E, Table E-3). In addition, it was assumed that 95% of the vegetables are home grown by the subsistence farmer and 25% for the adult and child resident. The concentration of chemicals in root vegetables was calculated by taking into account the predicted soil concentration with a mixing depth of 20 cm, chemical specific soil-water partition coefficient and the uptake of the chemicals from the soil pore water (see Appendix B, Table B-8). The estimated concentration of each chemical of concern in root vegetables is listed in Appendix B, Tables B-9, B-10 and B-11 for each receptor.

3. Air Exposure Route

Direct inhalation: This pathway assumed the inhalation of 20 m^3/day for adults and 5 m^3/day for the child receptor as specified by USEPA (1994a; see Appendix C, Table C-11; Appendix D, Table D-5; and Appendix E, Table E-5). The concentration of chemicals was based on the predicted annual ambient air

concentrations listed in Table III-3 (see Appendix A, Table A-1 for chemical-specific values).

IV. RISK CHARACTERIZATION

A. Estimation of Carcinogenic Risk and Noncarcinogenic Health Effects

In the final phase of the SLRA, the estimated intakes (as calculated using the formulas presented in Appendices C, D and E) and toxicity values (from Appendix B, Table B-1) are combined to calculate potential human health risks. Point estimates of carcinogenic risk (expressed as the probability of excess lifetime cases of cancer for an exposed individual) and the potential for noncarcinogenic health effects (expressed as hazard indices) are thereby developed.

To estimate potential cancer risks, the estimated intakes are multiplied by cancer slope factors (CSFs), representing the "plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime" (USEPA 1989).

The equation used to calculate carcinogenic risk for indirect exposures is as follows (USEPA 1994a - page C-6-9):

$$Risk = I \times \frac{ED \times EF}{BW \times AT \times 365} \times CSF$$

where:

Risk	=	Carcinogenic risk, (e.g., 1×10^{-6} is one excess cancer in one million persons exposed), (unitless);
I	=	Total daily intake of contaminant, (mg/day);
ED	=	Exposure duration, (years);
EF	=	Exposure frequency, (days/year);
BW	=	Body weight, (kg);
AT	=	Averaging time (years);
365	=	Units conversion factor, (days/year); and
CSF	=	Oral cancer slope factor, $(mg/kg\text{-}day)^{-1}$

The equation used to calculate carcinogenic risk for direct exposures is as follows (USEPA 1994a - page C-6-43):

$$Risk_{inh} = ADI_{inh} \times CSF_{inh}$$

where:

$Risk_{inh}$ = Carcinogenic risk via inhalation, (unitless);
ADI_{inh} = Average daily intake via inhalation, (mg/kg-day); and
CSF = Inhalation carcinogenic slope factor, $(mg/kg\text{-}day)^{-1}$

Current scientific knowledge is insufficient to determine whether the presence of more than one chemical would result in effects that are synergistic (greater than the summed risks from the individual chemicals) or antagonistic (less than the summed individual chemical risks). Given this uncertainty, USEPA guidance calls for the assumption of additivity of cancer risks in evaluating total risks from multiple chemical exposures (USEPA 1989).

To estimate the potential for noncarcinogenic health effects, chemical-specific intakes are compared to USEPA-derived reference values resulting in a hazard quotient (HQ). The reference value is "an estimate of daily exposures to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during the lifetime" (USEPA 1989).

The equation used to estimate the potential for noncarcinogenic health effects due to indirect exposure is as follows (USEPA 1994a - page C-6-10):

$$HQ = \frac{I}{BW \times RfD}$$

where:

HQ = Hazard quotient, (unitless);
I = Total daily intake of contaminant, (mg/day);
BW = Body weight, (kg); and
RfD = Reference dose (mg/kg-day).

The equation used to calculate noncarcinogenic risk as a result of a direct exposure is as follows (USEPA 1994a - page C-6-44):

$$HQ_{inh} = \frac{C_{(air)}}{RfC} \times 10^{-3}$$

where:

HQ_{inh} = Hazard quotient via inhalation, (unitless);

$C_{(air)}$ = Concentration in air, ($\mu g/m^3$);

RfC = Reference concentration, (mg/m^3); and

10^{-3} = Units conversion factor, ($mg/\mu g$).

An HQ is calculated for each chemical in each exposure route. The HQs for all chemicals affecting the same target organ are summed to derive a route-specific hazard index (HI). An HI that is less than 1 indicates that no reference values have been exceeded, and that it is unlikely that even sensitive sub-populations will experience adverse effects. If an HI exceeds 1, it is often necessary to perform a more detailed evaluation of potential exposure and mechanisms of toxicity. Since chemical exposure may occur from background sources, USEPA guidance (1994a) requires that 75% of the HI be allocated to background exposures, so that impacts from the facility cannot account for more than 25% of the HI.

The equations used to calculate the average daily intake for all indirect exposures and the average daily intake via inhalation (direct exposure) are presented in Appendix C for the subsistence farmer, Appendix D for the adult resident and Appendix E for the child resident. These average daily intakes were used to calculate the excess lifetime cancer risk and hazard quotient for each chemical constituent assumed to be present in stack emissions. The equations used to calculate cancer risks and hazard quotients are presented in Appendix F.

The SLRA guidance (USEPA 1994a) provides the procedure for calculating overall cancer risk and hazard indices for each receptor. Carcinogenic risks for indirect exposures were calculated separate from those for direct exposure for each receptor.

Addition of these subtotals yielded the overall excess lifetime cancer risk for each receptor from exposure to emissions from the facility. Hazard quotients for chemicals that affect the same target organ were added together to obtain a hazard index for the target organ.

Indirect Exposures

The SLRA guidance (USEPA 1994a) lists bis(2-ethylhexyl)phthalate, di(n)octylphthalate, hexachlorobenzene, pentachloronitrobenzene, and pentachlorophenol as hepatotoxins. Antimony, barium, cadmium, chromium VI, nickel and selenium are also reported to adversely effect the liver (ATSDR 1989). Therefore, in the indirect exposure scenarios, a hazard index for liver effects was calculated by addition of the individual hazard quotients calculated for bis(2-ethylhexyl)phthalate, di(n)octylphthalate, hexachlorobenzene, pentachloronitrobenzene, pentachlorophenol, antimony, barium, cadmium, chromium VI, nickel and selenium.

The SLRA guidance (USEPA 1994a) lists 2,4-dinitrotoluene, 2,6-dinitrotoluene and mercury as neurotoxicants. Antimony, barium, cadmium, chromium VI, nickel, selenium and silver are also reported to have adverse neurological affects. Therefore, the hazard index for neurotoxic effects was calculated by addition of the hazard quotients calculated for 2,4-dinitrotoluene, 2,6-dinitrotoluene, mercury, antimony, barium, cadmium, chromium VI, nickel, selenium and silver.

Direct Exposures

The liver is the target organ affected by exposure to 1,2,4-trichlorobenzene (USEPA 1994d) and 1,4-dichlorobenzene (USEPA 1995). Acrylonitrile, barium, chlorobenzene, methylene chloride, nitrobenzene, 2-nitropropane, toluene and 1,1,1-trichloroethane are reported to adversely affect the liver as well (ATSDR 1989). Therefore, in the direct exposure scenarios, a hazard index for liver effects was calculated by addition of individual hazard quotients calculated for 1,2,4-trichlorobenzene, 1,4-dichlorobenzene, acrylonitrile, barium, chlorobenzene, methylene chloride, nitrobenzene, 2-nitropropane, toluene and 1,1,1-trichloroethane. Acrylonitrile, ethylbenzene, barium, mercury, toluene and 1,1,1-trichloroethane are reported to have adverse neurological effects (ATSDR

1989). Thus a hazard index for neurotoxic effects was calculated by addition of the hazard quotients calculated for acrylonitrile, ethylbenzene, barium, mercury, toluene and 1,1,1-trichloroethane. In addition, the hazard quotients for each of the chemicals in the direct pathway were summed to calculate a total hazard index for the direct pathway. As this value was calculated to be less than 0.25, no further organ-specific toxicities were evaluated.

B. Results and Conclusions

The implementation guidance (USEPA 1994b) addresses acceptable target risk levels. To this end the guidance states that:

> "To ensure protection of human health from emissions of toxic constituents, the total incremental risk from the high-end individual exposure to carcinogenic constituents should not exceed 10^{-5}. For systemic toxicants, the hazard quotient (e.g., the ratio of the total daily oral intake to the reference dose) for the constituent or, when appropriate, the mixture should be less than 0.25. In the case of lead, for which there is no reference dose, direct comparison with media-specific health based levels is suggested, after adjusting for background levels; specifically, values of 100 mg/kg for soils and 0.2 $\mu g/m^3$ for air are recommended."

Table VI-1 summarizes the hypothetical excess lifetime cancer risks to the receptors through indirect and direct exposure to emissions from the facility. The total (sum of indirect and direct exposures) excess lifetime cancer risks are 3×10^{-6}, 4×10^{-7} and 1×10^{-7} for the subsistence farmer, adult resident and child resident, respectively. None of these calculated risks exceeds the benchmark of 1×10^{-5} established by the USEPA, indicating that excess lifetime cancer risk due to exposure to emissions from the Clive incinerator would not be expected.

Table VI-2 summarizes the hypothetical noncarcinogenic risks to the receptors through indirect and direct exposure to emissions from the facility. Noncarcinogenic effects measured via hepatotoxicity due to indirect exposure to emissions were 0.049,

TABLE VI-1 Excess Lifetime Cancer Risks to Hypothetical Receptors at the North Edge of the Buffer Zone Boundary			
	Subsistence Farmer	**Resident Adult**	**Resident Child**
Indirect Exposure	2×10^{-6}	7×10^{-8}	5×10^{-8}
Direct Exposure	4×10^{-7}	3×10^{-7}	6×10^{-8}
Total	3×10^{-6}	4×10^{-7}	1×10^{-7}

TABLE VI-2 Hazard Indices at the North Edge of the Buffer Zone Boundary			
	Subsistence Farmer	**Resident Adult**	**Resident Child**
Indirect Exposure			
Liver	0.049	0.00092	0.0042
Neurotoxic	0.15	0.0016	0.0091
Direct Exposure			
Liver	0.048	0.048	0.048
Neurotoxic	0.060	0.060	0.060
Total*	0.060	0.060	0.060

Note:

* Total is the sum of all HQs for the individual constituents for direct exposure.

0.00092 and 0.0042 for the subsistence farmer, adult resident and child resident, respectively. Neurotoxicity due to indirect exposure to emissions was calculated to be 0.15, 0.0016 and 0.0091 for the subsistence farmer, adult resident and child resident, respectively. For the direct exposure calculations, noncarcinogenic hepatoxicity was calculated to be 0.048 and neurotoxicity was calculated to be 0.060 for each receptor at a given location. The hazard index calculated for each toxic endpoint would be expected to be identical across receptors, as no receptor-specific variables are used in the calculation of these values.

The USEPA (1994b) has established a benchmark for hazard indices of 0.25, a level which is designed to be adequately protective of human health considering noncancer effects. Addition of the direct exposure hazard quotient for each chemical yields a hazard index of 0.060, a factor of 4 below the 0.25 level. Thus, the potential for noncancer health effects is below the level of regulatory concern.

The modeled concentration of lead in the soil was calculated to be 0.3 mg/kg. This value is well below the USEPA benchmark of 100 mg/kg. In addition, the modeled concentration of lead in air was calculated to be 0.004 $\mu g/m^3$. Again, this value is well below the USEPA benchmark of 0.2 $\mu g/m^3$. These calculations indicate that no adverse effects due to lead released in the emission would be expected.

C. Uncertainty

Prevailing winds will disperse the emitted stack gas constituents in the environment, effectively diluting the concentrations existing at the point of release. It is possible that individuals may be exposed to these emissions. The magnitude and extent of their exposure, however, will depend on the locations of these individuals in relation to the dispersed plume from the incinerator stack. In addition, the COMPDEP modeling results for the discrete receptors described in Appendix G, Table G-4 were calculated using meteorological data from two different years. The higher of the two sets of predictions was then used to estimate risks in this assessment. Since the exposure duration is 6-40 years, it would be more scientifically valid to use the average of these COMPDEP results to calculate the risk. Doing this would decrease the overall calculated risk estimates by approximately one-third.

To estimate emission rates for organic constituents that were expected to be major constituents in the waste feed, it was conservatively assumed that each organic constituent comprised 1% of the waste stream. In general, estimated emission rates were at least one order of magnitude greater for those constituents assumed to be 1% of the waste feed, than the trial burn data from the Aptus incinerator. Exposure to benzo(a)pyrene toxicity equivalents contribute to the majority of the indirect cancer risk at this facility. Benzo(a)pyrene toxicity equivalents is one of the constituents assumed to be 1% of the waste stream. The assumption that a number of the constituents represented 1% of the waste stream was intentionally conservative, thus resulting in a potential overestimation of the risks attributable to these constituents. Emission estimates for the twelve metals and PCBs were based on permit limits or maximum allowable waste feeds for the Clive facility and conservatively estimated SRE/DRE for these compounds.

The risk assessment methodology evaluates potential exposure to a hypothetical adult located continuously for 30-40 years at the selected receptor location points from modeling of contaminants emitted from the incinerator stack. The exposed individual is assumed to be restricted to this point of maximum exposure for 30-40 years, and is further assumed to be exposed irrespective of the operational status of the facility. Given the overly conservative nature of these assumptions, any actual risks will be significantly lower than those estimated in this assessment.

The volumetric soil water content (θ_s) has been assumed to be 20%. Due to the sandy nature of the soil and low rate of precipitation in the vicinity of the site, this assumption is very conservative. Site-specific data indicate that the soil would not be expected to support water retention to this extent.

The primary sources of uncertainty in the risk characterization are associated with the dose-response evaluation (toxicity assessment of chemicals of concern). It is well known that there is significant uncertainty associated with current assessments of the toxicity of various chemicals. Sources of uncertainty in current toxicity assessments for various chemicals may include a paucity of toxicological data, a need to extrapolate from animals to humans, a need to extrapolate from high to low doses and a lack of knowledge regarding potential interactions among various chemicals. The regulatory

approach to dealing with these sources of uncertainty is to apply conservative extrapolation methods or safety factors in deriving dose-response parameters (e.g., slope factors and reference doses).

USEPA has proposed a lower cancer slope factor for dioxins than the cancer slope factor which was used in this risk assessment. Applying the proposed lower cancer slope factor would reduce the cancer risks due to exposure to dioxins by a factor of approximately one-third (USEPA 1994c).

These results demonstrate that all USEPA-established criteria are met and, therefore, no acceptable carcinogenic or noncarcinogenic health risks are expected to result from exposure to stack gas constituents emitted from the USPCI Clive facility. As discussed above, several sources or uncertainty exist in the SLRA and conservative methodologies designed to overstate actual risks were incorporated in the assessment, therefore, the risk estimates presented in this SLRA likely overstate any actual risks posed by this facility.

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APPENDIX A

Emission Rates and Ambient Impacts for the Location at the North Edge of the Buffer Zone Boundary

TABLE A-1
Emission Rates and Ambient Impacts for the North Boundary Location[a]
Indirect Exposure

Chemical	Emission Rate[b] (g/sec)	Annual[c] Dry Deposition Rate (Dyd) (g/m^2-yr)	Annual[c] Wet Deposition Rate (Dyw) (g/m^2-yr)	Annual[c] Ambient Air Concentration (Cy) ($\mu g/m^3$)
Antimony	2.14e+00	7.73e-04	2.24e-05	1.35e-02
Arsenic	5.65e-03	2.04e-06	5.92e-08	3.56e-05
Barium	3.78e+00	1.37e-03	3.96e-05	2.38e-02
Beryllium	2.97e-04	1.07e-07	3.11e-09	1.87e-06
Benzo(a)pyrene Toxicity Equivalents	3.89e-03	1.41e-06	4.07e-08	2.45e-05
Bis(2-ethylhexyl)phthalate	1.07e-04	3.87e-08	1.12e-09	6.74e-07
Cadmium	9.92e-03	3.59e-06	1.04e-07	6.25e-05
Chromium (VI)	2.38e-03	8.60e-07	2.49e-08	1.50e-05
Dinitrobenzene, 1,3-	3.89e-03	1.41e-06	4.07e-08	2.45e-05
Dinitrotoluene, 2,4-	3.89e-03	1.41e-06	4.07e-08	2.45e-05
Dinitrotoluene, 2,6-	3.89e-03	1.41e-06	4.07e-08	2.45e-05
Di(n)octylphthalate	1.90e-05	6.87e-09	1.99e-10	1.20e-07
Hexachlorobenzene	1.93e-04	6.98e-08	2.02e-09	1.22e-06
Mercury	5.72e-01	2.07e-04	5.99e-06	3.60e-03
Nickel	3.78e+01	1.37e-03	3.96e-05	2.38e-02
Nitrobenzene	3.89e-03	1.41e-06	4.07e-08	2.45e-05
PCBs, Total	4.70e-04	1.70e-07	4.92e-09	2.96e-06
Pentachloronitrobenzene	3.89e-03	1.41e-06	4.07e-08	2.45e-05
Pentachlorophenol	3.89e-03	1.41e-06	4.07e-08	2.45e-05
Selenium	2.86e+01	1.03e-02	2.99e-04	1.80e-01
Silver	2.14e+01	7.73e-03	2.24e-04	1.35e-01
TCDDioxin Toxicity Equivalents, 2,3,7,8-	3.05e-07	1.10e-10	3.19e-12	1.92e-09
Thallium (I)	2.14e-01	7.73e-05	2.24e-06	1.35e-03
Lead	6.43e-01	2.32e-04	6.73e-06	4.05e-03

Notes:

(a) The unitized dry deposition rate, wet deposition rate and ambient air concentration are 3.61e-04, 1.05e-05 and 6.30e-03, respectively.
(b) Basis for each emission rate is provided in Table III-1.
(c) Annual rates and concentrations modeled from 1992 meteorological data as presented in Appendix G, Table G-4.

TABLE A-2
Emission Rates and Ambient Impacts for the North Boundary Location[a]
Direct Exposure

Chemical	Emission Rate[b] (g/sec)	Annual[c] Ambient Air Concentration (Cy) ($\mu g/m^3$)
Acetone	3.89e-03	2.45e-05
Acrylamide	3.89e-03	2.45e-05
Acrylonitrile	3.89e-03	2.45e-05
Benzene	3.89e-03	2.45e-05
Benzoic Acid	1.78e-03	1.12e-05
Bromodichloromethane	2.03e-04	1.28e-06
Bromoform	2.31e-03	1.45e-05
Bromomethane	1.13e-04	7.12e-07
Butyl Alcohol	3.89e-03	2.45e-05
Butylbenzylphthalate	3.38e-05	2.13e-07
Carbon Disulfide	3.89e-03	2.45e-05
Carbon Tetrachloride	3.89e-03	2.45e-05
Chlorobenzene	3.89e-03	2.45e-05
Chloroform	2.34e-03	1.47e-05
Chloromethane	1.10e-03	6.93e-06
Creosote	3.89e-03	2.45e-05
Cresols	3.89e-03	2.45e-05
Cresylic Acid	3.89e-03	2.45e-05
Cyclohexanone	3.89e-03	2.45e-05
Dibromochloromethane	1.56e-03	9.82e-06
Dichlorobenzene, 1,2-	4.95e-05	3.12e-07
Dichlorobenzene, 1,3-	4.49e-05	2.83e-07
Dichlorobenzene, 1,4-	3.87e-05	2.44e-07
Dichloroethane, 1,1-	3.78e-05	2.38e-07
Dichloroethane, 1,2-	1.93e-04	1.22e-06
Dichloroethylene, 1,1-	1.29e-04	8.12e-07
Dichloroethylene, 1,2-	8.24e-04	5.19e-06
Dichlorophenol, 2,4-	4.56e-05	2.87e-07
Dichloropropene, cis-1,3-	8.20e-05	5.16e-07
Dichloropropene, trans-1,3-	6.69e-05	4.21e-07
Dimethylphthalate	2.12e-05	1.33e-07
Di-n-butylphthalate	5.76e-05	3.63e-07
Ethoxyethanol, 2-	3.89e-03	2.45e-05
Ethyl Acetate	3.89e-03	2.45e-05
Ethyl Benzene	3.89e-03	2.45e-05
Ethyl Ether	3.89e-03	2.45e-05
Hexachlorocyclopentadiene	2.73e-04	1.72e-06
Isobutanol	3.89e-03	2.45e-05
Methanol	3.89e-03	2.45e-05
Methyl ethyl ketone	3.89e-03	2.45e-05
Methylene chloride	3.89e-03	2.45e-05
Methylnaphthalene, 2-	3.34e-05	2.10e-07

TABLE A-2
Emission Rates and Ambient Impacts for the North Boundary Location[a]
Direct Exposure

Chemical	Emission Rate[b] (g/sec)	Annual[c] Ambient Air Concentration (Cy) ($\mu g/m^3$)
Naphthalene	6.27e-05	3.95e-07
Nitropropane, 2-	3.89e-03	2.45e-05
Orthodichlorobenzene	3.89e-03	2.45e-05
Phenol	3.82e-05	2.41e-07
Pyridine	3.89e-03	2.45e-05
Tetrachloroethylene	3.89e-03	2.45e-05
Toluene	3.89e-03	2.45e-05
Trichlorobenzene, 1,2,4-	1.02e-04	6.42e-07
Trichloroethane, 1,1,1-	3.89e-03	2.45e-05
Trichloroethane, 1,1,2-	3.89e-03	2.45e-05
Trichloroethylene	3.89e-03	2.45e-05
Trichlorofluoromethane	4.78e-05	3.01e-07
Trichlorophenol, 2,4,6-	2.64e-04	1.66e-06
Trichlorotrifluoranthene	3.89e-03	2.45e-05
Trichlorotrifluoroethane	3.89e-03	2.45e-05
Vinyl Chloride	4.41e-04	2.78e-06
Xylene	3.89e-03	2.45e-05

Notes:

(a) The unitized ambient air concentration is 6.30e-03.
(b) Basis for each emission rate is provided in Table III-1.
(c) Annual rates and concentrations modeled from 1992 meteorological data as presented in Appendix G, Table G-4.

Attachment A-1

Stack Testing of the Hazardous Substance List Compounds at the Aptus Facility

Table 4–82
Hazardous Substance List
Volatile Organics

Run No. 11 — Volume of Gas Collected: 50.35 (DSL)

Name	Total Amount Detected (ng)	Stack Concentration (ng/m3)	Emission rate (lb/hr)
Benzene	570	11,321	0.0014
Bromodichloromethane	1300	25,820	0.0033
Bromoform	9470	188,086	0.0244
Bromomethane	380	7,547	0.0009
Chloroform	7355	146,080	0.0189
Chloromethane	1460	28,997	0.0037
Dibromochloromethane	3210	63,755	0.0082
1,1–Dichloroethane	78	1,549	0.0002
1,2–Dichloroethane	283	5,621	0.0007
cis–1,3–Dichloropropene	206	4,091	0.0005
1,1–Dichloroethylene	504	10,010	0.0012
trans–1,3–Dichloropropene	177	3,515	0.0004
Methylene chloride	2450	48,660	0.0063
Tetrachloroethylene	850	16,882	0.0021
Toluene	110	2,185	0.0002
Carbon Tetrachloride	13640	270,908	0.0351
Trichloroethylene	500	9,931	0.0012
Vinyl chloride	1110	22,046	0.0028

Table 4–83
Hazardous Substance List
Volatile Organics

Run No. 12 Volume of Gas Collecte 51.72 (DSL)

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission rate (lb/hr)
Benzene	660	12,760	0.0015
Bromodichloromethane	310	5,993	0.0007
Chloroform	7478	144,578	0.0176
Chloromethane	1850	35,768	0.0043
1,2–Dichloroethane	126	2,436	0.0002
cis–1,3–Dichloropropene	179	3,461	0.0004
1,1–Dichloroethylene	88	1,701	0.0002
trans–1,3–Dichloropropene	149	2,881	0.0003
Methylene chloride	2230	43,114	0.0052
Tetrachloroethylene	870	16,820	0.0020
Toluene	111	2,146	0.0002
Carbon Tetrachloride	8870	171,491	0.0209
Trichloroethylene	560	10,827	0.0013
Vinyl chloride	820	15,854	0.0019

Table 4-84
Hazardous Substance List
Volatile Organics

Run No. 13 Volume of Gas Collected: 50.34 (DSL)

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission rate (lb/hr)
Benzene	370	7,351	0.0008
Bromodichloromethane	201	3,993	0.0004
Chloroform	4826	95,876	0.0113
Chloromethane	910	18,079	0.0021
1,2-Dichloroethane	370	7,351	0.0008
cis-1,3-Dichloropropene	95	1,887	0.0002
1,2-Dichloroethylene	1700	33,773	0.0040
trans-1,3-Dichloropropene	64	1,271	0.0001
Methylene chloride	2060	40,925	0.0048
Tetrachloroethylene	390	7,748	0.0009
Toluene	101	2,007	0.0002
Carbon Tetrachloride	5000	99,333	0.0118
Trichloroethylene	292	5,801	0.0006
Vinyl chloride	490	9,735	0.0011

Table 4–85
Hazardous Substance List
Volatile Organics

Run No. 4 — Volume of Gas Collected: 53.29 (DSL)

Name	Total Amount Detected (ng)	Stack Concentration ng	Emission rate (lb/hr)
Benzene	324	6,080	0.0007
Bromodichloromethane	184	3,453	0.0004
Chloroform	3500	65,676	0.0084
Chloromethane	1380	25,895	0.0033
cis–1,3–Dichloropropene	247	4,635	0.0005
1,1–Dichloroethylene	130	2,439	0.0003
trans–1,3–Dichloropropene	215	4,034	0.0005
Methylene chloride	2580	48,412	0.0062
Tetrachloroethylene	960	18,014	0.0023
Toluene	245	4,597	0.0005
Carbon Tetrachloride	4350	81,626	0.0105
Trichloroethylene	370	6,943	0.0008
Vinyl chloride	630	11,822	0.0015

Table 4-86
Hazardous Substance List
Volatile Organics

Run No. 5 — Volume of Gas Collected: 52.64 (DSL)

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission rate (lb/hr)
Benzene	270	5,129	0.0006
Bromodichloromethane	339	6,440	0.0007
Bromomethane	91	1,729	0.0002
Chloroform	4835	91,850	0.0110
Chloromethane	4070	77,318	0.0092
cis-1,3-Dichloropropene	188	3,571	0.0004
1,2-Dichloroethane	96	1,824	0.0002
1,1-Dichloroethylene	507	9,631	0.0011
trans-1,3-Dichloropropene	147	2,793	0.0003
Methylene chloride	7730	146,847	0.0176
Tetrachloroethylene	1380	26,216	0.0031
Toluene	141	2,679	0.0003
Carbon Tetrachloride	10570	200,798	0.0241
Trichloroethylene	600	11,398	0.0013
Trichlorofluoromethane	180	3,419	0.0004
Vinyl chloride	1100	20,897	0.0025

Table 4-87
Hazardous Substance List
Volatile Organics

Run No. 6 — Volume of Gas Collected: 51.49 (DSL)

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission rate (lb/hr)
Benzene	460	8,934	0.0010
Chloroform	3024	58,735	0.0070
Chloromethane	3507	68,116	0.0081
1,2-Dichloroethane	590	11,459	0.0013
cis-1,3-Dichloropropene	180	3,496	0.0004
trans-1,3-Dichloropropene	145	2,816	0.0003
Ethylbenzene	44	855	0.0001
Methylene chloride	8250	160,238	0.0191
Tetrachloroethylene	1200	23,307	0.0027
Toluene	300	5,827	0.0006
1,1,1-Trichloroethane	150	2,913	0.0003
Carbon Tetrachloride	2264	43,973	0.0052
Trichloroethylene	460	8,934	0.0010
Vinyl chloride	820	15,927	0.0019

Table 4–88
Hazardous Substance List
Volatile Organics

Run No. 7 — Volume of Gas Collected 52.15 (DSL)

Name	Total Amount Detected (ng)	Stack Concentration (ng/m3)	Emission rate (lb/hr)
Benzene	295	5,657	0.0006
Bromodichloromethane	700	13,423	0.0016
Bromoform	58	1,112	0.0001
Chloroform	6135	117,639	0.0145
Chloromethane	5154	98,828	0.0121
1,2–Dichloroethane	1560	29,913	0.0036
cis–1,3–Dichloropropene	207	3,969	0.0004
1,1–Dichloroethylene	139	2,665	0.0003
trans–1,3–Dichloropropene	171	3,279	0.0004
Methylene chloride	5240	100,478	0.0124
Tetrachloroethylene	1050	20,134	0.0024
Toluene	138	2,646	0.0003
Carbon Tetrachloride	15250	292,420	0.0360
Trichloroethylene	410	7,862	0.0009
Trichlorofluoromethane	26	499	0.0000
Vinyl chloride	2430	46,595	0.0057

Table 4–89
Hazardous Substance List
Volatile Organics

Run No. 8 — Volume of Gas Collect 52.55 (DSL)

Name	Total Amount Detected (ng)	Stack Concentration (ng/m3)	Emission rate (lb/hr)
Benzene	203	3,863	0.0004
Bromodichloromethane	132	2,512	0.0003
Chloroform	3890	74,025	0.0092
Chloromethane	1343	25,557	0.0031
1,2–Dichloroethane	188	3,578	0.0004
cis–1,3–Dichloropropene	119	2,265	0.0002
trans–1,3–Dichloropropene	96	1,827	0.0002
Methylene chloride	1539	29,286	0.0036
Tetrachloroethylene	1220	23,216	0.0028
Toluene	109	2,074	0.0002
Carbon Tetrachloride	5180	98,573	0.0122
Trichloroethylene	370	7,041	0.0008
Vinyl chloride	540	10,276	0.0012

Table 4–90
Hazardous Substance List
Volatile Organics

Run No. 9 — Volume of Gas Collected: 52.38 (DSL)

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission rate (lb/hr)
Benzene	310	5,919	0.0007
Bromodichloromethane	253	4,830	0.0005
Chloroform	3664	69,956	0.0084
Chloromethane	1340	25,584	0.0030
1,2–Dichloroethane	61	1,165	0.0001
cis–1,3–Dichloropropene	150	2,864	0.0003
trans–1,3–Dichloropropene	118	2,253	0.0002
Ethylbenzene	48	916	0.0001
Methylene chloride	1608	30,701	0.0037
Tetrachloroethylene	760	14,511	0.0017
Toluene	165	3,150	0.0003
Carbon Tetrachloride	4787	91,397	0.0110
Trichloroethylene	310	5,919	0.0007
Vinyl chloride	500	9,546	0.0011

Table 4-91
Hazardous Substance List
Semivolatile Organics

Run No.: 11 Volume of Gas collected: 168.011

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission Rate (lb/hr)
1,3-Dichlorobenzene	7.01	1.47	0.000191
1,4-Dichlorobenzene	8.42	1.77	0.000229
1,2-Dichlorobenzene	6.55	1.38	0.000178
Benzoic Acid	212.32	44.62	0.005790
1,2,4-Trichlorobenzene	20.75	4.36	0.000565
Napthalene	18.32	3.85	0.000499
Hexachlorocyclopentadiene	35.64	7.49	0.000971
2,4,6-Trichlorophenol	64.03	13.46	0.001746
Hexachlorobenzene	16.86	3.54	0.000459
Di-n-butylphthalate	2.76	0.58	0.000075
bis(2-Ethylhexyl)phthalate	12.14	2.55	0.000331

Table 4-92
Hazardous Substance List
Semivolatile Organics

Run No.: 12 — Volume of Gas collected (dscf): 157.904

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission Rate (lb/hr)
1,3-Dichlorobenzene	6.34	1.42	0.000173
1,4-Dichlorobenzene	7.04	1.57	0.000192
Benzoic Acid	214.56	47.98	0.005864
1,2,4-Trichlorobenzene	20.39	4.56	0.000557
Napthalene	7.73	1.73	0.000211
2,4,6-Trichlorophenol	53.55	11.97	0.001463
Di-n-butylphthalate	21.42	4.79	0.000585
bis(2-Ethylhexyl)phthalate	6.56	1.47	0.000179

Table 4-93
Hazardous Substance List
Semivolatile Organics

Run No: 13 — Volume of Gas collected (dscf): 147.220

Name	Total Amount Detected (µg)	Stack Concentration (µg/m3)	Emission Rate (lb/hr)
Benzoic Acid	181.31	43.49	0.005167
1,2,4-Trichlorobenzene	8.41	2.02	0.000239
Napthalene	17.99	4.31	0.000512
2,4,6-Trichlorophenol	39.96	9.58	0.001138
bis(2-Ethylhexyl)phthalate	13.71	3.29	0.000390

Table 4–94
Hazardous Substance List
Semivolatile Organics

Run No: 4 — Volume of Gas collected (dscf): 155.295

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission Rate (kg/hr)
Phenol	4.55	1.03	0.000133
1,3–Dichlorobenzene	7.91	1.80	0.000232
1,4–Dichlorobenzene	5.06	1.15	0.000148
1,2–Dichlorobenzene	8.50	1.93	0.000249
Benzoic acid	356.57	81.08	0.010476
2,4–Dichlorophenol	5.23	1.19	0.000153
1,2,4–Trichlorobenzene	15.14	3.44	0.000444
Naphthalene	6.97	1.58	0.000204
Hexachlorocyclopentadiene	34.81	7.92	0.001022
2,4,6–Trichlorophenol	36.24	8.24	0.001064
Hexachlorobenzene	23.77	5.40	0.000698
Butylbenzylphthalate	5.71	1.30	0.000167
bis(2–Ethylhexyl)phthalate	21.71	4.94	0.000637
Di–n–octylphthalate	3.43	0.78	0.000100

Table 4-95
Hazardous Substance List
Semivolatile Organics

Run No: 5 Volume of Gas collected (dscf): 156.364

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission Rate (lb/hr)
Phenol	9.34	2.11	0.000253
1,3-Dichlorobenzene	10.77	2.43	0.000292
1,4-Dichlorobenzene	8.23	1.86	0.000223
1,2-Dichlorobenzene	11.15	2.52	0.000302
Benzoic acid	459.45	103.75	0.012461
2,4-Dichlorophenol	4.56	1.03	0.000124
1,2,4-Trichlorobenzene	26.08	5.89	0.000707
Naphthalene	10.40	2.35	0.000282
Hexachlorocyclopentadiene	107.46	24.27	0.002914
2,4,6-Trichlorophenol	61.80	13.96	0.001676
Hexachlorobenzene	49.04	11.07	0.001330
Butylbenzylphthalate	4.53	1.02	0.000123
bis(2-Ethylhexyl)phthalate	29.40	6.64	0.000797
Di-n-butylphthalate	7.93	1.79	0.000215

Table 4-96
Hazardous Substance List
Semivolatile Organics

Run No: 6 Volume of Gas collected (dscf): 147.439

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission Rate (lb/hr)
Phenol	6.50	1.56	0.000186
1,3-Dichlorobenzene	8.69	2.08	0.000249
1,2-Dichlorobenzene	9.54	2.28	0.000273
Benzoic acid	490.93	117.57	0.014044
2,4-Dichlorophenol	14.15	3.39	0.000405
1,2,4-Trichlorobenzene	20.34	4.87	0.000582
Naphthalene	6.67	1.60	0.000191
2-Methylnaphthalene	5.72	1.37	0.000164
Hexachlorocyclopentadiene	21.28	5.10	0.000609
2,4,6-Trichlorophenol	32.44	7.77	0.000928
Dimethylphthalate	3.65	0.87	0.000104
Hexachlorobenzene	48.68	11.66	0.001393
Butylbenzylphthalate	7.65	1.83	0.000219
bis(2-Ethylhexyl)phthalate	24.57	5.88	0.000703
Di-n-butylphthalate	9.56	2.29	0.000273

Table 4–97
Hazardous Substance List
Semivolatile Organics

Run No.: 7 — Volume of Gas collected (dscf): 152.521

Name	Total Amount Detected (ug)	Stack Concentration (ug/m3)	Emission Rate (lb/hr)
bis(2–Ethylhexyl)phthalate	17.59	4.07	0.00050270

Table 4–98
Hazardous Sustance List
Semivolatile Organics

Run No: 8 — Volume of Gas collected (dscf): 158.456

Name	Total Amount Detected (µg)	Stack Concentration (µg m⁻³)	Emission Rate (g hr⁻¹)
bis(2–Ethylhexyl)phthalate	31.45	7.01	0.000871

Table 4–99
Hazardous Substance List
Semivolatile Organics

Run No.: 9 Volume of Gas collected (dscf): 149.483

Name	Total Amount Detected (µg)	Stack Concentration (µg/m³)	Emission Rate (lb/hr)
bis(2–Ethylhexyl)phthalate	15.82	3.74	0.000452

Attachment A-2

Stack Testing Results for Dioxins and Dioxin-like Compounds at the Aptus Facility

Table 4-14
Chlorinated Dioxin/Furan Stack Concentrations
Condition 1
Run 11

Date: 05/07/92

Sample ID: APT-MM5-11

Volume of Gas collected (dscf): 168.011

Name	Concentration (1) (pg)	Stack Concentration (ng/m³)	Emission Rate (µg/hr)	Toxicity Equivalency Factor (2)	Toxicity Equivalent Concentration (ng/m³)	Toxicity Equivalent Emission Rate (µg/hr)
2,3,7,8-TCDD ✓	6.5	1.4	80	1	1.4	80
1,2,3,7,8-PeCDD	19.2	4.04	238	0.5	2.02	119
1,2,3,4,7,8-HxCDD	22.5	4.73	278	0.1	0.473	27.8
1,2,3,6,7,8-HxCDD	26.4	5.55	327	0.1	0.555	32.7
1,2,3,7,8,9-HxCDD	36.6	7.69	453	0.1	0.769	45.3
1,2,3,4,6,7,8-HpCDD	87.0 (4)	18.3	1076	0.01	0.183	10.8
OCDD	135	28.4	1670	0.001	0.0284	1.67
2,3,7,8-TCDF ✓	24.8 (1)	5.21	307	0.1	0.521	30.7
1,2,3,7,8-PeCDF	51.1 (4)	10.7	632	0.05	0.537	31.6
2,3,4,7,8-PeCDF	74.8 (4)	15.7	925	0.5	7.86	463
1,2,3,4,7,8-HxCDF	172 (4)	36.1	2128	0.1	3.61	213
1,2,3,6,7,8-HxCDF	43.5 (4)	9.14	538	0.1	0.914	53.8
2,3,4,6,7,8-HxCDF	54.5 (4)	11.5	674	0.1	1.15	67.4
1,2,3,7,8,9-HxCDF	12.7	2.67	157	0.1	0.267	15.7
1,2,3,4,6,7,8-HpCDF	113 (4)	23.7	1398	0.01	0.237	14.0
1,2,3,4,7,8,9-HpCDF	68.8	14.5	851	0.01	0.145	8.51
OCDF	155	32.6	1917	0.001	0.0326	1.92
TOTAL TCDD	111	23.3	1373		1.37 (3)	80
TOTAL PeCDD	182	38.3	2251		2.02 (3)	119
TOTAL HxCDD	268	56.3	3315		1.80 (3)	106
TOTAL HpCDD	169 (4)	35.5	2091		0.183 (3)	10.8
TOTAL TCDF	688 (4)	145	8511		0.521 (3)	30.7
TOTAL PeCDF	618 (4)	130	7645		8.40 (3)	494
TOTAL HxCDF	521 (4)	109	6445		5.94 (3)	350
TOTAL HpCDF	259 (4)	54.4	3204		0.382 (3)	22.5

(1) For 2,3,7,8-TCDF used confirmation analysis result.

(2) Source: 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (CDDs and CDFs). Part II, U.S. EPA, March, 1989

(3) Toxicity Equivalency Factors for all congeners not listed above are 0.

(4) Diluted result was used.

Table 4–15
Chlorinated Dioxin/Furan Stack Concentrations
Condition 1
Run 12

Date: 05/09/92

Sample ID: APT–MM5–12

Volume of Gas collected (dscf): 157.904

Name	Concentration (pg)	Stack Concentration (pg/m³)	Emission Rate (ug/hr)	Toxicity Equivalency Factor (2)	Toxicity Equivalent Concentration (pg/m³)	Toxicity Equivalent Emission Rate (ug/hr)
2,3,7,8–TCDD	2.8	0.63	35	1	0.63	35
1,2,3,7,8–PeCDD	8.5	1.9	105	0.5	0.95	53
1,2,3,4,7,8–HxCDD	8.6	1.9	107	0.1	0.19	11
1,2,3,6,7,8–HxCDD	12.0	2.68	149	0.1	0.268	14.9
1,2,3,7,8,9–HxCDD	17.5	3.91	217	0.1	0.391	21.7
1,2,3,4,6,7,8–HpCDD	56.9 (1)	12.7	705	0.01	0.127	7.05
OCDD	49.1	11.0	609	0.001	0.0110	0.609
2,3,7,8–TCDF	15.1 (4)	3.38	187	0.1	0.338	18.7
1,2,3,7,8–PeCDF	29.8	6.66	369	0.05	0.333	18.5
2,3,4,7,8–PeCDF	70.2 (1)	15.7	870	0.5	7.85	435
1,2,3,4,7,8–HxCDF	160 (1)	35.8	1984	0.1	3.58	198
1,2,3,6,7,8–HxCDF	39.5 (1)	8.83	490	0.1	0.883	49.0
2,3,4,6,7,8–HxCDF	62.4 (1)	14.0	774	0.1	1.40	77.4
1,2,3,7,8,9–HxCDF	7.6	1.7	94	0.1	0.17	9.4
1,2,3,4,6,7,8–HpCDF	102 (1)	22.8	1265	0.01	0.228	12.6
1,2,3,4,7,8,9–HpCDF	40.4	9.03	501	0.01	0.0903	5.01
OCDF	111 (1)	24.8	1376	0.001	0.0248	1.38
TOTAL TCDD	69.2	15.5	858		0.63 (3)	34.7
TOTAL PeCDD	113	25.3	1401		0.95 (3)	52.7
TOTAL HxCDD	169 (1)	37.8	2095		0.85 (3)	47.2
TOTAL HpCDD	115 (1)	25.7	1426		0.127 (3)	7.05
TOTAL TCDF	646 (1)	144	8009		0.338 (3)	18.7
TOTAL PeCDF	717 (1)	160	8889		8.18 (3)	454
TOTAL HxCDF	513 (1)	115	6360		6.03 (3)	334
TOTAL HpCDF	202 (1)	45.2	2504		0.318 (3)	17.7

(1) Diluted result was used.

(2) Source: 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo–p–Dioxins and –Dibenzofurans (CDDs and CDFs). Part II, U.S. EPA, March, 1989

(3) Toxicity Equivalency Factors for all congeners not listed above are 0.

(4) For 2,3,7,8–TCDF used confirmation analysis result.

Table 4–16
Chlorinated Dioxin/Furan Stack Concentrations
Condition 1
Run 13

Date: 05/10/92

Sample ID: APT–MM5–13

Volume of Gas collected (dscf): 147.270

Name	Concentration (pg)	Stack Concentration (pg/m³)	Emission Rate (µg/hr)	Toxicity Equivalency Factor (2)	Toxicity Equivalent Concentration (pg/m³)	Toxicity Equivalent Emission Rate (µg/hr)
2,3,7,8–TCDD	1.6	0.38	21	1	0.38	21
1,2,3,7,8–PeCDD	4.3	1.0	56	0.5	0.52	28
1,2,3,4,7,8–HxCDD	4.3	1.0	56	0.1	0.10	5.6
1,2,3,6,7,8–HxCDD	6.6	1.6	85	0.1	0.16	8.5
1,2,3,7,8,9–HxCDD	9.3	2.2	120	0.1	0.22	12
1,2,3,4,6,7,8–HpCDD	29.5	7.08	381	0.01	0.0708	3.81
OCDD	26.0	6.24	336	0.001	0.00624	0.336
2,3,7,8–TCDF	8.3 (4)	2.0	107	0.1	0.20	11
1,2,3,7,8–PeCDF	17.9	4.29	231	0.05	0.215	11.6
2,3,4,7,8–PeCDF	31.3	7.51	405	0.5	3.75	202
1,2,3,4,7,8–HxCDF	67.5	16.2	873	0.1	1.62	87.3
1,2,3,6,7,8–HxCDF	19.4	4.65	251	0.1	0.465	25.1
2,3,4,6,7,8–HxCDF	32.3	7.75	418	0.1	0.775	41.8
1,2,3,7,8,9–HxCDF	3.1	0.74	40	0.1	0.074	4.0
1,2,3,4,6,7,8–HpCDF	50.0 (1)	12.0	646	0.01	0.120	6.46
1,2,3,4,7,8,9–HpCDF	17.9	4.29	231	0.01	0.0429	2.31
OCDF	33.9	8.13	438	0.001	0.00813	0.438
TOTAL TCDD	48.2	11.6	623		0.38 (3)	20.7
TOTAL PeCDD	74.6	17.9	964		0.52 (3)	27.8
TOTAL HxCDD	92.2	22.1	1192		0.48 (3)	26.1
TOTAL HpCDD	60.7	14.6	785		0.0708 (3)	3.81
TOTAL TCDF	322 (1)	77.2	4163		0.20 (3)	10.7
TOTAL PeCDF	326	78.2	4214		3.97 (3)	214
TOTAL HxCDF	246	59.0	3180		2.93 (3)	158
TOTAL HpCDF	115 (1)	27.6	1487		0.163 (3)	8.78

(1) Dilution results was used.

(2) Source: 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo–p–Dioxins and –Dibenzofurans (CDDs and CDFs). Part II. U.S. EPA. March, 1989

(3) Toxicity Equivalency Factors for all congeners not listed above are 0.

(4) For 2,3,7,8–TCDF used confirmation analysis result.

Table 4-17
Chlorinated Dioxin/Furan Stack Concentrations
Condition 2
Run 4

Date: 03/19/92

Sample ID: APT-MMS-4

Volume of Gas collected (dscf): 155,195

Name	Concentration (ng)	Stack Concentration (ng/m³)	Emission Rate (µg/hr)	Toxicity Equivalency Factor (2)	Toxicity Equivalent Concentration (ng/m³)	Toxicity Equivalent Emission Rate (µg/hr)
2,3,7,8-TCDD	0.45	0.10	6.0	1	0.10	6.0
1,2,3,7,8-PeCDD	1.9	0.43	25	0.5	0.22	13
1,2,3,4,7,8-HxCDD	2.3	0.52	31	0.1	0.052	3.1
1,2,3,6,7,8-HxCDD	4.5	1.0	60	0.1	0.10	6.0
1,2,3,7,8,9-HxCDD	6.5	1.5	87	0.1	0.15	8.7
1,2,3,4,6,7,8-HpCDD	36.7	8.34	489	0.01	0.0834	4.89
OCDD	44.0	10.0	586	0.001	0.0100	0.586
2,3,7,8-TCDF	5.6 (1)	1.3	75	0.1	0.13	7.5
1,2,3,7,8-PeCDF	15.3	3.48	204	0.05	0.174	10.2
2,3,4,7,8-PeCDF	33.2	7.55	442	0.5	3.77	221
1,2,3,4,7,8-HxCDF	116 (4)	26.4	1546	0.1	2.64	155
1,2,3,6,7,8-HxCDF	35.4	8.05	472	0.1	0.805	47.2
2,3,4,6,7,8-HxCDF	68.0	15.5	906	0.1	1.55	90.6
1,2,3,7,8,9-HxCDF	3.4	0.77	45	0.1	0.077	4.5
1,2,3,4,6,7,8-HpCDF	137 (4)	31.2	1826	0.01	0.312	18.3
1,2,3,4,7,8,9-HpCDF	30.9	7.03	412	0.01	0.0703	4.12
OCDF	158	35.9	2106	0.001	0.0359	2.11
TOTAL TCDD	14.0	3.18	187		0.10 (3)	6.0
TOTAL PeCDD	39.4	8.96	525		0.22 (3)	13
TOTAL HxCDD	83.7	19.0	1115		0.30 (3)	18
TOTAL HpCDD	81.6	18.6	1087		0.0834 (3)	4.89
TOTAL TCDF	286 (4)	65.0	3811		0.13 (3)	7.5
TOTAL PeCDF	388	88.2	5171		3.95 (3)	231
TOTAL HxCDF	429 (4)	97.5	5717		5.07 (3)	297
TOTAL HpCDF	294 (4)	66.8	3918		0.382 (3)	22.4

(1) For 2,3,7,8-TCDF used confirmation analysis result.

(2) Source: 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (CDDs and CDFs). Part II. U.S. EPA. March 1989

(3) Toxicity Equivalency Factors for all congeners not listed above are 0.

(4) Diluted result was used.

Table 4-18
Chlorinated Dioxin/Furan Stack Concentrations
Condition 2
Run 5

Date: 03/20/92

Sample ID: APT-MMS-5

Volume of Gas collected (dscf): 156.364

Name	Concentration (ng)	Stack Concentration (ng/m³)	Emission Rate (µg/hr)	Toxicity Equivalency Factor (2)	Toxicity Equivalent Concentration (ng/m³)	Toxicity Equivalent Emission Rate (µg/hr)
2,3,7,8-TCDD	0.90	0.20	11	1	0.20	11
1,2,3,7,8-PeCDD	3.4	0.77	42	0.5	0.38	21
1,2,3,4,7,8-HxCDD	3.7	0.84	46	0.1	0.084	4.6
1,2,3,6,7,8-HxCDD	7.6	1.7	93	0.1	0.17	9.3
1,2,3,7,8,9-HxCDD	11.1	2.51	137	0.1	0.251	13.7
1,2,3,4,6,7,8-HpCDD	60.0	13.5	738	0.01	0.135	7.38
OCDD	77.1	17.4	948	0.001	0.0174	0.948
2,3,7,8-TCDF	10.2 (1)	2.30	125	0.1	0.230	12.5
1,2,3,7,8-PeCDF	26.1	5.89	321	0.05	0.295	16.1
2,3,4,7,8-PeCDF	58.8	13.3	723	0.5	6.64	362
1,2,3,4,7,8-HxCDF	251 (4)	56.7	3088	0.1	5.67	309
1,2,3,6,7,8-HxCDF	69.4	15.7	854	0.1	1.57	85.4
2,3,4,6,7,8-HxCDF	112	25.3	1378	0.1	2.53	138
1,2,3,7,8,9-HxCDF	4.1	0.93	50	0.1	0.093	5.0
1,2,3,4,6,7,8-HpCDF	287 (4)	64.8	3531	0.01	0.648	35.3
1,2,3,4,7,8,9-HpCDF	44.8	10.1	551	0.01	0.101	5.51
OCDF	239	54.0	2940	0.001	0.0540	2.94
TOTAL TCDD	23.5	5.31	289		0.20 (3)	11
TOTAL PeCDD	70.2	15.9	864		0.38 (3)	21
TOTAL HxCDD	138	31.2	1698		0.506 (3)	27.6
TOTAL HpCDD	132	29.8	1624		0.135 (3)	7.38
TOTAL TCDF	558 (4)	126	6865		0.230 (3)	12.5
TOTAL PeCDF	721	163	8870		6.93 (3)	378
TOTAL HxCDF	833 (4)	188	10248		9.86 (3)	537
TOTAL HpCDF	573 (4)	129	7049		0.749 (3)	40.8

(1) For 2,3,7,8-TCDF used confirmation analysis result.

(2) Source: 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (CDDs and CDFs), Part II, U.S. EPA, March, 1989

(3) Toxicity Equivalency Factors for all congeners not listed above are 0.

(4) Diluted result was used.

Table 4-19
Chlorinated Dioxin/Furan Stack Concentrations
Condition 2
Run 6

Date: 03/21/92

Sample ID: APT-MMS-6

Volume of Gas collected (dscf): 142.439

Name	Concentration (pg)	Stack Concentration (pg/m³)	Emission Rate (µg/hr)	Toxicity Equivalency Factor (2)	Toxicity Equivalent Concentration (pg/m³)	Toxicity Equivalent Emission Rate (µg/hr)
2,3,7,8-TCDD	0.45	0.11	5.8	1	0.11	5.8
1,2,3,7,8-PeCDD	2.1	0.50	27	0.5	0.25	14
1,2,3,4,7,8-HxCDD	2.3	0.55	30	0.1	0.055	3.0
1,2,3,6,7,8-HxCDD	4.1	0.98	53	0.1	0.098	5.3
1,2,3,7,8,9-HxCDD	6.6	1.6	86	0.1	0.16	8.6
1,2,3,4,6,7,8-HpCDD	31.9	7.64	414	0.01	0.0764	4.14
OCDD	49.7	11.9	645	0.001	0.0119	0.645
2,3,7,8-TCDF	7.9 (1)	1.9	103	0.1	0.19	10
1,2,3,7,8-PeCDF	23.9	5.72	310	0.05	0.286	15.5
2,3,4,7,8-PeCDF	43.2	10.3	561	0.5	5.17	280
1,2,3,4,7,8-HxCDF	211 (4)	50.5	2738	0.1	5.05	274
1,2,3,6,7,8-HxCDF	59.5	14.2	772	0.1	1.42	77.2
2,3,4,6,7,8-HxCDF	91.3	21.9	1185	0.1	2.19	118
1,2,3,7,8,9-HxCDF	4.5	1.1	58	0.1	0.11	5.8
1,2,3,4,6,7,8-HpCDF	258 (4)	61.8	3348	0.01	0.618	33.5
1,2,3,4,7,8,9-HpCDF	33.1	7.93	430	0.01	0.0793	4.30
OCDF	299	71.6	3880	0.001	0.0716	3.88
TOTAL TCDD	14.8	3.54	192		0.11 (3)	5.8
TOTAL PeCDD	37.6	9.00	488		0.25 (3)	14
TOTAL HxCDD	74.1	17.7	962		0.31 (3)	17
TOTAL HpCDD	70.7	16.9	917		0.0764 (3)	4.14
TOTAL TCDF	457	109	5930		0.19 (3)	10
TOTAL PeCDF	600	144	7786		5.46 (3)	296
TOTAL HxCDF	700 (4)	168	9083		8.77 (3)	475
TOTAL HpCDF	491 (4)	118	6410		0.697 (3)	37.8

(1) For 2,3,7,8-TCDF used confirmation analysis result.
(2) Source: 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (CDDs and CDFs), Part II, U.S. EPA, March, 1989
(3) Toxicity Equivalency Factors for all congeners not listed above are 0.
(4) Diluted result was used.

Table 4-20
Chlorinated Dioxin/Furan Stack Concentrations
Condition 3
Run 7

Date: 03/25/92

Sample ID: APT-MM5-7

Volume of Gas collected (dscf): 152.521

Name	Concentration (1) (ng)		Stack Concentration (ng/m³)	Emission Rate (µg/hr)	Toxicity Equivalency Factor (2)	Toxicity Equivalent Concentration (ng/m³)		Toxicity Equivalent Emission Rate (µg/hr)
2,3,7,8-TCDD	0.74		0.17	9.6	1	0.17		9.6
1,2,3,7,8-PeCDD	2.4		0.56	31	0.5	0.28		16
1,2,3,4,7,8-HxCDD	2.8		0.65	36	0.1	0.065		3.6
1,2,3,6,7,8-HxCDD	5.5		1.3	71	0.1	0.13		7.1
1,2,3,7,8,9-HxCDD	7.1		1.6	92	0.1	0.16		9.2
1,2,3,4,6,7,8-HpCDD	36.5		8.45	473	0.01	0.0845		4.73
OCDD	45.8		10.6	594	0.001	0.0106		0.594
2,3,7,8-TCDF	6.0	(1)	1.4	78	0.1	0.14		7.8
1,2,3,7,8-PeCDF	13.2		3.06	171	0.05	0.153		8.56
2,3,4,7,8-PeCDF	33.4		7.73	433	0.5	3.87		216
1,2,3,4,7,8-HxCDF	82.5		19.1	1069	0.1	1.91		107
1,2,3,6,7,8-HxCDF	24.2		5.60	314	0.1	0.560		31.4
2,3,4,6,7,8-HxCDF	56.9		13.2	738	0.1	1.32		73.8
1,2,3,7,8,9-HxCDF	3.9		0.90	51	0.1	0.090		5.1
1,2,3,4,6,7,8-HpCDF	83.2		19.3	1079	0.01	0.193		10.8
1,2,3,4,7,8,9-HpCDF	28.8		6.67	373	0.01	0.0667		3.73
OCDF	108		25.0	1400	0.001	0.0250		1.40
TOTAL TCDD	32.4		7.50	420		0.17	(3)	10
TOTAL PeCDD	53.5		12.4	694		0.28	(3)	16
TOTAL HxCDD	98.6		22.8	1278		0.36	(3)	20
TOTAL HpCDD	89.2		20.7	1156		0.0845	(3)	4.73
TOTAL TCDF	266		61.6	3448		0.14	(3)	7.8
TOTAL PeCDF	378		87.5	4900		4.02	(3)	225
TOTAL HxCDF	332		76.9	4304		3.88	(3)	217
TOTAL HpCDF	196		45.4	2541		0.259	(3)	14.5

(1) For 2,3,7,8-TCDF used confirmation analysis result.

(2) Source: 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (CDDs and CDFs). Part II. U.S. EPA. March, 1989

(3) Toxicity Equivalency Factors for all congeners not listed above are 0.

Table 4-21
Chlorinated Dioxin/Furan Stack Concentrations
Condition 3
Run 8

Date: 03/26/92

Sample ID: APT-MM5-8

Volume of Gas collected (dscf): 158.456

Name	Concentration (1) (ng)		Stack Concentration (ng/m³)	Emission Rate (µg/hr)	Toxicity Equivalency Factor (2)	Toxicity Equivalent Concentration (ng/m³)		Toxicity Equivalent Emission Rate (µg/hr)
2,3,7,8-TCDD	0.46		0.10	5.8	1	0.10		5.8
1,2,3,7,8-PeCDD	1.7		0.38	21	0.5	0.19		11
1,2,3,4,7,8-HxCDD	1.4		0.31	18	0.1	0.031		1.8
1,2,3,6,7,8-HxCDD	3.2		0.71	40	0.1	0.071		4.0
1,2,3,7,8,9-HxCDD	5.3		1.2	67	0.1	0.12		6.7
1,2,3,4,6,7,8-HpCDD	20.3		4.52	255	0.01	0.0452		2.55
OCDD	32.3		7.20	406	0.001	0.00720		0.406
2,3,7,8-TCDF	4.8	(1)	1.1	60	0.1	0.11		6.0
1,2,3,7,8-PeCDF	7.1		1.6	89	0.05	0.079		4.5
2,3,4,7,8-PeCDF	23.4		5.21	294	0.5	2.61		147
1,2,3,4,7,8-HxCDF	58.8		13.1	739	0.1	1.31		73.9
1,2,3,6,7,8-HxCDF	15.2		3.39	191	0.1	0.339		19.1
2,3,4,6,7,8-HxCDF	37.0		8.25	465	0.1	0.825		46.5
1,2,3,7,8,9-HxCDF	2.3		0.51	29	0.1	0.051		2.9
1,2,3,4,6,7,8-HpCDF	65.5		14.6	824	0.01	0.146		8.24
1,2,3,4,7,8,9-HpCDF	18.1		4.03	228	0.01	0.0403		2.28
OCDF	62.0		13.8	780	0.001	0.0138		0.780
TOTAL TCDD	11.9		2.65	150		0.10	(3)	5.8
TOTAL PeCDD	16.3		3.63	205		0.19	(3)	11
TOTAL HxCDD	44.9		10.0	565		0.22	(3)	12
TOTAL HpCDD	41.2		9.18	518		0.0452	(3)	2.55
TOTAL TCDF	129		28.7	1622		0.11	(3)	6.0
TOTAL PeCDF	243		54.2	3055		2.69	(3)	152
TOTAL HxCDF	206		45.9	2590		2.52	(3)	142
TOTAL HpCDF	135		30.1	1697		0.186	(3)	10.5

(1) For 2,3,7,8-TCDF used confirmation analysis result.

(2) Source: 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (CDDs and CDFs). Part II, U.S. EPA. March, 1989

(3) Toxicity Equivalency Factors for all congeners not listed above are 0.

Table 4–22
Chlorinated Dioxin/Furan Stack Concentrations
Condition 3
Run 9

Date: 03/27/92

Sample ID: APT–MM5–9

Volume of Gas collected (dscf): 149.493

Name	Concentration (1) (ng)	Stack Concentration (ng/m³)	Emission Rate (ng/hr)	Toxicity Equivalency Factor (2)	Toxicity Equivalent Concentration (ng/m³)	Toxicity Equivalent Emission Rate (µg/hr)
2,3,7,8–TCDD	0.37	0.087	4.8	1	0.087	4.8
1,2,3,7,8–PeCDD	1.4	0.33	18	0.5	0.17	9.1
1,2,3,4,7,8–HxCDD	1.2	0.28	16	0.1	0.028	1.6
1,2,3,6,7,8–HxCDD	2.9	0.69	38	0.1	0.069	3.8
1,2,3,7,8,9–HxCDD	5.1	1.2	66	0.1	0.12	6.6
1,2,3,4,6,7,8–HpCDD	19.3	4.56	250	0.01	0.0456	2.50
OCDD	29.8	7.04	387	0.001	0.00704	0.387
2,3,7,8–TCDF	4.9 (1)	1.2	64	0.1	0.12	6.4
1,2,3,7,8–PeCDF	5.7	1.3	74	0.05	0.067	3.7
2,3,4,7,8–PeCDF	19.5	4.61	253	0.5	2.30	127
1,2,3,4,7,8–HxCDF	41.2	9.73	535	0.1	0.973	53.5
1,2,3,6,7,8–HxCDF	11.8	2.79	153	0.1	0.279	15.3
2,3,4,6,7,8–HxCDF	26.4	6.24	343	0.1	0.624	34.3
1,2,3,7,8,9–HxCDF	1.8	0.43	23	0.1	0.043	2.3
1,2,3,4,6,7,8–HpCDF	43.0	10.2	558	0.01	0.102	5.58
1,2,3,4,7,8,9–HpCDF	11.6	2.74	151	0.01	0.0274	1.51
OCDF	33.1	7.82	430	0.001	0.00782	0.430
TOTAL TCDD	13.0	3.1	169		0.087 (3)	4.8
TOTAL PeCDD	21.8	5.15	283		0.17 (3)	9.1
TOTAL HxCDD	43.5	10.3	565		0.22 (3)	12
TOTAL HpCDD	39.9	9.43	518		0.0456 (3)	2.50
TOTAL TCDF	150	35.4	1947		0.12 (3)	6.4
TOTAL PeCDF	203	48.0	2635		2.37 (3)	130
TOTAL HxCDF	154	36.4	1999		1.92 (3)	105
TOTAL HpCDF	87.1	20.6	1130		0.129 (3)	7.09

(1) For 2,3,7,8–TCDF used confirmation analysis result.

(2) Source: 1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo–p–Dioxins and –Dibenzofurans (CDDs and CDFs). Part II. U.S. EPA, March, 1989

(3) Toxicity Equivalency Factors for all congeners not listed above are 0.

Attachment A-3

Target Analytes for Analysis of Stack Gas Samples

Table 1.
Target Analytes for Analysis of Stack Gas Samples
Collected by the VOST Train for
Volatile Organic Compounds by Method 8240A

Acetone	1,2-Dichloropropane
Benzene	1,3-Dichloro-2-propanol
Bromodichloromethane	cis-1,3-Dichloropropene
Bromoethene	trans-1,3-Dichloropropene
Bromoform	Ethylbenzene
Bromomethane	n-Hexane
2-Butanone	2-Hexanone
1,3-Butadiene	Iodomethane
Carbon disulfide	Methylene chloride
Carbon tetrachloride	Methyl iodide
Chlorobenzene	4-Methyl-2-pentanone
Chlorodibromomethane	Styrene
Chloroethane	1,1,1,2-Tetrachloroethane
Chloroform	1,1,2,2,-Tetrachloroethane
Chloromethane	Tetrachloroethene
2-Chloropropane	1,1,2-Trichloro-1,2,2-trifluoroethane
1,2-Dibromo-3-chloropropane	Toluene
1,2-Dibromoethane	1,1,1-Trichloroethane
Dibromoethane	1,1,2-Trichloroethane
1,4-Dichloro-2-butene	Trichloroethene
Dichlorodifluoromethane	1,2,3-Trichloropropane
1,1-Dichloroethane	Trichlorofluoromethane
1,2-Dichloroethane	Vinyl acetate
1,1-Dichloroethene	Vinyl chloride
trans-1,2-Dichloroethene	Xylene (Total)

Table 2.
Target Analytes for Analysis of Stack Gas Samples
Collected by the Semi-VOST Train for
Semi-Volatile Organic Compounds by Method 8270A

Acenaphthene	bis(2-Chloroethyl)ether
Acenaphthylene	bis(2-Chloroethoxy)methane
Acetophenone	bis(2-Chloroisopropyl)ether
2-Acetylaminofluorene	1-Chloronaphthalene
4-Aminobiphenyl	2-Chloronaphthalene
Aniline	2-Chlorophenol
Anthracene	4-Chlorophenylphenyl ether
Aramite	Chrysene
Benz(a)anthracene	DDE
Benz(a)pyrene	Di-n-butylphthalate
Benz(e)pyrene	Diallate (cis or trans)
Benzaldehyde	Dibenz(a,h)anthracene
Benzenethiol	Dibenz(a,j)acridine
Benzidine	Dibenzofuran
Benzo(b)fluoranthene	1,2-Dichlorobenzene
Benzo(g,h,i)perylene	1,3-Dichlorobenzene
Benzo(j)fluoranthene	1,4-Dichlorobenzene
Benzo(k)fluoranthene	3,3'-Dichlorobenzidine
Benzoic acid	2,4-Dichlorophenol
Benzyl alcohol	2,6-Dichlorophenol
Biphenyl	Diethylphthalate
4-Bromophenylphenyl ether	p-Dimethylaminoazobenzene
Butylbenzylphthalate	7,12-Dimethylbenz(a)anthracene
p-Chloroaniline	3,3'-Dimethylbenzidine

Table 2.
Target Analytes for Analysis of Stack Gas Samples
Collected by the Semi-VOST Train for
Semi-Volatile Organic Compounds by Method 8270A
(Continued)

4-Chloro-3-methylphenol	Dimethylphthalate
Chlorobenzilate	2,4-Dimethylphenol
Dimethylphenethylamine	3-Methylcholanthrene
1,3-Dinitrobenzene	Methyl methanesulfonate
4,6-Dinitro-2-methylphenol	2-Methylnaphthalene
2,4-Dinitrophenol	2-Methylphenol
2,4-Dinitrotoluene	3-Methylphenol
2,6-Dinitrotoluene	4-Methylphenol
Di-n-octylphthalate	N-Nitrosodiethylamine
Diphenylamine	N-Nitrosodimethylamine
1,2-Diphenylhydrazine	N-Nitrosodiphenylamine
bis(2-Ethylhexyl)phthalate	N-Nitroso-di-n-butylamine
Ethyl methanesulfonate	N-Nitroso-di-n-propylamine
Fluorene	N-Nitrosomethylethylamine
Fluoranthene	N-Nitrosomorpholine
Heptachlor	N-Nitrosopiperidine
Hexachlorobenzene	N-Nitrosopyrrolidine
Hexachlorobutadiene	Naphthalene
Hexachlorocyclopentadiene	1,4-Naphthoquinone
Hexachloroethane	1-Naphthylamine
Hexachlorophene	2-Naphthylamine
Hexachloropropene	2-Nitroaniline
Indeno(1,2,3-cd)pyrene	3-Nitroaniline

Table 2.
Target Analytes for Analysis of Stack Gas Samples
Collected by the Semi-VOST Train for
Semi-Volatile Organic Compounds by Method 8270A
(Continued)

Isosafrole	4-Nitroaniline
Isophorone	5-Nitro-o-toluidine
Methapyrilene	2-Nitrophenol
Methoxychlor	4-Nitrophenol
Methylcyclohexane	Nitrobenzene
4-Nitroquinoline-1-oxide	Pyridine
Pentachlorobenzene	Quinoline
Pentachloronitrobenzene	Safrole
Pentachlorophenol	1,2,4,5-Tetrachlorobenzene
Phenacetin	2,3,4,6-Tetrachlorophenol
Phenanthrene	o-Toluidine
Phenol	p-Toluidine
p-Phenylenediamine	1,2,4-Trichlorobenzene
2-Picoline	2,4,5-Trichlorophenol
Pronamide	2,4,6-Trichlorophenol
Pyrene	sym-Trinitrobenzene

APPENDIX B

Chemical Concentrations
for Evaluation of
All Receptors

Each of the equations presented in this appendix was provided in USEPA's *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes* (1994) with modifications to equations and exposure assumptions detailed in the errata entitled *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes: Errata*, revised draft dated October 14, 1994.

TABLE B-1
Chemical-Specific Constants Table

Chemical	Chemical/Physical Properties			Transfer Factors				Other Parameters
	ksg (yr^{-1})	Fv (unitless)	Kd_s (mL/g or L/kg)	Bv (μg pollutant/g plant) / (μg pollutant/g air)	RCF (μg pollutant/ g plant tissue)/ (μg pollutant/ mL pore water)	Ba_{beef} (day/kg)	Ba_{milk} (day/kg)	Fw (unitless)
INDIRECT EXPOSURE								
Antimony	NA	0.00	2.00e+00	NA	3.00e-02	1.00e-03	1.00e-04	6.00e-01
Arsenic	NA	0.00	2.90e+01	NA	8.00e-03	2.00e-03	6.00e-03	2.00e-01
Barium	NA	0.00	5.30e+02	NA	1.50e-02	1.50e-04	3.50e-04	6.00e-01
Beryllium	NA	0.00	7.00e+01	NA	1.50e-03	1.00e-03	8.00e-07	6.00e-01
Benzo(a)pyrene Toxicity Equivalents	NA	4.00e-01	1.20e+04	1.30e+06	1.60e+03	3.40e-02	1.10e-02	6.00e-01
Bis(2-ethylhexyl)phthalate	NA	8.00e-01	4.60e+04	6.40e+05	4.50e+03	NA	NA	6.00e-01
Cadmium	NA	0.00	1.60e+02	NA	3.20e-02	1.20e-01	7.60e-03	6.00e-01
Chromium (VI)	NA	0.00	1.80e+01	NA	4.50e-03	5.50e-03	1.30e-03	6.00e-01
Dinitrobenzene, 1,3-	NA	1.00e+00	2.80e-01	6.80e-03	1.25e+00	7.90e-07	2.50e-07	6.00e-01
Dinitrotoluene, 2,4-	NA	1.00e+00	8.70e-01	1.50e+02	1.90e+00	2.50e-06	7.90e-07	6.00e-01
Dinitrotoluene, 2,6-	NA	1.00e+00	6.70e-01	1.30e+02	1.70e+00	1.90e-06	6.10e-07	6.00e-01
Di(n)octylphthalate	NA	8.00e-01	1.90e+07	6.60e+09	4.60e+05	NA	NA	6.00e-01
Hexachlorobenzene	NA	1.00e+00	2.80e+03	2.90e+02	5.20e+02	8.00e-03	2.50e-03	6.00e-01
Mercury	NA	1.00e+00	1.50e+02	1.00e+03	7.00e-03	2.50e-01	4.50e-04	6.00e-01
Nickel	NA	0.00	8.20e+01	NA	4.00e-03	6.00e-03	1.00e-03	6.00e-01
Nitrobenzene	NA	1.00e+00	6.00e-01	7.00e-01	1.60e+00	1.70e-06	5.40e-07	6.00e-01
PCBs, Total	NA	1.00e+00	4.30e+03	4.20e+03	2.10e+03	5.00e-02	1.60e-02	6.00e-01
Pentachloronitrobenzene	NA	1.00e+00	3.80e+02	7.90e-01	1.10e+02	1.10e-03	3.50e-04	6.00e-01
Pentachlorophenol	NA	1.00e+00	1.10e+03	5.10e+03	2.50e+02	3.00e-03	9.60e-04	6.00e-01
Selenium	NA	0.00	4.30e+00	NA	2.00e-02	1.50e-02	4.00e-03	6.00e-01
Silver	NA	0.00	4.00e-01	NA	1.00e-01	3.00e-03	2.00e-02	6.00e-01
TCDDioxin Toxicity Equivalents, 2,3,7,8-	7.00e-02	6.00e-01	2.50e+04	2.70e+05	3.90e+03	1.10e-01	3.50e-02	6.00e-01
Thallium (I)	NA	0.00	7.40e+01	NA	4.00e-04	4.00e-02	2.00e-03	6.00e-01
Lead	NA	0.00	6.00e+02	NA	NA	NA	NA	6.00e-01

TABLE B-1
Chemical-Specific Constants Table

Chemical	Health Benchmarks							
	Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$		Oral Reference Dose (mg/kg-day)		Inhalation Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$		Chronic Reference Concentration (mg/m^3)	
INDIRECT EXPOSURE	Value	Reference*	Value	Reference*	Value	Reference*	Value	Reference*
Antimony	NA	S	4.00e-04	S	NA		NA	
Arsenic	1.750e+00	S	3.00e-04	S	1.50e+01	I	NA	
Barium	NA	S	7.00e-02	S	NA		5.00e-04	H
Beryllium	4.30e+00	S	5.00e-03	S	8.40e+00	H	NA	
Benzo(a)pyrene Toxicity Equivalents	7.30e+00	S	NA	S	6.10e+00[A,N]	B	NA	
Bis(2-ethylhexyl)phthalate	1.40e-02	S	2.00e-02	S	1.40e-02	E	NA	
Cadmium	NA	S	1.00-e-03	S	6.30e+00	I	NA	
Chromium (VI)	NA	S	5.00e-03	S	4.10e+01	H	NA	
Dinitrobenzene, 1,3-	NA	S	1.00e-04	S	NA		NA	
Dinitrotoluene, 2,4-	6.80e-01	S	2.00e-03	S	6.80e-01	E	NA	
Dinitrotoluene, 2,6-	6.80e-01	S	1.00e-03	S	6.80e-01	E	NA	
Di(n)octylphthalate	NA	S	2.00e-02	S	NA		NA	
Hexachlorobenzene	1.60e+00	S	8.00e-04	S	1.60e+00	H	NA	
Mercury	NA	S	3.00e-04	S	NA		3.00e-04	H
Nickel	NA	S	2.00e-02	S	NA		NA	
Nitrobenzene	NA	S	5.00e-04	S	NA		2.00e-03	H
PCBs, Total	7.70e+00	S	NA	S	7.70e+00	E	NA	
Pentachloronitrobenzene	2.60e-01	S	3.00e-03	S	2.60e-01	E	NA	
Pentachlorophenol	1.20e-01	S	3.00e-02	S	1.20e-01	E	NA	
Selenium	NA	S	5.00e-03	S	NA		NA	
Silver	NA	S	5.00e-03	S	NA		NA	
TCDDioxin Toxicity Equivalents, 2,3,7,8-	1.56e+05	S	NA	S	1.16e+05	H	NA	
Thallium (I)	NA	S	8.00e-05	S	NA		NA	
Lead	NA	S	NA	S	NA		NA	

TABLE B-1
Chemical-Specific Constants Table

Chemical	Health Benchmarks			
	Inhalation Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$		Chronic Reference Concentration (mg/m^3)	
DIRECT EXPOSURE	Value	Reference*	Value	Reference*
Acetone	NA		NA	
Acrylamide	4.55e+00	I	NA	
Acrylonitrile	2.38e-01	I	2.00e-03	I
Benzene	2.90e-02	II	6.00e-03	C
Benzoic Acid	NA		NA	
Bromodichloromethane	NA		NA	
Bromoform	3.85e-03	II	NA	
Bromomethane	NA		5.00e-03	I
Butyl Alcohol	NA		NA	
Butylbenzylphthalate	NA		NA	
Carbon Disulfide	NA		1.00e-02	II
Carbon Tetrachloride	5.30e-02	II	2.00e-03	D
Chlorobenzene	NA		2.00e-02	II
Chloroform	8.05e-02	II	NA	
Chloromethane	6.30e-03	II	NA	
Creosols	NA		NA	
Creosote	NA		NA	
Cresylic Acid	NA		NA	
Cyclohexanone	NA		NA	
Dibromochloromethane	NA		NA	
Dichlorobenzene, 1,2-	NA		2.00e-01	II

TABLE B-1
Chemical-Specific Constants Table

Chemical	Health Benchmarks			
	Inhalation Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$		Chronic Reference Concentration (mg/m^3)	
	Value	Reference*	Value	Reference*
Dichlorobenzene, 1,3-	NA		2.00e-01	G
Dichlorobenzene, 1,4-	NA		8.00e-01	I
Dichloroethane, 1,1-	NA		NA	
Dichloroethane, 1,2-	9.10e-02	H	NA	
Dichloroethylene, 1,1-	1.75e-01	I	NA	
Dichloroethylene, 1,2-	NA		NA	
Dichlorophenol, 2,4-	NA		NA	
Dichloropropene, cis-1,3-	1.30e-01	F	2.00e-02	F
Dichloropropene, trans-1,3-	1.30e-01	F	2.00e-02	F
Dimethylphthalate	NA		NA	
Di-n-butylphthalate	NA		NA	
Ethoxyethanol, 2-	NA		2.00e-01	I
Ethyl Acetate	NA		NA	
Ethyl Benzene	NA		1.00e+00	I
Ethyl Ether	NA		NA	
Hexachlorocyclopentadiene	NA		7.00e-05	H
Isobutanol	NA		NA	
MEK	NA		1.00e+00	I
Methanol	NA		NA	
Methylene chloride	1.64e-03	I	3.00e+00	H
Methylnaphthalene, 2-	NA		NA	
Naphthalene	NA		NA	

TABLE B-1
Chemical-Specific Constants Table

Chemical	Health Benchmarks			
	Inhalation Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$		Chronic Reference Concentration (mg/m^3)	
	Value	Reference*	Value	Reference*
Nitropropane, 2-	9.40e+00	H	2.00e-02	I
Orthodichlorobenzene	NA		NA	
Phenol	NA		NA	
Pyridine	NA		NA	
Tetrachloroethylene	2.00e-03[c]	A	NA	
Toluene	NA		4.00e-01	I
Trichlorobenzene, 1,2,4-	NA		2.00e-01	H
Trichloroethane, 1,1,1-	NA		1.00e+00	B
Trichloroethane, 1,1,2-	5.70e-02	H	NA	
Trichloroethylene	6.00e-03[c]	A	NA	
Trichlorofluoromethane	NA		NA	
Trichlorophenol, 2,4,6-	1.09e-02	H	NA	
Trichlorotrifluoranthene	NA		NA	
Trichlorotrifluoroethane	NA		NA	
Vinyl Chloride	3.00e-01	H	NA	
Xylene	NA		NA	

TABLE B-1
Chemical-Specific Constants Table

Chemical	Health Benchmarks	
	Inhalation Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$	Chronic Reference Concentration (mg/m^3)

Notes:

NA = Not Available.

(a) ENVIRON derived inhalation cancer slope factors (CSF_i) from the inhalation unit risk factors (URF_i) published in IRIS or HEAST using the following equation:

CSF_i (kg-day/mg) = URF_i ($m^3/\mu g$) x 70 kg x 1,000 $\mu g/mg$ ÷ 20 m^3/day, where 70 kg is body weight and 20 m^3/day is breathing rate.

(w) Withdrawn.

(i) Interim number.

References are as follows:

S = United States Environmental Protection Agency (USEPA). 1994. Office of Emergency and Remedial Response (OERR). *Draft Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes*. Washington, D.C. April 15, and, Utah Department of Environmental Quality (UDEQ), Division of Solid and Hazardous Waste. Letter to William D. Cobb regarding protocol documents and screening level risk assessment review comments which included copies of chemical specific inputs for eight metals, the errata dated October 4, 1994 and derivation of time-averaged soil concentration equations dated November 22, 1994.

I = USEPA. 1995. Integrated Risk Information System (IRIS) On-line Database. July 31.

H = USEPA. 1994. Health Effects Assessment Summary Tables (HEAST). Supplemental No. 1 to the March 1994 Annual Update. EPA 540/R-94/059. July.

A = USEPA. Environmental Criteria and Assessment Office (ECAO), Superfund Technical Support Center. 1993. Interim Criteria for PCE and TCE (facsimile). November.

B = USEPA. 1992. HEAST. Annual FY 1992. OERR 9200.6-303 (92-1). March.

C = USEPA. ECAO. 1994. Risk Assessment Issue Paper for: Derivation of a Provisional Chronic Inhalation RfC for Benzene. (CASRN 71-43-2). March 23.

D = USEPA. ECAO. 1994. Risk Assessment Issue Paper for: Derivation of a Provisional Chronic Inhalation RfC for Carbon Tetrachloride (CASRN 56-23-5). April 11.

E = Oral cancer slope factor used as the inhalation cancer slope factor.

F = ENVIRON derived based on 1,3-dichloropropene (total) [542-75-67].

G = ENVIRON derived based on analogy to 1,2-dichlorobenzene [95-50-1].

TABLE B-2
Soil Concentration Due to Deposition

Equation

$$Sc = \frac{Dyd + Dyw}{Z \cdot BD \cdot ks} \cdot [1.0 - \exp(-ks \cdot Tc)] \cdot 100$$

Parameter			Value
Sc	=	Soil concentration of pollutant after total time period of deposition (mg/kg)	
Dyd	=	Yearly dry deposition rate of pollutant ($g/m^2/yr$)	modeled (see Table A-1)
Dyw	=	Yearly wet deposition rate of pollutant ($g/m^2/yr$)	modeled (see Table A-1)
ks	=	soil loss constant (yr^{-1})	calculated (see Tables B-3, B-5)
Tc	=	Total time period over which deposition occurs (yr)	30
100	=	Units conversion factor ($[mg\text{-}m^2]/[kg\text{-}cm^2]$)	
Z	=	Soil mixing depth (cm)	Pathway Specific; 1 for soil, milk, beef, and aboveground vegetables; 20 for root vegetables
BD	=	Soil bulk density (g/cm^3)	1.5

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	Lead

Description

This equation is used to calculate soil concentration as a result of wet and dry deposition onto soil. Contaminants are assumed to be incorporated only to a finite depth (the mixing depth, Z). The equation should be used when the soil loss term, ks, is not zero.

Source

SLRA Guidance page C-4-15 and errata dated 10/14/94.

TABLE B-3
Loss Constant Due to Leaching

Equation

$$ksl = \frac{P + I - R - EV}{Z \cdot (\Theta_s + Kd_s \cdot BD)}$$

Parameter			Value
ksl	=	Loss constant due to leaching (yr^{-1})	
P	=	Average annual precipitation (cm/yr)	19
I	=	Average annual irrigation (cm/yr)	70
R	=	Average annual surface runoff (cm/yr)	3
EV	=	Average annual evapotranspiration (cm/yr)	60
Z	=	Soil mixing depth (cm)	1
Θ_s	=	Volumetric soil water content (cm^3/cm^3)	0.2
Kd_s	=	Soil-water partition coefficient (mL/g)	chemical-specific (see Table B-1)
BD	=	Soil bulk density (g/cm^3)	1.5

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene Toxicity Equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin Toxicity Equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	Lead

Description

This equation is used to calculate the soil loss constant, which accounts for the loss of contaminant from soil by several mechanisms.

Source

Errata dated 10/14/94.

TABLE B-4
Loss Constant Due to Surface Runoff

Equation

$$ksr = \frac{R}{Z \cdot (\Theta_s + Kd_s \cdot BD)}$$

Parameter			Value
ksr	=	Loss constant due to surface runoff (yr^{-1})	
R	=	Average annual surface runoff (cm/yr)	3
Z	=	Soil mixing depth (cm)	1
Θ_s	=	Volumetric soil water content (cm^3/cm^3)	0.2
Kd_s	=	Soil-water partition coefficient (mL/g)	chemical-specific (see Table B-1)
BD	=	Soil bulk density (g/cm^3)	1.5

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene Toxicity Equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin Toxicity Equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	Lead

Description

This equation is used to calculate the soil loss constant, which accounts for the loss of contaminant from soil by several mechanisms.

Source

Errata dated 10/14/94.

TABLE B-5
Soil Loss Constant

Equation

$$ks = ksl + kse + ksr + ksg + ksv$$

Parameter			Value
ks	=	Soil loss constant due to all processes (yr^{-1})	
ksl	=	Loss constant due to leaching (yr^{-1})	calculated (see Table B-3)
kse	=	Loss constant due to soil erosion (yr^{-1})	0
ksr	=	Loss constant due to surface runoff (yr^{-1})	calculated (see Table B-4)
ksg	=	Loss constant due to degradation (yr^{-1})	chemical-specific (see Table B-1)
ksv	=	Loss constant due to volatilization (yr^{-1})	0

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene Toxicity Equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin Toxicity Equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	Lead

Description

This equation is used to calculate the soil loss constant, which accounts for the loss of contaminant from soil by several mechanisms.

Source

SLRA Guidance page C-4-10.

TABLE B-6
Aboveground Vegetable Concentration Due to Direct Deposition

Equation

$$Pd = \frac{1000 \cdot [(1.0 - Fv) \cdot Dyd + (Fw \cdot Dyw)] \cdot Rp \cdot [1.0 - \exp(-kp \cdot Tp)]}{Yp \cdot kp}$$

Parameter			Value
Pd	=	Concentration in plant due to direct deposition (mg/kg)	
1000	=	Units conversion factor (mg/g)	
Fv	=	Fraction of air concentration in vapor phase (unitless)	chemical-specific (see Table B-1)
Dyd	=	Yearly dry deposition rate ($g/m^2/yr$)	modeled (see Table A-1)
Fw	=	Fraction of wet deposition that adheres to plant (unitless)	chemical-specific (see Table B-1)
Dyw	=	Yearly wet deposition rate ($g/m^2/yr$)	modeled (see Table A-1)
Rp	=	Interception fraction of edible portion of plant (unitless)	0.04
kp	=	Plant surface loss coefficient (yr^{-1})	18
Tp	=	Length of plant exposure to deposition of edible portion of plant, per harvest (yr)	0.16
Yp	=	Yield or standing crop biomass of the edible portion of the plant ($kg\ DW/m^2$)	1.7

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Description

This equation is used to calculate the contaminant concentration in aboveground vegetation due to wet and dry deposition of contaminants on the plant surface.

Source

SLRA Guidance page C-4-12.

TABLE B-7
Aboveground Vegetable Concentration Due to Air-to-Plant Transfer

Equation

$$Pv = \frac{(Fv \cdot Cy) \cdot (VG_{ab} \cdot Bv)}{\rho_a}$$

Parameter			Value
Pv	=	Concentration of pollutant in the plant due to air-to-plant transfer (mg/kg)	
Fv	=	Fraction of pollutant air concentration present in the vapor phase (unitless)	chemical-specific (see Table B-1)
Cy	=	Concentration of pollutant in air due to direct emissions ($\mu g/m^3$)	modeled (see Table A-1)
VG_{ab}	=	Aboveground vegetable correction factor (unitless)	0.01
Bv	=	Air-to-plant biotransfer factor ([mg pollutant/kg plant tissue DW]/[μg pollutant/g air])	chemical-specific (see Table B-1)
ρ_a	=	Density of air (g/m^3)	1.2×10^3

Chemicals

Benzo(a)pyrene toxicity equivalents	Hexachlorobenzene
Bis(2-ethylhexyl)phthalate	Mercury
1,3-Dinitrobenzene	Nitrobenzene
2,4-Dinitrotoluene	Total PCBs
2,6-Dinitrotoluene	Pentachloronitrobenzene
Di(n)octylphthalate	Pentachlorophenol
	2,3,7,8-TCDDioxin toxicity equivalents

Description

This equation is used to calculate the contaminant concentration in aboveground vegetation due to direct uptake of vapor phase contaminants into the plant leaves.

Source

SLRA Guidance page C-4-13 modified per errata dated 10/14/94.

TABLE B-8
Root Vegetable Concentration Due to Root Uptake

Equation

$$Pr_{bg} = \frac{Sc \cdot (VG_{bg} \cdot RCF)}{Kd_s} \cdot \frac{\mu g \cdot kg}{mg \cdot g}$$

Parameter			Value
Pr_{bg}	=	Concentration of pollutant in below ground plant parts due to root uptake (mg/kg)	
Sc	=	Soil concentration of pollutant (mg/kg)	calculated (see Tables B-2, B-3)
VG_{bg}	=	Below ground vegetable correction factor (unitless)	0.01
RCF	=	Ratio of concentration in roots to concentration in soil pore water ([mg pollutant/kg plant tissue FW]/[μg pollutant/mL pore water])	chemical-specific (see Table B-1)
Kd_s	=	Soil-water partition coefficient (mL/g)	chemical-specific (see Table B-1)

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Description

This equation is used to calculate the contaminant concentration in root vegetables due to uptake from the soil water.

Source

SLRA Guidance page C-4-16 modified per errata dated 10/14/94.

TABLE B-9
Calculations for Subsistence Farmer

Chemical	Sc (mg/kg)	ksl (yr^{-1})	ksr (yr^{-1})	ks (yr^{-1})	Pd (mg/kg)	Pv (mg/kg)	Scbg* (mg/kg)	Prbg (mg/kg)
Antimony	5.85e-03	8.13e+00	9.38e-01	9.06e+00	9.71e-04	0	2.93e-04	4.39e-08
Arsenic	2.11e-04	5.95e-01	6.86e-02	6.64e-01	2.53e-06	0	1.06e-05	2.91e-11
Barium	1.71e+00	3.27e-02	3.77e-03	3.65e-02	1.71e-03	0	8.55e-02	2.42e-08
Beryllium	2.67e-05	2.47e-01	2.85e-02	2.76e-01	1.35e-07	0	1.34e-06	2.86e-13
Benzo(a)pyrene Toxicity Equivalents	2.82e-03	1.44e-03	1.67e-04	1.61e-03	1.07e-06	1.06e-04	1.41e-04	1.88e-07
Bis(2-ethylhexyl)phthalate	7.91e-05	3.77e-04	4.35e-05	4.20e-04	1.04e-08	2.87e-06	3.95e-06	3.87e-09
Cadmium	1.98e-03	1.08e-01	1.25e-02	1.21e-01	4.50e-06	0	9.91e-05	1.98e-10
Chromium (VI)	5.53e-05	9.56e-01	1.10e-01	1.07e+00	1.08e-06	0	2.77e-06	6.92e-12
Dinitrobenzene, 1,3-	2.06e-06	4.19e+01	4.84e+00	4.68e+01	3.02e-08	1.39e-12	1.03e-07	4.60e-09
Dinitrotoluene, 2,4-	5.00e-06	1.73e+01	1.99e+00	1.93e+01	3.02e-08	3.06e-08	2.50e-07	5.47e-09
Dinitrotoluene, 2,6-	4.01e-06	2.16e+01	2.49e+00	2.41e+01	3.02e-08	2.65e-08	2.00e-07	5.08e-09
Di(n)octylphthalate	1.41e-05	9.12e-07	1.05e-07	1.02e-06	1.84e-09	5.26e-03	7.07e-07	1.71e-10
Hexachlorobenzene	1.30e-04	6.19e-03	7.14e-04	6.90e-03	1.50e-09	2.94e-09	6.48e-06	1.20e-08
Mercury	1.08e-01	1.15e-01	1.33e-02	1.29e-01	4.43e-06	3.00e-05	5.39e-03	2.52e-09
Nickel	3.98e-01	2.11e-01	2.44e-02	2.35e-01	1.71e-03	0	1.99e-02	9.70e-09
Nitrobenzene	3.66e-06	2.36e+01	2.73e+00	2.64e+01	3.02e-08	1.43e-10	1.83e-07	4.88e-09
PCBs, Total	3.27e-04	4.03e-03	4.65e-04	4.50e-03	3.64e-09	1.04e-07	1.64e-05	7.99e-08
Pentachloronitrobenzene	1.48e-03	4.56e-02	5.26e-03	5.09e-02	3.02e-08	1.61e-10	7.42e-05	2.15e-07
Pentachlorophenol	2.25e-03	1.58e-02	1.82e-03	1.76e-02	3.02e-08	1.04e-06	1.12e-04	2.56e-07
Selenium	1.63e-01	3.91e+00	4.51e-01	4.36e+00	1.30e-02	0	8.13e-03	3.78e-07
Silver	1.46e-02	3.25e+01	3.75e+00	3.63e+01	9.71e-03	0	7.32e-04	1.83e-06
TCDDioxin Toxicity Equivalents, 2,3,7,8-	9.41e-08	6.93e-04	8.00e-05	7.08e-02	5.68e-11	2.59e-09	4.70e-09	7.34e-12
Thallium (I)	2.03e-02	2.34e-01	2.70e-02	2.61e-01	9.71e-05	0	1.02e-03	5.50e-11
Lead	3.07e-01	2.89e-02	3.33e-03	3.22e-02	0	0	1.53e-02	0

Note:

* Scbg is the soil concentration due to deposition for root vegetables using a soil mixing depth of 20 cm.

TABLE B-10
Calculations for Adult Resident

Chemical	Sc (mg/kg)	ksl (yr^{-1})	ksr (yr^{-1})	ks (yr^{-1})	Pd (mg/kg)	Pv (mg/kg)	Scbg* (mg/kg)	Prbg (mg/kg)
Antimony	5.85e-03	8.13e+00	9.38e-01	9.06e+00	9.71e-04	0	2.93e-04	4.39e-08
Arsenic	2.11e-04	5.95e-01	6.86e-02	6.64e-01	2.53e-06	0	1.06e-05	2.91e-11
Barium	1.71e+00	3.27e-02	3.77e-03	3.65e-02	1.71e-03	0	8.55e-02	2.42e-08
Beryllium	2.67e-05	2.47e-01	2.85e-02	2.76e-01	1.35e-07	0	1.34e-06	2.86e-13
Benzo(a)pyrene Toxicity Equivalents	2.82e-03	1.44e-03	1.67e-04	1.61e-03	1.07e-06	1.06e-04	1.41e-04	1.88e-07
Bis(2-ethylhexyl)phthalate	7.91e-05	3.77e-04	4.35e-05	4.20e-04	1.04e-08	2.87e-06	3.95e-06	3.87e-09
Cadmium	1.98e-03	1.08e-01	1.25e-02	1.21e-01	4.50e-06	0	9.91e-05	1.98e-10
Chromium (VI)	5.53e-05	9.56e-01	1.10e-01	1.07e+00	1.08e-06	0	2.77e-06	6.92e-12
Dinitrobenzene, 1,3-	2.06e-06	4.19e+01	4.84e+00	4.68e+01	3.02e-08	1.39e-12	1.03e-07	4.60e-09
Dinitrotoluene, 2,4-	5.00e-06	1.73e+01	1.99e+00	1.93e+01	3.02e-08	3.06e-08	2.50e-07	5.47e-09
Dinitrotoluene, 2,6-	4.01e-06	2.16e+01	2.49e+00	2.41e+01	3.02e-08	2.65e-08	2.00e-07	5.08e-09
Di(n)octylphthalate	1.41e-05	9.12e-07	1.05e-07	1.02e-06	1.84e-09	5.26e-03	7.07e-07	1.71e-10
Hexachlorobenzene	1.30e-04	6.19e-03	7.14e-04	6.90e-03	1.50e-09	2.94e-09	6.48e-06	1.20e-08
Mercury	1.08e-01	1.15e-01	1.33e-02	1.29e-01	4.43e-06	3.00e-05	5.39e-03	2.52e-09
Nickel	3.98e-01	2.11e-01	2.44e-02	2.35e-01	1.71e-03	0	1.99e-02	9.70e-09
Nitrobenzene	3.66e-06	2.36e+01	2.73e+00	2.64e+01	3.02e-08	1.43e-10	1.83e-07	4.88e-09
PCBs, Total	3.27e-04	4.03e-03	4.65e-04	4.50e-03	3.64e-09	1.04e-07	1.64e-05	7.99e-08
Pentachloronitrobenzene	1.48e-03	4.56e-02	5.26e-03	5.09e-02	3.02e-08	1.61e-10	7.42e-05	2.15e-07
Pentachlorophenol	2.25e-03	1.58e-02	1.82e-03	1.76e-02	3.02e-08	1.04e-06	1.12e-04	2.56e-07
Selenium	1.63e-01	3.91e+00	4.51e-01	4.36e+00	1.30e-02	0	8.13e-03	3.78e-07
Silver	1.46e-02	3.25e+01	3.75e+00	3.63e+01	9.71e-03	0	7.32e-04	1.83e-06
TCDDioxin Toxicity Equivalents, 2,3,7,8-	9.41e-08	6.93e-04	8.00e-05	7.08e-02	5.68e-11	2.59e-09	4.70e-09	7.34e-12
Thallium (I)	2.03e-02	2.34e-01	2.70e-02	2.61e-01	9.71e-05	0	1.02e-03	5.50e-11
Lead	3.07e-01	2.89e-02	3.33e-03	3.22e-02	0	0	1.53e-02	0

Note:

* Scbg is the soil concentration due to deposition for root vegetables using a soil mixing depth of 20 cm.

TABLE B-11
Calculations for Child Resident

Chemical	Sc (mg/kg)	ksl (yr^{-1})	ksr (yr^{-1})	ks (yr^{-1})	Pd (mg/kg)	Pv (mg/kg)	Scbg* (mg/kg)	Prbg (mg/kg)
Antimony	5.85e-03	8.13e+00	9.38e-01	9.06e+00	9.71e-04	0	2.93e-04	4.39e-08
Arsenic	2.11e-04	5.95e-01	6.86e-02	6.64e-01	2.53e-06	0	1.06e-05	2.91e-11
Barium	1.71e+00	3.27e-02	3.77e-03	3.65e-02	1.71e-03	0	8.55e-02	2.42e-08
Beryllium	2.67e-05	2.47e-01	2.85e-02	2.76e-01	1.35e-07	0	1.34e-06	2.86e-13
Benzo(a)pyrene Toxicity Equivalents	2.82e-03	1.44e-03	1.67e-04	1.61e-03	1.07e-06	1.06e-04	1.41e-04	1.88e-07
Bis(2-ethylhexyl)phthalate	7.91e-05	3.77e-04	4.35e-05	4.20e-04	1.04e-08	2.87e-06	3.95e-06	3.87e-09
Cadmium	1.98e-03	1.08e-01	1.25e-02	1.21e-01	4.50e-06	0	9.91e-05	1.98e-10
Chromium (VI)	5.53e-05	9.56e-01	1.10e-01	1.07e+00	1.08e-06	0	2.77e-06	6.92e-12
Dinitrobenzene, 1,3-	2.06e-06	4.19e+01	4.84e+00	4.68e+01	3.02e-08	1.39e-12	1.03e-07	4.60e-09
Dinitrotoluene, 2,4-	5.00e-06	1.73e+01	1.99e+00	1.93e+01	3.02e-08	3.06e-08	2.50e-07	5.47e-09
Dinitrotoluene, 2,6-	4.01e-06	2.16e+01	2.49e+00	2.41e+01	3.02e-08	2.65e-08	2.00e-07	5.08e-09
Di(n)octylphthalate	1.41e-05	9.12e-07	1.05e-07	1.02e-06	1.84e-09	5.26e-03	7.07e-07	1.71e-10
Hexachlorobenzene	1.30e-04	6.19e-03	7.14e-04	6.90e-03	1.50e-09	2.94e-09	6.48e-06	1.20e-08
Mercury	1.08e-01	1.15e-01	1.33e-02	1.29e-01	4.43e-06	3.00e-05	5.39e-03	2.52e-09
Nickel	3.98e-01	2.11e-01	2.44e-02	2.35e-01	1.71e-03	0	1.99e-02	9.70e-09
Nitrobenzene	3.66e-06	2.36e+01	2.73e+00	2.64e+01	3.02e-08	1.43e-10	1.83e-07	4.88e-09
PCBs, Total	3.27e-04	4.03e-03	4.65e-04	4.50e-03	3.64e-09	1.04e-07	1.64e-05	7.99e-08
Pentachloronitrobenzene	1.48e-03	4.56e-02	5.26e-03	5.09e-02	3.02e-08	1.61e-10	7.42e-05	2.15e-07
Pentachlorophenol	2.25e-03	1.58e-02	1.82e-03	1.76e-02	3.02e-08	1.04e-06	1.12e-04	2.56e-07
Selenium	1.63e-01	3.91e+00	4.51e-01	4.36e+00	1.30e-02	0	8.13e-03	3.78e-07
Silver	1.46e-02	3.25e+01	3.75e+00	3.63e+01	9.71e-03	0	7.32e-04	1.83e-06
TCDDioxin Toxicity Equivalents, 2,3,7,8-	9.41e-08	6.93e-04	8.00e-05	7.08e-02	5.68e-11	2.59e-09	4.70e-09	7.34e-12
Thallium (I)	2.03e-02	2.34e-01	2.70e-02	2.61e-01	9.71e-05	0	1.02e-03	5.50e-11
Lead	3.07e-01	2.89e-02	3.33e-03	3.22e-02	2.92e-04	0	1.53e-02	0

Note:

* Scbg is the soil concentration due to deposition for root vegetables using a soil mixing depth of 20 cm.

APPENDIX C

Exposure Calculations for Subsistence Farmer

Each of the equations presented in this appendix was provided in USEPA's *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes* (1994) with modifications to equations and exposure assumptions detailed in the errata entitled *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes: Errata*, revised draft dated October 14, 1994.

TABLE C-1
Aboveground Plant Concentration Due to Direct Deposition

Equation

$$Pd = \frac{1000 \cdot [(1.0 - Fv) \cdot Dyd + (Fw \cdot Dyw)] \cdot Rp \cdot [1.0 - \exp(-kp \cdot Tp)]}{Yp \cdot kp}$$

Parameter			Value
Pd	=	Concentration in plant due to direct deposition (mg/kg)	
1000	=	Units conversion factor (mg/g)	
Fv	=	Fraction of air concentration present in the vapor phase (unitless)	chemical-specific (see Table B-1)
Dyd	=	Yearly dry deposition rate ($g/m^2/yr$)	modeled (see Table A-1)
Fw	=	Fraction of wet deposition that adheres to plant surfaces (unitless)	chemical-specific (see Table B-1)
Dyw	=	Yearly wet deposition rate ($g/m^2/yr$)	modeled (see Table A-1)
Rp	=	Interception fraction of edible portion of the plant tissue (unitless)	0.44
kp	=	Plant surface loss coefficient (yr^{-1})	18
Tp	=	Length of the plant's exposure to deposition per harvest of the edible portion of the plant (yr)	0.12
Yp	=	Yield or standing crop biomass of the edible portion of the plant ($kg\ DW/m^2$)	0.2

Chemicals

Antimony	Mercury
Arsenic	Nickel
Barium	Nitrobenzene
Beryllium	Total PCBs
Benzo(a)pyrene toxicity equivalents	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Hexachlorobenzene	

Description

This equation is used to calculate the contaminant concentration in aboveground vegetation due to wet and dry deposition of contaminants on the plant surface.

Source

SLRA Guidance pages C-2-4 and C-4-12.

TABLE C-2
Aboveground Plant Concentration Due to Air-to-Plant Transfer

Equation

$$Pv = \frac{(Fv \cdot Cy) \cdot (VG_{ab} \cdot Bv)}{\rho_a}$$

Parameter			Value
Pv	=	Concentration of pollutant in the plant due to air-to-plant transfer (mg/kg)	
Fv	=	Fraction of pollutant air concentration present in the vapor phase (unitless)	chemical-specific (see Table B-1)
Cy	=	Concentration of pollutant in air due to direct emissions (μg pollutant/m^3)	modeled (see Table A-1)
VG_{ab}	=	Aboveground vegetable correction factor (unitless)	0.01
Bv	=	Air-to-plant biotransfer factor ([mg pollutant/kg plant tissue DW]/[μg pollutant/g air])	chemical-specific (see Table B-1)
ρ_a	=	Density of air (g/m^2)	1.2 x 10^3

Chemicals

Benzo(a)pyrene toxicity equivalents	Nitrobenzene
1,3-Dinitrobenzene	Total PCBs
2,4-Dinitrotoluene	Pentachloronitrobenzene
2,6-Dinitrotoluene	Pentachlorophenol
Hexachlorobenzene	2,3,7,8-TCDDioxin toxicity equivalents
Mercury	

Description

This equation is used to calculate the contaminant concentration in aboveground vegetation due to direct uptake of vapor phase contaminants into the plant leaves.

Source

SLRA Guidance page C-4-13 modified per errata dated 10/14/94.

TABLE C-3
Beef Concentration Due to Plant and Soil Ingestion

Equation

$$A_{beef} = (F \cdot Qp \cdot P + Qs \cdot Sc) \cdot Ba_{beef}$$

Parameter			Value
A_{beef}	=	Concentration of pollutant in beef (mg/kg)	
F	=	Fraction of plant grown on contaminated soil and eaten by the animal (unitless)	1
Qp	=	Quantity of plant eaten by the animal each day (kg plant tissue DW/day)	8.8
P	=	Total concentration of pollutant in the plant eaten by the animal (mg/kg) = Pd + Pv	calculated (see Tables C-1, C-2)
Qs	=	Quantity of soil eaten by the animal (kg soil/day)	0.4
Sc	=	Soil concentration (mg/kg)	calculated (see Table B-2)
Ba_{beef}	=	Biotransfer factor for beef (day/kg)	chemical-specific (see Table B-1)

Chemicals

Antimony	Mercury
Arsenic	Nickel
Barium	Nitrobenzene
Beryllium	Total PCBs
Benzo(a)pyrene toxicity equivalents	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Hexachlorobenzene	

Description

This equation is used to calculate the concentration of contaminants in beef from ingestion of forage and soil.

Source

SLRA Guidance page C-4-22.

TABLE C-4
Milk Concentration Due to Plant and Soil Ingestion

Equation

$$A_{milk} = (F \cdot Qp \cdot P + Qs \cdot Sc) \cdot Ba_{milk}$$

Parameter			Value
A_{milk}	=	Concentration of pollutant in milk (mg/kg)	
F	=	Fraction of plant grown on contaminated soil and eaten by the animal (unitless)	1
Qp	=	Quantity of plant eaten by the animal each day (kg plant tissue DW/day)	13.2
P	=	Total concentration of pollutant in the plant eaten by the animal (mg/kg) = Pd + Pv	calculated (see Tables C-1, C-2)
Qs	=	Quantity of soil eaten by the animal (kg soil/day)	0.4
Sc	=	Soil concentration (mg/kg)	calculated (see Table B-2)
Ba_{milk}	=	Biotransfer factor for milk (day/kg)	chemical-specific (see Table B-1)

Chemicals

Antimony	Mercury
Arsenic	Nickel
Barium	Nitrobenzene
Beryllium	Total PCBs
Benzo(a)pyrene toxicity equivalents	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Hexachlorobenzene	

Description

This equation is used to calculate the concentration of contaminants in milk from ingestion of forage and soil.

Source

SLRA Guidance page C-4-23 and errata dated 10/14/94.

TABLE C-5
Soil Intake for Subsistence Farmer

Equation

$$I_{soil} = Sc \times CR_{soil} \times F_{soil}$$

Parameter			Value
I_{soil}	=	Daily intake of contaminant from soil (mg/day)	
Sc	=	Soil concentration (mg/kg)	calculated (see Table B-2)
CR_{soil}	=	Consumption rate of soil (kg/day)	0.0001
F_{soil}	=	Fraction of consumed soil contaminated (unitless)	1

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-5.)

TABLE C-6
Aboveground Vegetable Intake for Subsistence Farmer

Equation

$$I_{ag} = (Pd + Pv) \times CR_{ag} \times F_{ag}$$

Parameter			Value
I_{ag}	=	Daily intake of contaminant from aboveground vegetables (mg/day)	
Pd	=	Concentration in aboveground vegetables due to deposition (mg/kg)	calculated (see Table B-6)
Pv	=	Concentration in aboveground vegetables due to air-to-plant transfer (mg/kg)	calculated (see Table B-7)
CR_{bg}	=	Consumption rate of aboveground vegetables (kg/day)	0.024
F_{ag}	=	Fraction of aboveground vegetables contaminated (unitless)	0.95

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-6.

TABLE C-7
Root Vegetable Intake for Subsistence Farmer

Equation

$$I_{bg} = Pr_{bg} \times CR_{bg} \times F_{bg}$$

Parameter			Value
I_{bg}	=	Daily intake of contaminant from root vegetables (mg/day)	
Pr_{bg}	=	Concentration in root vegetables (mg/kg)	calculated (see Table B-8)
CR_{bg}	=	Consumption rate of root vegetables (kg/day)	0.0063
F_{bg}	=	Fraction of root vegetables contaminated (unitless)	0.95

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-6.

TABLE C-8
Beef Intake for Subsistence Farmer

Equation

$$I_{beef} = A_{beef} \times CR_{beef} \times F_{beef}$$

Parameter			Value
I_{beef}	=	Daily intake of contaminant from beef (mg/day)	
A_{beef}	=	Concentration in beef (mg/kg)	calculated (see Table C-3)
CR_{beef}	=	Consumption rate of beef (kg/day)	0.1
F_{beef}	=	Fraction of beef contaminated (unitless)	0.44

Chemicals

Antimony	Mercury
Arsenic	Nickel
Barium	Nitrobenzene
Beryllium	Total PCBs
Benzo(a)pyrene toxicity equivalents	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Hexachlorobenzene	

Source

SLRA Guidance page C-6-7.

TABLE C-9
Milk Intake for Subsistence Farmer

Equation

$$I_{milk} = A_{milk} \times CR_{milk} \times F_{milk}$$

Parameter			Value
I_{milk}	=	Daily intake of contaminant from milk (mg/day)	
A_{milk}	=	Concentration in milk (mg/kg)	calculated (see Table C-4)
CR_{milk}	=	Consumption rate of milk (kg/day)	0.3
F_{milk}	=	Fraction of milk contaminated (unitless)	0.40

Chemicals

Antimony	Mercury
Arsenic	Nickel
Barium	Nitrobenzene
Beryllium	Total PCBs
Benzo(a)pyrene toxicity equivalents	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Hexachlorobenzene	

Source

SLRA Guidance page C-6-7.

TABLE C-10
Total Daily Intake for Subsistence Farmer

Equation

$$I = I_{soil} + I_{ag} + I_{bg} + I_{beef} + I_{milk}$$

Parameter			Value
I	=	Total daily intake of contaminant (mg/day)	
I_{soil}	=	Daily intake of contaminant from soil (mg/day)	calculated (see Table C-5)
I_{ag}	=	Daily intake of contaminant from aboveground vegetables (mg/day)	calculated (see Table C-6)
I_{bg}	=	Daily intake of contaminant from root vegetables (mg/day)	calculated (see Table C-7)
I_{beef}	=	Daily intake of contaminant from beef (mg/day)	calculated (see Table C-8)
I_{milk}	=	Daily intake of contaminant from milk (mg/day)	calculated (see Table C-9)

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-8.

TABLE C-11
Average Daily Intake via Inhalation for Subsistence Farmer

Equation

$$ADI(inh)_{ij} = \frac{C(air)_{ij} \times IR_j \times ET \times EF \times ED_j \times 0.001}{BW_j \times AT}$$

Parameter			Value
$ADI(inh)_{i,j}$	=	Average daily intake via inhalation (mg/kg-day) for chemical i in exposure scenario j	i = 1..m j = 1..3
$C(air)_{i,j}$	=	Ambient air concentration ($\mu g/m^3$, from COMPDEP) for chemical i in exposure scenario j	i = 1..m j = 1..3
IR_j	=	Inhalation rate (m^3/hr)	1
ET	=	Exposure time (hr/day)	24
EF	=	Exposure frequency (day/yr)	350
ED_j	=	Exposure duration (years) for exposure scenario j	j = 1..3
BW_j	=	Body weight (kg) for exposure scenario j	j = 1..3
AT	=	Averaging time (days)	25,550
0.001	=	Units conversion factor ($mg/\mu g$)	

Description

The lifetime individual cancer risk is calculated from the average daily intake via inhalation (ADI). The ADI is calculated for each exposure scenario.

Source

SLRA Guidance pages C-6-42 and C-6-43.

TABLE C-12 Calculations (mg/kg) for Subsistence Farmer				
Chemical	Pd_{cattle}	Pv_{cattle}	A_{beef}	A_{milk}
Antimony	8.51e-02	0	7.51e-04	1.13e-04
Arsenic	2.22e-04	0	4.08e-06	1.81e-05
Barium	1.50e-01	0	3.01e-04	9.34e-04
Beryllium	1.18e-05	0	1.15e-07	1.33e-10
Benzo(a)pyrene Toxicity Equivalents	9.38e-05	1.06e-04	9.82e-05	4.15e-05
Bis(2-ethylhexyl)phthalate	0	0	0	0
Cadmium	3.94e-04	0	5.12e-04	4.56e-05
Chromium (VI)	9.46e-05	0	4.70e-06	1.65e-06
Dinitrobenzene, 1,3-	2.64e-06	1.39e-12	1.90e-11	8.93e-12
Dinitrotoluene, 2,4-	2.64e-06	3.06e-08	6.38e-11	2.95e-11
Dinitrotoluene, 2,6-	2.64e-06	2.65e-08	4.77e-11	2.25e-11
Di(n)octylphthalate	0	0	0	0
Hexachlorobenzene	1.31e-07	2.94e-09	4.24e-07	1.34e-07
Mercury	3.89e-04	3.00e-05	1.17e-02	2.19e-05
Nickel	1.50e-01	0	8.89e-03	2.14e-03
Nitrobenzene	2.64e-06	1.43e-10	4.20e-11	1.96e-11
PCBs, Total	3.19e-07	1.04e-07	6.73e-06	2.18e-06
Pentachloronitrobenzene	2.64e-06	1.61e-10	6.78e-07	2.20e-07
Pentachlorophenol	2.64e-06	1.04e-06	2.80e-06	9.10e-07
Selenium	1.14e+00	0	1.51e-01	6.03e-02
Silver	8.51e-01	0	2.25e-02	2.25e-01
TCDDioxin Toxicity Equivalents, 2,3,7,8-	4.97e-09	2.59e-09	1.15e-08	4.81e-09
Thallium (I)	8.51e-03	0	3.32e-03	2.41e-04
Lead	0	0	0	0

TABLE C-13
Intake Calculations (mg/day) for Subsistence Farmer

Chemical	I_{soil}	I_{ag}	I_{bg}	I_{beef}	I_{milk}	I
Antimony	5.85e-0	2.21e-05	2.63e-10	3.30e-05	1.35e-05	6.93e-05
Arsenic	2.11e-08	5.78e-08	1.74e-13	1.79e-07	2.17e-06	2.43e-06
Barium	1.71e-04	3.91e-05	1.45e-10	1.32e-05	1.12e-04	3.35e-04
Beryllium	2.67e-09	3.07e-09	1.71e-15	5.04e-09	1.60e-11	1.08e-08
Benzo(a)pyrene Toxicity Equivalents	2.82e-07	2.44e-06	1.13e-09	4.32e-06	4.98e-06	1.20e-05
Bis(2-ethylhexyl)phthalate	7.91e-09	6.58e-08	2.32e-11	0	0	7.37e-08
Cadmium	1.98e-07	1.03e-07	1.19e-12	2.25e-05	5.47e-06	2.83e-05
Chromium (VI)	5.53e-09	2.46e-08	4.14e-14	2.07e-07	1.98e-07	4.35e-07
Dinitrobenzene, 1,3-	2.06e-10	6.87e-10	2.75e-11	8.37e-13	1.07e-12	9.23e-10
Dinitrotoluene, 2,4-	5.00e-10	1.39e-09	3.27e-11	2.81e-12	3.53e-12	1.93e-09
Dinitrotoluene, 2,6-	4.01e-10	1.29e-09	3.04e-11	2.10e-12	2.70e-12	1.73e-09
Di(n)octylphthalate	1.41e-09	1.20e-04	1.02e-12	0	0	1.20e-04
Hexachlorobenzene	1.30e-08	1.01e-10	7.21e-11	1.87e-08	1.61e-08	4.79e-08
Mercury	1.08e-05	7.85e-07	1.51e-11	5.15e-04	2.63e-06	5.29e-04
Nickel	3.98e-05	3.91e-05	5.81e-11	3.91e-04	2.57e-04	7.27e-04
Nitrobenzene	3.66e-10	6.91e-10	2.92e-11	1.85e-12	2.36e-12	1.09e-09
PCBs, Total	3.27e-08	2.44e-09	4.78e-10	2.96e-07	2.62e-07	5.93e-07
Pentachloronitrobenzene	1.48e-07	6.91e-10	1.29e-09	2.99e-08	2.64e-08	2.07e-07
Pentachlorophenol	2.25e-07	2.44e-08	1.53e-09	1.23e-07	1.09e-07	4.83e-07
Selenium	1.63e-05	2.96e-04	2.26e-09	6.65e-03	7.24e-03	1.42e-02
Silver	1.46e-06	2.21e-04	1.09e-08	9.89e-04	2.70e-02	2.82e-02
TCDDioxin Toxicity Equivalents, 2,3,7,8-	9.41e-12	6.04e-11	4.39e-14	5.04e-10	5.78e-10	1.15e-09
Thallium (I)	2.03e-06	2.21e-06	3.29e-13	1.46e-04	2.89e-05	1.79e-04
Lead	0	0	0	0	0	0

TABLE C-14 Average Daily Intake Via Inhalation for Subsistence Farmer	
Chemical	ADI (mg/kg-day)
INDIRECT EXPOSURE	
Antimony	2.53e-06
Arsenic	6.68e-09
Barium	4.47e-06
Beryllium	3.51e-10
Benzo(a)pyrene Toxicity Equivalents	4.60e-09
Bis(2-ethylhexyl)phthalate	1.27e-10
Cadmium	1.17e-08
Chromium (VI)	2.82e-09
Dinitrobenzene, 1,3-	4.60e-09
Dinitrotoluene, 2,4-	4.60e-09
Dinitrotoluene, 2,6-	4.60e-09
Di(n)octylphthalate	2.25e-11
Hexachlorobenzene	2.28e-10
Mercury	6.77e-07
Nickel	4.47e-06
Nitrobenzene	4.60e-09
PCBs, Total	5.56e-10
Pentachloronitrobenzene	4.60e-09
Pentachlorophenol	4.60e-09
Selenium	3.38e-05
Silver	2.53e-05
TCDDioxin Toxicity Equivalents, 2,3,7,8-	3.61e-13
Thallium (I)	2.53e-07
Lead	7.61e-07
DIRECT EXPOSURE	
Acetone	4.60e-09
Acrylamide	4.60e-09
Acrylonitrile	4.60e-09
Benzene	4.60e-09
Benzoic Acid	2.11e-09
Bromodichloromethane	2.40e-10
Bromoform	2.73e-09
Bromomethane	1.34e-10
Butyl Alcohol	4.60e-09
Butylbenzylphthalate	4.00e-11

TABLE C-14 Average Daily Intake Via Inhalation for Subsistence Farmer	
Chemical	ADI (mg/kg-day)
Carbon Disulfide	4.60e-09
Carbon Tetrachloride	4.60e-09
Chlorobenzene	4.60e-09
Chloroform	2.77e-09
Chloromethane	1.30e-09
Creosote	4.60e-09
Cresols	4.60e-09
Cresylic Acid	4.60e-09
Cyclohexanone	4.60e-09
Dibromochloromethane	1.85e-09
Dichlorobenzene, 1,2-	5.86e-11
Dichlorobenzene, 1,3-	5.31e-11
Dichlorobenzene, 1,4-	4.58e-11
Dichloroethane, 1,1-	4.47e-11
Dichloroethane, 1,2-	2.28e-10
Dichloroethylene, 1,1-	1.53e-10
Dichloroethylene, 1,2-	9.75e-10
Dichlorophenol, 2,4-	5.39e-11
Dichloropropene, cis-1,3-	9.70e-11
Dichloropropene, trans-1,3-	7.91e-11
Dimethylphthalate	2.51e-11
Di-n-butylphthalate	6.81e-11
Ethoxyethanol, 2-	4.60e-09
Ethyl Acetate	4.60e-09
Ethyl Benzene	4.60e-09
Ethyl Ether	4.60e-09
Hexachlorocyclopentadiene	3.23e-10
Isobutanol	4.60e-09
MEK	4.60e-09
Methanol	4.60e-09
Methylene chloride	4.60e-09
Methylnaphthalene, 2-	3.95e-11
Naphthalene	7.42e-11
Nitropropane, 2-	4.60e-09
Orthodichlorobenzene	4.60e-09
Phenol	4.52e-11

TABLE C-14 Average Daily Intake Via Inhalation for Subsistence Farmer	
Chemical	**ADI (mg/kg-day)**
Pyridine	4.60e-09
Tetrachloroethylene	4.60e-09
Toluene	4.60e-09
Trichlorobenzene, 1,2,4-	1.21e-10
Trichloroethane, 1,1,1-	4.60e-09
Trichloroethane, 1,1,2-	4.60e-09
Trichloroethylene	4.60e-09
Trichlorofluoromethane	5.65e-11
Trichlorophenol, 2,4,6-	3.12e-10
Trichlorotrifluoranthene	4.60e-09
Trichlorotrifluoroethane	4.60e-09
Vinyl Chloride	5.22e-10
Xylene	4.60e-09

APPENDIX D

Exposure Calculations for Adult Resident

Each of the equations presented in this appendix was provided in USEPA's *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes* (1994) with modifications to equations and exposure assumptions detailed in the errata entitled *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes: Errata*, revised draft dated October 14, 1994.

TABLE D-1
Soil Intake for Adult Resident

Equation

$$I_{soil} = Sc \times CR_{soil} \times F_{soil}$$

Parameter			Value
I_{soil}	=	Daily intake of contaminant from soil (mg/day)	
Sc	=	Soil concentration (mg/kg)	calculated (see Table B-2)
CR_{soil}	=	Consumption rate of soil (kg/day)	0.0001
F_{soil}	=	Fraction of consumed soil contaminated (unitless)	1

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-25.

TABLE D-2
Aboveground Vegetable Intake for Adult Resident

Equation

$$I_{ag} = (Pd + Pv) \times CR_{ag} \times F_{ag}$$

Parameter			Value
I_{ag}	=	Daily intake of contaminant from aboveground vegetables (mg/day)	
Pd	=	Concentration in aboveground vegetables due to deposition (mg/kg)	calculated (see Table B-6)
Pv	=	Concentration in aboveground vegetables due to air-to-plant transfer (mg/kg)	calculated (see Table B-7)
CR_{ag}	=	Consumption rate of aboveground vegetables (kg/day)	0.024
F_{ag}	=	Fraction of aboveground vegetables contaminated (unitless)	0.25

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-26.

TABLE D-3
Root Vegetable Intake for Adult Resident

Equation

$$I_{bg} = Pr_{bg} \times CR_{bg} \times F_{bg}$$

Parameter			Value
I_{bg}	=	Daily intake of contaminant from root vegetables (mg/day)	
Pr_{bg}	=	Concentration in root vegetables (mg/kg)	calculated (see Table B-8)
CR_{bg}	=	Consumption rate of root vegetables (kg/day)	0.0063
F_{bg}	=	Fraction of root vegetables contaminated (unitless)	0.25

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-26.

TABLE D-4
Total Daily Intake for Adult Resident

Equation

$$I = I_{soil} + I_{ag} + I_{bg}$$

Parameter			Value
I	=	Total daily intake of contaminant (mg/day)	
I_{soil}	=	Daily intake of contaminant from soil (mg/day)	calculated (see Table D-1)
I_{ag}	=	Daily intake of contaminant from aboveground vegetables (mg/day)	calculated (see Table D-2)
I_{bg}	=	Daily intake of contaminant from root vegetables (mg/day)	calculated (see Table D-3)

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-27.

TABLE D-5
Average Daily Intake via Inhalation

Equation

$$ADI(inh)_{ij} = \frac{C(air)_{ij} \times IR_j \times ET \times EF \times ED_j \times 0.001}{BW_j \times AT}$$

Parameter			Value
$ADI(inh)_{ij}$	=	Average daily intake via inhalation (mg/kg-day) for chemical i in exposure scenario j	i = 1..m j = 1..3
$C(air)_{ij}$	=	Ambient air concentration ($\mu g/m^3$, from COMPDEP) for chemical i in exposure scenario j	i = 1..m j = 1..3
IR_j	=	Inhalation rate (m^3/hr)	1
ET	=	Exposure time (hr/day)	24
EF	=	Exposure frequency (day/yr)	350
ED_j	=	Exposure duration (years) for exposure scenario j	j = 1..3
BW_j	=	Body weight (kg) for exposure scenario j	j = 1..3
AT	=	Averaging time (day)	25,550
0.001	=	Units conversion factor (mg/μg)	

Description

The lifetime individual cancer risk is calculated from the average daily intake via inhalation (ADI). The ADI is calculated for each exposure scenario.

Source

SLRA Guidance pages C-6-42 and C-6-43.

TABLE D-6 Intake Calculations (mg/day) for Adult Resident				
Chemical	I_{soil}	I_{ag}	I_{bg}	I
Antimony	5.85e-07	5.82e-06	6.92e-11	6.41e-06
Arsenic	2.11e-08	1.52e-08	4.59e-14	3.63e-08
Barium	1.71e-04	1.03e-05	3.81e-11	1.81e-04
Beryllium	2.67e-09	8.08e-10	4.51e-16	3.48e-09
Benzo(a)pyrene Toxicity Equivalents	2.82e-07	6.43e-07	2.97e-10	9.26e-07
Bis(2-ethylhexyl)phthalate	7.91e-09	1.73e-08	6.09e-12	2.52e-08
Cadmium	1.98e-07	2.70e-08	3.12e-13	2.25e-07
Chromium (VI)	5.53e-09	6.48e-09	1.09e-14	1.20e-08
Dinitrobenzene, 1,3-	2.06e-10	1.81e-10	7.25e-12	3.94e-10
Dinitrotoluene, 2,4-	5.00e-10	3.65e-10	8.61e-12	8.74e-10
Dinitrotoluene, 2,6-	4.01e-10	3.40e-10	8.01e-12	7.49e-10
Di(n)octylphthalate	1.41e-09	3.16e-05	2.69e-13	3.16e-05
Hexachlorobenzene	1.30e-08	2.66e-11	1.90e-11	1.30e-08
Mercury	1.08e-05	2.07e-07	3.96e-12	1.10e-05
Nickel	3.98e-05	1.03e-05	1.53e-11	5.01e-05
Nitrobenzene	3.66e-10	1.82e-10	7.68e-12	5.55e-10
PCBs, Total	3.27e-08	6.43e-10	1.26e-10	3.35e-08
Pentachloronitrobenzene	1.48e-07	1.82e-10	3.38e-10	1.49e-07
Pentachlorophenol	2.25e-07	6.43e-09	4.02e-10	2.32e-07
Selenium	1.63e-05	7.78e-05	5.96e-10	9.41e-05
Silver	1.46e-06	5.82e-05	2.88e-09	5.97e-05
TCDDioxin Toxicity Equivalents, 2,3,7,8-	9.41e-12	1.59e-11	1.16e-14	2.53e-11
Thallium (I)	2.03e-06	5.82e-07	8.66e-14	2.62e-06
Lead	0	0	0	0

TABLE D-7 Average Daily Intake Via Inhalation for Adult Resident	
Chemical	ADI (mg/kg-day)
INDIRECT EXPOSURE	
Antimony	1.90e-06
Arsenic	5.01e-09
Barium	3.35e-06
Beryllium	2.64e-10
Benzo(a)pyrene Toxicity Equivalents	3.45e-09
Bis(2-ethylhexyl)phthalate	9.49e-11
Cadmium	8.80e-09
Chromium (VI)	2.11e-09
Dinitrobenzene, 1,3-	3.45e-09
Dinitrotoluene, 2,4-	3.45e-09
Dinitrotoluene, 2,6-	3.45e-09
Di(n)octylphthalate	1.69e-11
Hexachlorobenzene	1.71e-10
Mercury	5.08e-07
Nickel	3.35e-06
Nitrobenzene	3.45e-09
PCBs, Total	4.17e-10
Pentachloronitrobenzene	3.45e-09
Pentachlorophenol	3.45e-09
Selenium	2.54e-05
Silver	1.90e-05
TCDDioxin Toxicity Equivalents, 2,3,7,8-	2.71e-13
Thallium (I)	1.90e-07
Lead	5.71e-07
DIRECT EXPOSURE	
Acetone	3.45e-09
Acrylamide	3.45e-09
Acrylonitrile	3.45e-09
Benzene	3.45e-09
Benzoic Acid	1.58e-09
Bromodichloromethane	1.80e-10
Bromoform	2.05e-09
Bromomethane	1.00e-10
Butyl Alcohol	3.45e-09
Butylbenzylphthalate	3.00e-11

TABLE D-7 Average Daily Intake Via Inhalation for Adult Resident	
Chemical	ADI (mg/kg-day)
Carbon Disulfide	3.45e-09
Carbon Tetrachloride	3.45e-09
Chlorobenzene	3.45e-09
Chloroform	2.08e-09
Chloromethane	9.76e-10
Creosote	3.45e-09
Cresols	3.45e-09
Cresylic Acid	3.45e-09
Cyclohexanone	3.45e-09
Dibromochloromethane	1.38e-09
Dichlorobenzene, 1,2-	4.39e-11
Dichlorobenzene, 1,3-	3.98e-11
Dichlorobenzene, 1,4-	3.43e-11
Dichloroethane, 1,1-	3.35e-11
Dichloroethane, 1,2-	1.71e-10
Dichloroethylene, 1,1-	1.14e-10
Dichloroethylene, 1,2-	7.31e-10
Dichlorophenol, 2,4-	4.05e-11
Dichloropropene, cis-1,3-	7.28e-11
Dichloropropene, trans-1,3-	5.94e-11
Dimethylphthalate	1.88e-11
Di-n-butylphthalate	5.11e-11
Ethoxyethanol, 2-	3.45e-09
Ethyl Acetate	3.45e-09
Ethyl Benzene	3.45e-09
Ethyl Ether	3.45e-09
Hexachlorocyclopentadiene	2.42e-10
Isobutanol	3.45e-09
MEK	3.45e-09
Methanol	3.45e-09
Methylene chloride	3.45e-09
Methylnaphthalene, 2-	2.96e-11
Naphthalene	5.56e-11
Nitropropane, 2-	3.45e-09
Orthodichlorobenzene	3.45e-09
Phenol	3.39e-11

TABLE D-7 Average Daily Intake Via Inhalation for Adult Resident	
Chemical	**ADI (mg/kg-day)**
Pyridine	3.45e-09
Tetrachloroethylene	3.45e-09
Toluene	3.45e-09
Trichlorobenzene, 1,2,4-	9.05e-11
Trichloroethane, 1,1,1-	3.45e-09
Trichloroethane, 1,1,2-	3.45e-09
Trichloroethylene	3.45e-09
Trichlorofluoromethane	4.24e-11
Trichlorophenol, 2,4,6-	2.34e-10
Trichlorotrifluoranthene	3.45e-09
Trichlorotrifluoroethane	3.45e-09
Vinyl Chloride	3.91e-10
Xylene	3.45e-09

APPENDIX E

Exposure Calculations for Child Resident

Each of the equations presented in this appendix was provided in USEPA's *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes* (1994) with modifications to equations and exposure assumptions detailed in the errata entitled *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes: Errata*, revised draft dated October 14, 1994.

TABLE E-1
Soil Intake for Child Resident

Equation

$$I_{soil} = Sc \times CR_{soil} \times F_{soil}$$

Parameter			Value
I_{soil}	=	Daily intake of contaminant from soil (mg/day)	
Sc	=	Soil concentration (mg/kg)	calculated (see Table B-2)
CR_{soil}	=	Consumption rate of soil (kg/day)	0.0002
F_{soil}	=	Fraction of consumed soil contaminated (unitless)	1

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-34.

TABLE E-2
Aboveground Vegetable Intake for Child Resident

Equation

$$I_{ag} = (Pd + Pv) \times CR_{ag} \times F_{ag}$$

Parameter			Value
I_{ag}	=	Daily intake of contaminant from aboveground vegetables (mg/day)	
Pd	=	Concentration in aboveground vegetables due to deposition (mg/kg)	calculated (see Table B-6)
Pv	=	Concentration in aboveground vegetables due to deposition (mg/kg)	calculated (see Table B-7)
CR_{ag}	=	Consumption rate of aboveground vegetables (kg/day)	0.005
F_{ag}	=	Fraction of aboveground vegetables contaminated (unitless)	0.25

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-35.

TABLE E-3
Root Vegetable Intake for Child Resident

Equation

$$I_{bg} = Pr_{bg} \times CR_{bg} \times F_{bg}$$

Parameter			Value
I_{bg}	=	Daily intake of contaminant from root vegetables (mg/day)	
Pr_{bg}	=	Concentration in root vegetables (mg/kg)	calculated (see Table B-8)
CR_{bg}	=	Consumption rate of root vegetables (kg/day)	0.0014
F_{bg}	=	Fraction of root vegetables contaminated (unitless)	0.25

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-35.

TABLE E-4
Total Daily Intake for Child Resident

Equation

$$I = I_{soil} + I_{ag} + I_{bg}$$

Parameter			Value
I	=	Total daily intake of contaminant (mg/day)	
I_{soil}	=	Daily intake of contaminant from soil (mg/day)	calculated (see Table E-1)
I_{ag}	=	Daily intake of contaminant from aboveground vegetables (mg/day)	calculated (see Table E-2)
I_{bg}	=	Daily intake of contaminant from root vegetables (mg/day)	calculated (see Table E-3)

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Benzo(a)pyrene toxicity equivalents	Total PCBs
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
1,3-Dinitrobenzene	Silver
2,4-Dinitrotoluene	2,3,7,8-TCDDioxin toxicity equivalents
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-36.

TABLE E-5
Average Daily Intake via Inhalation

Equation

$$ADI(inh)_{ij} = \frac{C(air)_{ij} \times IR_j \times ET \times EF \times ED_j \times 0.001}{BW_j \times AT}$$

Parameter			Value
$ADI(inh)_{i,j}$	=	Average daily intake via inhalation (mg/kg-day) for chemical i in exposure scenario j	i = 1..m j = 1..3
$C(air)_{i,j}$	=	Ambient air concentration ($\mu g/m^3$, from COMPDEP) for chemical i in exposure scenario j	i = 1..m j = 1..3
IR_j	=	Inhalation rate (m^3/hr)	0.2
ET	=	Exposure time (hr/day)	24
EF	=	Exposure frequency (day/yr)	350
ED_j	=	Exposure duration (years) for exposure scenario j	j = 1..3
BW_j	=	Body weight (kg) for exposure scenario j	j = 1..3
AT	=	Averaging time (day)	25,550
0.001	=	Units conversion factor (mg/μg)	

Description

The lifetime individual cancer risk is calculated from the average daily intake via inhalation (ADI). The ADI is calculated for each exposure scenario.

Source

SLRA Guidance pages C-6-42 and C-6-43.

TABLE E-6 Intake Values (mg/day) for Child Resident				
Chemical	I_{soil}	I_{ag}	I_{bg}	I
Antimony	1.17e-06	1.21e-06	1.54e-11	2.38e-06
Arsenic	4.22e-08	3.17e-09	1.02e-14	4.54e-08
Barium	3.42e-04	2.14e-06	8.47e-12	3.44e-04
Beryllium	5.34e-09	1.68e-10	1.00e-16	5.51e-09
Benzo(a)pyrene Toxicity Equivalents	5.65e-07	1.34e-07	6.59e-11	6.99e-07
Bis(2-ethylhexyl)phthalate	1.58e-08	3.61e-09	1.35e-12	1.94e-08
Cadmium	3.97e-07	5.63e-09	6.94e-14	4.02e-07
Chromium (VI)	1.11e-08	1.35e-09	2.42e-15	1.24e-08
Dinitrobenzene, 1,3-	4.12e-10	3.77e-11	1.61e-12	4.52e-10
Dinitrotoluene, 2,4-	1.00e-09	7.60e-11	1.91e-12	1.08e-09
Dinitrotoluene, 2,6-	8.01e-10	7.09e-11	1.78e-12	8.74e-10
Di(n)octylphthalate	2.83e-09	6.58e-06	5.99e-14	6.58e-06
Hexachlorobenzene	2.59e-08	5.54e-12	4.21e-12	2.59e-08
Mercury	2.16e-05	4.31e-08	8.80e-13	2.16e-05
Nickel	7.96e-05	2.14e-06	3.40e-12	8.17e-05
Nitrobenzene	7.32e-10	3.79e-11	1.71e-12	7.71e-10
PCBs, Total	6.54e-08	1.34e-10	2.79e-11	6.56e-08
Pentachloronitrobenzene	2.97e-07	3.79e-11	7.52e-11	2.97e-07
Pentachlorophenol	4.50e-07	1.34e-09	8.94e-11	4.51e-07
Selenium	3.25e-05	1.62e-05	1.32e-10	4.87e-05
Silver	2.93e-06	1.21e-05	6.40e-10	1.51e-05
TCDDioxin Toxicity Equivalents, 2,3,7,8-	1.88e-11	3.31e-12	2.57e-15	2.21e-11
Thallium (I)	4.07e-06	1.21e-07	1.92e-14	4.19e-06
Lead	0	3.65e-07	0	0

TABLE E-7 Average Daily Intake Via Inhalation for Child Resident	
Chemical	ADI (mg/kg-day)
INDIRECT EXPOSURE	
Antimony	3.54e-07
Arsenic	9.36e-10
Barium	6.26e-07
Beryllium	4.92e-11
Benzo(a)pyrene Toxicity Equivalents	6.44e-10
Bis(2-ethylhexyl)phthalate	1.77e-11
Cadmium	1.64e-09
Chromium (VI)	3.94e-10
Dinitrobenzene, 1,3-	6.44e-10
Dinitrotoluene, 2,4-	6.44e-10
Dinitrotoluene, 2,6-	6.44e-10
Di(n)octylphthalate	3.15e-12
Hexachlorobenzene	3.20e-11
Mercury	9.47e-08
Nickel	6.26e-07
Nitrobenzene	6.44e-10
PCBs, Total	7.78e-11
Pentachloronitrobenzene	6.44e-10
Pentachlorophenol	6.44e-10
Selenium	4.74e-06
Silver	3.54e-06
TCDDioxin Toxicity Equivalents, 2,3,7,8-	5.05e-14
Thallium (I)	3.54e-08
Lead	1.06e-07
DIRECT EXPOSURE	
Acetone	6.44e-10
Acrylamide	6.44e-10
Acrylonitrile	6.44e-10
Benzene	6.44e-10
Benzoic Acid	2.95e-10
Bromodichloromethane	3.36e-11
Bromoform	3.83e-10
Bromomethane	1.87e-11
Butyl Alcohol	6.44e-10
Butylbenzylphthalate	5.60e-12

TABLE E-7 Average Daily Intake Via Inhalation for Child Resident	
Chemical	**ADI (mg/kg-day)**
Carbon Disulfide	6.44e-10
Carbon Tetrachloride	6.44e-10
Chlorobenzene	6.44e-10
Chloroform	3.88e-10
Chloromethane	1.82e-10
Creosote	6.44e-10
Cresols	6.44e-10
Cresylic Acid	6.44e-10
Cyclohexanone	6.44e-10
Dibromochloromethane	2.58e-10
Dichlorobenzene, 1,2-	8.20e-12
Dichlorobenzene, 1,3-	7.44e-12
Dichlorobenzene, 1,4-	6.41e-12
Dichloroethane, 1,1-	6.26e-12
Dichloroethane, 1,2-	3.20e-11
Dichloroethylene, 1,1-	2.14e-11
Dichloroethylene, 1,2-	1.36e-10
Dichlorophenol, 2,4-	7.55e-12
Dichloropropene, cis-1,3-	1.36e-11
Dichloropropene, trans-1,3-	1.11e-11
Dimethylphthalate	3.51e-12
Di-n-butylphthalate	9.54e-12
Ethoxyethanol, 2-	6.44e-10
Ethyl Acetate	6.44e-10
Ethyl Benzene	6.44e-10
Ethyl Ether	6.44e-10
Hexachlorocyclopentadiene	4.52e-11
Isobutanol	6.44e-10
MEK	6.44e-10
Methanol	6.44e-10
Methylene chloride	6.44e-10
Methylnaphthalene, 2-	5.53e-12
Naphthalene	1.04e-11
Nitropropane, 2-	6.44e-10
Orthodichlorobenzene	6.44e-10
Phenol	6.33e-12

TABLE E-7 Average Daily Intake Via Inhalation for Child Resident	
Chemical	**ADI (mg/kg-day)**
Pyridine	6.44e-10
Tetrachloroethylene	6.44e-10
Toluene	6.44e-10
Trichlorobenzene, 1,2,4-	1.69e-11
Trichloroethane, 1,1,1-	6.44e-10
Trichloroethane, 1,1,2-	6.44e-10
Trichloroethylene	6.44e-10
Trichlorofluoromethane	7.92e-12
Trichlorophenol, 2,4,6-	4.37e-11
Trichlorotrifluoranthene	6.44e-10
Trichlorotrifluoroethane	6.44e-10
Vinyl Chloride	7.30e-11
Xylene	6.44e-10

APPENDIX F

Risk Calculations

Each of the equations presented in this appendix was provided in USEPA's *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes* (1994) with modifications to equations and exposure assumptions detailed in the errata entitled *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes: Errata*, revised draft dated October 14, 1994.

TABLE F-1
Indirect Cancer Risk for Subsistence Farmer
Carcinogens

Equation

$$Cancer\ Risk = \frac{I \times ED \times EF \times CSF}{BW \times AT \times 365}$$

Parameter			Value
Cancer Risk	=	Individual lifetime cancer risk (unitless)	
I	=	Total daily intake of contaminant (mg/day)	calculated (see Table C-10)
ED	=	Exposure duration (yr)	40
EF	=	Exposure frequency (day/yr)	350
CSF	=	Oral cancer slope factor (per mg/kg-day)	chemical-specific (see Table B-1)
BW	=	Body weight (kg)	70
AT	=	Averaging time (yr)	70
365	=	Units conversion factor (day/yr)	

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Total PCBs
Barium	Nickel
Beryllium	Pentachloronitrobenzene
Benzo(a)pyrene toxicity equivalents	Pentachlorophenol
Bis(2-ethylhexyl)phthalate	Selenium
Cadmium	Silver
Chromium (VI)	2,3,7,8-TCDDioxin toxicity equivalents
2,4-Dinitrotoluene	Thallium (I)
2,6-Dinitrotoluene	

Source

SLRA Guidance page C-6-9.

TABLE F-2
Total Indirect Cancer Risk for Subsistence Farmer
Carcinogens

Equation

$$Total\ Cancer\ Risk = \sum Cancer\ Risk_i$$

Parameter			Value
Total Cancer Risk	=	Total individual lifetime cancer risk for all chemicals (unitless)	
$Cancer\ Risk_i$	=	Individual lifetime cancer risk for chemical carcinogen i (unitless)	calculated (see Table F-1)

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Total PCBs
Barium	Nickel
Beryllium	Pentachloronitrobenzene
Benzo(a)pyrene toxicity equivalents	Pentachlorophenol
Bis(2-ethylhexyl)phthalate	Selenium
Cadmium	Silver
Chromium (VI)	2,3,7,8-TCDDioxin toxicity equivalents
2,4-Dinitrotoluene	Thallium (I)
2,6-Dinitrotoluene	

Source

SLRA Guidance page C-6-11.

TABLE F-3
Direct Cancer Risk for Subsistence Farmer
Carcinogens

Equation

$$Cancer\ Risk(inh)_{ij} = ADI(inh)_{ij} \times CSF(inh)_i$$

Parameter			Value
Cancer Risk$(inh)_{i,j}$	=	Excess lifetime cancer risk via inhalation (unitless) for chemical i in exposure scenario j	i = 1..m j = 1..3
ADI$(inh)_{i,j}$	=	Average daily intake via inhalation (mg/kg-day) for chemical i in exposure scenario j	i = 1..m j = 1..3
CSF$(inh)_i$	=	Inhalation carcinogenic slope factor (per mg/kg-day) for chemical i	i = 1..m

Description

The excess lifetime individual cancer risk is calculated from the carcinogenic slope factor (CSF) and the average daily intake via inhalation (ADI) for each exposure scenario.

Source

SLRA Guidance page C-6-43.

TABLE F-4
Total Direct Cancer Risk for Subsistence Farmer Carcinogens

Equation

$$Total\,Cancer\,Risk(inh)_j = \sum Cancer\,Risk(inh)_{ij}$$

Parameter			Value
Total Cancer Risk(inh)$_j$	=	Total excess lifetime cancer risk via inhalation (unitless) for exposure scenario j	j = 1..3
Cancer Risk(inh)$_{ij}$	=	Excess lifetime cancer risk via inhalation (unitless) for chemical i in exposure scenario j	i = 1..m+n j = 1..3

Description

The total cancer risk to the individual via inhalation is estimated by summing the lifetime cancer risk for all chemicals that are carcinogens via the inhalation route of exposure.

Source

SLRA Guidance page C-6-44.

TABLE F-5
Overall Direct and Indirect Cancer Risk for Subsistence Farmer Carcinogens

Equation

$$Overall\ Cancer\ Risk_j = Total\ Cancer\ Risk(inh)_j + Total\ Cancer\ Risk(oral)_j$$

Parameter			Value
Overall Cancer Risk$_j$	=	Overall excess lifetime cancer risk via all routes of exposure (unitless), exposure scenario j	j = 1..3
Total Cancer Risk (inh)$_j$	=	Total excess lifetime cancer risk via inhalation (unitless from Table C-15) in exposure scenario j	j = 1..3
Total Cancer Risk(oral)$_j$	=	Total excess lifetime cancer risk via indirect (i.e., oral) exposures (unitless, from Table F-13) in exposure scenario j	j = 1..3

Description

To determine the overall carcinogenic risk from all exposure pathways, both direct inhalation and indirect exposure pathways (as calculated for each exposure scenario in Tables F-3, F-9 and F-14), the total cancer risks for the indirect pathways are added to the total cancer risk via inhalation for each exposure scenario.

Source

SLRA Guidance page C-6-45.

TABLE F-6
Indirect Cancer Risk for Adult Resident
Carcinogens

Equation

$$Cancer\ Risk = \frac{I \times ED \times EF \times CSF}{BW \times AT \times 365}$$

Parameter			Value
Cancer Risk	=	Individual lifetime cancer risk (unitless)	
I	=	Total daily intake of contaminant (mg/day)	calculated (see Table D-4)
ED	=	Exposure duration (yr)	30
EF	=	Exposure frequency (day/yr)	350
CSF	=	Oral cancer slope factor (per mg/kg-day)	chemical-specific (see Table B-1)
BW	=	Body weight (kg)	70
AT	=	Averaging time (yr)	70
365	=	Units conversion factor (day/yr)	

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Nickel
Barium	Total PCBs
Beryllium	Pentachloronitrobenzene
Benzo(a)pyrene toxicity equivalents	Pentachlorophenol
Bis(2-ethylhexyl)phthalate	Selenium
Cadmium	Silver
Chromium (VI)	2,3,7,8-TCDDioxin toxicity equivalents
2,4-Dinitrotoluene	Thallium (I)
2,6-Dinitrotoluene	

Source

SLRA Guidance page C-6-28.

TABLE F-7
Total Indirect Cancer Risk for Adult Resident Carcinogens

Equation

$$Total\ Cancer\ Risk = \sum Cancer\ Risk_i$$

Parameter			Value
Total Cancer Risk	=	Total individual lifetime cancer risk for all chemicals (unitless)	
$Cancer\ Risk_i$	=	Individual lifetime cancer risk for chemical carcinogen i (unitless)	calculated (see Table F-6)

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Nickel
Barium	Total PCBs
Beryllium	Pentachloronitrobenzene
Benzo(a)pyrene toxicity equivalents	Pentachlorophenol
Bis(2-ethylhexyl)phthalate	Selenium
Cadmium	Silver
Chromium (VI)	2,3,7,8-TCDDioxin toxicity equivalents
2,4-Dinitrotoluene	Thallium (I)
2,6-Dinitrotoluene	

Source

SLRA Guidance page C-6-30.

TABLE F-8
Direct Cancer Risk for Adult Resident

Equation

$$Cancer\ Risk(inh)_{ij} = ADI(inh)_{ij} \times CSF(inh)_i$$

Parameter			Value
$Cancer\ Risk(inh)_{ij}$	=	Excess lifetime cancer risk via inhalation (unitless) for chemical i in exposure scenario j	i = 1..m j = 1..3
$ADI(inh)_{ij}$	=	Average daily intake via inhalation (mg/kg-day) for chemical i in exposure scenario j	i = 1..m j = 1..3
$CSF(inh)_i$	=	Inhalation carcinogenic slope factor (per mg/kg-day) for chemical i	i = 1..m

Description

The excess lifetime individual cancer risk is calculated from the carcinogenic slope factor (CSF) and the average daily intake via inhalation (ADI) for each exposure scenario.

Source

SLRA Guidance page C-6-43.

TABLE F-9
Total Direct Cancer Risk for Adult Resident

Equation

$$Total\,Cancer\,Risk(inh)_j = \sum Cancer\,Risk(inh)_{ij}$$

Parameter			Value
Total Cancer Risk(inh)$_j$	=	Total excess lifetime cancer risk via inhalation (unitless) for exposure scenario j	j = 1..3
Cancer Risk(inh)$_{ij}$	=	Excess lifetime cancer risk via inhalation (unitless) for chemical i in exposure scenario j	i = 1..m+n j = 1..3

Description

The total cancer risk to the individual via inhalation is estimated by summing the lifetime cancer risk for all chemicals that are carcinogens via the inhalation route of exposure.

Source

SLRA Guidance page C-6-44.

TABLE F-10
Overall Direct and Indirect Cancer Risk for Adult Resident

Equation

$$Overall\ Cancer\ Risk_j = Total\ Cancer\ Risk(inh)_j + Total\ Cancer\ Risk(oral)_j$$

Parameter			Value
Overall Cancer Risk$_j$	=	Overall excess lifetime cancer risk via all routes of exposure (unitless), exposure scenario j	j = 1..3
Total Cancer Risk (inh)$_j$	=	Total excess lifetime cancer risk via inhalation (unitless from Table C-15) in exposure scenario j	j = 1..3
Total Cancer Risk(oral)$_j$	=	Total excess lifetime cancer risk via indirect (i.e., oral) exposures (unitless, from Table F-13) in exposure scenario j	j = 1..3

Description

To determine the overall carcinogenic risk from all exposure pathways, both direct inhalation and indirect exposure pathways (as calculated for each exposure scenario in Tables F-3, F-9 and F-14), the total cancer risks for the indirect pathways are added to the total cancer risk via inhalation for each exposure scenario.

Source

SLRA Guidance page C-6-45.

TABLE F-11
Cancer Risk for Individual Chemicals for Child Resident Carcinogens

Equation

$$Cancer\ Risk = \frac{I \times ED \times EF \times CSF}{BW \times AT \times 365}$$

Parameter			Value
Cancer Risk	=	Individual lifetime cancer risk (unitless)	
I	=	Total daily intake of contaminant (mg/day)	calculated (see Table E-4)
ED	=	Exposure duration (yr)	6
EF	=	Exposure frequency (day/yr)	350
CSF	=	Oral cancer slope factor (per mg/kg-day)	chemical-specific (see Table B-1)
BW	=	Body weight (kg)	15
AT	=	Averaging time (yr)	70
365	=	Units conversion factor (day/yr)	

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Nickel
Barium	Total PCBs
Beryllium	Pentachloronitrobenzene
Benzo(a)pyrene toxicity equivalents	Pentachlorophenol
Bis(2-ethylhexyl)phthalate	Selenium
Cadmium	Silver
Chromium (VI)	2,3,7,8-TCDDioxin toxicity equivalents
2,4-Dinitrotoluene	Thallium (I)
2,6-Dinitrotoluene	

Source

SLRA Guidance page C-6-37.

TABLE F-12
Total Cancer Risk for Child Resident
Carcinogens

Equation

$$Total\ Cancer\ Risk = \sum CancerRisk_i$$

Parameter			Value
Total Cancer Risk	=	Total individual lifetime cancer risk for all chemicals (unitless)	
$Cancer\ Risk_i$	=	Individual lifetime cancer risk for chemical carcinogen i (unitless)	calculated (see Table F-11)

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Nickel
Barium	Total PCBs
Beryllium	Pentachloronitrobenzene
Benzo(a)pyrene toxicity equivalents	Pentachlorophenol
Bis(2-ethylhexyl)phthalate	Selenium
Cadmium	Silver
Chromium (VI)	2,3,7,8-TCDDioxin toxicity equivalents
2,4-Dinitrotoluene	Thallium (I)
2,6-Dinitrotoluene	

Source

SLRA Guidance page C-6-39.

TABLE F-13
Direct Cancer Risk for Child Resident

Equation

$$Cancer\ Risk(inh)_{ij} = ADI(inh)_{ij} \times CSF(inh)_i$$

Parameter			Value
Cancer Risk(inh)$_{i,j}$	=	Excess lifetime cancer risk via inhalation (unitless) for chemical i in exposure scenario j	i = 1..m j = 1..3
ADI(inh)$_{i,j}$	=	Average daily intake via inhalation (mg/kg-day) for chemical i in exposure scenario j	i = 1..m j = 1..3
CSF(inh)$_i$	=	Inhalation carcinogenic slope factor (per mg/kg-day) for chemical i	i = 1..m

Description

The excess lifetime individual cancer risk is calculated from the carcinogenic slope factor (CSF) and the average daily intake via inhalation (ADI) for each exposure scenario.

Source

SLRA Guidance page C-6-43.

TABLE F-14
Direct Cancer Risk for Child Resident

Equation

$$Total\ Cancer\ Risk(inh)_j = \sum Cancer\ Risk(inh)_{ij}$$

Parameter			Value
Total Cancer Risk(inh)$_j$	=	Total excess lifetime cancer risk via inhalation (unitless) for exposure scenario j	j = 1..3
Cancer Risk(inh)$_{i,j}$	=	Excess lifetime cancer risk via inhalation (unitless) for chemical i in exposure scenario j	i = 1..m+n j = 1..3

Description

The total cancer risk to the individual via inhalation is estimated by summing the lifetime cancer risk for all chemicals that are carcinogens via the inhalation route of exposure.

Source

SLRA Guidance page C-6-44.

TABLE F-15
Overall Direct and Indirect Cancer Risk for Child Resident

Equation

$$Overall\ Cancer\ Risk_j = Total\ Cancer\ Risk(inh)_j + Total\ Cancer\ Risk(oral)_j$$

Parameter			Value
$Overall\ Cancer\ Risk_j$	=	Overall excess lifetime cancer risk via all routes of exposure (unitless), exposure scenario j	j = 1..3
$Total\ Cancer\ Risk\ (inh)_j$	=	Total excess lifetime cancer risk via inhalation (unitless from Table 6-15) in exposure scenario j	j = 1..3
$Total\ Cancer\ Risk(oral)_j$	=	Total excess lifetime cancer risk via indirect (i.e., oral) exposures (unitless, from Table F-13) in exposure scenario j	j = 1..3

Description

To determine the overall carcinogenic risk from all exposure pathways, both direct inhalation and indirect exposure pathways (as calculated for each exposure scenario in Tables F-3, F-9 and F-14), the total cancer risks for the indirect pathways are added to the total cancer risk via inhalation for each exposure scenario.

Source

SLRA Guidance page C-6-45.

TABLE F-16
Hazard Quotient for Individual Chemicals for Subsistence Farmer
Noncarcinogens

Equation

$$HQ = \frac{I}{BW \times RfD}$$

Parameter			Value
HQ	=	Hazard quotient (unitless)	
I	=	Total daily intake of contaminant (mg/day)	calculated (see Table C-10)
BW	=	Body weight (kg)	70
RfD	=	Reference Dose (mg/kg-day)	chemical-specific (see Table B-1)

Chemicals

Antimony	Hexachlorobenzene
Arsenic	Mercury
Barium	Nickel
Beryllium	Nitrobenzene
Bis(2-ethylhexyl)phthalate	Total PCBs
Cadmium	Pentachloronitrobenzene
Chromium (VI)	Pentachlorophenol
1,3-Dinitrobenzene	Selenium
2,4-Dinitrotoluene	Silver
2,6-Dinitrotoluene	Thallium (I)
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-10.

TABLE F-17
Hazard Index for Liver Effects for Subsistence Farmer
Noncarcinogens

Equation

$$HI_{liver} = \sum HQ_i$$

Parameter			Value
HI_{liver}	=	Hazard index for liver effects (unitless)	
HQ_i	=	Hazard quotient for chemical i with liver effects (unitless)	calculated (see Table F-16)

Chemicals

Antimony	Hexachlorobenzene
Barium	Nickel
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-12.

TABLE F-18
Hazard Index for Neurotoxic Effects for Subsistence Farmer
Noncarcinogens

Equation
$HI_{neurotoxic} = \sum HQ_i$

Parameter			Value
$HI_{neurotoxic}$	=	Hazard index for neurotoxic effects (unitless)	
HQ_i	=	Hazard quotient for chemical i with neurotoxic effects (unitless)	calculated (see Table F-16)

Chemicals	
Antimony	2,6-Dinitrotoluene
Barium	Mercury
Cadmium	Nickel
Chromium (VI)	Selenium
2,4-Dinitrotoluene	Silver

Source
SLRA Guidance page C-6-13.

TABLE F-19
Hazard Quotient for Individual Chemicals for Subsistence Farmer Noncarcinogens

Equation

$$HQ(inh)_{ij} = \frac{C(air)_{ij} \times 0.001}{RFC_i}$$

Parameter			Value
$HQ(inh)_{ij}$	=	Hazard quotient via inhalation (unitless) for chemical i in exposure scenario j	i = 1..1 j = 1..3
$C(air)_{ij}$	=	Concentration in air ($\mu g/m^3$, from COMPDEP) for chemical i in exposure scenario j	i = 1..1 j = 1..3
RFC_i	=	Reference concentration (mg/m^3) for chemical i	i = 1..1
0.001	=	Units conversion factor ($mg/\mu g$)	

Description

The hazard quotient for inhalation exposures to chemicals which have noncancer health effects is calculated for each exposure scenario.

Source

SLRA Guidance page C-6-44.

TABLE F-20
Hazard Index for Subsistence Farmer
Noncarcinogens

Equation

$$HI(inh)_{jk} = \sum HQ(inh)_{i,j,k}$$

Parameter			Value
$HQ(inh)_{j,k}$	=	Hazard index via inhalation (unitless) for target organ k in exposure scenario j	k = 1..h j = 1..3
$HQ(inh)_{i,j,k}$	=	Hazard quotient via inhalation (unitless) for target organ k for chemical i in exposure scenario j	k = 1..h i = 1..l j = 1..3

Description

For the screening analysis, the hazard quotients for inhalation exposures to chemicals that affect the same target organ are added together to obtain a hazard index for the target organ. This is done for each exposure scenario.

Source

SLRA Guidance page C-6-44.

TABLE F-21
Hazard Quotient for Individual Chemicals for Adult Resident Noncarcinogens

Equation

$$HQ = \frac{I}{BW \times RfD}$$

Parameter			Value
HQ	=	Hazard quotient (unitless)	
I	=	Total daily intake of contaminant (mg/day)	calculated (see Table D-4)
BW	=	Body weight (kg)	70
RfD	=	Reference Dose (mg/kg-day)	chemical-specific (see Table B-1)

Chemicals

Antimony	Di(n)octylphthalate
Arsenic	Hexachlorobenzene
Barium	Mercury
Beryllium	Nickel
Bis(2-ethylhexyl)phthalate	Nitrobenzene
Cadmium	Pentachloronitrobenzene
Chromium (VI)	Pentachlorophenol
1,3-Dinitrobenzene	Selenium
2,4-Dinitrotoluene	Silver
2,6-Dinitrotoluene	Thallium (I)

Source

SLRA Guidance page C-6-29.

TABLE F-22
Hazard Index for Liver Effects for Adult Resident Noncarcinogens

Equation

$$HI_{liver} = \sum HQ_i$$

Parameter			Value
HI_{liver}	=	Hazard index for liver effects (unitless)	
HQ_i	=	Hazard quotient for chemical i with liver effects (unitless)	calculated (see Table F-21)

Chemicals

Antimony	Hexachlorobenzene
Barium	Nickel
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-31.

TABLE F-23
Hazard Index for Neurotoxic Effects for Adult Resident
Noncarcinogens

Equation

$$HI_{neurotoxic} = \sum HQ_i$$

Parameter			Value
$HI_{neurotoxic}$	=	Hazard index for neurotoxic effects (unitless)	
HQ_i	=	Hazard quotient for chemical i with neurotoxic effects (unitless)	calculated (see Table F-21)

Chemicals

Antimony	2,6-Dinitrotoluene
Barium	Mercury
Cadmium	Nickel
Chromium (VI)	Selenium
2,4-Dinitrotoluene	Silver

Source

SLRA Guidance page C-6-32.

TABLE F-24
Hazard Quotient for Adult Resident
Noncarcinogens

Equation

$$HQ(inh)_{ij} = \frac{C(air)_{ij} \times 0.001}{RFC_i}$$

Parameter			Value
$HQ(inh)_{i,j}$	=	Hazard quotient via inhalation (unitless) for chemical i in exposure scenario j	i = 1..1 j = 1..3
$C(air)_{i,j}$	=	Concentration in air ($\mu g/m^3$, from COMPDEP) for chemical i in exposure scenario j	i = 1..1 j = 1..3
RFC_i	=	Reference concentration (mg/m^3) for chemical i	i = 1..1
0.001	=	Units conversion factor ($mg/\mu g$)	

Description

The hazard quotient for inhalation exposures to chemicals which have noncancer health effects is calculated for each exposure scenario.

Source

SLRA Guidance page C-6-44.

TABLE F-25
Hazard Index for Adult Resident Noncarcinogens

Equation

$$HI(inh)_{jk} = \sum HQ(inh)_{i,j,k}$$

Parameter			Value
$HQ(inh)_{j,k}$	=	Hazard index via inhalation (unitless) for target organ k in exposure scenario j	k = 1..h j = 1..3
$HQ(inh)_{i,j,k}$	=	Hazard quotient via inhalation (unitless) for target organ k for chemical i in exposure scenario j	k = 1..h i = 1..l j = 1..3

Description

For the screening analysis, the hazard quotients for inhalation exposures to chemicals that affect the same target organ are added together to obtain a hazard index for the target organ. This is done for each exposure scenario.

Source

SLRA Guidance page C-6-44.

TABLE F-26
Hazard Quotient for Child Resident
Noncarcinogens

Equation

$$HQ = \frac{I}{BW \times RfD}$$

Parameter			Value
HQ	=	Hazard quotient (unitless)	
I	=	Total daily intake of contaminant (mg/day)	calculated (see Table E-4)
BW	=	Body weight (kg)	15
RfD	=	Reference Dose (mg/kg-day)	chemical-specific (see Table B-1)

Chemicals

Antimony	Di(n)octylphthalate
Arsenic	Hexachlorobenzene
Barium	Mercury
Beryllium	Nickel
Bis(2-ethylhexyl)phthalate	Nitrobenzene
Cadmium	Pentachloronitrobenzene
Chromium (VI)	Pentachlorophenol
1,3-Dinitrobenzene	Selenium
2,4-Dinitrotoluene	Silver
2,6-Dinitrotoluene	Thallium (I)

Source

SLRA Guidance page C-6-38.

TABLE F-27
Hazard Index for Liver Effects for Child Resident
NonCarcinogens

Equation

$$HI_{liver} = \sum HQ_i$$

Parameter			Value
HI_{liver}	=	Hazard index for liver effects (unitless)	
HQ_i	=	Hazard quotient for chemical i with liver effects (unitless)	calculated (see Table F-26)

Chemicals

Antimony	Hexachlorobenzene
Barium	Nickel
Bis(2-ethylhexyl)phthalate	Pentachloronitrobenzene
Cadmium	Pentachlorophenol
Chromium (VI)	Selenium
Di(n)octylphthalate	

Source

SLRA Guidance page C-6-40.

TABLE F-28
Hazard Index for Neurotoxic Effects for Child Resident NonCarcinogens

Equation

$$HI_{neurotoxic} = \sum HQ_i$$

Parameter			Value
$HI_{neurotoxic}$	=	Hazard index for neurotoxic effects (unitless)	
HQ_i	=	Hazard quotient for chemical i with neurotoxic effects (unitless)	calculated (see Table F-26)

Chemicals

Antimony	2,6-Dinitrotoluene
Barium	Mercury
Cadmium	Nickel
Chromium (VI)	Selenium
2,4-Dinitrotoluene	Silver

Source

SLRA Guidance page C-6-41.

TABLE F-29
Hazard Quotient for Child Resident

Equation

$$HQ(inh)_{ij} = \frac{C(air)_{ij} \times 0.001}{RFC_i}$$

Parameter			Value
$HQ(inh)_{i,j}$	=	Hazard quotient via inhalation (unitless) for chemical i in exposure scenario j	i = 1..l j = 1..3
$C(air)_{i,j}$	=	Concentration in air ($\mu g/m^3$, from COMPDEP) for chemical i in exposure scenario j	i = 1..l j = 1..3
RFC_i	=	Reference concentration (mg/m^3) for chemical i	i = 1..l
0.001	=	Units conversion factor ($mg/\mu g$)	

Description

The hazard quotient for inhalation exposures to chemicals which have noncancer health effects is calculated for each exposure scenario.

Source

SLRA Guidance page C-6-44.

TABLE F-30
Hazard Index for Child Resident

Equation

$$HI(inh)_{jk} = \sum HQ(inh)_{i,j,k}$$

Parameter			Value
$HQ(inh)_{j,k}$	=	Hazard index via inhalation (unitless) for target organ k in exposure scenario j	k = 1..h j = 1..3
$HQ(inh)_{i,j,k}$	=	Hazard quotient via inhalation (unitless) for target organ k for chemical i in exposure scenario j	k = 1..h i = 1..l j = 1..3

Description

For the screening analysis, the hazard quotients for inhalation exposures to chemicals that affect the same target organ are added together to obtain a hazard index for the target organ. This is done for each exposure scenario.

Source

SLRA Guidance page C-6-44.

TABLE F-31 Cancer Risk for Subsistence Farmer		
Chemical	Indirect Cancer Risk	Direct Cancer Risk
INDIRECT EXPOSURE		
Antimony	NA	NA
Arsenic	3.33e-08	1.01e-07
Barium	NA	NA
Beryllium	3.64e-10	2.95e-09
Benzo(a)pyrene Toxicity Equivalents	6.87e-07	2.81e-08
Bis(2-ethylhexyl)phthalate	8.08e-12	1.77e-12
Cadmium	NA	7.39e-08
Chromium (VI)	NA	1.15e-07
Dinitrobenzene, 1,3-	NA	NA
Dinitrotoluene, 2,4-	1.02e-11	3.13e-09
Dinitrotoluene, 2,6-	9.20e-12	3.13e-09
Di(n)octylphthalate	NA	NA
Hexachlorobenzene	6.00e-10	3.65e-10
Mercury	NA	NA
Nickel	NA	NA
Nitrobenzene	NA	NA
PCBs, Total	3.58e-08	4.28e-09
Pentachloronitrobenzene	4.20e-10	1.20e-09
Pentachlorophenol	4.54e-10	5.52e-10
Selenium	NA	NA
Silver	NA	NA
TCDDioxin Toxicity Equivalents, 2,3,7,8-	1.41e-06	4.19e-08
Thallium (I)	NA	NA
Lead	NA	NA
DIRECT EXPOSURE		
Acetone	NA	NA
Acrylamide	NA	2.09e-08
Acrylonitrile	NA	1.10e-09
Benzene	NA	1.33e-10
Benzoic Acid	NA	NA
Bromodichloromethane	NA	NA
Bromoform	NA	1.05e-11
Bromomethane	NA	NA

TABLE F-31 Cancer Risk for Subsistence Farmer		
Chemical	Indirect Cancer Risk	Direct Cancer Risk
Butyl Alcohol	NA	NA
Butylbenzylphthalate	NA	NA
Carbon Disulfide	NA	NA
Carbon Tetrachloride	NA	2.44e-10
Chlorobenzene	NA	NA
Chloroform	NA	2.23e-10
Chloromethane	NA	8.20e-12
Creosote	NA	NA
Cresols	NA	NA
Cresylic Acid	NA	NA
Cyclohexanone	NA	NA
Dibromochloromethane	NA	NA
Dichlorobenzene, 1,2-	NA	NA
Dichlorobenzene, 1,3-	NA	NA
Dichlorobenzene, 1,4-	NA	NA
Dichloroethane, 1,1-	NA	NA
Dichloroethane, 1,2-	NA	2.08e-11
Dichloroethylene, 1,1-	NA	2.67e-11
Dichloroethylene, 1,2-	NA	NA
Dichlorophenol, 2,4-	NA	NA
Dichloropropene, cis-1,3-	NA	1.26e-11
Dichloropropene, trans-1,3-	NA	1.03e-11
Dimethylphthalate	NA	NA
Di-n-butylphthalate	NA	NA
Ethoxyethanol, 2-	NA	NA
Ethyl Acetate	NA	NA
Ethyl Benzene	NA	NA
Ethyl Ether	NA	NA
Hexachlorocyclopentadiene	NA	NA
Isobutanol	NA	NA
MEK	NA	NA
Methanol	NA	NA
Methylene chloride	NA	7.55e-12
Methylnaphthalene, 2-	NA	NA
Naphthalene	NA	NA

TABLE F-31 Cancer Risk for Subsistence Farmer		
Chemical	Indirect Cancer Risk	Direct Cancer Risk
Nitropropane, 2-	NA	4.33e-08
Orthodichlorobenzene	NA	NA
Phenol	NA	NA
Pyridine	NA	NA
Tetrachloroethylene	NA	9.20e-12
Toluene	NA	NA
Trichlorobenzene, 1,2,4-	NA	NA
Trichloroethane, 1,1,1-	NA	NA
Trichloroethane, 1,1,2-	NA	2.62e-10
Trichloroethylene	NA	2.76e-11
Trichlorofluoromethane	NA	NA
Trichlorophenol, 2,4,6-	NA	3.4NAe-12
Trichlorotrifluoranthene	NA	NA
Trichlorotrifluoroethane	NA	NA
Vinyl Chloride	NA	1.57e-10
Xylene	NA	NA
	Total Indirect Cancer Risk	Total Direct Cancer Risk
	2.16e-06	4.42e-07
		Overall Cancer Risk
		2.61e-06

Note:

NA = Not Applicable.

TABLE F-32 Cancer Risk for Adult Resident		
Chemical	Indirect Cancer Risk	Direct Cancer Risk
INDIRECT EXPOSURE		
Antimony	NA	NA
Arsenic	3.73e-10	7.57e-08
Barium	NA	NA
Beryllium	8.78e-11	2.21e-09
Benzo(a)pyrene Toxicity Equivalents	3.97e-08	2.11e-08
Bis(2-ethylhexyl)phthalate	2.07e-12	1.33e-12
Cadmium	NA	5.54e-08
Chromium (VI)	NA	8.66e-08
Dinitrobenzene, 1,3-	NA	NA
Dinitrotoluene, 2,4-	3.49e-12	2.35e-09
Dinitrotoluene, 2,6-	2.99e-12	2.35e-09
Di(n)octylphthalate	NA	NA
Hexachlorobenzene	1.22e-10	2.74e-10
Mercury	NA	NA
Nickel	NA	NA
Nitrobenzene	NA	NA
PCBs, Total	1.51e-09	3.21e-09
Pentachloronitrobenzene	2.27e-10	8.97e-10
Pentachlorophenol	1.63e-10	4.14e-10
Selenium	NA	NA
Silver	NA	NA
TCDDioxin Toxicity Equivalents, 2,3,7,8-	2.32e-08	3.14e-08
Thallium (I)	NA	NA
Lead	NA	NA
DIRECT EXPOSURE		
Acetone	NA	NA
Acrylamide	NA	1.57e-08
Acrylonitrile	NA	8.21e-10
Benzene	NA	1.00e-10
Butyl Alcohol	NA	NA
Carbon Disulfide	NA	NA
Carbon Tetrachloride	NA	1.83e-10
Chlorobenzene	NA	NA

TABLE F-32 Cancer Risk for Adult Resident		
Chemical	Indirect Cancer Risk	Direct Cancer Risk
Cresols	NA	NA
Creosote	NA	NA
Cresylic Acid	NA	NA
Cyclohexanone	NA	NA
Ethoxyethanol, 2-	NA	NA
Ethyl Acetate	NA	NA
Ethyl Benzene	NA	NA
Ethyl Ether	NA	NA
Isobutanol	NA	NA
MEK	NA	NA
Methanol	NA	NA
Methylene chloride	NA	5.66e-12
Nitropropane, 2-	NA	3.24e-08
Orthodichlorobenzene	NA	NA
Pyridine	NA	NA
Tetrachloroethylene	NA	6.90e-12
Toluene	NA	NA
Trichloroethane, 1,1,1-	NA	NA
Trichloroethane, 1,1,2-	NA	1.97e-10
Trichloroethylene	NA	2.07e-11
Trichlorotrifluoranthene	NA	NA
Trichlorotrifluoroethane	NA	NA
Xylene	NA	NA
Benzoic Acid	NA	NA
Bromodichloromethane	NA	NA
Bromoform	NA	7.89e-12
Bromomethane	NA	NA
Butylbenzylphthalate	NA	NA
Chloroform	NA	1.67e-10
Chloromethane	NA	6.15e-12
Dibromochloromethane	NA	NA
Dichlorobenzene, 1,2-	NA	NA
Dichlorobenzene, 1,3-	NA	NA
Dichlorobenzene, 1,4-	NA	NA
Dichloroethane, 1,1-	NA	NA

TABLE F-32 Cancer Risk for Adult Resident		
Chemical	Indirect Cancer Risk	Direct Cancer Risk
Dichloroethane, 1,2-	NA	1.56e-11
Dichloroethylene, 1,1-	NA	2.00e-11
Dichloroethylene, 1,2-	NA	NA
Dichlorophenol, 2,4-	NA	NA
Dichloropropene, cis-1,3-	NA	9.46e-12
Dichloropropene, trans-1,3-	NA	7.72e-12
Dimethylphthalate	NA	NA
Di-n-butylphthalate	NA	NA
Hexachlorocyclopentadiene	NA	NA
Methylnaphthalene, 2-	NA	NA
Naphthalene	NA	NA
Phenol	NA	NA
Trichlorobenzene, 1,2,4-	NA	NA
Trichlorofluoromethane	NA	NA
Trichlorophenol, 2,4,6-	NA	2.55e-12
Vinyl Chloride	NA	1.17e-10
	Total Indirect Cancer Risk	Total Direct Cancer Risk
	6.54e-08	3.32e-07
		Overall Cancer Risk
		3.97e-07

Note:

NA = Not Applicable.

TABLE F-33 Cancer Risk for Child Resident		
Chemical	Indirect Cancer Risk	Direct Cancer Risk
INDIRECT EXPOSURE		
Antimony	NA	NA
Arsenic	4.35e-10	1.41e-08
Barium	NA	NA
Beryllium	1.30e-10	4.13e-10
Benzo(a)pyrene Toxicity Equivalents	2.80e-08	3.93e-09
Bis(2-ethylhexyl)phthalate	1.49e-12	2.48e-13
Cadmium	NA	1.04e-08
Chromium (VI)	NA	1.62e-08
Dinitrobenzene, 1,3-	NA	NA
Dinitrotoluene, 2,4-	4.02e-12	4.38e-10
Dinitrotoluene, 2,6-	3.26e-12	4.38e-10
Di(n)octylphthalate	NA	NA
Hexachlorobenzene	2.27e-10	5.11e-11
Mercury	NA	NA
Nickel	NA	NA
Nitrobenzene	v	NA
PCBs, Total	2.77e-09	5.99e-10
Pentachloronitrobenzene	4.23e-10	1.68e-10
Pentachlorophenol	2.97e-10	7.73e-11
Selenium	NA	NA
Silver	NA	NA
TCDDioxin Toxicity Equivalents, 2,3,7,8-	1.89e-08	5.86e-09
Thallium (I)	NA	NA
Lead	NA	NA
DIRECT EXPOSURE		
Acetone	NA	NA
Acrylamide	NA	2.93e-09
Acrylonitrile	NA	1.53e-10
Benzene	NA	1.87e-11
Benzoic Acid	NA	NA
Bromodichloromethane	NA	NA
Bromoform	NA	1.47e-12
Bromomethane	NA	NA

TABLE F-33 Cancer Risk for Child Resident		
Chemical	Indirect Cancer Risk	Direct Cancer Risk
Butyl Alcohol	NA	NA
Butylbenzylphthalate	NA	NA
Carbon Disulfide	NA	NA
Carbon Tetrachloride	NA	3.41e-11
Chlorobenzene	NA	NA
Chloroform	NA	3.12e-11
Chloromethane	NA	1.15e-12
Creosote	NA	NA
Cresols	NA	NA
Cresylic Acid	NA	NA
Cyclohexanone	NA	NA
Dibromochloromethane	NA	NA
Dichlorobenzene, 1,2-	NA	NA
Dichlorobenzene, 1,3-	NA	NA
Dichlorobenzene, 1,4-	NA	NA
Dichloroethane, 1,1-	NA	NA
Dichloroethane, 1,2-	NA	2.91e-12
Dichloroethylene, 1,1-	NA	3.74e-12
Dichloroethylene, 1,2-	NA	NA
Dichlorophenol, 2,4-	NA	NA
Dichloropropene, cis-1,3-	NA	1.77e-12
Dichloropropene, trans-1,3-	NA	1.44e-12
Dimethylphthalate	NA	NA
Di-n-butylphthalate	NA	NA
Ethoxyethanol, 2-	NA	NA
Ethyl Acetate	NA	NA
Ethyl Benzene	NA	NA
Ethyl Ether	NA	NA
Hexachlorocyclopentadiene	NA	NA
Isobutanol	NA	NA
MEK	NA	NA
Methanol	NA	NA
Methylene chloride	NA	1.06e-12
Methylnaphthalene, 2-	NA	NA
Naphthalene	NA	NA

TABLE F-33 Cancer Risk for Child Resident		
Chemical	Indirect Cancer Risk	Direct Cancer Risk
Nitropropane, 2-	NA	6.06e-09
Orthodichlorobenzene	NA	NA
Phenol	NA	NA
Pyridine	NA	NA
Tetrachloroethylene	NA	1.29e-12
Toluene	NA	NA
Trichlorobenzene, 1,2,4-	NA	NA
Trichloroethane, 1,1,1-	NA	NA
Trichloroethane, 1,1,2-	NA	3.67e-11
Trichloroethylene	NA	3.87e-12
Trichlorofluoromethane	NA	NA
Trichlorophenol, 2,4,6-	NA	4.77e-13
Trichlorotrifluoranthene	NA	NA
Trichlorotrifluoroethane	NA	NA
Vinyl Chloride	NA	2.19e-11
Xylene	NA	NA
	Total Indirect Cancer Risk	**Total Direct Cancer Risk**
	5.12e-08	6.19e-08
		Overall Cancer Risk
		1.13e-07

Note:

NA = Not Applicable.

TABLE F-34 Hazard Index for Subsistence Farmer		
Chemical	Indirect HQ	Direct HQ
INDIRECT EXPOSURE		
Antimony	2.47e-03	NA
Arsenic	1.16e-04	NA
Barium	6.84e-05	4.76e-02
Beryllium	3.09e-08	NA
Benzo(a)pyrene Toxicity Equivalents	NA	NA
Bis(2-ethylhexyl)phthalate	5.27e-08	NA
Cadmium	4.04e-04	NA
Chromium (VI)	1.24e-06	NA
Dinitrobenzene, 1,3-	1.32e-07	NA
Dinitrotoluene, 2,4-	1.38e-08	NA
Dinitrotoluene, 2,6-	2.47e-08	NA
Di(n)octylphthalate	8.57e-05	NA
Hexachlorobenzene	8.55e-07	NA
Mercury	2.52e-02	1.20e-02
Nickel	5.19e-03	NA
Nitrobenzene	3.11e-08	1.22e-05
PCBs, Total	NA	NA
Pentachloronitrobenzene	9.84e-07	NA
Pentachlorophenol	2.30e-07	NA
Selenium	4.06e-02	NA
Silver	8.05e-02	NA
TCDDioxin Toxicity Equivalents, 2,3,7,8-	NA	NA
Thallium (I)	3.20e-02	NA
Lead	NA	NA
DIRECT EXPOSURE		
Acetone	NA	NA
Acrylamide	NA	NA
Acrylonitrile	NA	1.22e-05
Benzene	NA	4.08e-06
Benzoic Acid	NA	NA
Bromodichloromethane	NA	NA
Bromoform	NA	NA
Bromomethane	NA	1.42e-07
Butyl Alcohol	NA	NA
Butylbenzylphthalate	NA	NA
Carbon Disulfide	NA	2.45e-06
Carbon Tetrachloride	NA	1.22e-05
Chlorobenzene	NA	1.22e-06
Chloroform	NA	NA

TABLE F-34 Hazard Index for Subsistence Farmer		
Chemical	Indirect HQ	Direct HQ
Chloromethane	NA	NA
Creosote	NA	NA
Cresols	NA	NA
Cresylic Acid	NA	NA
Cyclohexanone	NA	NA
Dibromochloromethane	NA	NA
Dichlorobenzene, 1,2-	NA	1.56e-09
Dichlorobenzene, 1,3-	NA	1.41e-09
Dichlorobenzene, 1,4-	NA	3.05e-10
Dichloroethane, 1,1-	NA	NA
Dichloroethane, 1,2-	NA	NA
Dichloroethylene, 1,1-	NA	NA
Dichloroethylene, 1,2-	NA	NA
Dichlorophenol, 2,4-	NA	NA
Dichloropropene, cis-1,3-	NA	2.58e-08
Dichloropropene, trans-1,3-	NA	2.11e-08
Dimethylphthalate	NA	NA
Di-n-butylphthalate	NA	NA
Ethoxyethanol, 2-	NA	1.22e-07
Ethyl Acetate	NA	NA
Ethyl Benzene	NA	2.45e-08
Ethyl Ether	NA	NA
Hexachlorocyclopentadiene	NA	2.46e-05
Isobutanol	NA	NA
MEK	NA	2.45e-08
Methanol	NA	NA
Methylene chloride	NA	8.17e-09
Methylnaphthalene, 2-	NA	NA
Naphthalene	NA	NA
Nitropropane, 2-	NA	1.22e-06
Orthodichlorobenzene	NA	NA
Phenol	NA	NA
Pyridine	NA	NA
Tetrachloroethylene	NA	NA
Toluene	NA	6.12e-08
Trichlorobenzene, 1,2,4-	NA	3.21e-09
Trichloroethane, 1,1,1-	NA	2.45e-08
Trichloroethane, 1,1,2-	NA	NA
Trichloroethylene	NA	NA
Trichlorofluoromethane	NA	NA
Trichlorophenol, 2,4,6-	NA	NA

TABLE F-34 Hazard Index for Subsistence Farmer		
Chemical	Indirect HQ	Direct HQ
Trichlorotrifluoranthene	NA	NA
Trichlorotrifluoroethane	NA	NA
Vinyl Chloride	NA	NA
Xylene	NA	NA
	HI_{liver} [a]	HI_{liver} [c]
	4.88e-02	4.76e-02
	$HI_{neurotoxic}$ [b]	$HI_{neurotoxic}$ [d]
	1.54e-01	5.96e-02
		HI_{total} [e]
		5.97e-02

Notes:

NA = Not Applicable.

(a) HI_{liver} equals the sum of the HQs for bis(2-ethylhexyl)phthalate, di(n)octylphthalate, hexachlorobenzene, pentachloronitrobenzene, pentachlorophenol, antimony, barium, cadmium, chromium, nickel and selenium.

(b) $HI_{neurotoxic}$ equals the sum of the HQs for 2,4-dinitrotoluene, 2,6-dinitrotoluene, mercury, antimony, barium, cadmium, chromium, nickel, selenium and silver.

(c) HI_{liver} equals the sum of the HQs for acrylonitrile, chlorobenzene, methylene chloride, barium, nitrobenzene, 2-nitropropane, toluene, 1,1,1-trichloroethane, 1,2,4-trichlorobenzene and 1,4-dichlorobenzene.

(d) $HI_{neurotoxic}$ equals the sum of the HQs for acrylonitrile, ethylbenzene, barium, mercury, toluene and 1,1,1-trichloroethane.

(e) HI_{total} is the sum of direct exposure HQs.

TABLE F-35 Hazard Index for Adult Resident		
Chemical	Indirect HQ	Direct HQ
INDIRECT EXPOSURE		
Antimony	2.29e-04	NA
Arsenic	1.73e-06	NA
Barium	3.70e-05	4.76e-02
Beryllium	9.94e-09	NA
Benzo(a)pyrene Toxicity Equivalents	NA	NA
Bis(2-ethylhexyl)phthalate	1.80e-08	NA
Cadmium	3.22e-06	NA
Chromium (VI)	3.43e-08	NA
Dinitrobenzene, 1,3-	5.63e-08	NA
Dinitrotoluene, 2,4-	6.24e-09	NA
Dinitrotoluene, 2,6-	1.07e-08	NA
Di(n)octylphthalate	2.26e-05	NA
Hexachlorobenzene	2.32e-07	NA
Mercury	5.23e-04	1.20e-02
Nickel	3.58e-04	NA
Nitrobenzene	1.59e-08	1.22e-05
PCBs, Total	NA	NA
Pentachloronitrobenzene	7.09e-07	NA
Pentachlorophenol	1.10e-07	NA
Selenium	2.69e-04	NA
Silver	1.71e-04	NA
TCDDioxin Toxicity Equivalents, 2,3,7,8-	NA	NA
Thallium (I)	4.67e-04	NA
Lead	NA	NA
DIRECT EXPOSURE		
Acetone	NA	NA
Acrylamide	NA	NA
Acrylonitrile	NA	1.22e-05
Benzene	NA	4.08e-06
Benzoic Acid	NA	NA
Bromodichloromethane	NA	NA
Bromoform	NA	NA
Bromomethane	NA	1.42e-07
Butyl Alcohol	NA	NA
Butylbenzylphthalate	NA	NA
Carbon Disulfide	NA	2.45e-06
Carbon Tetrachloride	NA	1.22e-05
Chlorobenzene	NA	1.22e-06
Chloroform	NA	NA

TABLE F-35 Hazard Index for Adult Resident		
Chemical	Indirect HQ	Direct HQ
Chloromethane	NA	NA
Creosote	NA	NA
Cresols	NA	NA
Cresylic Acid	NA	NA
Cyclohexanone	NA	NA
Dibromochloromethane	NA	NA
Dichlorobenzene, 1,2-	NA	1.56e-09
Dichlorobenzene, 1,3-	NA	1.41e-09
Dichlorobenzene, 1,4-	NA	3.05e-10
Dichloroethane, 1,1-	NA	NA
Dichloroethane, 1,2-	NA	NA
Dichloroethylene, 1,1-	NA	NA
Dichloroethylene, 1,2-	NA	NA
Dichlorophenol, 2,4-	NA	NA
Dichloropropene, cis-1,3-	NA	2.58e-08
Dichloropropene, trans-1,3-	NA	2.11e-08
Dimethylphthalate	NA	NA
Di-n-butylphthalate	NA	NA
Ethoxyethanol, 2-	NA	1.22e-07
Ethyl Acetate	NA	NA
Ethyl Benzene	NA	2.45e-08
Ethyl Ether	NA	NA
Hexachlorocyclopentadiene	NA	2.46e-05
Isobutanol	NA	NA
MEK	NA	2.45e-08
Methanol	NA	NA
Methylene chloride	NA	8.17e-09
Methylnaphthalene, 2-	NA	NA
Naphthalene	NA	NA
Nitropropane, 2-	NA	1.22e-06
Orthodichlorobenzene	NA	NA
Phenol	NA	NA
Pyridine	NA	NA
Tetrachloroethylene	NA	NA
Toluene	NA	6.12e-08
Trichlorobenzene, 1,2,4-	NA	3.21e-09
Trichloroethane, 1,1,1-	NA	2.45e-08
Trichloroethane, 1,1,2-	NA	NA
Trichloroethylene	NA	NA
Trichlorofluoromethane	NA	NA
Trichlorophenol, 2,4,6-	NA	NA

TABLE F-35
Hazard Index for Adult Resident

Chemical	Indirect HQ	Direct HQ
Trichlorotrifluoranthene	NA	NA
Trichlorotrifluoroethane	NA	NA
Vinyl Chloride	NA	NA
Xylene	NA	NA
	HI_{liver} [a]	HI_{liver} [c]
	9.19e-04	4.76e-02
	$HI_{neurotoxic}$ [b]	$HI_{neurotoxic}$ [d]
	1.59e-03	5.96e-02
		HI_{total} [e]
		5.97e-02

Notes:

NA = Not Applicable.

[a] HI_{liver} equals the sum of the HQs for bis(2-ethylhexyl)phthalate, di(n)octylphthalate, hexachlorobenzene, pentachloronitrobenzene, pentachlorophenol, antimony, barium, cadmium, chromium, nickel and selenium.

[b] $HI_{neurotoxic}$ equals the sum of the HQs for 2,4-dinitrotoluene, 2,6-dinitrotoluene, mercury, antimony, barium, cadmium, chromium, nickel, selenium and silver.

[c] HI_{liver} equals the sum of the HQs for acrylonitrile, chlorobenzene, methylene chloride, barium, nitrobenzene, 2-nitropropane, toluene, 1,1,1-trichloroethane, 1,2,4-trichlorobenzene and 1,4-dichlorobenzene.

[d] $HI_{neurotoxic}$ equals the sum of the HQs for acrylonitrile, ethylbenzene, barium, mercury, toluene and 1,1,1-trichloroethane.

[e] HI_{total} is the sum of direct exposure HQs.

TABLE F-36 Hazard Index for Child Resident		
Chemical	Indirect HQ	Direct HQ
INDIRECT EXPOSURE		
Antimony	3.97e-04	NA
Arsenic	1.01e-05	NA
Barium	3.28e-04	4.76e-02
Beryllium	7.35e-08	NA
Benzo(a)pyrene Toxicity Equivalents	NA	NA
Bis(2-ethylhexyl)phthalate	6.47e-08	NA
Cadmium	2.68e-05	NA
Chromium (VI)	1.66e-07	NA
Dinitrobenzene, 1,3-	3.01e-07	NA
Dinitrotoluene, 2,4-	3.60e-08	NA
Dinitrotoluene, 2,6-	5.83e-08	NA
Di(n)octylphthalate	2.19e-05	NA
Hexachlorobenzene	2.16e-06	NA
Mercury	4.80e-03	1.20e-02
Nickel	2.72e-03	NA
Nitrobenzene	1.03e-07	1.22e-05
PCBs, Total	NA	NA
Pentachloronitrobenzene	6.60e-06	NA
Pentachlorophenol	1.00e-06	NA
Selenium	6.50e-04	NA
Silver	2.01e-04	NA
TCDDioxin Toxicity Equivalents, 2,3,7,8-	NA	NA
Thallium (I)	3.49e-03	NA
Lead	NA	NA
DIRECT EXPOSURE		
Acetone	NA	NA
Acrylamide	NA	NA
Acrylonitrile	NA	1.22e-05
Benzene	NA	4.08e-06
Benzoic Acid	NA	NA
Bromodichloromethane	NA	NA
Bromoform	NA	NA
Bromomethane	NA	1.42e-07
Butyl Alcohol	NA	NA
Butylbenzylphthalate	NA	NA
Carbon Disulfide	NA	2.45e-06
Carbon Tetrachloride	NA	1.22e-05
Chlorobenzene	NA	1.22e-06
Chloroform	NA	NA

TABLE F-36 Hazard Index for Child Resident		
Chemical	Indirect HQ	Direct HQ
Chloromethane	NA	NA
Creosote	NA	NA
Cresols	NA	NA
Cresylic Acid	NA	NA
Cyclohexanone	NA	NA
Dibromochloromethane	NA	NA
Dichlorobenzene, 1,2-	NA	1.56e-09
Dichlorobenzene, 1,3-	NA	1.41e-09
Dichlorobenzene, 1,4-	NA	3.05e-10
Dichloroethane, 1,1-	NA	NA
Dichloroethane, 1,2-	NA	NA
Dichloroethylene, 1,1-	NA	NA
Dichloroethylene, 1,2-	NA	NA
Dichlorophenol, 2,4-	NA	NA
Dichloropropene, cis-1,3-	NA	2.58e-08
Dichloropropene, trans-1,3-	NA	2.11e-08
Dimethylphthalate	NA	NA
Di-n-butylphthalate	NA	NA
Ethoxyethanol, 2-	NA	1.22e-07
Ethyl Acetate	NA	NA
Ethyl Benzene	NA	2.45e-08
Ethyl Ether	NA	NA
Hexachlorocyclopentadiene	NA	2.46e-05
Isobutanol	NA	NA
MEK	NA	2.45e-08
Methanol	NA	NA
Methylene chloride	NA	8.17e-09
Methylnaphthalene, 2-	NA	NA
Naphthalene	NA	NA
Nitropropane, 2-	NA	1.22e-06
Orthodichlorobenzene	NA	NA
Phenol	NA	NA
Pyridine	NA	NA
Tetrachloroethylene	NA	NA
Toluene	NA	6.12e-08
Trichlorobenzene, 1,2,4-	NA	3.21e-09
Trichloroethane, 1,1,1-	NA	2.45e-08
Trichloroethane, 1,1,2-	NA	NA
Trichloroethylene	NA	NA
Trichlorofluoromethane	NA	NA
Trichlorophenol, 2,4,6-	NA	NA

TABLE F-36 Hazard Index for Child Resident		
Chemical	Indirect HQ	Direct HQ
Trichlorotrifluoranthene	NA	NA
Trichlorotrifluoroethane	NA	NA
Vinyl Chloride	NA	NA
Xylene	NA	NA
	HI_{liver} [a]	HI_{liver} [c]
	4.16e-03	4.76-02
	$HI_{neurotoxic}$ [b]	$HI_{neurotoxic}$ [d]
	9.13e-03	5.96e-02
		HI_{total} [e]
		5.97e-02

Notes:

NA = Not Applicable.

(a) HI_{liver} equals the sum of the HQs for bis(2-ethylhexyl)phthalate, di(n)octylphthalate, hexachlorobenzene, pentachloronitrobenzene, pentachlorophenol, antimony, barium, cadmium, chromium, nickel and selenium.

(b) $HI_{neurotoxic}$ equals the sum of the HQs for 2,4-dinitrotoluene, 2,6-dinitrotoluene, mercury, antimony, barium, cadmium, chromium, nickel, selenium and silver.

(c) HI_{liver} equals the sum of the HQs for acrylonitrile, chlorobenzene, methylene chloride, barium, nitrobenzene, 2-nitropropane, toluene, 1,1,1-trichloroethane, 1,2,4-trichlorobenzene and 1,4-dichlorobenzene.

(d) $HI_{neurotoxic}$ equals the sum of the HQs for acrylonitrile, ethylbenzene, barium, mercury, toluene and 1,1,1-trichloroethane.

(e) HI_{total} is the sum of direct exposure HQs.

APPENDIX G

Dispersion Modeling

I. COMPDEP MODEL

The Clive Incinerator is located in rough terrain that increases in elevation by as much as 1000 feet within 10 kilometers. This higher terrain is at an elevation well above the incinerator stack top, while a considerable area of terrain near the incinerator is at an elevation near that of the stack base. Therefore, the modeling analysis of the area considered both simple and complex terrain as well as the intermediate terrain processing technique as described in the USEPA's *Guideline on Air Quality Models* (GAQM). The model chosen for this analysis is the COMPDEP model.

COMPDEP will estimate annual average concentrations as well as annual dry and wet deposition. COMPDEP produces the same results as the Industrial Source Complex Short Term (ISCST) model in simple terrain, and the same results as COMPLEX I in complex terrain. Intermediate terrain is processed by modeling the receptors between stack top and plume height with both models and choosing the higher of the two concentrations. To account for pollutant deposition, the concentration algorithms in COMPLEX I were replaced with those from the Multiple Point Source Algorithm with Terrain Adjustments Including Deposition and Sedimentation (MPTER-DS) model.

II. METEOROLOGICAL DATA

COMPDEP uses two binary meteorological input files. One is a file of hourly values of wind speed, wind direction, stability, mixing height and temperature. Data collected at the Clive monitoring station in 1991 and 1992 were used to produce separate input files. The data were processed with the EPA PCRAMMET program. Wind frequency distributions for the Clive monitoring station for 1991 and 1992 are shown in Figures G-1 and G-2.

A second meteorological input file is required by COMPDEP to compute estimates of wet deposition. This file contains hourly values of precipitation intensity and values for the fraction of each hour that precipitation occurred (F value). Because precipitation is not measured at the Clive monitoring station, hourly precipitation records for 1991 and 1992 from nearby National Weather Service stations were used. Data from Dugway, Utah, which is located approximately 25 miles southeast of the Clive site, were used as primary data. Records from September, 1991 were missing from the Dugway data set and records from Grantsville, Utah, were substituted for that month. Grantsville is located approximately 35 miles east of the Clive site. The data from the two sites did not include hourly start and stop times for the precipitation events, so hourly F values were estimated from the duration of events and the amount of precipitation measured. A listing of the precipitation records that were used to build the binary input file can be found in Attachment G-2. Table G-1 summarizes the selection criteria for the intensity and duration values.

FIGURE G-1

Wind Rose--Clive 1991

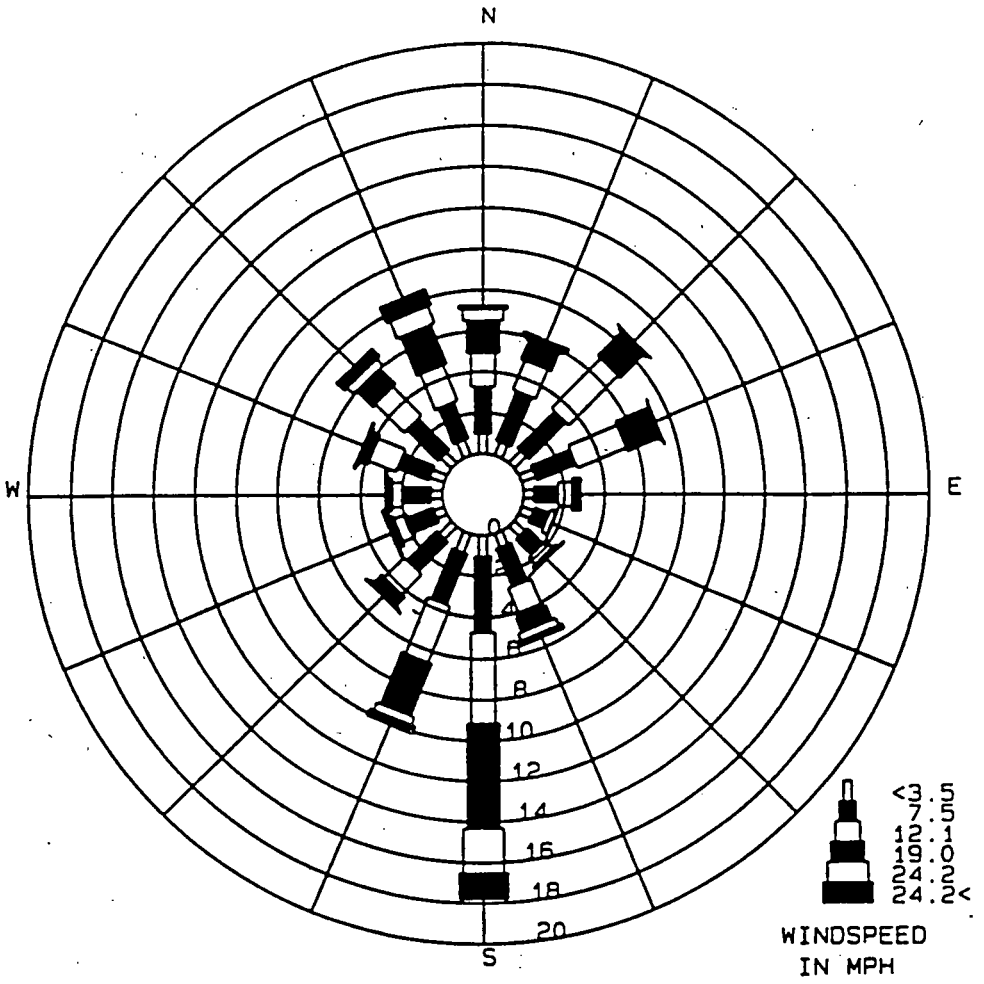


FIGURE G-2

Wind Rose--Clive 1992-

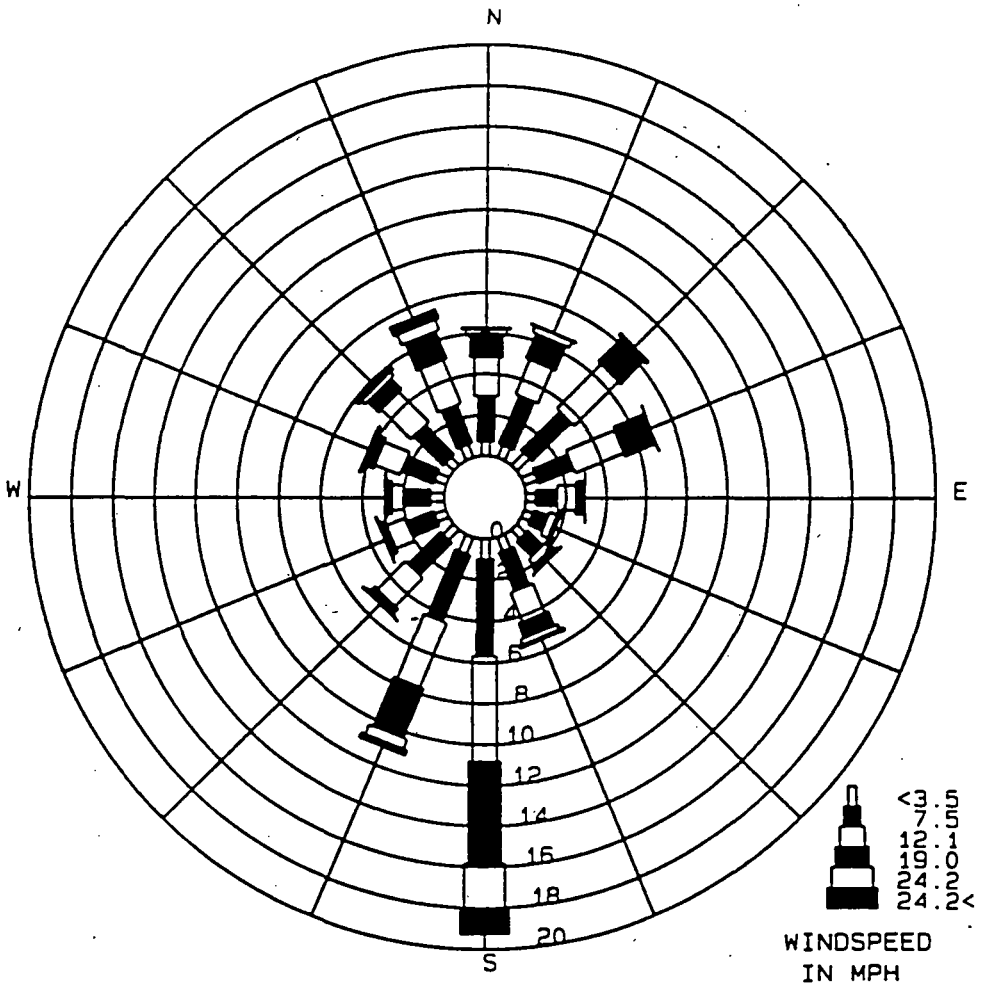


TABLE G-1
Criteria for Assigning Values of Precipitation Intensity and Duration

Precipitation Intensity			Precipitation Duration (F Value)		
Category	Intensity (in/hour)	Value	Precipitation Type	Value	Dugway Data[(a)]
None	0.0	0	Steady (e.g. rain, drizzle, snow)	1.0	Consecutive hours with measurable precipitation
Light	trace to 0.10	1	Showers (e.g. rain, snow)	0.5	isolated hours with less than 0.10" precipitation
Moderate	0.11 to 0.30	2	Thunderstorm or squall	0.25	isolated hours with more than 0.10" precipitation
Heavy	> 0.30	3	Frozen or none	0.0	no precipitation

Note:

(a) Criteria developed to assign F values to hourly precipitation from Dugway site, all other listed criteria taken from COMPDEP documentation.

III. RECEPTOR GRID

COMPDEP modeling was conducted at the location of the actual residence nearest to the incinerator. This receptor was located in the general vicinity of Iosepa in the Skull Valley. The UTM coordinates and elevations for this location were as follows:

Resident) 358380 meters E, 4503600 meters N, 4257 ft MSL.

In addition, two theoretical receptor locations were identified outside the 10 mile buffer zone (see Attachment G-1). These theoretical receptor locations were identified as the northern and southern receptors. The UTM coordinates and elevations for these two locations were as follows:

Northern) 318438 meters E, 4540714 meters N, 4232 ft MSL; and
Southern) 318438 meters E, 4489238 meters N, 4265 ft MSL.

IV. SOURCE PARAMETERS

A. Particle Size Distribution

COMPDEP predicts the deposition of particles to the ground. Deposition depends on particle size with larger particles typically depositing faster. Particle sizes from the Clive incinerator were divided into three categories in accord with the default parameters provided in the *Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Waste.* The particle size categories are based on mean particle diameter and the chosen categories included 1.0, 6.0, and 15.0 microns. The fractional mass contained in each category were 0.78, 0.19, and 0.03, respectively.

B. Incinerator Stack

The incinerator exhausts from a single stack and therefore the incinerator emissions were modeled as a single point source. Stack parameters are listed in Table G-2.

Direction-specific building dimensions for the structures surrounding the incinerator stack were determined with the GEP program from BEE-LINE Software. The GEP program utilizes the algorithms from the USEPA Building Profile Input Program (BPIP). Figure G-3 shows the structures surrounding the incinerator. GEP output is included in Attachment G-3. The building height and width for the structure yielding the highest GEP stack height were input to COMPDEP.

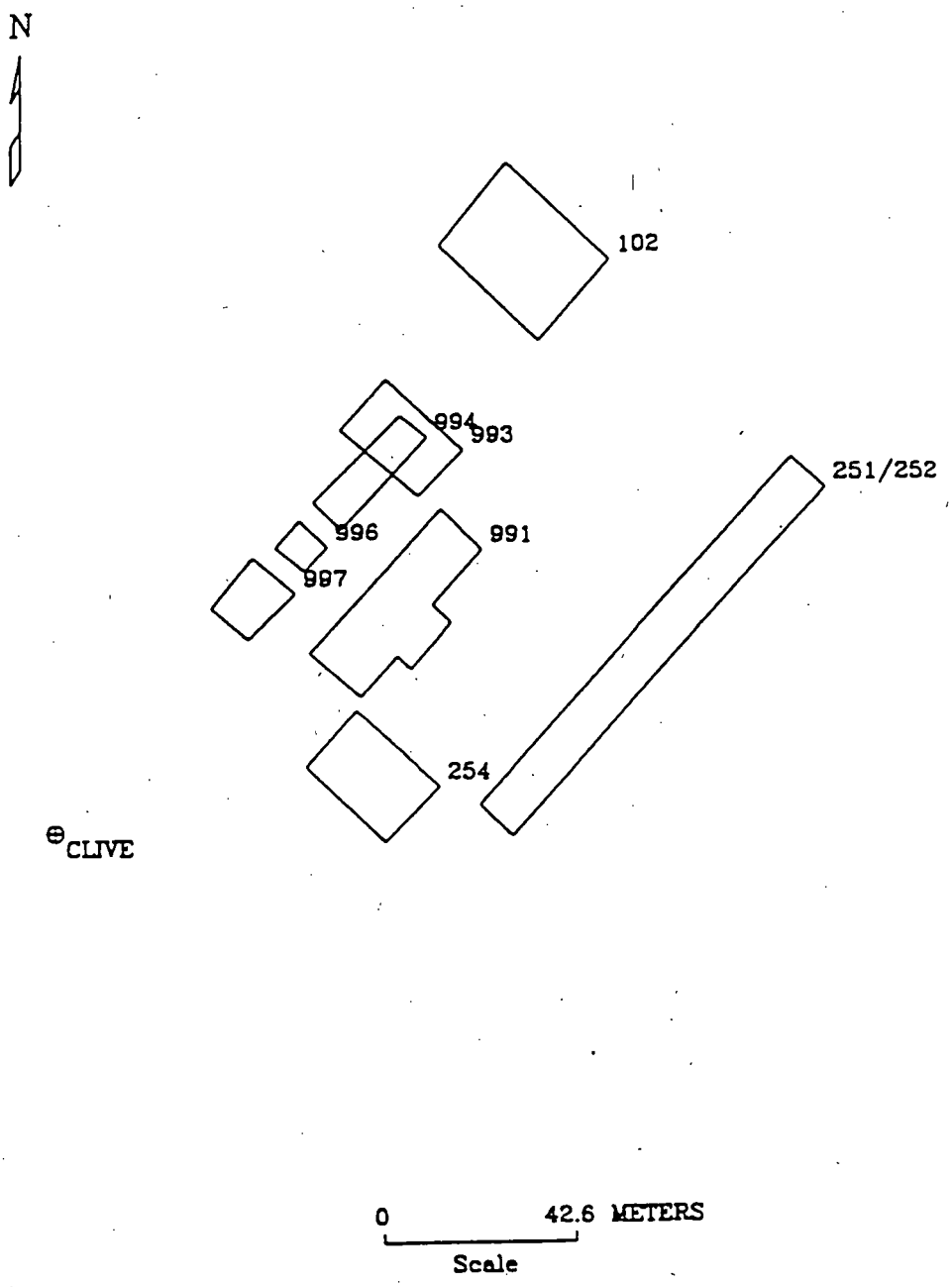
C. Model Technical Options

COMPDEP was run to produce estimates of annual deposition and annual average concentrations at each receptor for both 1991 and 1992 meteorological data. An emission rate of 1 gram per second was used for the incinerator. The following USEPA-recommended technical options were selected.

TABLE G-2 Clive Incinerator Stack Parameters					
UTM Location	Stack Base Elevation (feet)	Stack Height (m)	Exhaust Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
318438.0 meters E 4505611.0 meters N	4265.3	60.96	345.9	19.44	1.83

FIGURE G-3

Structures Surrounding Clive Incinerator



- Include stack downwash;
- Include gradual plume rise;
- Include buoyancy induced dispersion;
- Include calm processing option;
- Evaluate building wake effects (ISCST);
- Power-law wind exponents: 0.07,0.07,0.10,0.15,0.35,0.55;
- Terrain adjustments: 0.5,0.5,0.5,0.5,0.0, and 0.0; and
- Zmin = 10.0 meters.

A particle density of 1.0 and a surface roughness of 5.0 cm were also selected.

V. MODELING RESULTS

Results for the discrete receptors are listed in Table G-3.

TABLE G-3
COMPDEP Modeling Results for Discrete Receptors

Receptor	Receptor Location (UTM meters)	Year	Annual Dry Deposition (g/m^2)	Annual Wet Deposition (g/m^2)	Annual Combined Deposition (g/m^2)	Annual Average Concentration ($\mu g/m^3$)
Nearest Residence	358380 E 4503600 N	1991	1.00e-04	6.55e-06	1.07e-04	2.38e-03
		1992	3.53e-05	6.02e-06	4.13e-05	6.97e-04
North Edge of Buffer Zone	318438 E 4540714 N	1991	3.48e-04	2.31e-05	3.71e-04	5.68e-03
		1992	3.61e-04	1.05e-05	3.72e-04	6.30e-03
South Edge of Buffer Zone	318438 E 4489238 N	1991	3.35-04	1.49e-05	3.50e-04	6.00e-03
		1992	2.73e-04	7.37e-05	3.47e-04	5.02e-03

01-3937A:PCC00795.W51/7-28-95/2:15pm

Attachment G-1

Tooele County Clarification of
Residential Areas and Map

TOOELE COUNTY
DEPARTMENT OF ENGINEERING
47 SOUTH MAIN, TOOELE, UTAH 84074
(801) 882-9160

J. RAYMOND JOHNSON, P.E.
DIRECTOR

December 6, 1994

USPCI
ATTN: Charlie Roberts
8960 North Highway 40
Lake Point, UT. 84074

Dear Mr. Roberts,

Pursuant to our discussion, dwelling units are not permitted within ten miles of a hazardous waste zone. This is covered in the Tooele County Zoning Ordnance, Chapter 18.

Further, single family dwelling units are not permitted within commercial or industrial zones.

Sincerely,

J. Raymond Johnson, P.E.
Director

Attachment G-2

Dugway, Utah, Precipitation Record for 1991 and 1992

DUGWAY, UTAH PRECIPITATION RECORDS FOR 1991 AND 1992

example:	920103	04	1	1.0
	(yr mo day)	(hr)	(intensity value)	(F value)

910104 04 1 0.5 06 1 1.0 07 1 1.0 08 1 1.0 09 1 1.0
910107 23 1 1.0 24 1 1.0
910108 01 1 0.5
910113 12 1 1.0 13 1 1.0 15 1 0.5 22 1 1.0 23 1 1.0
115 10 1 0.5 11 1 1.0 12 1 1.0 13 1 1.0
10216 13 1 0.5 15 1 1.0 16 1 1.0 17 1 1.0 18 2 1.0 19 1 1.0
910228 08 1 1.0 09 1 1.0 10 1 1.0
910301 15 1 1.0 16 1 1.0 19 1 1.0 20 1 1.0 21 1 1.0
910311 12 1 0.5
910315 06 1 1.0 07 1 1.0
910319 24 1 0.5
910320 01 1 0.5
910321 11 1 1.0 12 1 1.0
910402 22 1 0.5
910410 02 1 0.5 05 1 1.0 06 1 1.0 07 1 1.0 08 1 1.0
910411 23 1 1.0 24 1 1.0
910412 01 1 0.5 08 1 1.0 09 1 1.0
910424 12 1 0.5
910425 05 1 1.0 06 1 1.0 07 1 1.0 08 1 1.0 09 1 1.0 10 1 1.0 11 1 1.0 12 1 1.0 13 1 1.0 15 1 0.5
26 24 1 0.5
910427 01 1 0.5 03 1 1.0 04 1 1.0 05 1 1.0 06 1 1.0 07 1 1.0 08 1 1.0 09 1 1.0 13 1 1.0 14 1 1.0
910503 07 1 1.0 08 1 1.0 10 1 0.5
910509 14 1 1.0 15 1 1.0 16 1 1.0 17 1 1.0
910511 07 2 1.0 08 2 1.0 09 1 1.0
910514 09 1 1.0 10 1 1.0 17 1 1.0 18 1 1.0 22 1 1.0 23 1 1.0
910515 04 1 1.0 05 1 1.0 06 1 1.0
910525 14 1 1.0 15 1 1.0 18 1 0.5
910526 07 1 0.5
910530 06 1 0.5 11 1 1.0 12 1 1.0 15 1 1.0 16 1 1.0 17 1 1.0 18 1 1.0 24 1 0.5
531 09 1 0.5 15 1 1.0 16 1 1.0
10601 07 1 1.0 08 1 1.0 09 2 1.0 12 1 1.0 13 1 1.0
910602 01 1 0.5 07 1 1.0 08 1 1.0 09 1 1.0 10 1 1.0 11 1 1.0 12 1 1.0 13 1 1.0 14 1 1.0
910709 07 1 1.0 08 1 1.0
910717 19 1 1.0 20 1 1.0
910718 19 1 1.0 20 2 1.0
1 24 1 0.5
910801 07 1 0.5
910803 09 1 1.0 10 1 1.0 16 1 0.5
910804 19 1 1.0 20 1 1.0
910805 02 1 0.5
910811 18 2 1.0 19 1 1.0
910814 19 1 1.0 20 1 1.0 22 1 0.5
910815 02 1 1.0 03 1 1.0 05 1 0.5
910818 12 1 0.5
910824 09 1 0.5 18 1 0.5
910831 19 1 0.5
910907 06 1 0.25 20 1 0.25 22 1 0.25
910908 21 1 0.25
910909 04 1 0.25 11 1 0.25
910912 15 2 1.0 16 1 1.0
911023 04 2 1.0 05 2 1.0 06 1 1.0 08 1 0.5 10 1 1.0 11 1 1.0
911026 21 1 1.0 22 1 1.0 23 2 1.0 24 2 1.0
911027 01 2 1.0 02 1 1.0 03 1 1.0 04 1 1.0 05 1 1.0 06 1 1.0 07 1 1.0
911029 09 1 0.5 11 1 1.0 12 1 1.0 13 1 1.0 14 1 1.0
1101 22 1 1.0 23 1 1.0
1102 12 1 1.0 13 1 1.0
911109 07 1 0.5
911114 01 1 1.0 02 1 1.0 05 1 0.5 22 1 0.5
911117 19 1 1.0 20 2 1.0 21 1 1.0 22 1 1.0 23 1 1.0 24 2 1.0
911118 03 1 0.5

911120 18 1 0.5
911127 18 1 1.0 19 1 1.0
911129 12 1 0.5 14 1 0.5
911207 18 1 1.0 19 1 1.0 20 1 1.0 21 1 1.0 24 1 0.5
08 11 1 0.5
911219 03 1 1.0 04 1 1.0 05 1 1.0 07 1 0.5
911230 06 1 1.0 07 1 1.0 09 1 1.0 10 1 1.0 11 1 1.0
911231 13 1 1.0 14 1 1.0 15 1 1.0

920103 24 1 0.5
920104 02 1 1.0 03 1 1.0 04 1 1.0 05 1 1.0 06 1 1.0 07 1 1.0 08 1 1.0
920106 09 1 1.0 10 1 1.0 15 1 0.5 23 1 0.5
920107 09 1 0.5
208 12 1 0.5 19 1 0.5 24 1 0.5
920211 06 1 1.0 07 1 1.0 08 1 1.0 19 1 1.0 20 1 1.0 21 1 1.0 23 1 0.5
920212 19 1 1.0 20 1 1.0 21 1 1.0
920213 15 1 0.5
920214 10 1 0.5 15 1 0.5
920216 04 1 1.0 05 1 1.0 11 1 1.0 12 1 1.0 16 1 1.0 17 1 1.0
920222 07 2 1.0 08 1 1.0 09 1 1.0
920304 10 1 1.0 11 1 1.0 15 1 0.5
920306 16 1 1.0 17 1 1.0 24 2 0.5
920307 01 1 1.0 02 1 1.0
920308 20 1 0.5
920317 02 1 1.0 03 1 1.0 05 1 1.0 06 1 1.0 07 1 1.0 08 1 1.0
920322 17 1 0.5 21 1 1.0 22 1 1.0
920326 07 1 0.5 15 1 0.5
920421 18 1 1.0 19 1 1.0
[redacted] 16 1 0.5
920507 17 1 1.0 18 2 1.0
920508 24 1 0.5
920509 05 1 1.0 06 2 1.0 07 1 1.0
920512 24 1 0.25
920513 03 1 0.5 19 1 0.5
920524 16 1 0.5
920526 18 1 0.5
920607 15 2 0.25
920614 18 1 0.5
1616 07 2 1.0 08 1 1.0
920630 13 1 0.5 24 1 0.5
920701 01 1 1.0 02 1 1.0 04 1 1.0 05 1 1.0 06 1 1.0 07 2 1.0 08 2 1.0 09 1 1.0 10 1 1.0 13 1 0.5 17 2 0.5
920707 22 2 0.25
920711 18 1 0.5 22 1 1.0 23 1 1.0
920712 03 2 1.0 04 1 1.0
[redacted] 15 2 0.25
[redacted] 15 1 1.0 16 1 1.0
920904 05 1 1.0 06 1 1.0 07 1 1.0 08 1 1.0
920923 21 1 0.5
921003 06 1 0.5
921021 24 1 0.5
921022 01 1 0.5
921025 07 1 1.0 08 1 1.0 09 1 1.0 10 1 1.0 11 1 1.0 12 1 1.0 13 1 1.0
921027 19 2 1.0 20 1 1.0 21 1 1.0 23 1 1.0 24 1 1.0
921028 05 1 1.0 06 1 1.0 07 1 1.0 08 1 1.0 09 1 1.0 10 1 1.0
921029 15 1 0.5
921030 08 1 1.0 09 1 1.0 15 2 1.0 16 1 1.0 17 1 1.0 18 2 1.0 19 1 1.0 20 1 1.0 21 1 1.0 22 1 1.0
921101 24 1 0.5
921102 01 1 0.5 05 1 1.0 06 1 1.0 07 1 1.0 08 1 1.0
921119 21 1 1.0 22 1 1.0
921122 11 1 1.0 12 1 1.0 13 1 1.0 14 1 1.0
921123 02 1 1.0 03 1 1.0 09 1 0.5
921127 21 1 1.0 22 1 1.0
921205 06 1 0.5
1211 15 1 0.5 17 1 1.0 18 1 1.0 19 2 1.0 20 1 1.0 21 1 1.0 22 1 1.0 23 1 1.0
1212 10 1 1.0 11 1 1.0 12 1 1.0
921215 01 1 1.0 02 1 1.0 03 1 1.0 06 1 0.5
921217 24 1 0.5
921218 01 1 1.0 02 1 1.0 03 1 1.0 04 1 1.0
921228 04 1 1.0 05 1 1.0 06 1 1.0 07 1 1.0 08 1 1.0 09 1 1.0

921229 22 1 1.0 23 1 1.0 24 1 1.0
921230 05 1 1.0 06 1 1.0 09 1 1.0 10 1 1.0

Attachment G-3

Building Profile Input Program (PBIP) Output

BEE-Line Software Version: 5.1

Input File - USPCI.GEP
Input File - USPCI.PIP
Output File - USPCI.TAB
Output File - USPCI.SUM
Output File - USPCI.SO

BPIP (Dated: 95086)

==========
BPIP PROCESSING INFORMATION:
==========

The ST flag has been set for processing for an ISCST2 run.

Inputs entered in METERS will be converted to meters using a conversion factor of 1.0000. Output will be in meters.

The UTMP variable is set to UTMY. The input is assumed to be in UTM coordinates. BPIP will move the UTM origin to the first pair of UTM coordinates read. The UTM coordinates of the new origin will be subtracted from all the other UTM coordinates entered to form this new local coordinate system.

The new local coordinates will be displayed in parentheses just below the UTM coordinates they represent.

Plant north is set to 0.00 degrees with respect to True North.

==========
INPUT SUMMARY:
==========

Number of buildings to be processed : 8

993 has 1 tier(s) with a base elevation of 1300.00 METERS

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
993	1	1	23.93	4		
					318527.00	4505694.00 meters
					(0.00	0.00) meters
					318517.00	4505684.00 meters
					(-10.00	-10.00) meters
					318500.00	4505699.00 meters
					(-27.00	5.00) meters
					318510.00	4505710.00 meters
					(-17.00	16.00) meters

254 has 1 tier(s) with a base elevation of 1300.00 METERS

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER X	COORDINATES Y
254	1	5	14.33	4		
					318521.00	4505620.00 meters
					(-6.00	-74.00) meters
					318509.00	4505608.00 meters
					(-18.00	-86.00) meters
					318492.00	4505625.00 meters
					(-35.00	-69.00) meters
					318503.00	4505637.00 meters
					(-24.00	-57.00) meters

251/252 has 1 tier(s) with a base elevation of 1300.00 METERS

BUILDING	TIER	BLDG-TIER	TIER	NO. OF	CORNER	COORDINATES

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER COORDINATES X	Y
251/252	1	9	12.65	4		
					318607.00	4505685.00 meters
					(80.00	-9.00) meters
					318537.00	4505609.00 meters
					(10.00	-85.00) meters
					318530.00	4505616.00 meters
					(3.00	-78.00) meters
					318600.00	4505692.00 meters
					(73.00	-2.00) meters

997 has 1 tier(s) with a base elevation of 1300.00 METERS

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER COORDINATES X	Y
997	1	13	17.07	4		
					318490.00	4505663.00 meters
					(-37.00	-31.00) meters
					318480.00	4505653.00 meters
					(-47.00	-41.00) meters
					318472.00	4505660.00 meters
					(-55.00	-34.00) meters
					318481.00	4505671.00 meters
					(-46.00	-23.00) meters

996 has 1 tier(s) with a base elevation of 1300.00 METERS

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER COORDINATES X	Y
996	1	17	28.65	4		
					318497.00	4505673.00 meters
					(-30.00	-21.00) meters
					318492.00	4505668.00 meters
					(-35.00	-26.00) meters
					318486.00	4505673.00 meters
					(-41.00	-21.00) meters
					318491.00	4505679.00 meters
					(-36.00	-15.00) meters

102 has 1 tier(s) with a base elevation of 1300.00 METERS

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER COORDINATES X	Y
102	1	21	19.20	4		
					318560.00	4505736.00 meters
					(33.00	42.00) meters
					318544.00	4505718.00 meters
					(17.00	24.00) meters
					318522.00	4505739.00 meters
					(-5.00	45.00) meters
					318537.00	4505757.00 meters
					(10.00	63.00) meters

991 has 1 tier(s) with a base elevation of 1300.00 METERS

BUILDING NAME	TIER NUMBER	BLDG-TIER NUMBER	TIER HEIGHT	NO. OF CORNERS	CORNER COORDINATES X	Y
991	1	25	19.81	8		
					318531.00	4505672.00 meters
					(4.00	-22.00) meters
					318520.00	4505660.00 meters
					(-7.00	-34.00) meters
					318524.00	4505656.00 meters
					(-3.00	-38.00) meters
					318515.00	4505646.00 meters
					(-12.00	-48.00) meters
					318512.00	4505649.00 meters
					(-15.00	-45.00) meters
					318504.00	4505640.00 meters
					(-23.00	-54.00) meters

```
                                        318493.00  4505650.00 meters
                                    (      -34.00      -44.00) meters
                                        318522.00  4505681.00 meters
                                    (       -5.00      -13.00) meters


994      has 1 tier(s) with a base elevation of 1300.00 METERS
BUILDING  TIER  BLDG-TIER  TIER   NO. OF      CORNER   COORDINATES
  NAME   NUMBER   NUMBER  HEIGHT  CORNERS        X          Y

994        1       29     19.20     4
                                        318519.00  4505697.00 meters
                                    (       -8.00        3.00) meters
                                        318500.00  4505677.00 meters
                                    (      -27.00      -17.00) meters
                                        318494.00  4505683.00 meters
                                    (      -33.00      -11.00) meters
                                        318513.00  4505702.00 meters
                                    (      -14.00        8.00) meters

Number of stacks to be processed :  1

                  STACK            STACK   COORDINATES
 STACK NAME      BASE  HEIGHT         X          Y

 CLIVE        1300.00   60.96 METERS
                                  318438.00  4505611.00 meters
                              (      -89.00      -83.00) meters

  No stacks have been detected as being atop any structures.


                  Overall GEP Summary Table
                      (Units: meters)


StkNo:  1  Stk Name:CLIVE    Stk Ht:  60.96 Prelim. GEP Stk.Ht:   65.00
          GEP:  BH:  23.93  PBW:   23.96            *Eqn1 Ht:   59.83
        *adjusted for a Stack-Building elevation difference of    0.00
 No. of Tiers affecting Stk:  1  Direction occurred:  219.75
  Bldg-Tier nos. contributing to GEP:   1



                  Summary By Direction Table
                      (Units:  meters)

Dominate stand alone tiers:


Drtcn:  10.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
    No single tier affects this stack for this direction.

Drtcn:  20.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
    No single tier affects this stack for this direction.

Drtcn:  30.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
    No single tier affects this stack for this direction.

Drtcn:  40.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
    No single tier affects this stack for this direction.
```

```
Drtcn:  50.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn:  60.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn:  70.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn:  80.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn:  90.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn: 100.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn: 110.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn: 120.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn: 130.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn: 140.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn: 150.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn: 160.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
   No single tier affects this stack for this direction.

Drtcn: 170.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
```

```
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No single tier affects this stack for this direction.

Drtcn: 180.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No single tier affects this stack for this direction.

Drtcn: 190.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No single tier affects this stack for this direction.

Drtcn: 200.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No single tier affects this stack for this direction.

Drtcn: 210.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    Single tier MAX:  BH:  23.93  PBW:  25.88  *Wake Effect Ht:   59.83
        *adjusted for a Stack-Building elevation difference of    0.00
             BldNo:  1  Bld Name:993       TierNo:  1

Drtcn: 220.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    Single tier MAX:  BH:  23.93  PBW:  23.90  *Wake Effect Ht:   59.78
        *adjusted for a Stack-Building elevation difference of    0.00
             BldNo:  1  Bld Name:993       TierNo:  1

Drtcn: 230.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    Single tier MAX:  BH:  23.93  PBW:  24.42  *Wake Effect Ht:   59.83
        *adjusted for a Stack-Building elevation difference of    0.00
             BldNo:  1  Bld Name:993       TierNo:  1

Drtcn: 240.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    Single tier MAX:  BH:  19.81  PBW:  26.81  *Wake Effect Ht:   49.52
        *adjusted for a Stack-Building elevation difference of    0.00
             BldNo:  7  Bld Name:991       TierNo:  1

Drtcn: 250.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    Single tier MAX:  BH:  19.81  PBW:  32.37  *Wake Effect Ht:   49.52
        *adjusted for a Stack-Building elevation difference of    0.00
             BldNo:  7  Bld Name:991       TierNo:  1

Drtcn: 260.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    Single tier MAX:  BH:  14.33  PBW:  29.60  *Wake Effect Ht:   35.83
        *adjusted for a Stack-Building elevation difference of    0.00
             BldNo:  2  Bld Name:254       TierNo:  1

Drtcn: 270.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    Single tier MAX:  BH:  14.33  PBW:  29.00  *Wake Effect Ht:   35.83
        *adjusted for a Stack-Building elevation difference of    0.00
```

BldNo: 2 Bld Name:254 TierNo: 1

Drtcn: 280.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No single tier affects this stack for this direction.

Drtcn: 290.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No single tier affects this stack for this direction.

Drtcn: 300.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No single tier affects this stack for this direction.

Drtcn: 310.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No single tier affects this stack for this direction.

Drtcn: 320.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No single tier affects this stack for this direction.

Drtcn: 330.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No single tier affects this stack for this direction.

Drtcn: 340.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No single tier affects this stack for this direction.

Drtcn: 350.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No single tier affects this stack for this direction.

Drtcn: 360.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No single tier affects this stack for this direction.

Dominate combined buildings:

Drtcn: 10.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 20.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 30.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83

No combined tiers affect this stack for this direction.

Drtcn: 40.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 50.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 60.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 70.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 80.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 90.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 100.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 110.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 120.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 130.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 140.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 150.00

StkNo: 1 Stk Name:CLIVE Stack Ht: 60.96
GEP: BH: 23.93 PBW: 23.96 *Equation 1 Ht: 59.83
No combined tiers affect this stack for this direction.

Drtcn: 160.00

```
StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction.

Drtcn: 170.00

StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction.

Drtcn: 180.00

StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction.

Drtcn: 190.00

StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction.

Drtcn: 200.00

StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction.

Drtcn: 210.00

StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
  Combined tier MAX:  BH:  23.93  PBW:  25.88  *Wake Effect Ht:   59.83
       *adjusted for a Stack-Building elevation difference of    0.00
 No. of Tiers affecting Stk:  2
  Bldg-Tier nos. contributing to MAX:   1  17

Drtcn: 220.00

StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
  Combined tier MAX:  BH:  23.93  PBW:  23.90  *Wake Effect Ht:   59.78
       *adjusted for a Stack-Building elevation difference of    0.00
 No. of Tiers affecting Stk:  2
  Bldg-Tier nos. contributing to MAX:   1  17

Drtcn: 230.00

StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
  Combined tier MAX:  BH:  23.93  PBW:  24.42  *Wake Effect Ht:   59.83
       *adjusted for a Stack-Building elevation difference of    0.00
 No. of Tiers affecting Stk:  2
  Bldg-Tier nos. contributing to MAX:   1  17

Drtcn: 240.00

StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
  Combined tier MAX:  BH:  19.81  PBW:  40.58  *Wake Effect Ht:   49.52
       *adjusted for a Stack-Building elevation difference of    0.00
 No. of Tiers affecting Stk:  2
  Bldg-Tier nos. contributing to MAX:  17  25

Drtcn: 250.00

StkNo:  1 Stk Name:CLIVE                                Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96  *Equation 1 Ht:   59.83
  Combined tier MAX:  BH:  19.81  PBW:  41.09  *Wake Effect Ht:   49.52
       *adjusted for a Stack-Building elevation difference of    0.00
 No. of Tiers affecting Stk:  2
  Bldg-Tier nos. contributing to MAX:  17  25

Drtcn: 260.00
```

```
StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
  Combined tier MAX:  BH:  14.33  PBW:  69.63  *Wake Effect Ht:   35.83
       *adjusted for a Stack-Building elevation difference of    0.00
 No. of Tiers affecting Stk:  2
  Bldg-Tier nos. contributing to MAX:   5  25

Drtcn: 270.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
  Combined tier MAX:  BH:  14.33  PBW:  73.00  *Wake Effect Ht:   35.83
       *adjusted for a Stack-Building elevation difference of    0.00
 No. of Tiers affecting Stk:  2
  Bldg-Tier nos. contributing to MAX:   5  25

Drtcn: 280.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction

Drtcn: 290.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction

Drtcn: 300.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction

Drtcn: 310.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction

Drtcn: 320.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction

Drtcn: 330.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction

Drtcn: 340.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction

Drtcn: 350.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction

Drtcn: 360.00

StkNo:  1  Stk Name:CLIVE                              Stack Ht:   60.96
              GEP:  BH:  23.93  PBW:  23.96   *Equation 1 Ht:   59.83
    No combined tiers affect this stack for this direction
```