JCI
JAVAHERIAN CONSULTING, INC.

The Flood Building
870 Market Street, Suite 712
San Francisco, CA 94102
(415) 986-3336
Fax (415) 986-3370
jci@javaherianconsulting.com

August 22, 2000

MEMORANDUM

To: Doug Oram, Ph.D.
ETIC Engineering, Inc.

From: Mehrdad M. Javaherian, Ph.D., P.Hg., P.E., DABT
Javaherian Consulting, Inc.

Re: Risk-Based Corrective Action Analysis
Nestle USA, Inc. Facility
1310 14th Street, Oakland, CA

1.0 INTRODUCTION

This memorandum documents a risk-based corrective action (RBCA) analysis and associated conceptual site model (CSM) for the above referenced site (see Figure 1), focusing on protection of human health at and in the vicinity of the site. This analysis was based on RBCA guidelines outlined by the American Society for Testing and Materials (ASTM, 1995 and 1998), the US Environmental Protection Agency ([USEPA], 1991), and the California Environmental Protection Agency Department of Toxic Substance Control ([DTSC], 1999).

This RBCA analysis focuses on continued commercial/industrial land use at the site, with the purpose of determining potential health risks to future site occupants in the absence of continued remediation. The RBCA analysis is supplemented by proposed continued monitoring of groundwater quality focusing on determining the effectiveness of past remediation efforts and natural attenuation in the future (ETIC Engineering, Inc. ([ETIC], 2000a), together with an upcoming risk management plan (RMP) outlining measures for protection of construction workers, land use restrictions, and/or institutional controls for future use of the site.

Past investigations and associated site characterization data serving as the basis for this RBCA analysis have been compiled and summarized ETIC Engineering, Inc. ([ETIC], 2000b). This RBCA analysis makes direct references to results of past investigations documented by ETIC, (2000b), with tabular summaries of specific data used for risk calculations included herein.

2.0 CONCEPTUAL SITE MODEL

As the initial step in evaluation of health risks resulting from potential exposure to contaminants at the site, a conceptual site model (CSM) of chemical occurrence, fate, transport, and potential exposure was developed. Specifically, the CSM documents sources of chemicals, affected media and transport mechanisms, and potential exposure pathways and

Risk Assessment & Toxicology · Environmental Modeling
Water Resource Development & Management
www.javaherianconsulting.com

receptors at the site. Development of the CSM was based on available information characterizing land use and hydrogeologic conditions, together with soil gas, soil matrix, and groundwater quality data summarized by ETIC (2000b). Figure 2 is a graphical representation of the CSM, which is comprised of the components summarized below.

2.1 Sources of Chemicals

Historical site investigations have identified the subsurface presence of chemicals consistent with those used at the site (see Appendix I). Occurrence of chemicals in soil and groundwater underlying the site is likely due to historical spills and releases associated with former underground storage tanks (USTs) and dust control operations, which utilized used oil. No primary sources in the form of on-going leaks and/or spills are known to exist at the site, with USTs and associated piping and dispensers removed in 1988 and 1989 (ETIC, 2000b). The presence of residual non-aqueous phase liquids (NAPLs) and impacted soils and groundwater serve as potential secondary sources of chemicals. To address secondary sources, remedial efforts at the site have included soil excavation, NAPL skimming, soil vapor extraction, and multi-phase extraction activities. Details of remedial actions are summarized by ETIC (2000b).

2.2 Affected Media and Transport Mechanisms

Review of historical investigation results indicates the presence of petroleum hydrocarbons and volatile organic compounds (VOCs) in surface soils (≤ 4 ft below ground surface [bgs]), subsurface soils (>4 ft bgs), and groundwater (see Figures 10 through 21 of ETIC, 2000b). Impacted groundwater is a result of historical dissolution and leaching of chemicals through soils and NAPL migration to the water table. Due to the volatile nature of various chemicals released at the site, soil vapor underlying the site has also been impacted (see Appendix I). Offsite migration of chemicals in groundwater appears limited to the immediate vicinity of the site (see Figures 16 through 18 of ETIC, 2000b). This is due in part to the limited groundwater velocity (0.1 to 1 ft/day) estimated at the site (Harding Lawson Associates [HLA], 1991).

2.3 Land and Groundwater Use

Historical land use at the site has been limited to industrial use. Plans for future property development involve continued industrial/commercial land use (ETIC, 2000b). While much of the area surrounding the site is characterized by industrial land use, a residential building is located approximately 100 feet hydraulically downgradient of the site.

Review of available data indicates that no water supply wells are present at or within a one-mile radius of the site. This finding is based in part on results of two door-to-door well surveys performed in March 1999 and March 2000 (ETIC, 1999 and 2000c). Given the low permeability fine-grained sediments, combined with the limited saturated thickness of the water-bearing formation underlying the site, development of potable water supplies at and in the vicinity of the site is highly unlikely. Furthermore, potential water supply development would likely be limited to deeper water-bearing units, as opposed to the shallow unit impacted by past site operations.

2.4 Potential Exposure Pathways and Receptors

Potential exposure pathways and receptors (exposure scenarios) were evaluated based on the previously defined sources of chemicals, affected media, transport mechanisms, and land use at and in the vicinity of the site. This analysis accounted for the four principal elements of an exposure pathway:

1) a source and mechanism of chemical release;
2) one or more retention or transport media (e.g., soil, groundwater, and/or air);
3) a point of potential contact with the contaminated medium (referred to as the exposure point); and
4) an exposure route at the point of contact (e.g., inhalation, ingestion, or dermal contact).

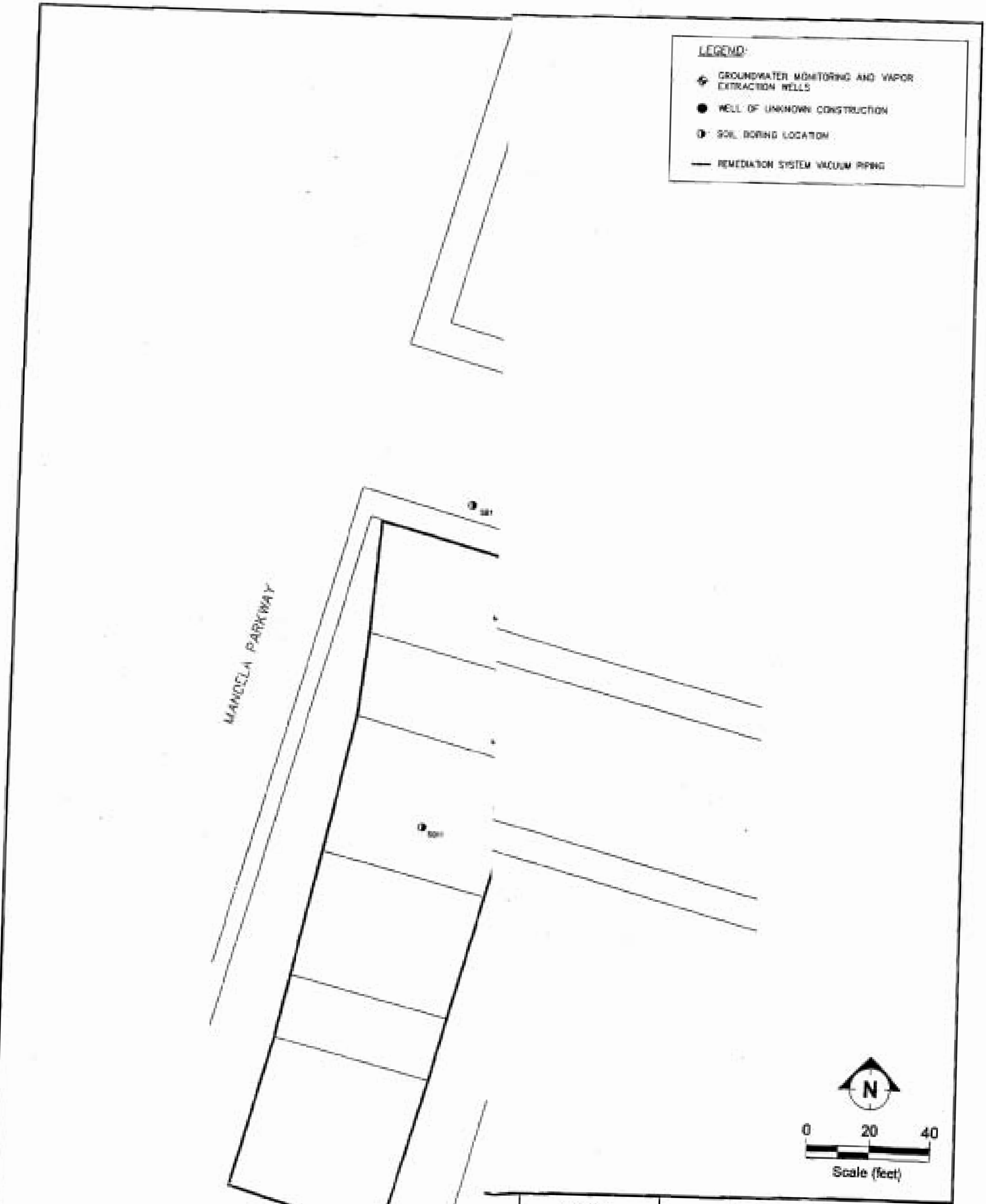
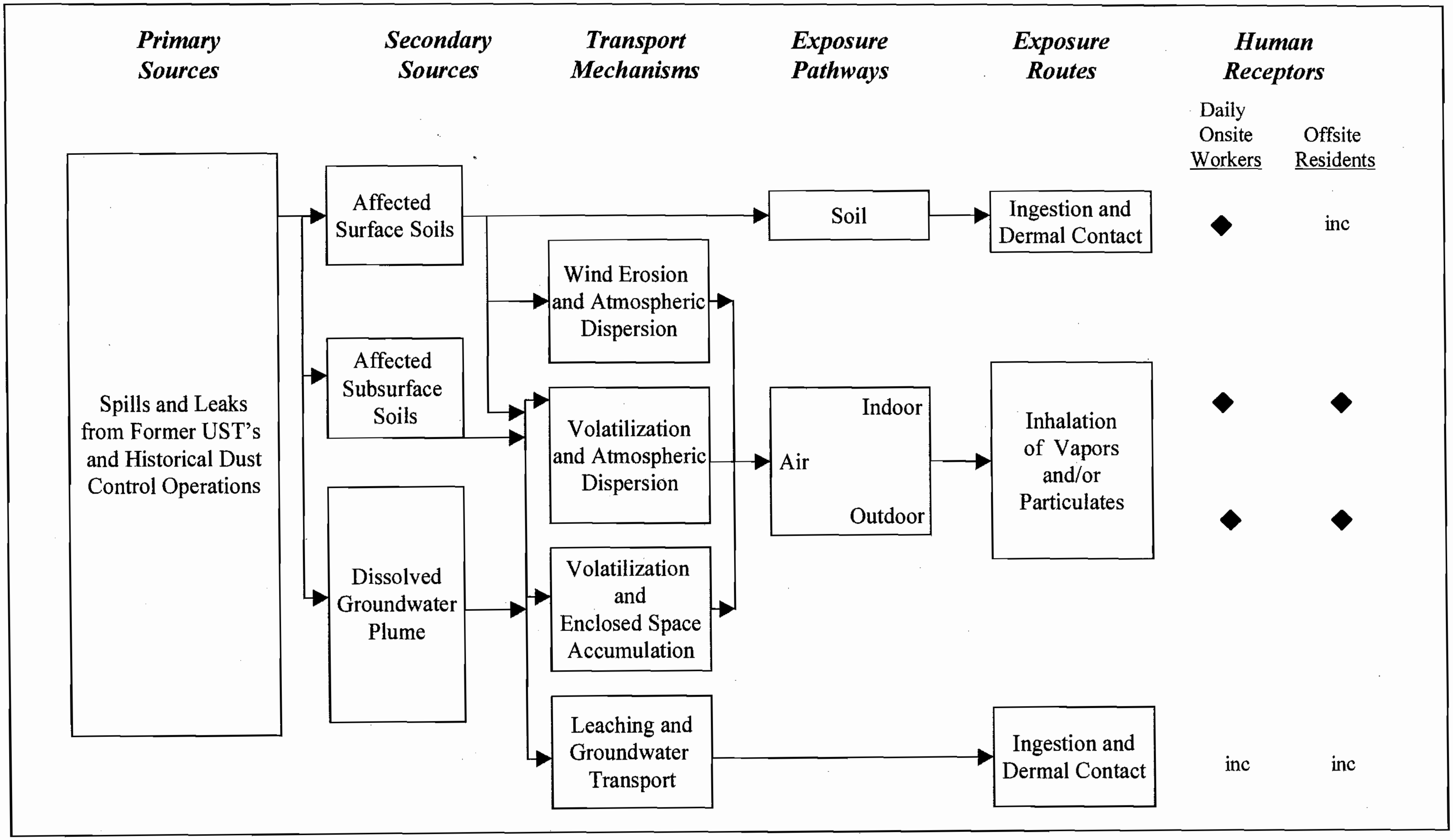


Figure
1
August 2000

FILENAME: SITEMAP 10/17/99



◆	Complete pathway
inc	Incomplete pathway

Conceptual Site Model
Nestle Oakland Facility
1310 14th Street, Oakland, California

Figure
2
August 2000

JAVAHERIAN CONSULTING, INC.

Analysis of exposure pathways links sources, locations, and types of environmental releases with population locations and activity patterns, in order to establish significant and complete exposure pathways. Based on available data, analysis of exposure pathways for human receptors at and in the vicinity of the site is summarized below.

Because of the current presence of a paved surface throughout the site, direct exposure of site occupants to surface soils (<4 ft bgs) and associated contaminants is not likely. Future site development plans (industrial/commercial use) indicate the presence of a paved surface throughout much of the site, with some unpaved areas (ETIC, 2000b). Accordingly, future site occupants may potentially be exposed to chemicals in surface soils within unpaved areas. Direct exposure to soils may occur via ingestion, inhalation, and dermal contact.

Based on the presence of volatile chemicals in soil and groundwater underlying the site, daily onsite industrial/commercial workers may be subject to inhalation of contaminated vapor emissions to outdoor and/or indoor air. Exposure of offsite downwind receptors to vapor emissions from the site is assumed negligible, since the magnitude of risk-based screening levels associated with the inhalation route of exposure will be governed by the larger intake associated with onsite receptors.

Based on the depth to the water table of the shallow aquifer (approximately 5 to 7 feet below ground surface) and absence of potential drinking water sources at and in the vicinity of the site, direct exposure to groundwater at on- and offsite locations is assumed incomplete. Chemical concentrations in groundwater have historically remained at low levels in downgradient monitoring wells immediately adjacent to the site (ETIC, 2000b). As a result, indirect exposure (inhalation of volatiles from groundwater) of nearby residents to chemicals in offsite groundwater is considered insignificant. Nevertheless, this pathway was assumed complete and conservatively evaluated based on potential volatilization of chemicals (to outdoor and indoor air) detected in groundwater at offsite locations.

Review of soil quality data (Appendix I) indicates sporadic detection of chemicals at low levels in unsaturated soils. The higher soil detections are limited to saturated or capillary fringe soils near the water table (approximately 5 ft bgs), where residual NAPLs may be present. The absence of measurable soil contamination above the water table is consistent with historical date of releases and remediation activities, suggesting that soil leaching to groundwater in the future is not a significant release mechanism. This is further corroborated by the stability of chemical concentrations in groundwater (wells MW-28 and MW-29) at offsite locations. Hence, potential (on- and offsite) indirect exposure to chemicals subject to leaching to groundwater in the future was considered negligible. As mentioned above, potential indirect exposure of offsite receptors to chemicals emanating from the site was accounted for through evaluation of exposure to chemicals currently (and historically) detected in groundwater at offsite locations.

Future construction work at the site may also result in exposure of construction workers to chemicals in soil and groundwater. Consistent with RWQCB practice, this risk will be addressed through the RMP for the site, outlining risk management practices and appropriate health and safety measures necessary prior to initiation of construction at the site.

To summarize, the following exposure scenarios corresponding to relevant human receptors were assumed complete in this RBCA analysis:

- Ingestion, inhalation, and dermal contact with surface soils (on-site industrial/commercial worker);
- inhalation of volatile emissions from subsurface soils and groundwater to indoor air (on-site industrial/commercial worker);
- inhalation of volatile emissions from subsurface soils and groundwater to outdoor air (on-site industrial/commercial worker);
- inhalation of volatile emissions from groundwater to indoor air (off-site residents); and
- inhalation of volatile emissions from groundwater to outdoor air (off-site residents).

3.0 RISK-BASED CORRECTIVE ACTION ANALYSIS

Making use of available site characterization data, a RBCA analysis based on ASTM (1995 and 1998) USEPA (1991), and DTSC (1999) guidelines was performed. The RBCA process is the integration of site assessment, remedial action selection, and monitoring with USEPA-recommended risk and exposure assessment practices. This creates a process by which corrective action decisions are made in a consistent manner that is protective of human health and the environment.

3.1 Tier I RBCA Input Data

Consistent with the tiered approach adopted by the ASTM RBCA guidelines, the initial attempt at evaluating the risk associated with potential exposure to chemicals emanating from the site was based on a Tier I evaluation. As outlined in ASTM (1995 and 1998), the Tier I evaluation involves comparison of the site-specific chemical source concentrations to highly conservative, generic Risk-Based Screening Levels (RBSLs) based on simplified chemical transport and exposure equations. These algorithms are supplemented by generalized site conditions conservatively represented by default data adopted by ASTM (1995 and 1998). All Tier I input data are included as Appendix II. Chemical-specific toxicity data and chemical-physical properties are included as Appendix III.

For each exposure scenario, chemicals of potential concern (COPCs) and media-specific source concentrations were identified based on available soil matrix, soil vapor, and groundwater quality data. Hydrocarbon fuel mixtures (i.e. total petroleum hydrocarbons [TPH] as gasoline [TPH-g] and as diesel [TPH-d]) were included as COPCs, with risks quantified based on the approach outlined by the Massachusetts Department of Environmental Protection ([MDEP] 1994), The rationale behind selection of COPCs and associated source concentrations for each exposure scenario is summarized below.

3.1.1 Inhalation, Ingestion, and Dermal Contact with Soils-Onsite Commercial/Industrial Receptor: For evaluation of direct exposure to chemicals in onsite soils, all chemicals detected in surface soils (<4 ft bgs) were included as COPCs (see Appendix I). As a conservative measure, selection of COPC soil source concentrations focused on historical maximum chemical levels detected in surface soil (see Table 1). Specifically, maximum chemical concentrations in soil samples collected from <4 feet bgs were used to represent soil quality in surface soils. Sample locations are depicted on Figure 1.

Table 1. Chemicals of Potential Concern and Source Concentrations
Direct Exposure to Surface Soils Onsite Commercial/Industrial Receptor

COPC	Sample ID	COPC Source Concentration* (mg/kg)
1,2-Dichloroethane (1,2-DCA)	SB13	2.50E-03
Ethylbenzene	SB13	2.70E-03
Toluene	SB13	2.00E-03
Xylenes	SB13	2.70E-03
TPH-g	SB13	6.30E-01
TPH-d	SB13	3.90E+02

* Concentrations represent historical maximum values in shallow (<4 ft bgs) soil samples

3.1.2 Outdoor and Indoor Air Inhalation of Volatiles from Soils and Groundwater-Onsite Commercial/Industrial Receptor: For evaluation of indirect exposure to chemicals in soils and groundwater, shallow (3 ft bgs) soil vapor quality data within the footprint of contaminated soils and groundwater plumes (see Figure 26 of ETIC, 2000b) were used as representative of COPC source concentrations (Appendix I). Soil vapor concentrations at 3 feet bgs correspond to vapor contribution from all potential subsurface sources, including residual NAPLs, soils, and groundwater. Hence, risk estimates using soil vapor quality data represent total pathway risks to indoor and outdoor receptors from combined soil and groundwater sources. Use of soil vapor data in risk assessments is acknowledged by the USEPA (1989), DTSC (1994, 1999), GSI (1995 and 1997), and the California Regional Water Quality Control Board San Francisco Bay Region

(RWQCB, 1999). The method and rationale behind collection of soil gas samples at the site are summarized by ETIC (2000a and 2000b).

As a result of using soil vapor quality data, chemicals detected in shallow soil vapor samples were included as COPCs, with their maximum detected concentrations used as representative of source levels in vapor phase (see Table 2).

Table 2. Chemicals of Potential Concern and Source Concentrations
Volatilization to Outdoor and Indoor Air Pathways Onsite Commercial/Industrial Receptor

COPC	Sample ID	COPC Source Concentration* (ppbv)
Benzene	SB3	9,900
Toluene	SB3 (dup)	240
Ethylbenzene	SB3	68
Total Xylenes	SB12	610
Methyl t-butyl ether	SB14	2.9
TPH-g	SB12	750,000
Acetone	SB2	260
1,3-Butadiene	SB5	61
2-Butanone	SB2	24
Carbon Disulfide	SB5	18
Chloroform	SB2	3.9
Chloromethane	SB11	3.7
1,2-Dichlorobenzene	SB12	480
1,4-Dichlorobenzene	SB12	76
1,4-Dioxane	SB11	22
Hexane	SB12	18,000
4-Methyl-2-pentanone	SB4	15
Methylene chloride	SB4	340
Styrene	SB2	3
Tetrachloroethene	SB4	160
Tetrahydrofuran	SB13	58
1,1,1-Trichloroethane	SB4	21
1,3,5-Trimethylbenzene	SB12	740
1,2,4-Trimethylbenzene	SB12	580

* Concentrations represent historical maximum values in shallow (3 ft bgs) soil vapor samples
dup = Concentration detected in duplicate sample

This list of COPCs represents a larger number of chemicals than those encountered in soil matrix and groundwater beneath the site. Due to the absence of data characterizing chemical toxicity and physical/chemical properties, eight chemicals (Cyclohexane, Ethanol, 4-Ethyltoluene, Freon 11, Freon 12, Freon 113, Heptane, and 2-Propanol) detected in soil vapor samples were excluded as COPCs; however, detection of most of these chemicals was limited in frequency and magnitude (see Appendix I). The limited presence of these chemicals is corroborated by their absence at above detection limits in soil matrix and groundwater samples across the site.

3.1.3 Outdoor and Indoor Air Inhalation of Volatiles from Groundwater-Offsite Residential Receptor: For evaluation of potential indirect exposure to chemicals in groundwater at the nearest (100 ft downgradient) residential property, chemicals detected over the past two years in offsite monitoring wells MW-28 and MW-29 (see Figure 1) located approximately 50 ft downgradient of the site were included as COPCs (see Appendix I). As a conservative measure, historical maximum concentrations of these COPCs (Table 3) were used as representative of source concentrations.

Table 3. Chemicals of Potential Concern and Source Concentrations Volatilization to Outdoor and Indoor Air Pathways Offsite Residential Receptor

COPC	Sample ID	COPC Source Concentration* (mg/l)
Benzene	MW-28	1.80E-02
1,1 DCA	MW-29	8.70E-02
1,2 DCA	MW-28	1.70E-01
cis-1,2 DCE	MW-29	2.30E-03
Ethylbenzene	MW-28	2.20E-03
MTBE	MW-28	5.60E-02
Toluene	MW-28	2.00E-02
TCE	MW-29	1.90E-03
Xylenes	MW-28	1.30E-02

* Concentrations represent historical maximum values in groundwater at offsite monitoring wells MW-28 and MW-29

The basis for using data from these wells as a conservative representation of potential future COPC concentrations at offsite locations include:

1. stability of the groundwater plume with respect to offsite migration;
2. consistent presence of COPCs at residual levels (i.e. at or below detection levels) in wells MW-28 and MW-29 over the (7-year) period of record (see Appendix I);
3. conservative omission of additional attenuation between the offsite wells and the nearest residential building..

Quarterly monitoring of groundwater quality at MW-28 and MW-29 has been conducted for over 7 years, yielding COPC levels at or around detection limits throughout the monitoring period (see Appendix I). Accordingly, data from these wells and farther downgradient wells CC-1 and CC-2 (see Figure 1) have been used to represent the downgradient extent of COPC plumes in groundwater underlying the site. Comparatively, historical operations at the site date back to 1929 through 1991, with groundwater contamination initially encountered in 1989. Based on estimated groundwater seepage velocities of 0.1 to 1 ft per day (HLA, 1991) and the absence of hydraulic control at the site, quarterly data collected over the past 7 years at MW-28 and MW-29 reflect the stability of the groundwater plume with respect to offsite migration. Hence, use of these data as representative of the offsite presence of chemicals is considered conservative in that it ignores further attenuation in groundwater between monitored locations and potential offsite receptors located 100 to 200 feet downgradient of the site. The occurrence of this attenuation is corroborated by the absence of COPC detections in further downgradient monitoring well CC-1 and sporadic detections at residual levels in monitoring well CC-2.

3.2 Tier I RBCA Results

COPCs, media-specific concentrations, and ASTM (1995) default input data were incorporated into the highly conservative ASTM (1995) exposure algorithms, yielding Tier I RBSLs corresponding to target risk and hazard levels of 1×10^{-6} and 1.0, respectively. Tier I output data, including sample calculations using soil vapor data, are included as Appendix IV and are summarized below. Calculation of RBSLs for TPH is summarized in Appendix V. Table 4 depicts a comparison of highly conservative Tier I RBSLs with COPC source concentrations for direct exposure of daily site occupants to chemicals in surface (<4 ft bgs) soils. As indicated in Table 4, source concentrations for all COPCs are protective of the highly conservative Tier I RBSLs for direct exposure to surface soils.

Table 4. Tier I Results for Direct Exposure to Surface Soils
Onsite Commercial/Industrial Receptor

COPC	COPC Source Concentration (mg/kg)	Tier I RBSLs * (mg/kg)
1,2 DCA	2.50E-03	1
Ethylbenzene	2.70E-03	3,400**
Toluene	2.00E-03	6,400**
Xylenes	2.70E-03	66,000**
TPH-g	6.30E-01	1,400
TPH-d	3.90E+02	1,600

*: RBSL corresponds to lower endpoint of target risk and hazard levels of 1 x 10^{-6} and 1.0, respectively

**: RBSL is greater than constituent residual saturation in soil

Tables 5 depicts a comparison of the highly conservative Tier I RBSLs with COPC source concentrations for indirect exposure of daily onsite receptors to vapor emissions to outdoor air.

Table 5. Tier I Results Volatilization-to-Outdoor Air Pathway
Onsite Commercial/Industrial Receptor

COPC	COPC Source Concentration (ppbv)	Tier I RBSLs* (ppbv)	Carcinogenic Risk	Non-Carcinogenic Hazard
Benzene	9.9E+03	1.7E+04	5.90E-07	9.80E-03
Toluene	240	6.2E+07	-	3.90E-06
Ethylbenzene	68	1.5E+08	-	4.40E-07
Total Xylenes	610	1.1E+08	-	5.50E-06
Methyl t-butyl ether	2.9	1.1E+07	2.50E-13	5.20E-09
TPH-g	7.5E+05	1.5E+06	-	5.0E-01
Acetone	260	5.8E+07	-	4.50E-06
1,3-Butadiene	61	7.1E+03	8.60E-09	-
2-Butanone	24	2.0E+08	-	1.20E-07
Carbon Disulfide	18	1.1E+08	-	1.60E-07
Chloroform	3.9	1.2E+04	3.20E-10	1.30E-04
Chloromethane	3.7	2.3E+04	1.60E-10	6.50E-08
1,2-Dichlorobenzene	480	2.4E+07	-	2.00E-05
1,4-Dichlorobenzene	76	3.0E+04	2.50E-09	5.90E-06
1,4-Dioxane	22	2.5E+06	8.70E-12	-
Hexane	1.8E+04	1.4E+07	-	1.30E-03
4-Methyl-2-pentanone	15	1.4E+07	-	1.10E-06
Methylene chloride	340	4.1E+05	8.40E-10	7.80E-07
Styrene	3	1.7E+08	-	1.80E-08
Tetrachloroethene	160	4.8E+04	3.30E-09	4.00E-06
Tetrahydrofuran	58	2.5E+05	2.30E-10	1.10E-06
1,1,1-Trichloroethane	21	1.2E+08	-	1.80E-07
1,3,5-Trimethylbenzene	740	2.5E+08	-	3.00E-06
1,2,4-Trimethylbenzene	580	1.4E+09	-	4.10E-07
Total Pathway Risk/Hazard:		-	**6.06E-07**	**5.11E-01**

*: RBSL corresponds to lower endpoint of target risk and hazard levels of 1 x 10^{-6} and 1.0, respectively

As previously indicated, this analysis made use of maximum detected soil vapor concentrations as representative of vapor contribution from all potential subsurface sources (i.e. residual NAPL, soil, and groundwater). Hence, RBSLs represent soil vapor concentrations at 3 ft bgs (see Appendix IV), corresponding to target risk/hazard levels of 1 x 10^{-6} and 1.0, respectively.

Due to the quantity of COPCs detected in soil vapor, individual and total pathway risks/hazards were also quantified (see Table 5) to represent potential cumulative impacts. As indicated in Table 5, soil vapor concentrations for all COPCs are protective of the highly conservative Tier I RBSLs. In addition, total pathway (i.e. cumulative) risk/hazard estimates remain protective of the target risk/hazard of 1 x 10^{-6} and 1.0, respectively.

Table 6 provides a comparison between the highly conservative Tier I RBSLs and COPC source concentrations for indoor air inhalation of vapors associated with daily onsite receptors.

Table 6. Tier I Results Volatilization-to-Indoor Air Pathway
Onsite Commercial/Industrial Receptor

COPC	COPC Source Concentration* (ppbv)	Tier I RBSLs* (ppbv)	Carcinogenic Risk	Non-Carcinogenic Hazard
Benzene	**9,900**	**660**	**1.50E-05**	**2.40E-01**
Toluene	240	2.4E+06	-	9.80E-05
Ethylbenzene	68	6.2E+06	-	1.10E-05
Total Xylenes	610	4.4E+06	-	1.40E-04
Methyl t-butyl ether	2.9	4.6E+05	6.30E-12	1.30E-07
TPH-g	**7.5E+05**	**6.5E+04**	-	**1.15E+01**
Acetone	260	2.4E+06	-	1.10E-04
1,3-Butadiene	61	2.9E+02	2.10E-07	-
2-Butanone	24	8.3E+06	-	2.90E-06
Carbon Disulfide	18	4.4E+06	-	4.10E-06
Chloroform	3.9	4.9E+02	7.90E-09	3.20E-03
Chloromethane	3.7	1.2E+04	3.10E-10	1.60E-06
1,2-Dichlorobenzene	480	9.4E+05	-	5.10E-04
1,4-Dichlorobenzene	76	1.2E+03	6.30E-08	1.50E-04
1,4-Dioxane	22	1.0E+05	2.20E-10	-
Hexane	1.8E+04	5.6E+05	-	3.20E-02
4-Methyl-2-pentanone	15	5.4E+05	-	2.80E-05
Methylene chloride	340	1.6E+04	2.10E-08	1.90E-05
Styrene	3	6.7E+06		4.50E-07
Tetrachloroethene	160	1.9E+03	8.30E-09	1.00E-04
Tetrahydrofuran	58	1.0E+04	5.70E-09	2.70E-05
1,1,1-Trichloroethane	21	4.6E+06	-	4.60E-06
1,3,5-Trimethylbenzene	740	1.0E+07	-	7.40E-05
1,2,4-Trimethylbenzene	580	5.8E+07	-	1.00E-05
Total Pathway Risk/Hazard:		-	**1.54E-05**	**1.17E+01**

*: RBSL corresponds to lower endpoint of target risk and hazard levels of 1 x 10^{-6} and 1.0, respectively
Bolded parameters indicate exceedance of RBSLs.

As indicated in Table 6, with the exception of the benzene and TPH-g, shallow soil vapor concentrations for all COPCs are protective of the highly conservative Tier I RBSLs for indoor air exposure. For the more stringent indoor air pathway, the carcinogenic risk and noncarcinogenic hazard for benzene approximate 1.5 x 10^{-5} and 0.24, respectively. The carcinogenic risk associated with benzene represents 98 percent of the total pathway risk. The noncarcinogenic hazard for TPH-g represents 98 percent of the total pathway hazard and results in exceedance of the target hazard level of 1.0. Accordingly, benzene and TPH-g volatilization to onsite indoor air was further evaluated in the Tier II analysis.

Table 7 depicts a comparison between highly conservative Tier I RBSLs and COPC concentrations for the groundwater volatilization-to-indoor air and outdoor air pathways for offsite residential receptors. As indicated, with the exception of benzene and 1,2-DCA volatilization-to-indoor air, all COPCs are protective of the highly conservative RBSLs for both indoor and outdoor air exposure pathways.

Table 7. Tier I Results Volatilization to Indoor and Outdoor Air
Offsite Residential Receptor

COPC	COPC Source Concentration (mg/l)	Tier I RBSLs* (mg/l) Groundwater Volatilization to Indoor Air	Tier I RBSLs* (mg/l) Groundwater Volatilization to Outdoor Air
Benzene	**1.80E-02**	**7E-03**	**3.2**
1,1 DCA	8.70E-02	21	11,000**
1,2 DCA	**1.70E-01**	**2.20E-02**	**7.5**
cis-1,2 DCE	2.30E-03	0.780	410**
Ethylbenzene	2.20E-03	77	37,000**
MTBE	5.60E-02	24	3,600
Toluene	2.00E-02	33	16,000**
TCE	1.90E-03	2.80E-02	8
Xylenes	1.30E-02	610**	290,000**

*: RBSL corresponds to target risk and hazard levels of 1 x 10^{-6} and 1.0, respectively
**: RBSL is greater than constituent solubility in water
Bolded parameters indicate exceedance of RBSLs.

Based on the Tier I results, the following exposure scenarios were further evaluated in the Tier II analysis:

- Benzene volatilization to indoor air from subsurface sources (Onsite commercial/industrial receptor);
- TPH-g volatilization to indoor air from subsurface sources (Onsite commercial/industrial receptor); and
- Benzene and 1,2-DCA volatilization to indoor air from groundwater (Offsite residential receptor).

3.3 Tier II RBCA Input Data

Consistent with the ASTM guidelines, a Tier II analysis was performed on exposure scenarios and COPCs exceeding the highly conservative Tier I RBSLs. Specifically, site-specific target levels (SSTLs) were calculated accounting for site-specific conditions, chemical attenuation between source and receptor locations, and relevant target risk levels.

As part of the Tier II analysis, the highly conservative vapor transport and exposure algorithms used in the Tier I analysis were maintained. The sole deviation from the Tier I analysis involved changes to select input data characterizing site conditions. These data, as summarized in Table 8, correspond to values adopted for the Oakland Urban Land Redevelopment Program Tier I Risk-Based Screening Levels (Spence and Gomez, 1997 and 1999), and accordingly maintain significant conservatism. All other input data were maintained from the Tier I analysis (see Appendix II).

Table 8. Tier II Input Data

Parameter	Value	Reference
Depth to groundwater	7 ft	Site specific value
Capillary fringe thickness	2 ft	Default value for mixed sediments (Spence and Gomez, 1997 and 1999)
Vadose zone thickness	5 ft	Back-calculated from capillary fringe thickness and depth to groundwater
Soil porosity	0.4	Default value for mixed sediments (Spence and Gomez, 1997 and 1999)
Vadose zone water content	0.25	Default value for mixed sediments (Spence and Gomez, 1997 and 1999)
Vadose zone air content	0.15	Default value for mixed sediments (Spence and Gomez, 1997 and 1999)
Capillary fringe water content	0.38	Default value for mixed sediments (Spence and Gomez, 1997 and 1999)
Capillary fringe air content	0.02	Default value for mixed sediments (Spence and Gomez, 1997 and 1999)
Building air exchange rate	0.00056/s	Default value for Oakland (Spence and Gomez, 1999)
Foundation crack fraction	0.001	Default value (Spence and Gomez, 1997 and 1999)

3.4 Tier II RBCA Results

Tier II output data are included as Appendix VI, including sample calculation for Tier II SSTLs using soil gas data. SSTL development for TPH-g is summarized in Appendix V. Results of the Tier II analysis are summarized in Table 9. As indicated in Table 9, Tier II COPC source concentrations are protective of SSTLs for both on- and offsite receptors.

Table 9. Tier II RBCA Results

Exposure Scenario	COPC	COPC Source Concentration	Tier II SSTL
Volatilization to Indoor Air-Onsite Commercial/Industrial Receptor	Benzene	9,900 ppbv	43,800 ppbv
Volatilization to Indoor Air-Onsite Commercial/Industrial Receptor	TPH-g	750,000 ppbv	4,000,000 ppbv
Volatilization to Indoor Air-Offsite Residential Receptor	Benzene	0.018 mg/l	1.10 mg/l
Volatilization to Indoor Air-Offsite Residential Receptor	1,2-DCA	0.170 mg/l	3.90 mg/l

3.5 Uncertainty Analysis

The assumptions, procedures, and parameters used in this RBCA analysis are subject to various degrees of uncertainty. To this end, conservative assumptions are incorporated into the RBCA process to ensure protection of human health, as documented herein. Specifically, uncertainty and conservatism associated with sample collection and analysis, fate and transport calculations, representation of site conditions, standard exposure factors, toxicological endpoints, and interpretation of target risk levels are documented below.

3.5.1 Sample Collection and Analysis: Environmental sampling and analysis error can stem from improper sample collection and handling procedures, inadequate sample numbers, laboratory analysis errors, and the heterogeneity of the subsurface environment. The use of standard techniques such as the collection of duplicates, and the use of trip and method blanks can be used to reduce the likelihood of errors. Errors in data analyses can occur from the simplest tabulation and typographical errors to complex interpretational errors. Matrix interference due to the presence of high concentrations often raise the detection limits of other chemicals in the analytical procedure and introduce uncertainty in the method of data analyses.

The sampling effort implemented at the Nestle site was specifically designed to identify areas that were suspected to have elevated chemical concentrations. This sampling bias resulted in a data base that focused on the worst-case areas of the site. This focused approach resulted in assumptions related to representation of COPC concentrations that make this RBCA analysis conservative in nature. These conditions will result in a significant overestimation of risk and excessively low RBSLs and SSTLs.

3.5.2 ASTM RBCA Fate and Transport Algorithms: The ASTM guidelines and the GSI RBCA Spreadsheet System used in this analysis employ a series of simplified fate and transport models for predicting COPC concentrations at points of exposure. The simplified analytic nature of these models, particularly those used to simulate volatilization and transport of vapor emissions to outdoor and indoor air, often result in grossly over-estimated COPC exposure point concentrations (Sanders and Stern, 1994; GSI, 1995 and 1997; AEHS, 1997; Javaherian, 1994 and 1997); in turn, these result in over-estimation of health risks and lower RBSLs and SSTLs. In fact, GSI (1995 and 1997) warns against delineation of cleanup levels based on the use of its formulation for vapor intrusion to indoor air. Examples of physical and chemical processes ignored by the simplified GSI vapor transport models include:

- loss mechanisms- absence of loss mechanisms such as biodegradation and adsorption results in over-estimation of vapor and contaminant flux to outdoor and indoor air;
- depleting contaminant source- use of a non-depleting, constant source results in an unlimited supply of contaminated vapor and an over-estimation of vapor and contaminant flux to outdoor and indoor air over time; and
- water movement- absence of water movement through subsurface soils results in an over-estimation of air-filled porosity and vapor and contaminant flux to outdoor and indoor air.

3.5.3 Representation of Site Conditions: As part of the Tier I analysis, the ASTM RBCA process promotes the use of conservative default values for various parameters representing site conditions. This RBCA analysis consistently incorporated conservative assumptions for selection of input parameters, while attempting to maintain a reasonable, site-specific evaluation. Examples of conservative assumptions used to formulate input parameters include:

- On- and offsite buildings will directly overlie locations of historical maximum soil matrix, soil vapor, and groundwater concentrations;
- Cracks may exist in foundations of both onsite and offsite buildings;
- The paved surface at the site has a negligible impact on vapor emissions to outdoor air;
- Historical maximum chemical concentrations in surface soil, soil vapor, and groundwater are representative of current and future source concentrations; and
- No chemical attenuation occurs in groundwater between the site and the location of the nearest offsite residential facility.

Use of these conservative assumptions results in an over-estimation of health risks and lower RBSLs and SSTLs.

3.5.4 Standard Exposure Factors: Standard exposure scenarios evaluated in this RBCA analysis incorporate the most likely site-specific exposure pathways and represent the greatest potential for exposure to contaminants at the site. Conservative assumptions consistent with state and federal guidelines were used to conceptualize the exposure scenarios. These methods and procedures contribute to an overall overestimation of potential exposure.

Numerous conservative exposure assumptions serve as the basis for exposure parameters adopted by ASTM (1995). Duration, frequency, and other input parameters were selected to represent the maximally exposed individual and are not an accurate portrayal of time spent at a place of business or residence. The quantitative effect of these uncertainties may be significant in overestimating overall potential health risk.

The exposure parameters used to develop the onsite indoor worker exposure scenarios at the site are conservative estimates of the true exposures. Although indoor workers are present at the site, the assumed duration of exposure is likely to be much greater than the true duration. For instance, an indoor onsite worker is assumed to be indoors 8-hours per day, 250-days per year, for 25 years. In reality, based on Department of Labor statistics regarding average job tenure nationwide, this type of worker would be expected to remain in his/her job less than 10 years.

Further, the hypothetical worker is assumed to be exposed to chemical emissions that were conservatively estimated from maximum reported soil and groundwater concentrations (e.g. Tier I analysis). Therefore, assuming exposure to air concentrations of COPCs based on maximum concentrations and using the conservative exposure parameters provided, the onsite indoor worker scenario significantly overestimates the true risk/hazard associated with site-related COPC emissions; this results in underestimation (i.e. lower) of RBSLs.

Likewise, the onsite outdoor worker is assumed to have the same exposure frequency and duration as the indoor worker. In reality, based on weather conditions alone, a worker will not be outdoors 250-days per year. For the same reasons documented above, a worker would not be expected to remain in his/her job for a 25-year duration. Consequently, the outdoor worker scenario also overestimates the true risk/hazard, while underestimating action levels associated with site-related COPC emissions.

3.5.5 Toxicological Endpoints: Several aspects of the toxicological data employed in the ASTM RBCA process contain a high degree of uncertainty that affect estimation of risk and delineation of SSTLs. These uncertainties arise in two primary areas: first, slope factors used in this assessment correspond to the 95% upper confidence limit (UCL) on the low-dose portion of the chemical's dose-response curve, as extrapolated from high-dose human or animal response data using the EPA linearized multistage model (LMS). This assumption means actual risks are likely to be lower than the risk estimates calculated in this assessment.

Second, results of animal studies are often used to predict the potential human health effects of a chemical. Extrapolation of toxicological data from animal tests is one of the largest sources of uncertainty in the human health risk evaluation process. There may be important, but unidentified differences in uptake, metabolism, distribution, and elimination of chemicals between a test species and humans. Animal studies are usually conducted under high-dose conditions, whereas humans are rarely exposed to such high doses. The dose level itself may be responsible for the observed carcinogenic effects. Also, animal lifetimes tend to be less than two years, while assumed human life expectancy is 70 years.

3.5.6 Interpretation of Target Risk Levels: The excess lifetime cancer risk used to evaluate carcinogenic compounds is often misunderstood. For example, a risk level of one-in-one million (1×10^{-6}) associated with exposure to a particular chemical is often misconstrued as an expectation that one out of one million people exposed to the chemical will be stricken with cancer. In actuality the carcinogenic risk is not an actual risk, but rather a mathematical risk based on conservative scientific assumptions used in the risk assessment process. The Food and Drug Administration (FDA) uses this conservative estimate to ensure that the risk is not understated.

Uncertainties from the various sources discussed above are additive; hence, the overall effect of using conservative assumptions in each step of the risk assessment process results in significant overestimation of potential risks/hazards, and an underestimation of action levels. Accordingly, comparison of COPC concentrations with applicable RBSLs must be viewed with an understanding of the uncertainty and conservatism involved, and how these effect risk estimations. Because of the high degree of conservatism associated with the RBCA process, findings of insignificant risk (high RBSLs) may reflect conditions close to reality; however, findings of measurable risk (low RBSLs) may reflect conditions that result from the conservative nature of the evaluation.

4.0 CONCLUSIONS

Based on the historical levels of chemicals in soil matrix, soil vapor, and groundwater at on- and offsite locations, together with results of this RBCA analysis, the following conclusions are formulated for the site:

- Risks/hazards associated with direct exposure of daily site (commercial/industrial) occupants to observed levels of chemicals in surface soils are protective of USEPA-defined target risk/hazard levels;
- Risks/hazards associated with onsite (commercial/industrial) indoor and outdoor air inhalation of volatiles detected in shallow soil vapor samples are protective of USEPA-defined target risk/hazard levels;
- Risks/hazards associated with offsite (residential) indoor and outdoor air inhalation of volatiles detected in groundwater at offsite locations are protective of USEPA-defined target risk/hazard levels;
- A risk management plan outlining appropriate risk management practices, health and safety measures, and deed restrictions should be developed prior to initiation of construction activities and redevelopment at the site.

5.0 REFERENCES

Anon, 1994. Interim Final Petroleum Report: Development of Health-Based Alternative to the Total Petroleum Hydrocarbon Parameter. Prepared for the Bureau of Waste Site Cleanup, Massachusetts Department of Environmental Protection. August.

Agency for Toxic Substances and Disease Registry (ATSDR), 1993. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). Update. US Department of Health and Human Services.

ATSDR, 1994. Toxicological Profile for naphthalene. Draft Update. US Department of Health and Human Services.

Association for the Environmental Health of Soils (AEHS), 1997, Exposure Pathway Modeling for RBCA, 7th Annual West Coast Conference on Contaminated Soils and Groundwater. March.

American Petroleum Institute (API), 1993. APIDSS: Exposure/Risk Assessment Decision Framework for the Management of Subsurface Contaminants.

American Society for Testing and Materials (ASTM), 1995.Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

ASTM, 1998. Standard Provisional Guide for Risk-Based Corrective Action, PS 104-98.

Bruya, J., and A. Friedman, 1992. Petroleum Hydrocarbons, What Are They? Friedman and Bruya, Inc., Seattle Washington.

California Department of Toxic Substance Control (DTSC), 1994. California Cancer Potency Factors: Update. Office of Environmental Health Hazard Assessment. State of California Environmental Protection Agency (Cal-EPA). November 1, 1994.

EMCON, 1995. Fractionation Approach for Assessing Risk from Petroleum Hydrocarbons (From Appendix B of the Ecological Risk Assessment for King Salmon Airport).

ETIC Engineering, Inc., 1999. Door-to-Door Wells Survey, Nestle USA Facility, 1310 14th Street, Oakland, CA, March 3.

ETIC, 2000a. Response to Comments from ACHA and RWQCB on Draft Risk Assessment for Nestle USA, Inc. Site, 1340 14th Street, Oakland, California, June 27th.

ETIC, 2000b. Comprehensive Site Characterization Report, Support for the Site as a Low-Risk Soil and Groundwater Case, Nestle USA Facility, 1310 14th Street, Oakland CA, October.

ETIC, 2000c. Door-to-Door Well Survey, Nestle USA Facility, 1310 14th Street, Oakland CA, March 22.

Gruse, W.A., and D.R. Stevens, 1960. The Chemical Technology of Petroleum.

Groundwater Services, Inc. (GSI), 1995. Tier I and Tier II RBCA Spreadsheet System, Version 1.0.

GSI, 1997. Tier I and Tier II RBCA Spreadsheet System, Version 1.01.

Javaherian, M.M., 1994. Evaluation of Unsaturated/Vadose Zone Models for Superfund Sites, Research and Development, USEPA Center for Subsurface Modeling Support.

Javaherian, M.M., 1997. A Finite-Difference Model for Simulation of Contaminant Fate and Transport and Exposure Pathways Through the Vadose Zone, *Water Resources Research.*

Massachusetts Department of Environmental Protection (MDEP), 1994. Interim Final Petroleum Report: Development of Health-Based Alternative to the Total Petroleum Hydrocarbon Parameter, August.

Millner, G.C., R.C. James, and A.C. Nye, 1992. Human Health-Based Soil Cleanup Guidelines for Diesel Fuel No. 2. *Journ. of Soil Cont.* 1(2).

Montgomery Watson, 1996. Fuel Action Level Development, US Army Corps of Engineers, The Presidio, San Francisco, CA.

Office of Environmental Health Hazard Assessment (OEHHA), 2000, Toxicity Criteria Database, California Environmental Protection Agency, on-line @ www.oehha.org/risk.html

Purdy, G.A., 1957. Petroleum: Prehistoric to Petrochemicals.

Regional Water Quality Control Board (RWQCB) San Francisco Bay Region, 1999. Personal communication with Dr. Ravi Arulanantham, November 2nd.

Sanders, P.F., and A.L. Stern, 1994, Calculation of Soil Cleanup Criteria for Carcinogenic Volatile Organic Compounds as Controlled by the Soil-to-Indoor Air Exposure Pathway, *Environ. Tox. and Chem.*, 12(8): 745-758.

Speight, J.G., 1980. The Chemistry and Technology of Petroleum.

Speight, J.G., 1991. The Chemistry and Technology of Petroleum, 2nd Edition.

Spence, L.R., and M. Gomez, 1997. Draft Tier I: Risk-Based Screening Levels, Oakland Urban Land Redevelopment Program, City of Oakland Environmental Services Division, Oakland, CA.

Spence, L.R., and M. Gomez, 1999. Tier I: Risk-Based Screening Levels, Oakland Urban Land Redevelopment Program, City of Oakland Environmental Services Division, Oakland, CA.

USEPA, 1989. Risk Assessment Guidance for Superfund (RAGS). Volume 1, Human Health Evaluation Manual (PartA). Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002.

USEPA, 1990a. Guidance for Data Usability in Risk Assessment, Interim Final. EPA/540/G-90/008, Directive 9285.7-05. October.

USEPA, 1990b. Hazardous Waste Management System Toxicity Characteristics, Revisions 55 FR 11798-11863, Washington, D.C.

USEPA, 1991, Risk Assessment Guidance for Superfund, Volume I, Part C. Risk Evaluation of Remedial Alternatives, Interim, December.

USEPA, 1997, Health Effects Assessment Summary Tables (HEAST).

USEPA, 1999, Region 9 Preliminary Remediation Goals Chemical Toxicity Database, on-line @ www.epa.gov/region09/waste/sfund/prg/

USEPA, 2000, Integrated Risk Information System (IRIS), on-line database.

Appendix I

Soil Matrix, Soil Vapor, and Groundwater Quality Data

Table I.1. Concentrations of Volatile Organic Compounds in Soil Samples, 12-13 AUGUST 1999
NESTLE USA FACILITY, OAKLAND, CA

	(µg/kg)				(mg/kg)		(µg/kg)																
Sample ID	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPH-g	TPH-d	Chloro-benzene	Chloro-form	Chloro-methane	1,2-Di-chloro-benzene	1,3-Di-chloro-benzene	1,4-Di-chloro-benzene	1,1-Di-chloro-ethane	1,2-Di-chloro-ethane	1,1-Di-chloro-ethene	cis-1,2-Dichloro-ethene	Freon 11	Freon 12	Methylene Chloride	Methyl t-butyl ether	Tetra-chloro-ethene	1,1,1-Tri-chloro-ethane	Tri-chloro-ethene
SB1, 3.5-4.0	<1.3	<1.3	<1.3	<1.3	<0.13	**1,200**	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.3	<1.1	<1.1	<1.1
SB1, 6.5-7.0	<1.0	<1.0	<1.0	<1.0	<0.10	<5.9	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<1.0	<0.8	<0.8	<0.8
SB2, 3.5-4.0	<0.9	<0.9	<0.9	<0.9	<0.09	<5.6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.9	<1.0	<1.0	<1.0
SB2, 6.5-7.0	<1.0	<1.0	<1.0	<1.0	<0.10	<5.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**1.0**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
SB3, 3.5-4.0	<1.0	<1.0	<1.0	<1.0	<0.10	<5.6	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	**0.7**	<0.7	<0.7	<0.7	<0.7	<0.7	<1.0	<0.7	<0.7	<0.7
SB3, 6.5-7.0	**11,000**	**190,000**	**100,000**	**460,000**	**6,160**	<5.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	**1.8**	<0.7	<0.7	<0.7	<0.7	<0.7	73	<0.7	<0.7	<0.7
SB4, 3.5-4.0	<1.0	<1.0	<1.0	<1.0	<0.10	<5.5	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<1.0	<0.7	<0.7	<0.7
SB4, 6.5-7.0	**82**	**8.5**	**7.3**	**13**	**0.55**	**94**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	**1.0**	<0.8	<0.8	<0.8	<0.8	<0.8	<1.1	<0.8	<0.8	<0.8
SB5, 3.5-4.0	<0.9	<0.9	<0.9	<0.9	<0.09	<5.5	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	**0.6**	<0.6	<0.6	<0.6	<0.6	<0.6	<0.9	<0.6	<0.6	<0.6
SB5, 6.5-7.0	<0.8	<0.8	<0.8	<0.8	<0.08	<5.9	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	**0.9**	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
SB6, 3.5-4.0	<1.0	<1.0	<1.0	<1.0	<0.10	<5.5	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<1.0	<0.8	<0.8	<0.8
SB6, 6.5-7.0	**76,000**	**490,000**	**170,000**	**990,000**	**10,100**	**1,100**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**430**	<1.0	<1.0	<1.0	<1.0	<1.0	**32**	<1.0	<1.0	<1.0
SB7, 3.5-4.0	<1.0	<1.0	<1.0	<1.0	<0.10	<5.4	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<1.0	<0.8	<0.8	<0.8
SB7, 6.5-7.0	<1.1	<1.1	<1.1	<1.1	<0.11	<5.8	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<1.1	<0.9	<0.9	<0.9
SB8, 3.5-4.0	<1.0	<1.0	<1.0	<1.0	<0.10	<5.6	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<1.0	<0.7	<0.7	<0.7
SB8, 6.5-7.0	**430**	**360**	**120**	**830**	**13**	<5.8	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	**1.2**	<0.9	<0.9	<0.9	<0.9	<0.9	**22**	<0.9	<0.9	<0.9
SB9, 3.5-4.0	<0.9	<0.9	<0.9	<0.9	<0.09	<5.6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.9	<1.0	<1.0	<1.0
SB9, 6.5-7.0	**24**	<6.1	<6.1	<6.1	<0.61	<5.8	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<6.1	<1.1	<1.1	<1.1
SB10, 3.5-4.0	<0.9	<0.9	<0.9	<0.9	<0.09	<5.6	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.9	<0.8	<0.8	<0.8
SB10, 6.5-7.0	<1.3	<1.3	<1.3	<1.3	<0.13	<6.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.3	<1.0	<1.0	<1.0
SB11, 3.5-4.0	<2.0	<2.0	<2.0	<2.0	<0.20	<5.5	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<2.0	<1.1	<1.1	<1.1
SB11, 6.5-7.0	<1.1	<1.1	<1.1	<1.1	<0.11	<5.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.1	<1.0	<1.0	<1.0
SB12, 3.5-4.0	<1.0	<1.0	<1.0	<1.0	<0.10	<5.5	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<1.0	<0.6	<0.6	<0.6
SB12, 4.5-5.0	**70**	**32**	**4,000**	**6,700**	**496**	**2,900**	**1.7**	<0.9	<0.9	**3,100**	**38**	**330**	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	**14**	<0.9	<0.9	<0.9
SB12, 6.5-7.0	<1.0	<1.0	**23**	**9.8**	**2.25**	**60**	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	**0.6**	<1.1	<1.1	<1.1
SB13, 3.5-4.0	<1.2	**2.0**	**2.7**	**2.7**	**0.63**	**390**	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	**2.5**	<0.9	<0.9	<0.9	<0.9	<0.9	<1.2	<0.9	<0.9	<0.9
SB13, 6.5-7.0	**250**	**48**	**150**	**490**	**12**	**65**	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	**1.4**	<1.4	<1.4	<1.4	<1.4	<1.4	<5.5	<1.4	<1.4	<1.4
SB14, 3.5-4.0	<0.8	<0.8	<0.8	<0.8	<0.08	<5.5	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
SB14, 6.5-7.0	**560**	**290**	**330**	**1,700**	**28.5**	**450**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	9.7	<1.0	<1.0	<1.0	<1.0	<1.0	**84**	<1.0	<1.0	<1.0
SB15, 3.5-4.0	<5.4	<5.4	<5.4	<5.4	<0.51	**140**	<9.1	<9.1	<9.1	<9.1	<9.1	<9.1	<9.1	<9.1	<9.1	<9.1	<9.1	<9.1	<9.1	<5.4	<9.1	<9.1	<9.1
SB15, 6.5-7.0	<6.1	**12**	<6.1	**8.5**	<0.57	**81**	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<9.8	<6.1	<9.8	<9.8	<9.8

Notes:

µg/kg	Micrograms per kilogram.
mg/kg	Milligrams per kilogram.
NA	Not analyzed.
TPH-g	Total Petroleum Hydrocarbons as gasoline.
TPH-d	Total Petroleum Hydrocarbons as diesel.

Table I.2. Concentrations of Volatile Organic Comopunds in Soil Vapor Samples, 12-13 AUGUST 1999
NESTLE USE FACILITY, OAKLAND, CA

Sample ID	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPH-g	Acetone	1,3-Bu-tadiene	2-Bu-tanone	Carbon Disulfide	Chloro-benzene	Chloro-form	Chloro-methane	Cyclo-hexane	1,2-Di-chloro-benzene	1,3-Di-chloro-benzene	1,4-Di-chloro-benzene	1,1-Di-chloro-ethane	1,2-Di-chloro-ethane	1,1-Di-chloro-ethene	cis-1,2-Dichloro-ethene
SB1, 3'	**4.3**	**3.1**	<0.65	**2.74**	**800**	**77 a**	**2.8**	**13**	**6.2**	<0.65	<0.65	<0.65	<2.6	<0.65	<0.65	**0.77**	<0.65	<0.65	<0.65	<0.65
SB2, 3'	**7.5**	**12**	**3.6**	**17.6**	**1100**	**260 a**	<2.7	**24**	**9.0**	<0.67	**3.9**	<0.67	**12**	<0.67	<0.67	**1.8**	<0.67	<0.67	<0.67	<0.67
SB3, 3'	**9,900**	**230**	**68**	**67**	**36000**	<190	<190	<190	<190	<48	<48	<48	<190	<48	<48	<48	<48	<48	<48	<48
SB3, 3' dup	**9,500**	**240**	<140	<140	**40000**	<580	<580	<580	<580	<140	<140	<140	<580	<140	<140	<140	<140	<140	<140	<140
SB4, 3'	**1,200**	**76**	**8.1**	**18.7**	**4600**	**200 a**	**19**	<14	<14	<3.5	<3.5	<3.5	**32**	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5
SB5, 3'	**7.6**	**5.6**	**0.80**	**1.9**	**1900**	**45 a**	**61**	**12**	**18**	<0.71	<0.71	**0.77**	**8.2**	<0.71	<0.71	<0.71	<0.71	<0.71	<0.71	<0.71
SB6, 3'	**3.0**	**4.2**	<0.68	**2.52**	**560**	**11 a**	<2.7	**4.0**	<2.7	<0.68	<0.68	<0.68	<2.7	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68
SB7, 3'	**5.9**	**6.2**	**0.87**	**4.3**	**780**	**43 a**	**3.4**	**7.9**	**3.3**	<0.73	<0.73	<0.73	**5.1**	<0.73	<0.73	**2.0**	<0.73	<0.73	<0.73	<0.73
SB8, 3'	**10**	**12**	**3.8**	**15.7**	**1300**	**42 a**	<11	<11	<11	<2.8	<2.8	<2.8	<11	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8
SB9, 3'	**12**	**18**	**1.7**	**9.9**	**690**	**19 a**	<2.7	**6.0**	<2.7	<0.68	**1.1**	<0.68	**4.9**	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68	<0.68
SB10, 3'	**3.5**	**2.8**	<0.80	**1.7**	**610**	**39 a**	<3.2	**9.7**	<3.2	<0.80	**1.6**	<0.80	<3.2	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80
SB11, 3'	**2.7**	**1.9**	<0.82	**0.91**	**520**	**38 a**	<3.3	**9.9**	<3.3	<0.82	<0.82	**3.7**	<3.3	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82
SB12, 3'	**250**	<70	<70	**610**	**750000**	<280	<280	<280	<280	<70	<70	<70	<280	**480**	<70	**76**	<70	<70	<70	<70
SB13, 3'	**0.91**	**8.5**	<0.67	**1.3**	**550**	**49 a**	<2.7	**5.5**	**6.4**	<0.67	<0.67	<0.67	<2.7	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
SB14, 3'	**2.7**	**5.3**	**0.87**	**4.7**	**620**	**10 a**	<2.8	**3.5**	<2.8	<0.70	<0.70	<0.70	<2.8	<0.70	<0.70	**1.6**	<0.70	<0.70	<0.70	<0.70
SB15, 3'	**42**	**12**	**1.6**	**6.7**	**2100**	**51 a**	**13**	**13**	<5.8	<1.4	<1.4	<1.4	<5.8	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4

Notes:

All Concentrations in ppbv

ppbv	Parts per billion volumetric.
a	Compound present in laboratory blank greater than reporting limit (background subtraction not performed).
b	Exceeds instrument calibration range.
NA	Not analyzed.
TPH-g	Total Petroleum Hydrocarbons as gasoline.
TPH-d	Total Petroleum Hydrocarbons as diesel.

Table I.2 (Continued)

Sample ID	1,4-Dioxane	Ethanol	4-Ethyltoluene	Freon 11	Freon 12	Freon 113	Heptane	Hexane	4-Methyl-2-pentanone	Methylene Chloride	Methyl t-butyl ether	2-Propanol	Styrene	Tetrachloroethene	Tetrahydrofuran	1,1,1-Trichloroethane	Trichloroethene	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene
SB1, 3'	<2.6	63	<2.6	0.74	0.93	27	<2.6	4.4	3.8	3.7	<2.6	5.6	<0.65	1.2	<2.6	<0.65	<0.65	1.1	<0.65
SB2, 3'	<2.7	110	<2.7	1.2	200	<0.67	3.3	5.3	8.1	2.2	<2.7	<2.7	3.0	<0.67	<2.7	<0.67	<0.67	2.0	0.77
SB3, 3'	<190	<190	<190	<48	180	<48	<190	590	<190	<48	<190	<190	<48	<48	<190	<48	<48	<48	<48
SB3, 3' dup	<580	<580	<580	<140	160	<140	<580	580	<580	<140	<580	<580	<140	<140	<580	<140	<140	<140	<140
SB4, 3'	<14	1,400	<14	<3.5	100	<3.5	<14	19	15	340	<14	22	<3.5	160	<14	21	<3.5	<3.5	<3.5
SB5, 3'	3.3	55	<2.8	4.4	1.2	3.4	<2.8	<2.8	<2.8	<0.71	<2.8	<2.8	<0.71	<0.71	<2.8	<0.71	<0.71	<0.71	<0.71
SB6, 3'	<2.7	35	<2.7	<0.68	<0.68	<0.68	<2.7	<2.7	<2.7	<0.68	<2.7	<2.7	<0.68	<0.68	<2.7	<0.68	<0.68	1.1	<0.68
SB7, 3'	8.2	94	<2.9	0.74	1.1	<0.73	<2.9	6.8	4.4	<0.73	<2.9	3.8	1.0	2.0	<2.9	<0.73	<0.73	1.8	<0.73
SB8, 3'	<11	62	<11	6.5	630	<2.8	<11	<11	<11	<2.8	<11	<11	<2.8	<2.8	<11	<2.8	<2.8	5.3	<2.8
SB9, 3'	<2.7	47	<2.7	1.5	20	<0.68	<2.7	4.3	<2.7	<0.68	<2.7	<2.7	<0.68	<0.68	<2.7	<0.68	<0.68	2.3	0.77
SB10, 3'	<3.2	40	<3.2	<0.80	1.4	<0.80	<3.2	3.9	<3.2	<0.80	<3.2	<3.2	<0.80	<0.80	<3.2	<0.80	<0.80	1.2	<0.80
SB11, 3'	22	23	<3.3	4.6	<0.82	<0.82	<3.3	<3.3	<3.3	1.2	<3.3	<3.3	<0.82	<0.82	<3.3	<0.82	<0.82	0.85	<0.82
SB12, 3'	<280	<280	760	<70	<70	<70	<280	18,000	<280	<70	<280	<280	<70	<70	<280	<70	<70	580	740
SB13, 3'	4.3	410 b	<2.7	<0.67	<0.67	<0.67	3.4	<2.7	<2.7	5.6	<2.7	26	<0.67	<0.67	58	<0.67	<0.67	1.1	<0.67
SB14, 3'	<2.8	67	<2.8	<0.70	<0.70	<0.70	<2.8	<2.8	2.8	1.3	2.9	<2.8	0.82	<0.70	<2.8	<0.70	<0.70	2.0	0.81
SB15, 3'	<5.8	190	<5.8	<1.4	46	<1.4	<5.8	50	<5.8	4.8	<5.8	<5.8	<1.4	2.1	<5.8	<1.4	<1.4	1.8	<1.4

Notes:

All Concentrations in ppbv

ppbv	Parts per billion volumetric.
a	Compound present in laboratory blank greater than reporting limit (background subtraction not performed).
b	Exceeds instrument calibration range.
NA	Not analyzed.
TPH-g	Total Petroleum Hydrocarbons as gasoline.
TPH-d	Total Petroleum Hydrocarbons as diesel.

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

Well No.	Date Sampled	Concentration (µg/L) Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	Notes
MW-2	03/23/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	07/27/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	11/05/93	--	--	--	--	--	--	--	--	--	--	--	
	02/25/94	<1	<1	<1	<1	<100	<1,000	--	--	--	--	--	
	06/03/94	<0.5	<0.5	<0.5	<0.5	<50	<20,000	--	--	--	--	--	
	08/31/94	<0.3	<0.3	<0.3	<0.6	<500	<500	--	--	--	--	--	
	12/22/94	<0,5	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	a
	03/13/95	0.8	<0.5	<0.5	<0.5	<50	<400	--	--	--	--	--	
	06/09/95	<0.5	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	09/21/95	0.7	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	
	12/12/95	<0.5	<0.5	<0.5	<1.0	<100	<50	--	--	--	--	--	
	03/12/96	<0.5	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	06/21/96	--	--	--	--	--	--	--	--	--	--	--	
	08/29/96	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	--	
	01/16/97	<0.5	<0.5	<0.5	<0.5	<50	<150	0.7	<0.5	<0.5	<0.5	--	
	07/07/97	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	<0.5	
	01/27/98	<0.5	<0.5	<0.5	<0.5	100	<150	--	--	--	--	<0.5	
	07/22/98	<0.5	<0.5	<0.5	<0.5	<50	--	--	--	--	--	<0.5	
	07/22/99	<0.5	<0.5	<0.5	<0.5	<50	<200	<0.5	<0.5	<0.5	<0.5	<0.5	
MW-3	03/23/93	35	2.9	2	3.2	300	ND	--	--	--	--	--	
	07/27/93	97	1	4	1.1	220	ND	--	--	--	--	--	
	11/05/93	4.9	ND	ND	1.2	170	ND	--	--	--	--	--	
	02/25/94	42	<1	<1	<1	100	<1,000	--	--	--	--	--	
	06/03/94	120	8.2	8.4	4.5	320	<20,000	--	--	--	--	--	
	08/31/94	83	1.1	5.3	2.9	<500	<500	--	--	--	--	--	
	12/22/94	1,460	18	100	50	3,800	270	--	--	--	--	--	
	03/13/95	3,600	260	270	280	14,000	1,700	--	--	--	--	--	
	06/09/95	4,700	58	140	71	3,700	120	--	--	--	--	--	
	09/21/95	9,800	58	600	95	14,000	300	--	--	--	--	--	
	12/12/95	330	2.1	47	5.3	700	<50	--	--	--	--	--	
	03/12/96	350	4.6	23	8.7	600	<50	--	--	--	--	--	
	06/21/96	940	76	98	57	1,900	<50	--	--	--	--	--	
	08/29/96	420	29	44	28	900	<150	--	--	--	--	--	
	01/16/97	1,600	270	120	194	3,600	700	<0.5	9.2	<0.5	<0.5	--	

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

Well No.	Date Sampled	Concentration (µg/L)											Notes
		Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	
MW-3	04/15/97	1,300	300	180	160	4,300	800	<0.5	16	<0.5	1.1	6.9	
	07/07/97	100	84	100	67	1,900	350	--	--	--	--	3.8	
	10/27/97	1,030	60	54	40	2,200	--	<0.5	2.4	<0.5	<0.5	3.1	
	01/27/98	1,070	98	73	69	3,200	--	--	--	--	--	3.9	
	04/22/98	610	56	49	54	1,800	--	<0.5	3.0	<0.5	<0.5	1.1	
	07/22/98	1,800	230	160	180	3,600	370	--	--	--	--	5.0	
	10/21/98	78	1.0	3.8	0.6	110	<250	<0.5	0.6	<0.5	<0.5	<0.5	
	07/23/99	1,500	140	76.0	260	4,000	790	<0.5	1.0	<0.5	<0.5	5.60	
	10/28/99	1,100	43	58	102	3,000	600	<0.5	0.9	--	<0.5	--	
	02/10/00	**690**	**22**	**36**	**49**	**1,400**	**520**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**2.20**	
	04/27/00	**1,100**	**140**	**73**	**163**	**2,400**	**250**	**<0.5**	**0.6**	**<0.5**	**<0.5**	**<0.5**	
MW-5	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	<150	<0.5	<0.5	<0.5	<0.5	<0.5	
MW-6	03/23/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	07/27/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	11/05/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	02/25/94	<1	<1	<1	3.5	<100	<1,000	--	--	--	--	--	
	06/03/94	2.7	<0.5	<0.5	<0.5	69	<20,000	--	--	--	--	--	
	08/31/94	<0.3	8.7	1.6	3.5	<500	<500	--	--	--	--	--	
	12/22/94	<0.5	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	a
	03/13/95	1.2	<0.5	<0.5	<0.5	<50	<400	--	--	--	--	--	
	06/09/95	0.6	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	09/21/95	<0.5	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	
	12/12/95	<0.5	<0.5	<0.5	<1.0	<100	<50	--	--	--	--	--	
	03/12/96	<0.5	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	06/21/96	--	--	--	--	--	--	--	--	--	--	--	
	08/29/96	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	--	
	01/16/97	5.5	16	2.9	16	140	220	<0.5	6.3	<0.5	<0.5	--	
	07/07/97	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	<0.5	
	07/22/98	<0.5	<0.5	<0.5	<0.5	<50	<250	--	--	--	--	<0.5	
MW-11	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	<0.5	
MW-12	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	<0.5	

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

Well No.	Date Sampled	Concentration (µg/L)											Notes
		Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	
MW-13	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	<0.5	
MW-15	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	430	<0.5	<0.5	<0.5	<0.5	<0.5	
	07/22/99	<0.5	<0.5	<0.5	<0.5	<50	<200	<0.5	<0.5	<0.5	<0.5	<0.5	
MW-25	03/23/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	07/27/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	11/05/93	4.2	4.4	2.5	20	170	ND	--	--	--	--	--	
	02/25/94	2.1	<1	<1	<1	<100	<1,000	--	--	--	--	--	
	06/03/94	2.4	14	<0.5	3.4	97	<20,000	--	--	--	--	--	
	08/31/94	0.5	<0.3	<0.3	<0.6	<500	<500	--	--	--	--	--	
	12/22/94	0.5	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	
	03/13/95	0.58	<0.5	<0.5	<0.5	150	950	--	--	--	--	--	a
	06/09/95	0.8	<0.5	<0.5	<0.5	<100	60	--	--	--	--	--	
	09/21/95	<0.5	<0.5	<0.5	<0.5	50	<50	--	--	--	--	--	
	12/12/95	<0.5	<0.5	<0.5	<1.0	<100	<50	--	--	--	--	--	
	03/12/96	<0.5	<0.5	<0.5	<0.5	120	<50	--	--	--	--	--	
	06/21/96	--	--	--	--	--	--	--	--	--	--	--	
	08/29/96	<0.5	<0.5	<0.5	<0.5	90	<150	--	--	--	--	--	
	01/16/97	0.6	<0.5	<0.5	<0.5	80	<150	25	41	<0.5	<0.5	--	
	07/07/97	<0.5	<0.5	<0.5	<0.5	140	<150	--	--	--	--	11	
	01/27/98	<0.5	<0.5	<0.5	<0.5	<100	--	--	--	--	--	10	
	07/22/98	<0.5	<0.5	<0.5	<0.5	<50	<250	--	--	--	--	24	
	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	340	28	59	<0.5	<0.5	28	h
	04/07/99	<0.5	<0.5	<0.5	<0.5	<50	<250	27	72	<0.5	<0.5	27	i
	07/23/99	1.80	<0.5	<0.5	<0.5	<50	<200	30	58	<0.5	<0.5	23.0	
	10/27/99	<0.5	1.4	<0.5	1.0	<100	<200	35	47	--	<0.5	--	
	02/08/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**100**	**<250**	**39**	**41**	**<0.5**	**<0.5**	**29.0**	**q**
	04/26/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<100**	**<250**	**51**	**38**	**<0.5**	**<0.5**	**18**	**t**
MW-26	03/23/93	180	190	55	330	7,000	1,300	ND	ND	ND	ND	--	
	07/27/93	470	96	30	80	1,800	ND	ND	140	ND	ND	--	
	11/05/93	4,700	1,300	9	1,400	19,000	ND	ND	120	ND	ND	--	
	02/25/94	4,800	570	200	860	14,000	<1,000	<1	28	<1	<1	--	

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

Well No.	Date Sampled	Concentration (µg/L) Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	Notes
MW-26	06/03/94	4,100	300	120	230	12,000	<20,000	1.7	140	<0.5	<0.5	--	c
	08/31/94	4,100	360	170	450	93,000	1,400	<4.0	<4.0	<4.0	<4.0	--	
	12/22/94	1,030	170	85	290	5,000	560	<2.0	<2.0	<2.0	<2.0	--	d
	03/13/95	320	19	23	66	3,000	810	53	5.8	<0.5	<0.5	--	
	06/09/95	14,000	64	31	230	10,800	310	240	3.1	1	<0.5	--	
	09/21/95	1,900	160	160	330	8,000	200	1.3	120	<0.5	<0.5	--	
	12/12/95	13,000	38	36	120	25,000	0.6	1.4	180	<0.5	<0.5	--	b
	03/12/96	9,000	33	30	65	4,400	<50	<0.5	180	<0.5	<0.5	--	
	06/21/96	14,000	27	16	66	5,400	<50	3.2	170	<0.5	<0.5	--	
	08/29/96	8,500	26	28	74	19,000	<150	<0.5	160	<0.5	<0.5	--	
	01/16/97	6,500	21	31	47	4,600	--	4.3	>50	<0.5	<0.5	26	
	04/15/97	16,000	33	40	160	26,000	2,200	3.5	97	<0.5	2.4	40	e
	07/07/97	22,000	44	170	200	28,000	1,100	<5.0	<5.0	<5.0	<5.0	95	
	10/27/97	16,000	26	100	37	30,000	--	3.6	92	<0.5	<0.5	38	
	01/27/98	23,600	<5.0	<5.0	<5.0	26,000	420	8.3	100	<0.5	<0.5	100	
	04/22/98	5,000	4.3	9.2	16	14,000	--	13	130	<0.5	<0.5	27	
	07/22/98	3,800	5.7	6.9	11	5,200	750	10	110	--	<1.0	33	
	10/21/98	420	<0.5	2.1	2.7	820	<250	24	82	<0.5	<0.5	31	
	02/05/99	20	<0.5	0.60	0.80	230	230	10	51	<0.5	<0.5	29	
	04/07/99	<0.5	<0.5	<0.5	<0.5	80	<250	15	54	<0.5	<0.5	25	
	07/23/99	7.10	<0.5	<0.5	0.80	180	<200	12	32	<0.5	<0.5	12.0	
	10/27/99	14	1.4	2.9	7.8	400	<200	13	30	--	<0.5	--	
	02/08/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**80**	**<250**	**13**	**32**	**<0.5**	**<0.5**	**28.0**	
	04/26/00	**0.7**	**<0.5**	**0.6**	**<0.5**	**200**	**340**	**7.5**	**39**	**<0.5**	**<0.5**	**22**	
MW-27	06/21/96	<0.5	<0.5	<0.5	<0.5	<50	<50	<0.5	6.8	<0.5	<0.5	--	
	08/29/96	--	--	--	--	--	--	--	--	--	--	--	
	01/16/97	12	5.0	<0.5	2.6	70	<150	<0.5	5.7	<0.5	<0.5	--	
	07/22/98	<0.5	<0.5	<0.5	<0.5	<50	<250	<1.0	1.4	--	<1.0	<0.5	
	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	<150	<0.5	0.7	<0.5	<0.5	<0.5	
	07/23/99	<0.5	<0.5	<0.5	<0.5	<50	<200	<0.5	0.7	<0.5	<0.5	<0.5	
	10/27/99	<0.5	<0.5	<0.5	<0.5	<100	<200	<0.5	<0.5	--	<0.5	--	
	02/08/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<50**	**<250**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	
	04/27/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<100**	**250**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

Well No.	Date Sampled	Concentration (µg/L)											Notes
		Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	
MW-28	03/23/93	ND	ND	ND	ND	110	ND	--	--	--	--	--	
	07/27/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	11/05/93	ND	ND	ND	2.1	ND	ND	--	--	--	--	--	
	02/25/94	<1	<1	<1	<1	<100	<1	--	--	--	--	--	
	06/03/94	3.1	<0.5	<0.5	<0.5	<50	<20,000	--	--	--	--	--	
	08/31/94	1.4	<0.3	<0.3	<0.6	<500	<500	--	--	--	--	--	
	12/22/94	<0.5	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	a
	03/13/95	0.91	<0.5	<0.5	<0.5	<50	<400	--	--	--	--	--	
	06/09/95	<0.5	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	09/21/95	<0.5	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	
	12/12/95	<0.5	<0.5	<0.5	<1.0	<100	<50	--	--	--	--	--	
	03/12/96	<0.5	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	06/21/96	<0.5	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	08/29/96	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	--	
	01/16/97	18	20	2.2	13	220	<150	5.1	85	<0.5	<0.5	8.2	
	04/15/97	<0.5	<0.5	<0.5	<0.5	120	<150	1.1	150	<0.5	<0.5	7.1	
	07/07/97	<0.5	<0.5	<0.5	<0.5	110	<150	<5.0	170	<5.0	<5.0	7.2	
	10/27/97	3.6	<0.5	<0.5	<0.5	300	--	6.2	120	<0.5	<0.5	36	
	01/27/98	7.6	<0.5	<0.5	<0.5	500	<150	--	--	--	--	56	
	04/22/98	<0.5	<0.5	<0.5	<0.5	<50	--	1.0	89	<0.5	<0.5	8.6	
	07/22/98	<0.5	<0.5	<0.5	<0.5	<50	--	<1.0	85	--	<1.0	18	
	10/21/98	<0.5	<0.5	<0.5	<0.5	<50	<250	0.5	80	<0.5	<0.5	12	
	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	<150	32	29	<0.5	<0.5	5.0	h
	04/07/99	<0.5	<0.5	<0.5	<0.5	<50	<250	<0.5	62	<0.5	<0.5	4.5	
	07/23/99	<0.5	<0.5	<0.5	<0.5	<50	<200	<0.5	50	<0.5	<0.5	1.80	
	10/27/99	--	--	--	--	--	<200	--	--	--	--	--	
	11/02/99	0.7	<0.5	<0.5	<0.5	<100	--	<0.5	32	--	<0.5	--	
	02/08/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<50**	**<250**	**<0.5**	**39**	**<0.5**	**<0.5**	**4.30**	
	04/26/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<100**	**<250**	**<0.5**	**50**	**<0.5**	**<0.5**	**1.5**	
MW-29	03/23/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	07/27/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	11/05/93	ND	ND	2.1	11	ND	ND	--	--	--	--	--	
	02/25/94	<1	<1	<1	<1	<100	<1,000	--	--	--	--	--	
	06/03/94	<0.5	<0.5	<0.5	<0.5	<50	<20,000	--	--	--	--	--	

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

Well No.	Date Sampled	Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	Notes
		Concentration (µg/L)											
MW-29	08/31/94	<0.3	<0.3	<0.3	<0.6	<500	<500	--	--	--	--	--	
	12/22/94	<0.5	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	a
	03/13/95	0.59	<0.5	<0.5	<0.5	<50	<400	--	--	--	--	--	
	06/09/95	<0.5	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	09/21/95	<0.5	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	
	12/12/95	<0.5	<0.5	<0.5	<1.0	<100	<50	--	--	--	--	--	
	03/12/96	<0.5	<0.5	<0.5	<1.0	<100	<50	--	--	--	--	--	
	06/21/96	--	--	--	--	--	--	--	--	--	--	--	
	08/29/96	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	--	
	01/16/97	6.6	8.9	0.6	9.3	120	<150	47	24	<0.5	<0.5	1.8	
	07/07/97	<0.5	<0.5	<0.5	<0.5	<50	<150	52	21	<5.0	<5.0	1.2	
	01/27/98	<0.5	<0.5	<0.5	<0.5	100	<150	--	--	--	--	8.0	
	07/22/98	<0.5	<0.5	<0.5	<0.5	<50	<250	12	29	--	<1.0	7.8	
	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	<150	<0.5	68	<0.5	<0.5	8.5	
	04/07/99	<0.5	<0.5	<0.5	<0.5	<50	<250	30	38	<0.5	<0.5	4.9	j
	07/23/99	<0.5	<0.5	<0.5	<0.5	<50	<200	44	33	<0.5	1.9	4.70	k, l
	10/27/99	<0.5	<0.5	<0.5	<0.5	<100	<200	36	23	--	<0.5	--	
	02/08/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<50**	**<250**	**87**	**25**	**<0.5**	**<0.5**	**18.0**	**s**
	04/26/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<100**	**<250**	**61**	**38**	**<0.5**	**<0.5**	**12**	**u**
MW-30	03/23/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	07/27/93	ND	ND	ND	ND	ND	ND	--	--	--	--	--	
	11/05/93	ND	ND	ND	2.8	ND	ND	--	--	--	--	--	
	02/25/94	1.3	<1	<1	<1	<100	<1,000	--	--	--	--	--	
	06/03/94	1.1	<0.5	<0.5	<0.5	<50	<20,000	--	--	--	--	--	
	08/31/94	0.8	<0.3	<0.3	<0.6	<500	<500	--	--	--	--	--	
	12/22/94	0.6	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	a
	03/13/95	0.98	<0.5	<0.5	<0.5	<50	<400	--	--	--	--	--	
	06/09/95	<0.5	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	09/21/95	<0.5	<0.5	<0.5	<0.5	<50	<50	--	--	--	--	--	
	12/12/95	<0.5	<0.5	<0.5	<1.0	<100	<50	--	--	--	--	--	
	03/12/96	<0.5	<0.5	<0.5	<0.5	<100	<50	--	--	--	--	--	
	06/21/96	--	--	--	--	--	--	--	--	--	--	--	
	08/29/96	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	--	
	01/16/97	<0.5	<0.5	<0.5	0.6	80	<150	<0.5	<0.5	<0.5	0.9	--	

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

Well No.	Date Sampled	Concentration (µg/L) Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	Notes
MW-30	07/07/97	<0.5	<0.5	<0.5	<0.5	<50	<150	--	--	--	--	<0.5	
	01/27/98	5.4	<0.5	<0.5	<0.5	100	--	--	--	--	--	<0.5	
	07/22/98	<0.5	<0.5	<0.5	<0.5	<50	--	--	--	--	--	<0.5	
	04/07/99	<0.5	<0.5	<0.5	<0.5	<50	<250	--	--	--	--	<0.5	
	07/22/99	<0.5	<0.5	<0.5	<0.5	<50	--	<0.5	<0.5	<0.5	<0.5	<0.5	
	10/28/99	<0.5	<0.5	<0.5	<0.5	<100	<200	<0.5	<0.5	--	<0.5	--	
	02/08/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<50**	**<250**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	
	04/27/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<100**	**250**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	
MW-32	03/23/93	391	6.2	3.1	9	440	ND	ND	60	ND	ND	--	
	07/27/93	ND	ND	ND	ND	ND	ND	ND	14	ND	ND	--	
	11/05/93	20	ND	1.8	2.1	170	ND	ND	7.9	ND	ND	--	
	02/25/94	5.6	<1	<1	<1	<100	<1,000	<1	<1	<1	<1	--	
	06/03/94	120	1.3	<0.5	1.4	350	<20,000	<0.5	11	<0.5	<0.5	--	
	08/31/94	39	0.5	2.2	1.2	<500	<500	<4.0	10	<4.0	<4.0	--	
	12/22/94	4.8	<0.5	<0.5	<0.5	<50	<50	<2.0	4.6	<2.0	<2.0	--	a
	03/13/95	220	3.6	6.5	5.8	1,100	<400	<0.5	16	<0.5	<0.5	--	
	06/09/95	1,500	7.9	43	14	2,200	180	0.7	<0.5	0.5	<0.5	--	
	09/21/95	1,200	2.4	72	4.5	2,300	60	<0.5	6.7	<0.5	1.4	--	
	12/12/95	230	<0.5	8.9	<1.0	500	<50	<0.5	28	<0.5	<0.5	--	
	03/12/96	40	<0.5	1.7	<0.5	110	<50	<0.5	6.8	<0.5	<0.5	--	
	06/21/96	--	--	--	--	--	--	--	--	--	--	--	
	08/29/96	150	<0.5	49	<0.5	700	<150	<0.5	27	<0.5	<0.5	--	
	01/16/97	14	<0.5	1.9	<0.5	150	<150	<0.5	10	<0.5	0.7	--	f
	07/07/97	370	11	110	21	1,600	190	--	--	--	--	11	g
	01/27/98	13	<0.5	1.0	<0.5	300	--	<0.5	7.5	<0.5	<0.5	2.5	
	07/22/98	700	55	88	66	2,300	--	--	--	--	--	14	
	07/22/99	59.0	0.80	1.80	<0.5	900	220	<0.5	5.9	<0.5	<0.5	8.70	
	10/28/99	95	2.5	2.1	1.6	500	<200	<0.5	12	--	<0.5	--	
	02/10/00	**7.0**	**<0.5**	**<0.5**	**<0.5**	**120**	**<250**	**<0.5**	**4.3**	**<0.5**	**<0.5**	**1.10**	
	04/27/00	**240**	**7.0**	**12**	**18.8**	**800**	**250**	**<0.5**	**9.8**	**<0.5**	**<0.5**	**<0.5**	
MW-33	04/07/99	0.60	<0.5	0.90	<0.5	<50	<250	--	--	--	--	<0.5	
	07/22/99	8.90	<0.5	1.00	<0.5	<50	<200	0.6	0.7	<0.5	<0.5	<0.5	
	10/28/99	40	0.9	21	3.8	200	<200	0.8	1.3	--	<0.5	--	

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

Well No.	Date Sampled	Concentration (µg/L) Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	Notes
MW-33	**02/10/00**	**20**	**0.7**	**12**	**10.0**	**380**	**<250**	**0.9**	**0.6**	**<0.5**	**<0.5**	**1.30**	
	04/27/00	**6.9**	**<0.5**	**6.4**	**<0.5**	**<100**	**250**	**4.3**	**0.9**	**<0.5**	**<0.5**	**<0.5**	
MW-?	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	430	--	--	--	--	<0.5	
PR-26	07/26/99	20,000	15,000	1,100	7,250	82,500	11,000	--	--	--	--	33.0	
	10/26/99	28,000	25,000	2,300	8,400	110,000	60,000	<0.5	24	--	<0.5	--	
PR-45	07/26/99	13,200	8,200	2,600	15,600	82,500	39,000	--	--	--	--	35.0	
	10/28/99	12,000	8,200	1,700	8,500	45,000	25,000	<0.5	<0.5	--	<0.5	--	
	02/09/00	**24,000**	**25,000**	**10,000**	**53,000**	**360,000**	**82,000**	**<0.5**	**4.0**	**<0.5**	**<0.5**	**1,000**	
	04/27/00	**17,000**	**9,500**	**16,000**	**92,000**	**1,300,000**	**20,300**	**<5.0**	**<5.0**	**<5.0**	**<5.0**	**<5.0**	
PR-52	07/26/99	12,000	1,720	750	12,400	172,000	40,000	<0.5	1.8	<0.5	<0.5	217	m
	10/28/99	19,000	530	1,800	5,800	40,000	450,000	<0.5	<0.5	--	<0.5	--	
	02/09/00	**22,000**	**1,600**	**4,100**	**15,800**	**200,000**	**140,000**	**<0.5**	**1.3**	**<0.5**	**<0.5**	**430**	
	04/28/00	**20,000**	**2,200**	**4,700**	**18,600**	**270,000**	**88,000**	**<1.0**	**<1.0**	**<1.0**	**<1.0**	**<5.0**	
PR-53	07/26/99	31,000	12,000	1,900	8,800	110,000	98,000	<0.5	43	<0.5	<0.5	43.0	n
	10/27/99	17,000	3,900	890	3,320	54,000	16,000	<0.5	18	--	<0.5	--	
	02/09/00	**21,000**	**5,000**	**1,200**	**5,300**	**65,000**	**9,400**	**0.6**	**20**	**<0.5**	**<0.5**	**67.0**	r
	04/28/00	**34,000**	**30,000**	**9,300**	**51,000**	**730,000**	**104,000**	**<1.0**	**<1.0**	**<1.0**	**<1.0**	**340**	
PR-54	07/26/99	32,000	22,000	1,500	21,800	170,000	28,000	<0.5	3.0	<0.5	<0.5	56.0	o
	10/26/99	27,000	10,000	3,700	19,500	190,000	350,000	<0.5	<0.5	--	<0.5	--	
	02/09/00	**27,000**	**23,000**	**9,900**	**50,000**	**960,000**	**110,000**	**<0.5**	**3.9**	**<0.5**	**<0.5**	**1,000**	
	04/28/00	**24,000**	**14,000**	**1,200**	**9,000**	**76,000**	**80,000**	**<1.0**	**1.6**	**<1.0**	**<1.0**	**300**	
PR-64	07/26/99	22,000	18,000	1,700	10,300	110,000	--	<0.5	130	<0.5	<0.5	35.0	p
	10/27/99	11,000	7,400	1,200	3,900	66,000	50,000	<0.5	110	--	<0.5	--	
	02/09/00	**22,000**	**20,000**	**6,000**	**17,000**	**120,000**	**40,000**	**<0.5**	**>50**	**<0.5**	**<0.5**	**110**	
	04/28/00	**19,000**	**16,000**	**1,800**	**13,900**	**130,000**	**78,000**	**<1.0**	**67**	**<1.0**	**<1.0**	**300**	
PR-65	07/26/99	12,000	1,400	1,300	13,000	68,000	16,500	<0.5	2.6	<0.5	<0.5	20.0	
	10/26/99	14,000	2,300	1,800	11,000	65,000	50,000	<0.5	<0.5	--	<0.5	--	

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

Well No.	Date Sampled	Concentration (µg/L)											
		Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	Notes
PR-68	07/26/99	1,900	24.0	27.0	62.0	4,900	11,000	<0.5	1.2	<0.5	<0.5	4.40	
	10/26/99	2,800	36	86	62	8,000	2,800	<0.5	<0.5	--	<0.5	--	
PR-76	04/07/99	<0.5	<0.5	<0.5	<0.5	<50	<250	--	--	--	--	<0.5	
V-24	04/07/99	<0.5	<0.5	<0.5	<0.5	120	<250	--	--	--	--	0.5	
V-31	07/26/99	7,000	600	550	1,370	17,500	5,350	--	--	--	--	19.0	
	10/26/99	7,000	120	850	950	18,000	3,000	<0.5	<0.5	--	<0.5	--	
V-46	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	270	<0.5	<0.5	<0.5	<0.5	<0.5	
V-55	07/22/99	8,000	480	740	2,880	30,000	2,100	<0.5	<0.5	<0.5	<0.5	13.0	
	10/28/99	11,000	59	1,200	317	28,000	38,000	<0.5	<0.5	--	<0.5	--	
	02/09/00	**2,200**	**59**	**760**	**350**	**7,900**	**10,000**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**9.70**	
	04/28/00	**2,900**	**510**	**440**	**2,340**	**14,000**	**26,500**	**<5.0**	**<5.0**	**<5.0**	**<5.0**	**<5.0**	
V-72	07/26/99	13,500	6.80	1.10	3.90	3,900	12,900	<0.5	11	<0.5	<0.5	<0.5	
	10/28/99	2,900	58	21	47.7	6,000	48,000	<0.5	3.4	--	<0.5	--	
	02/09/00	**670**	**8.2**	**<0.5**	**17.8**	**890**	**6,100**	**<0.5**	**3.0**	**<0.5**	**<0.5**	**<0.5**	
	04/28/00	**130**	**<0.5**	**<0.5**	**<0.5**	**200**	**5,950**	**<0.5**	**0.7**	**<0.5**	**<0.5**	**<0.5**	
V-84	07/26/99	2,400	440	80.0	340	8,700	2,350	<0.5	2.4	<0.5	<0.5	6.40	
	10/26/99	1,100	130	46	108	4,000	700	<0.5	<0.5	--	<0.5	--	
	02/09/00	**300**	**30**	**8.9**	**53**	**2,300**	**1,100**	**<0.5**	**1.2**	**<0.5**	**<0.5**	**<0.5**	
	04/28/00	**30**	**1.9**	**<0.5**	**<0.5**	**100**	**550**	**<5.0**	**<5.0**	**<5.0**	**<5.0**	**<0.5**	
29 (CC-1)	07/23/99	<0.5	<0.5	<0.5	<0.5	<50	<200	<0.5	<0.5	<0.5	<0.5	<0.5	
	10/28/99	<0.5	<0.5	<0.5	<0.5	<100	<200	<0.5	<0.5	--	<0.5	--	
	02/08/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<50**	**<250**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	
	04/26/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<100**	**<250**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	
30 (CC-2)	07/22/99	0.90	<0.5	<0.5	<0.5	<50	<200	<0.5	<0.5	<0.5	<0.5	<0.5	
	10/28/99	<0.5	<0.5	<0.5	<0.5	<100	<200	<0.5	<0.5	--	<0.5	--	

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

		Concentration (µg/L)											
Well No.	Date Sampled	Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	Notes
30 (CC-2)	**02/08/00**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<50**	**<250**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	
	04/26/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<100**	**<250**	**<0.5**	**0.7**	**<0.5**	**<0.5**	**<0.5**	
81	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	<150	<0.5	<0.5	<0.5	<0.5	<0.5	
	07/22/99	0.70	<0.5	<0.5	<0.5	<50	<200	<0.5	<0.5	<0.5	<0.5	<0.5	
94	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	170	--	--	--	--	<0.5	
	07/22/99	<0.5	<0.5	<0.5	<0.5	<50	<200	<0.5	<0.5	<0.5	<0.5	<0.5	
210	02/05/99	<0.5	<0.5	<0.5	<0.5	<50	960	--	--	--	--	<0.5	
223	10/26/99	<0.5	<0.5	<0.5	<0.5	<100	<200	<0.5	<0.5	--	<0.5	--	
	02/10/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<50**	**640**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	
	04/27/00	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<100**	**250**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	
224	07/26/99	<0.5	<0.5	<0.5	<0.5	<50	640	<0.5	<0.5	<0.5	<0.5	<0.5	
239	07/26/99	55,000	85.0	1,500	190	30,000	--	<0.5	<0.5	<0.5	<0.5	5.30	
	10/26/99	23,000	53	1,500	103.2	28,000	10,000	<0.5	<0.5	--	<0.5	--	
	02/10/00	**40,000**	**48**	**1,900**	**52**	**44,000**	**21,000**	**<0.5**	**1.0**	**<0.5**	**<0.5**	**14.0**	
	04/28/00	**25,000**	**540**	**2,000**	**710**	**36,000**	**12,500**	**<5.0**	**<5.0**	**<5.0**	**<5.0**	**<5.0**	
241	04/07/99	<0.5	<0.5	<0.5	<0.5	<50	<250	--	--	--	--	<0.5	
249	07/22/99	<0.5	<0.5	<0.5	<0.5	<50	<200	<0.5	<0.5	<0.5	<0.5	<0.5	

Notes:

a. Non-diesel peak reported.
b. No diesel pattern detected; result due to high gasoline concentration.
c. Bromodichloromethane detected, 0.84 µg/L.
d. 8 other volatiles detected by 8260.
e. cis-1,2-DCE detected, 0.7 µg/L.
f. cis-1,2-DCE detected, 0.8 µg/L.
g. Values for benzene and ethylbenzene are estimated.
h. 1,1-DCE detected, 0.9 µg/L.

Table I.3. Concentrations (µg/L) Of Organic Compounds In Groundwater Samples
NESTLE USA FACILITY, OAKLAND

		Concentration (µg/L)											
Well No.	Date Sampled	Benzene	Toluene	Ethyl-benzene	Xylenes	TPH-g	TPH-d	1,1-DCA	1,2-DCA	1,1,1-TCA	TCE	MTBE	Notes

i. 1,1-DCE detected, 1.6 µg/L.
j. 1,1-DCE detected, 1.4 µg/L.
k. 1,1-Dichloroethene detected at 2.3 µg/L.
l. cis-1,2-Dichloroethene detected at 2.3 µg/L.
m. Methylene chloride detected at 7.9 µg/L.
n. Methylene chloride detected at 6.2 µg/L.
o. Methylene chloride detected at 2.5 µg/L.
p. Methylene chloride detected at 1.4 µg/L.
q. 1,1-Dichloroethene detected at 3.1 µg/L.
r. Methylene chloride detected at 0.8 µg/L.
s. 1,1-Dichloroethene detected at 9.6 µg/L.
t. 1,1-Dichloroethene detected at 4.2 µg/L.
u. 1,1-Dichloroethene detected at 5.2 µg/L.

ND	Not detected.
--	Not analyzed or not sampled.
µg/L	Micrograms per liter.
TPH-g	Total Petroleum Hydrocarbons as gasoline.
TPH-d	Total Petroleum Hydrocarbons as diesel.
1,1-DCA	1,1-Dichloroethane.
1,2-DCA	1,2-Dichloroethane.
1,1-DCE	1,1-Dichloroethene.
1,1,1-TCA	1,1,1-Trichloroethane.
c 1,2-DCE	cis 1,2-Dichloroethylene.
TCE	Trichloroethene.
MTBE	Methyl t-butyl ether.

Appendix II

Tier I Input Data

RBCA TIER 1 Input Data

Table II.1

Site Name: Nestle USA, Inc., Facility
Site Location: Oakland, CA
Completed By: JCI
Software: GSI RBCA Spreadsheet

NOTE: values correspond to ASTM (1995) Tier 1 default values

Exposure Parameter	Definition (Units)	Residential Adult	Residential (1-6yrs)	Residential (1-16 yrs)	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
ATc	Averaging time for carcinogens (yr)	70				
ATn	Averaging time for non-carcinogens (yr)	30	6	16	25	1
BW	Body Weight (kg)	70	15	35	70	
ED	Exposure Duration (yr)	30	6	16	25	1
t	Averaging time for vapor flux (yr)	30			25	1
EF	Exposure Frequency (days/yr)	350			250	180
EF.Derm	Exposure Frequency for dermal exposure	350			250	
IRgw	Ingestion Rate of Water (L/day)	2			1	
IRs	Ingestion Rate of Soil (mg/day)	100	200		50	100
IRadj	Adjusted soil ing. rate (mg-yr/kg-d)	1.1E+02			9.4E+01	
IRa.in	Inhalation rate indoor (m^3/day)	15			20	
IRa.out	Inhalation rate outdoor (m^3/day)	20			20	10
SA	Skin surface area (dermal) (cm^2)	5.8E+03		2.0E+03	5.8E+03	5.8E+03
SAadj	Adjusted dermal area (cm^2-yr/kg)	2.1E+03			1.7E+03	
M	Soil to Skin adherence factor	1				
AAFs	Age adjustment on soil ingestion	FALSE			FALSE	
AAFd	Age adjustment on skin surface area	FALSE			FALSE	
tox	Use EPA tox data for air (or PEL based)?	TRUE				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Outdoor Air Pathways:				
SS.v	Volatiles and Particulates from Surface Soils	FALSE	TRUE	FALSE
S.v	Volatilization from Subsurface Soils	FALSE	FALSE	
GW.v	Volatilization from Groundwater	FALSE	FALSE	
Indoor Air Pathways:				
S.b	Vapors from Subsurface Soils	FALSE	FALSE	
GW.b	Vapors from Groundwater	FALSE	FALSE	
Soil Pathways:				
SS.d	Direct Ingestion and Dermal Contact	FALSE	TRUE	FALSE
Groundwater Pathways:				
GW.i	Groundwater Ingestion	FALSE	FALSE	
S.l	Leaching to Groundwater from all Soils	FALSE	FALSE	

Matrix of Receptor Distance and Location On- or Off-Site		Residential Distance	Residential On-Site	Commercial/Industrial Distance	Commercial/Industrial On-Site
GW	Groundwater receptor (cm)		TRUE		TRUE
S	Inhalation receptor (cm)		TRUE		TRUE

Matrix of Target Risks		Individual	Cumulative
TRab	Target Risk (class A&B carcinogens)	1.0E-06	
TRc	Target Risk (class C carcinogens)	1.0E-05	
THQ	Target Hazard Quotient	*1.0E-05*	
Opt	Calculation Option (1, 2, or 3)	1	
Tier	RBCA Tier	1	

Surface Parameters	Definition (Units)	Residential	Constrctn
A	Contaminated soil area (cm^2)	2.2E+06	1.0E+06
W	Length of affect. soil parallel to wind (cm)	1.5E+03	1.0E+03
W.gw	Length of affect. soil parallel to groundwater (cm)	1.5E+03	
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02	
delta	Air mixing zone height (cm)	2.0E+02	
Lss	Thickness of affected surface soils (cm)	1.0E+02	
Pe	Particulate areal emission rate (g/cm^2/s)	6.9E-14	

Groundwater	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	2.0E+02
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	2.5E+03
Ugw.tr	Groundwater seepage velocity (cm/yr)	6.6E+03
Ks	Saturated hydraulic conductivity(cm/s)	
grad	Groundwater gradient (cm/cm)	
Sw	Width of groundwater source zone (cm)	
Sd	Depth of groundwater source zone (cm)	
phi.eff	Effective porosity in water-bearing unit	3.8E-01
foc.sat	Fraction organic carbon in water-bearing unit	1.0E-03
BIO?	Is bioattenuation considered?	FALSE
BC	Biodegradation Capacity (mg/L)	

Soil	Definition (Units)	Value		
hc	Capillary zone thickness (cm)	5.0E+00		
hv	Vadose zone thickness (cm)	3.0E+02		
rho	Soil density (g/cm^3)	1.7		
foc	Fraction of organic carbon in vadose zone	0.01		
phi	Soil porosity in vadose zone	0.38		
Lgw	Depth to groundwater (cm)	3.0E+02		
Ls	Depth to top of affected subsurface soil (cm)	1.0E+02		
Lsubs	Thickness of affected subsurface soils (cm)	2.0E+02		
pH	Soil/groundwater pH	6.5		
		capillary	vadose	foundation
phi.w	Volumetric water content	0.342	0.12	0.12
phi.a	Volumetric air content	0.038	0.26	0.26

Building	Definition (Units)	Residential	Commercial
Lb	Building volume/area ratio (cm)	2.0E+02	3.0E+02
ER	Building air exchange rate (s^-1)	1.4E-04	2.3E-04
Lcrk	Foundation crack thickness (cm)	1.5E+01	
eta	Foundation crack fraction	0.01	

Transport Parameters	Definition (Units)	Residential	Commercial
Groundwater			
ax	Longitudinal dispersivity (cm)		
ay	Transverse dispersivity (cm)		
az	Vertical dispersivity (cm)		
Vapor			
dcy	Transverse dispersion coefficient (cm)		
dcz	Vertical dispersion coefficient (cm)		

Table II.2. RBCA Tier I Input/Output Data
Outdoor Air Inhalation of Benzene from Soil Vapor-Onsite Commercial/Industrial Receptor

	Soil Specific Parameters		
ASTM Default	ρ_a	1.7	Soil Bulk Density (g/cm^) of (kg/L)
ASTM Default	θ_{as}	0.26	Air Content of Soil (v/v)
ASTM Default	θ_{ws}	0.12	Water Content of Soil (v/v)
ASTM Default	θ_t	0.38	Total Soil Porosity (v/v)
Site-Specific	d	91	Depth to location of vapor sample (cm) – 3 ft depth
	Diffusivity Parameters		
ASTM Default	H	0.22	Henry's Constant (dimensionless)
ASTM Default	D^{air}	9.30E-02	Air Diffusion Coefficient (cm^/s)
ASTM Default	D^{wat}	1.10E-05	Water Diffusion Coefficient (cm^/s)
Calculated	D^{eff}_s	0.0073	Effective Diffusion Coefficient through Soil (cm^/s)
	Prediction of Flux from Soil Vapor Concentration		
Site Specific	C_v	**9,900**	Maximum Benzene Concentration in Soil Vapor (ppbv)
Unit Conv	C_v	32	Maximum Benzene Concentration in Soil Vapor (μg/L)
Calculated	F	2.6E-06	Maximum Diffusive Vapor Flux Predicted from Benzene Concentration in Soil Vapor (μg/cm^2-sec)
	Outdoor Air Concentration		
ASTM Default	s	200	Outdoor Mixing Height (cm)
ASTM Default	U_{air}outdoor	225	Outdoor Wind Velocity (cm/sec)
ASTM Default	W	1500	Width of Outdoor Source Area Parallel to Wind Direction (cm)
Calculated	$C_{Outdoor}$	8.5E-08	Outdoor Air Concentration (μg/cm^3)
	Dose		
ASTM Default	IR_{air}Outdoor	20	Daily Outdoor Inhalation Rate (m^3/day)
ASTM Default	EF	250	Exposure Frequency (days/year)
ASTM Default	ED	25	Exposure Duration (years)
Calculated	Dose	11	Dose (mg)
	Risk		
CAL EPA	SF_i	0.1	California Cancer Slope Factor for Benzene(kg-day/mg)
ASTM Default	BW	70	Body Weight (kg)
ASTM Default	AT_c	70	Averaging Time for Carcinogens (years)
Calculated	Risk	**5.9E-07**	Risk (positive/population)
Calculated	RBSL	**17,000**	Tier 1 Risk-Based Screening Level (ppbv) for TRL = 1E-06

Formulas

$$D^{eff}_{soil} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F = D^{eff}_{soil}\frac{C_v}{d}$$

$$C_{outdoor} = \frac{F \times W}{U_{air\text{-}outdoor} \times s}$$

$$Dose = C_{outdoor} \times IR_{air\text{-}outdoor} \times EF \times ED$$

$$Risk = \frac{Dose \times SF}{BW \times AT}$$

Notes:

ASTM = American Standard for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentrations, dose, and risk calculations from ASTM 95 guidance formulas presented above.
level.

Table II.3. RBCA Tier I Input/Output Data
Indoor Air Inhalation of Benzene from Soil Vapor-Onsite Commercial/Industrial Receptor

	Soil/Building Parameters		
ASTM Default	ρ_a	1.7	Soil Bulk Density (g/cm^3) of (kg/L)
ASTM Default	θ_{as}	0.26	Air Content of Soil (v/v)
ASTM Default	θ_{ws}	0.12	Water Content of Soil (v/v)
ASTM Default	θ_{ac}	0.26	Air Content of Crack (v/v)
ASTM Default	θ_{wc}	0.12	Water Content of Crack (v/v)
ASTM Default	θ_t	0.38	Total Porosity-Soil and Crack (v/v)
Site-specific	Lsoil	91	Depth to Location of Vapor Sample (cm) – 3.0 ft depth
ASTM Default	Lcrack	15	Foundation Crack Thickness (cm)
ASTM Default	η	0.01	Foundation Crack Fraction (dimensionless)
	Diffusivity Parameters		
ASTM Default	H	0.22	Henry's Constant (dimensionless)
ASTM Default	D^{air}	9.30E-02	Air Diffusion Coefficient (cm^2/s)
ASTM Default	D^{wat}	1.10E-05	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_{soil}	0.0073	Effective Diffusion Coefficient through Soil (cm^2/s)
Calculated	D^{eff}_{crack}	0.0073	Effective Diffusion Coefficient through Foundation Cracks (cm^2/s)
	Prediction of Flux from Soil Vapor Concentration		
Site Specific	$C_{source} = C_v$	**9,900**	Maximum Benzene Concentration in Soil Vapor (ppbv)
Unit Conv	$C_{source} = C_v$	32	Maximum Benzene Concentration in Soil Vapor (μg/L)
Calculated	F	1.5E-07	Diffusive Vapor Flux Predicted from Benzene Concentration in Soil Vapor (μg/cm^2-sec)
	Indoor Air Concentration		
ASTM Default	Lb	300	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM Default	ER_{air}indoor	0.00023	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	2.1E-06	Enclosed Space Air Concentration (μg/cm^3)
	Dose		
ASTM Default	IR_{air}indoor	20	Daily Indoor Inhalation Rate (m^3/day)
ASTM Default	EF	250	Exposure Frequency-Adult (days/year)
ASTM Default	ED	25	Exposure Duration (years)
Calculated	Dose	260	Dose (mg)
	Risk		
DTSC	SF_i	0.1	Inhalation California Cancer Slope Factor for Benzene (kg-day/mg)
ASTM Default	BW	70	Body Weight (kg)
ASTM Default	AT	70	Averaging Time for Carcinogens (years)
Calculated	Risk	**1.5E-05**	Risk (positive/population)
Calculated	RBSL	**660.0**	Tier I Risk-Based Screening Level (ppbv) for TRL = 1E-06

Formulas

$$D^{eff}_{soil} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^{2}} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^{2}}$$

$$D^{eff}_{crack} = D^{air}\frac{\theta_{ac}^{3.33}}{\theta_T^{2}} + D^{wat}\frac{1}{H}\frac{\theta_{wc}^{3.33}}{\theta_T^{2}}$$

$$D^{eff}_{v} = \frac{L_{soil} + L_{crack}}{\frac{L_{crack}}{D^{eff}_{crack}\eta} + \frac{L_{soil}}{D^{eff}_{soil}}}$$

$$F = D^{eff}_{v}\frac{\Delta C_v}{\Delta \chi} = \frac{C_{source}\frac{D^{eff}_{soil}}{L_{soil}}}{1 + \frac{D^{eff}_{soil}}{L_{soil}}\frac{L_{crack}}{D^{eff}_{crack}\eta}}$$

$$C_{indoor} = \frac{F}{ER_{air\text{-}indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air\text{-}indoor} \times EF \times ED$$

$$Risk = \frac{Dose \times SF}{BW \times AT}$$

Notes:

ASTM = American Standard for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentrations, dose, and risk calculations from ASTM 95 guidance formulas presented above.

Appendix III

Chemical-Specific Data

Table III.1
Chemical Toxicity Data

COPC	INHALATION		ORAL	
	RfD	CSF	RfD	CSF
Benzene	1.70E-03	1.00E-01	NA	NA
Toluene	1.10E-01	NA	2.00E-01	NA
Ethylbenzene	2.90E-01	NA	1.00E-01	NA
Total Xylenes	2.00E-01	NA	2.00E+00	NA
Methyl t-butyl ether	8.57E-01	1.60E-04	NA	NA
Acetone	1.00E-01	NA	NA	NA
1,3-Butadine	NA	1.80E+00	NA	NA
2-Butanone	2.86E-01	NA	NA	NA
Carbon Disulfide	2.00E-01	NA	NA	NA
Chloroform	NA	8.10E-02	NA	NA
Chloromethane	8.60E-05	6.30E-03	NA	NA
Cis-1,2-Dichloroethene	1.00E-02	NA	NA	NA
1,1-Dichloroethane	1.43E-01	NA	NA	NA
1,2-Dichloroethane	NA	NA	3.00E-02	9.10E-02
1,2-Dichlorobenzene	5.70E-02	NA	NA	NA
1,4-Dichlorobenzene	3.00E-02	4.00E-02	NA	NA
1,4-Dioxane	NA	2.70E-01	NA	NA
n-Hexane	5.71E-02	NA	NA	NA
4-Methyl-2-pentanone	2.29E-02	NA	NA	NA
Methylene chloride	8.57E-01	3.50E-03	NA	NA
Naphthalene	8.60E-04	NA	2.00E-02	NA
n-Nonane	6.00E-01	NA	6.00E-01	NA
Styrene	2.86E-01	NA	NA	NA
Tetrachloroethene	1.10E-01	2.10E-02	NA	NA
Tetrahydrofuran	8.60E-02	6.80E-03	NA	NA
Trichloroethene	NA	1.00E-02	NA	NA
1,1,1-Trichloroethane	2.86E-01	NA	NA	NA
1,3,5-Trimethylbenzene	1.70E-03	NA	NA	NA
1,2,4-Trimethylbenzene	1.70E-03	NA	NA	NA

NA = Not applicable for evaluation of complete exposure pathways
COPC = Chemical of Potential Concern
RfD = Reference Dose (mg/kg-day)
CSF = Cancer Slope Factor 1/(mg/kg-day)
Source: IRIS (USEPA 2000), HEAST (USEPA, 1997), DTSC (1994).
Region IX PRGs (USEPA, 1999), OEHHA (2000)

Table III.2
Chemical and Physical Properties for COPCs

COPC	Henry's Law Constant (dim)	Diffusion Coefficient in air (cm2/sec)	Diffusion Coefficient in water (cm2/sec)	Log Koc (log l/kg)
Benzene	2.20E-01	9.30E-02	1.10E-05	NA
Toluene	2.60E-01	8.50E-02	9.40E-06	2.13E+00
Ethylbenzene	3.20E-01	7.60E-02	8.50E-06	1.98E+00
Total Xylenes	2.90E-01	7.20E-02	8.50E-06	2.38E+00
Methyl t-butyl ether	2.40E-02	7.90E-02	9.41E-05	NA
Acetone	1.04E-03	1.24E-01	1.14E-05	NA
1,3-Butadine	7.00E+00	1.70E-02	1.00E-05	NA
2-Butanone	1.81E-03	8.08E-02	9.80E-06	NA
Carbon Disulfide	6.99E-01	1.04E-01	1.00E-05	NA
Chloroform	1.41E-01	1.00E-01	1.00E-05	NA
Chloromethane	3.67E-01	1.30E-01	1.68E-04	NA
Cis-1,2-Dichloroethylene	2.00E-01	7.00E-02	1.00E-05	NA
1,1-Dichloroethane	2.00E-01	7.00E-02	1.00E-05	NA
1,2-Dichloroethane	4.00E-02	1.00E-01	1.00E-05	1.76E+00
1,2-Dichlorobenzene	8.07E-02	6.90E-02	7.90E-06	NA
1,4-Dichlorobenzene	6.65E-02	6.90E-02	7.90E-06	NA
1,4-Dioxane	4.00E-04	1.00E-04	1.00E-05	NA
n-Hexane	5.07E+00	2.00E-01	7.77E-06	2.94E+00
4-Methyl-2-pentanone	1.73E-02	7.35E-02	8.68E-05	NA
Methylene chloride	1.33E-01	1.00E-01	1.17E-05	NA
Naphthalene	4.90E-02	7.20E-02	9.40E-06	3.11E+00
n-Nonane	5.00E+00	2.00E-01	7.00E-06	2.90E+00
Styrene	1.09E-01	7.10E-02	8.00E-06	NA
Tetrachloroethene	1.21E+00	7.20E-02	8.20E-06	NA
Tetrahydrofuran	2.20E-01	1.00E-01	1.00E-05	NA
Trichloroethene	4.00E-01	8.00E-02	9.00E-06	NA
1,1,1-Trichloroethane	7.15E-01	7.80E-02	8.80E-06	NA
1,3,5-Trimethylbenzene	3.00E-01	2.40E-04	7.10E-06	NA
1,2,4-Trimethylbenzene	2.00E-01	4.10E-05	7.10E-06	NA

NA = Not applicable for evaluation of complete exposure pathways
dim = dimensionless
COPC = Chemical of Potential Concern
Koc = Organic-carbon partition coefficient
Source: Region IX PRGs (USEPA, 1999); ASTM (1995, 1998)

Appendix IV

Tier I Output Data

RBCA TIER I OUTPUT DATA-ONSITE COMMERCIAL/INDUSTRIAL RECEPTOR

Table IV.1

Site Name: Nestle USA, Inc., Facility
Completed By: JCI
Site Location: Oakland, CA

1 OF 1

SURFACE SOIL RBSL VALUES (<4 Ft BGS)

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 1

RBSL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		**Representative Concentration**	☐ Soil Leaching to Groundwater			X Ingestion, Inhalation and Dermal Contact		☐ Construction Worker	Applicable RBSL	RBSL Exceeded ?	Required CRF
CAS No.	**Name**	(mg/kg)	Residential: (on-site)	Commercial: (on-site)	Regulatory(MCL): (on-site)	Residential: (on-site)	Commercial: (on-site)	Commercial: (on-site)	(mg/kg)	"■" If yes	Only if "yes" left
107-06-2	Dichloroethane, 1,2-	2.5E-3	NA	NA	NA	NA	1.0E+0	NA	1.0E+0	☐	<1
100-41-4	Ethylbenzene	2.7E-3	NA	NA	NA	NA	3.4E+3	NA	3.4E+3	☐	<1
108-88-3	Toluene	2.0E-3	NA	NA	NA	NA	6.4E+3	NA	6.4E+3	☐	<1
1330-20-7	Xylene (mixed isomers)	2.7E-3	NA	NA	NA	NA	6.6E+4	NA	6.6E+4	☐	<1

>Res indicates risk-based target concentration greater than constituent residual saturation value

Software: GSI RBCA Spreadsheet
Version: 1.0.1

Serial: G-273-IBX-894

RBCA TIER I OUTPUT DATA-OFFSITE RESIDENTIAL RECEPTORS

Table IV.2

Site Name: NESTLE OAKLAND FACILITY
Completed By: JCI
Site Location: Oakland, CA

1 OF 1

GROUNDWATER RBSL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 1

RBSL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		**Representative Concentration**	Groundwater Ingestion			X Groundwater Volatilization to Indoor Air		X Groundwater Volatilization to Outdoor Air		Applicable RBSL	RBSL Exceeded ?	Required CRF
CAS No.	**Name**	(mg/L)	Residential: (on-site)	Commercial: (on-site)	Regulatory(MCL): (on-site)	Residential: (off-site)	Commercial: (on-site)	Residential (off-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.8E-2	NA	NA	NA	7.0E-3	NA	3.2E+0	NA	7.0E-3	■	-
156-59-2	Dichloroethene, cis-1,2-	2.3E-3	NA	NA	NA	7.8E-1	NA	4.1E+2	NA	7.8E-1	☐	-
75-34-3	Dichloroethane, 1,1-	8.7E-2	NA	NA	NA	2.1E+1	NA	1.1E+4	NA	2.1E+1	☐	-
107-06-2	Dichloroethane, 1,2-	1.7E-1	NA	NA	NA	2.2E-2	NA	7.5E+0	NA	2.2E-2	■	-
100-41-4	Ethylbenzene	2.2E-3	NA	NA	NA	7.7E+1	NA	3.7E+4	NA	7.7E+1	☐	-
1634-04-4	Methyl t-Butyl Ether	5.6E-2	NA	NA	NA	2.4E+1	NA	3.6E+3	NA	2.4E+1	☐	-
79-01-6	Trichloroethene	1.9E-3	NA	NA	NA	2.8E-2	NA	8.0E+0	NA	2.8E-2	☐	-
108-88-3	Toluene	2.0E-2	NA	NA	NA	3.3E+1	NA	1.6E+4	NA	3.3E+1	☐	-
1330-20-7	Xylene (mixed isomers)	1.3E-2	NA	NA	NA	6.1E+2	NA	2.9E+5	NA	6.1E+2	☐	-

>Sol indicates risk-based target concentration greater than constituent solubility

Software: GSI RBCA Spreadsheet
Version: 1.0.1

Serial: G-273-IBX-894

Table IV.3. RBCA Tier I Output Data
Tier I Risk and RBSL Sample Calculation
Outdoor Air Inhalation of Benzene from Soil Vapor-Onsite Commercial/Industrial Receptor

	Soil Specific Parameters		
ASTM Default	ρ_a	1.7	Soil Bulk Density (g/cm^) of (kg/L)
ASTM Default	θ_{as}	0.26	Air Content of Soil (v/v)
ASTM Default	θ_{ws}	0.12	Water Content of Soil (v/v)
ASTM Default	θ_t	0.38	Total Soil Porosity (v/v)
Site-Specific	d	91	Depth to location of vapor sample (cm) – 3 ft depth
	Diffusivity Parameters		
ASTM Default	H	0.22	Henry's Constant (dimensionless)
ASTM Default	D^{air}	9.30E-02	Air Diffusion Coefficient (cm^/s)
ASTM Default	D^{wat}	1.10E-05	Water Diffusion Coefficient (cm^/s)
Calculated	$D^{eff}{}_s$	0.0073	Effective Diffusion Coefficient through Soil (cm^/s)
	Prediction of Flux from Soil Vapor Concentration		
Site Specific	C_v	**9,900**	Maximum Benzene Concentration in Soil Vapor (ppbv)
Unit Conv	C_v	32	Maximum Benzene Concentration in Soil Vapor (µg/L)
Calculated	F	2.6E-06	Maximum Diffusive Vapor Flux Predicted from Benzene Concentration in Soil Vapor (µg/cm^2-sec)
	Outdoor Air Concentration		
ASTM Default	s	200	Outdoor Mixing Height (cm)
ASTM Default	U_{air}outdoor	225	Outdoor Wind Velocity (cm/sec)
ASTM Default	W	1500	Width of Outdoor Source Area Parallel to Wind Direction (cm)
Calculated	$C_{Outdoor}$	8.5E-08	Outdoor Air Concentration (µg/cm^3)
	Dose		
ASTM Default	IR_{air}Outdoor	20	Daily Outdoor Inhalation Rate (m^3/day)
ASTM Default	EF	250	Exposure Frequency (days/year)
ASTM Default	ED	25	Exposure Duration (years)
Calculated	Dose	11	Dose (mg)
	Risk		
CAL EPA	SF_i	0.1	California Cancer Slope Factor for Benzene(kg-day/mg)
ASTM Default	BW	70	Body Weight (kg)
ASTM Default	AT_c	70	Averaging Time for Carcinogens (years)
Calculated	Risk	**5.9E-07**	Risk (positive/population)
Calculated	RBSL	**17,000**	Tier 1 Risk-Based Screening Level (ppbv) for TRL = 1E-06

Formulas

$$D^{eff}_{soil} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F = D^{eff}_{soil}\frac{C_v}{d}$$

$$C_{outdoor} = \frac{F \times W}{U_{air\text{-}outdoor} \times s}$$

$$Dose = C_{outdoor} \times IR_{air\text{-}outdoor} \times EF \times ED$$

$$Risk = \frac{Dose \times SF}{BW \times AT}$$

Notes:

ASTM = American Standard for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentrations, dose, and risk calculations from ASTM 95 guidance formulas presented above.
level.

Table IV.4. RBCA Tier I Output Data

Tier I Risk and RBSL Sample Calculation

Indoor Air Inhalation of Benzene from Soil Vapor-Onsite Commercial/Industrial Receptor

	Soil/Building Parameters		
ASTM Default	ρ_a	1.7	Soil Bulk Density (g/cm^3) of (kg/L)
ASTM Default	θ_{as}	0.26	Air Content of Soil (v/v)
ASTM Default	θ_{ws}	0.12	Water Content of Soil (v/v)
ASTM Default	θ_{ac}	0.26	Air Content of Crack (v/v)
ASTM Default	θ_{wc}	0.12	Water Content of Crack (v/v)
ASTM Default	θ_t	0.38	Total Porosity-Soil and Crack (v/v)
Site-specific	Lsoil	91	Depth to Location of Vapor Sample (cm) – 3.0 ft depth
ASTM Default	Lcrack	15	Foundation Crack Thickness (cm)
ASTM Default	η	0.01	Foundation Crack Fraction (dimensionless)
	Diffusivity Parameters		
ASTM Default	H	0.22	Henry's Constant (dimensionless)
ASTM Default	D^{air}	9.30E-02	Air Diffusion Coefficient (cm^2/s)
ASTM Default	D^{wat}	1.10E-05	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_{soil}	0.0073	Effective Diffusion Coefficient through Soil (cm^2/s)
Calculated	D^{eff}_{crack}	0.0073	Effective Diffusion Coefficient through Foundation Cracks (cm^2/s)
	Prediction of Flux from Soil Vapor Concentration		
Site Specific	$C_{source} = C_v$	**9,900**	Maximum Benzene Concentration in Soil Vapor (ppbv)
Unit Conv	$C_{source} = C_v$	32	Maximum Benzene Concentration in Soil Vapor (μg/L)
Calculated	F	1.5E-07	Diffusive Vapor Flux Predicted from Benzene Concentration in Soil Vapor (μg/cm^2-sec)
	Indoor Air Concentration		
ASTM Default	Lb	300	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM Default	ER_{air}indoor	0.00023	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	2.1E-06	Enclosed Space Air Concentration (μg/cm^3)
	Dose		
ASTM Default	IR_{air}indoor	20	Daily Indoor Inhalation Rate (m^3/day)
ASTM Default	EF	250	Exposure Frequency-Adult (days/year)
ASTM Default	ED	25	Exposure Duration (years)
Calculated	Dose	260	Dose (mg)
	Risk		
DTSC	SF_I	0.1	Inhalation California Cancer Slope Factor for Benzene (kg-day/mg)
ASTM Default	BW	70	Body Weight (kg)
ASTM Default	AT	70	Averaging Time for Carcinogens (years)
Calculated	Risk	**1.5E-05**	Risk (positive/population)
Calculated	RBSL	**660.0**	Tier I Risk-Based Screening Level (ppbv) for TRL = 1E-06

Formulas

$$D^{eff}_{soil} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^{2}} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^{2}}$$

$$D^{eff}_{crack} = D^{air}\frac{\theta_{ac}^{3.33}}{\theta_T^{2}} + D^{wat}\frac{1}{H}\frac{\theta_{wc}^{3.33}}{\theta_T^{2}}$$

$$D^{eff}_{v} = \frac{L_{soil} + L_{crack}}{\dfrac{L_{crack}}{D^{eff}_{crack}\eta} + \dfrac{L_{soil}}{D^{eff}_{soil}}}$$

$$F = D^{eff}_{v}\frac{\Delta C_v}{\Delta \chi}$$

$$= \frac{C_{source}\dfrac{D^{eff}_{soil}}{L_{soil}}}{1 + \dfrac{D^{eff}_{soil}}{L_{soil}}\dfrac{L_{crack}}{D^{eff}_{crack}\eta}}$$

$$C_{indoor} = \frac{F}{ER_{air\text{-}indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air\text{-}indoor} \times EF \times ED$$

$$Risk = \frac{Dose \times SF}{BW \times AT}$$

Notes:

ASTM = American Standard for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentrations, dose, and risk calculations from ASTM 95 guidance formulas presented above.

Appendix V

TPH RBSL and SSTL Calculations

APPENDIX V
TPH RBSL and SSTL Analysis

There are two common ways of assessing potential risks from hydrocarbon mixtures. One method involves selection of indicator constituents (e.g. BTEX) and assessing risks to only these chemicals. The assumption inherent in this approach is that the indicator constituents represent the majority of the risk, and the constituents in the mixture that are not assessed contribute a negligible amount to the total risk.

A second method for assessing the potential risks from constituent mixtures involves separating the mixture into constituent fractions and selecting surrogate compounds to represent the toxicity and mobility of each fraction. It is not necessary for the surrogate compound to be present in the fraction, as long as there is reasonable certainty that the surrogate compound has similar or greater toxicity and similar or greater mobility than compounds that are known to exist in the fraction.

The surrogate compound approach generally yields lower, more conservative screening levels for TPH (MDEP, 1994; Montgomery Watson, 1996); hence, this approach was used to develop RBSLs for TPH at the Nestle site. It should be noted that potential risks associated with indicator chemicals is already addressed through development of RBSLs for individual hydrocarbon compounds detected at the site. Making use of the surrogate chemical approach, RBSLs were developed for TPH-g and TPH-d, where applicable.

V-1 TPH CHARACTERISTICS

Toxicity values are available for a limited number of petroleum hydrocarbons; thus, the approach taken evaluated select surrogate constituents that represent gasoline-range and diesel-range compounds. The variability in constituent composition of the commercial products refined from crude oil is exacerbated by the inability to obtain a constituent-specific breakdown of hydrocarbon mixtures, as the high cost of constituent analyses outweighs usefulness of the data.

General criteria for selecting indicator or surrogate compounds include:

- Percent contribution of constituent in a given petroleum product;
- Mobility and persistence in the environmental media; and
- Availability of human toxicity criteria.

V-1.1 Gasoline

Gasoline is a hydrocarbon mixture produced for use in internal combustion engines. The composition of gasoline mixtures has varied over time among different refineries and among different sources of the crude oil feedstock. Commercial gasoline is generally reported in the literature as having a boiling point range of approximately 40 degrees C to 200-210 degrees C, encompassing carbon numbers from C_4/C_5 to C_{11}/C_{12}. The composition of gasoline typically is as follows:

- 49 to 62 percent alkanes (15 to 17 percent straight chain and 28 to 36 percent branched chain);
- 3 to 5 percent cyclolkanes;
- 1 to 11 percent alkenes;
- 20 to 49 percent alkylated benzenes (including benzene); and
- less than 1 percent naphthalenes.

The branched-chain alkanes and aromatic constituents increase the octane rating of the gasoline, and the presence of these constituents has slightly increased as alkyl leads have been phased out.

The ASTM Standard Specification for Automotive Spark-Ignition Engine Fuel, D 4814, indicates that the average percentages of aliphatic and aromatic fractions in gasoline are 60 percent and 40 percent respectively. A USEPA reference dose is available for only one alkane, n-hexane, which is present in gasoline at an average of 6.65 percent by weight (EMCON, 1995). BTEX comprises the largest fraction of the monocyclic aromatic constituents and specific screening levels for each of these compounds are presented in this report. Based on the boiling point range, polycyclic aromatic hydrocarbons (PAHs) are not expected to be prevalent in gasoline with naphthalene reported at an average weight percent of 0.79 percent (EMCON, 1995). Benzo(a)pyrene has been reported at 0.19 to 2.8 ppm. These low PAH concentrations are corroborated by Cline et al. (1991), who cite data that 0.2 to 0.5 percent by volume naphthalene, 3.9 ppm benzo(b)flouranthene, and 1.8 ppm anthracene were present in a gasoline sample.

Commercial gasoline also contains a variety of additives to improve fuel performance, or to act as antioxidants, metal scavenging agents, or as deicing agents. From the 1920's until approximately 1981, alkyl leads were added to gasoline as anti-knock agents. To scavenge the lead as volatile lead halide salts, 1,2-dibromomethane and 1,2-dichloroethane were also added. With the phase-out of alkyl leads, additives such as t-butyl alcohol, methanol, ethanol, and MTBE are used as anti-knock agents. Alcohols also serve as deicing agents and to inhibit water separation.

V-1.2 Diesel Fuels

Diesel fuels are products prepared for use in diesel engines for a variety of vehicles (e.g. automobiles, trucks, diesel locomotives, and boats) as well as other small engines. Diesel products are from the middle distillate range, and are characterized by boiling points ranging from 150 to 400 degrees C, with the carbon range C_9 to C_{22}. As a further definition, kerosene is a light fraction within this diesel range, with a boiling point range of 180 to 230 degrees C, and a carbon range of C_{11} to C_{12}. Diesel has been reported to contain the following classes of constituents:

- 64 percent aliphatic hydrocarbons;
- 1 to 2 percent alkenes; and
- 35 percent aromatic hydrocarbons and 2-to 3-ring PAHs.

However, it is expected that these amounts will vary with the specific type of diesel and the sources.

Given the boiling point range, very low concentrations of benzene are expected in diesel fuels. Millner et al. (Millner, 1992) state that diesel typically has less than 0.02 percent benzene. Additionally, the boiling point range of diesel is below the boiling points of most of the 3-ring and larger PAHs, so the PAHs in diesel are largely of the naphthalene class. n-alkanes have also been reported in diesel, with constituents from n-undecane to nonadecane composing 10 to 63 weight percent of samples analyzed.

V-2 SELECTION OF SURROGATE COMPOUNDS

Surrogate compounds were selected based on the above analysis and a review of available literature (Purdy, 1957; Gruse and Stevens, 1960; Speight, 1980 and 1991; Bruya and Friedman, 1992; Millner, 1992; and Anon, 1994). Specifically, n-Hexane and n-nonane were selected as surrogate compounds for the aliphatic fraction of gasoline and diesel, respectively. Naphthalene was used as the surrogate compound for the aromatic fraction of gasoline and diesel.

Use of these compounds is consistent with documented composition of the target hydrocarbons and with the conservative nature of this analysis, as the selected compounds are considered the most mobile and/or toxic within hydrocarbon mixtures. For example, n-nonae is more mobile in the environment than larger alkanes, with higher neurotoxic effects than larger chain length compounds. Also, the relative ability of n-nonae to produce toxic effects is similar whether the exposure occurs via inhalation or oral exposure route. Naphthalene has a short half-life in the environment because of its tendency to volatilize and biodegrade; however, its exposure to humans has manifested in hemolytic anemia (ATSDR, 1994). Selection of these constituents as surrogates is also consistent with approaches implemented at other sites in the San Francisco Bay Area (e.g. Montgomery Watson, 1996) and with MDEP (1994) guidance.

V-3 CALCULATION OF TPH RBSLs and SSTLs

Tables V-1 and V-2 document RBSLs for TPH-g and TPH-d in soil, respectively, accounting for direct exposure of daily site occupants to surface soils. The TPH RBSLs are based on the weight percent distribution of each of the surrogate compounds, also presented on Tables V-1 and V-2.

Table V-1.TPH-g Surface Soil RBSL Calculation
Onsite Commercial/Industrial Receptor

Surrogate Chemical	Chemical-Specific RBSL (mg/kg)	Percent Distribution (by weight)	TPH-g RBSL (mg/kg)
Aliphatic (n-Hexane as surrogate)	2,000	60 %	3,333
Aromatic (Naphthalene as surrogate)	560	40 %	**1,400**

Under the surrogate compound approach, the TPH RBSL is calculated by dividing the constituent-specific screening level for the surrogate compound in soil by the weight percent of the fraction the surrogate compound represents. Constituent-specific screening levels were calculated based on the previously referenced ASTM (1995 and 1998) algorithms.

As indicated in Table V-1,the TPH-g soil RBSL based on the surrogate approach approximates 1,400 mg/kg. This RBSL corresponds to the more conservative value derived from the aromatic fraction.

Table V-2. TPH-d Surface Soil RBSL Calculation
Onsite Commercial/Industrial Receptor

Surrogate Chemical	Chemical-Specific RBSL (mg/kg)	Percent Distribution (by weight)	TPH-d RBSL (mg/kg)
Aliphatic (n-nonane as surrogate)	10,000	65 %	15,384
Aromatic (Naphthalene as surrogate)	560	35 %	**1,600**

As indicated in Table V-2, the TPH-d soil RBSL based on the surrogate approach (aromatic fraction) approximates 1,600 mg/kg.

Table V-3 depicts use of the surrogate approach for development of shallow soil vapor RBSLs for TPH-g. As indicated, conservative TPH-g RBSLs of 1,500,000 ppbv and 65,000 ppbv are derived using the surrogate (aromatic fraction) approach for the volatilization to outdoor air and indoor air pathways, respectively.

Table V-3. TPH-g Soil Vapor RBSL Calculation
Onsite Commercial/Industrial Receptor

Exposure Pathway	Surrogate Chemical	Chemical-Specific RBSL (ppbv)	Percent Distribution (by weight)	TPH-g RBSL (ppbv)
Volatilization to Outdoor Air	Aliphatic (n-Hexane as surrogate)	14,000,000	60 %	2.33E+07
Volatilization to Outdoor Air	Aromatic (Naphthalene as surrogate)	610,000	40 %	**1,500,000**
Volatilization to Indoor Air	Aliphatic (n-Hexane as surrogate)	560,000	60 %	933,000
Volatilization to Indoor Air	Aromatic (Naphthalene as surrogate)	26,000	40 %	**65,000**

Because the Tier I TPH-g RBSL for indoor air (65,000 ppbv) is exceeded by the site maximum TPH-g shallow soil vapor concentration (750,000 ppbv), a Tier II SSTL was developed using the same approach. The chemical-specific SSTLs, as documented in Table V-4, were based on Tier II input data documented in Section 3.3 of this Memorandum. Based on the Tier II TPH-g SSTL for indoor air inhalation approximates 4,000,000 ppbv. This SSTL is protective of the maximum TPH-g concentration (750,000 ppbv) detected in shallow soil vapor samples underlying the site.

Table V-4. TPH-g Soil Vapor SSTL Calculation
Onsite Commercial/Industrial Receptor

Exposure Pathway	Surrogate Chemical	Chemical-Specific SSTL (ppbv)	Percent Distribution (by weight)	TPH-g SSTL (ppbv)
Volatilization to Indoor Air	Aliphatic (n-Hexane as surrogate)	37,000,000	60 %	62,000,000
Volatilization to Indoor Air	Aromatic (Naphthalene as surrogate)	1,600,000	40 %	**4,000,000**

Appendix VI

Tier II Output Data

Table VI.1. RBCA Tier II Input/Output Data
Tier 2 Risk and SSTL Calculation
Indoor Air Inhalation of Benzene from Soil Vapor-Onsite Commercial/Industrial Receptor

	Soil/Building Parameters		
ASTM Default	ρ_a	1.7	Soil Bulk Density (g/cm^3) of (kg/L)
Oakland ULR	θ_{as}	0.15	Air Content of Soil (v/v)
Oakland ULR	θ_{ws}	0.25	Water Content of Soil (v/v)
Oakland ULR	θ_{ac}	0.15	Air Content of Crack (v/v)
Oakland ULR	θ_{wc}	0.25	Water Content of Crack (v/v)
Oakland ULR	θ_t	0.40	Total Porosity-Soil and Crack (v/v)
Site-specific	Lsoil	91	Depth to Location of Vapor Sample (cm) – 3.0 ft depth
ASTM Default	Lcrack	15	Foundation Crack Thickness (cm)
Oakland ULR	η	0.001	Foundation Crack Fraction (dimensionless)
	Diffusivity Parameters		
ASTM Default	H	0.22	Henry's Constant (dimensionless)
ASTM Default	D^{air}	9.30E-02	Air Diffusion Coefficient (cm^2/s)
ASTM Default	D^{wat}	1.10E-05	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_{soil}	0.0011	Effective Diffusion Coefficient through Soil (cm^2/s)
Calculated	D^{eff}_{crack}	0.0011	Effective Diffusion Coefficient through Foundation Cracks (cm^2/s)
	Prediction of Flux from Soil Vapor Concentration		
Site Specific	$C_{source} = C_v$	**9,900**	Maximum Benzene Concentration in Soil Vapor (ppbv)
Unit Conv	$C_{source} = C_v$	32	Maximum Benzene Concentration in Soil Vapor (µg/L)
Calculated	F	2.2E-09	Diffusive Vapor Flux Predicted from Benzene Concentration in Soil Vapor (µg/cm^2-sec)
	Indoor Air Concentration		
ASTM Default	Lb	300	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM Default	ER_{air}indoor	0.00023	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	3.2E-08	Enclosed Space Air Concentration (µg/cm^3)
	Dose		
ASTM Default	IR_{air}indoor	20	Daily Indoor Inhalation Rate (m^3/day)
ASTM Default	EF	250	Exposure Frequency-Adult (days/year)
ASTM Default	ED	25	Exposure Duration (years)
Calculated	Dose	260	Dose (mg)
	Risk		
DTSC	SF_i	0.1	Inhalation California Cancer Slope Factor for Benzene (kg-day/mg)
ASTM Default	BW	70	Body Weight (kg)
ASTM Default	AT	70	Averaging Time for Carcinogens (years)
Calculated	Risk	**2.3E-07**	Risk (positive/population)
Calculated	SSTL	**43,800**	Tier II Site-Specific Target Level (ppbv) for TRL = 1E-06

Formulas

$$D^{eff}_{soil} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$D^{eff}_{crack} = D^{air}\frac{\theta_{ac}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{wc}^{3.33}}{\theta_T^2}$$

$$D^{eff}_v = \frac{L_{soil} + L_{crack}}{\dfrac{L_{crack}}{D^{eff}_{crack}\eta} + \dfrac{L_{soil}}{D^{eff}_{soil}}}$$

$$F = D^{eff}_v \frac{\Delta C_v}{\Delta \chi}$$

$$= \frac{C_{source}\dfrac{D^{eff}_{soil}}{L_{soil}}}{1 + \dfrac{D^{eff}_{soil}}{L_{soil}}\dfrac{L_{crack}}{D^{eff}_{crack}\eta}}$$

$$C_{indoor} = \frac{F}{ER_{air\text{-}indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air\text{-}indoor} \times EF \times ED$$

$$Risk = \frac{Dose \times SF}{BW \times AT}$$

Notes:

ASTM = American Standard for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

ULR = Tier I Risk-Based Screening Levels, Oakland Urban Land Redevelopment Program (Spence and Gomez, 1997 and 1999).

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentrations, dose, and risk calculations from ASTM 95 guidance formulas presented above.

RBCA TIER II OUTPUT DATA-OFFSITE RESIDENTIAL RECEPTOR

Table VI.2

Site Name: Nestle USA Inc., Facility

Completed By: JCI

Site Location: Oakland, CA

1 OF 1

GROUNDWATER SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 2

SSTL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	Groundwater Ingestion			X Groundwater Volatilization to Indoor Air		Groundwater Volatilization to Outdoor Air		Applicable SSTL	SSTL Exceeded ?	Required CRF
CAS No.	Name	(mg/L)	Residential: (on-site)	Commercial: (on-site)	Regulatory(MCL): (on-site)	Residential: (off-site)	Commercial: (on-site)	Residential (on-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.8E-2	NA	NA	NA	1.1E+0	NA	NA	NA	1.1E+0	☐	<1
107-06-2	Dichloroethane, 1,2-	1.7E-1	NA	NA	NA	3.9E+0	NA	NA	NA	3.9E+0	☐	<1

>Sol indicates risk-based target concentration greater than constituent solubility

Software: GSI RBCA Spreadsheet
Version: 1.0.1

Serial: G-273-IBX-894

10/17/99

Site Location and